MEN AND MERIDIANS

Don W. Thomson

olume 2

MEN AND MERIDIANS, Vol. 2

Don W. Thomson

In Volume One of this history the origins and growth of surveying and mapping in Canada were traced in the context of Old World developments in these allied fields of activity.

From the adoption in 1867 of the concept of a distinctive Canadian nationality the country began to take on a new form and its citizens to display new vision and vitality. The eyes of the world turned, at the start of a new century, toward the western interior of North America as a glittering land of promise and opportunity. The centre of gravity of Canada's population began to shift westward as more than a million people swarmed into Western Canada during the first ten years of the twentieth century, settling on more than 80,000 homesteads.

To prepare for and to accommodate this immense influx a campaign of speedy, economical and accurate land surveys in the West had to be undertaken on a scale so large as to be without precedent. The opening chapters of Volume Two of MEN AND MERIDIANS tell how these extensive operations were performed under surveyors-general Dennis, Russell and Deville. In the wake of these ambitious, foundation-laying efforts great cities began to take shape and hundreds of towns sprang into existence.

In the post-Confederation period railway surveyors also worked under intense pressures to help provide, in quick order, transportation links essential to national unity and to the provision of entry into international markets. Giants of the earliest rail surveys in this country, men such as Sanford Fleming, T. C. Keefer and S. Gzowski, are pictured in dramatic action. Here also is the stirring story of how surveyors Dennis, Pearce and others of the profession helped to make possible the successful introduction of irrigation to southern Alberta as well as a memorable description of the feats of Bridgman, Wheeler and McArthur in pioneering the use of the survey camera in mountainous areas in the 1880s.

An adventure-filled account is given of the meticulous measurements involved in the establishment of thousands of miles of boundary lines between Canada and the United States. Featured in these episodes are the dedicated services of Canadian surveyors as they pursued their important tasks along the 49th parallel, the Alaska Panhandle and the 141st meridian.

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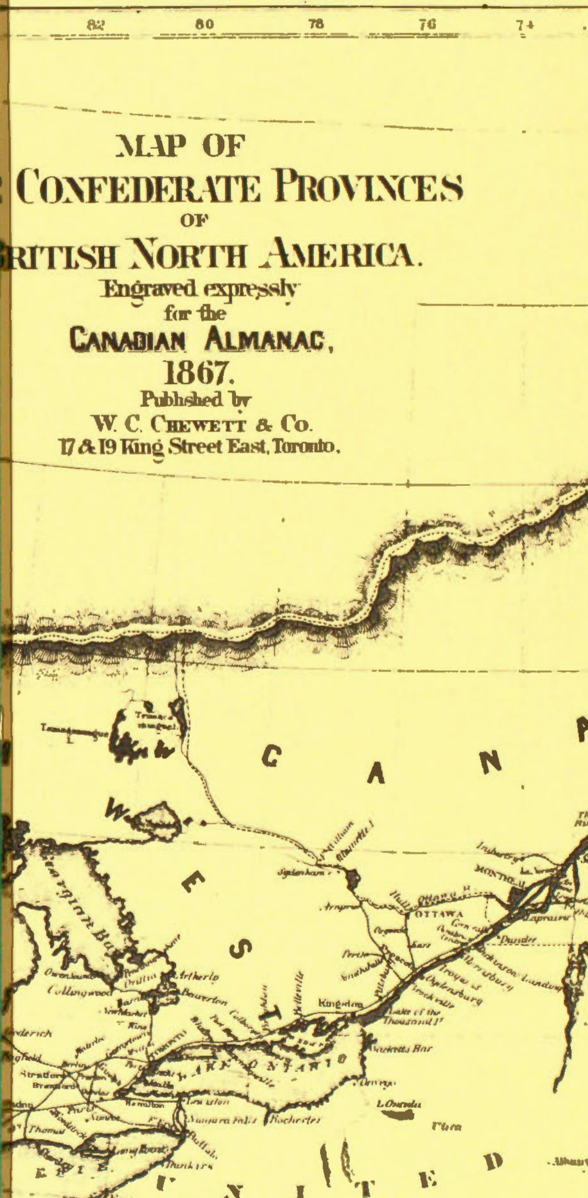

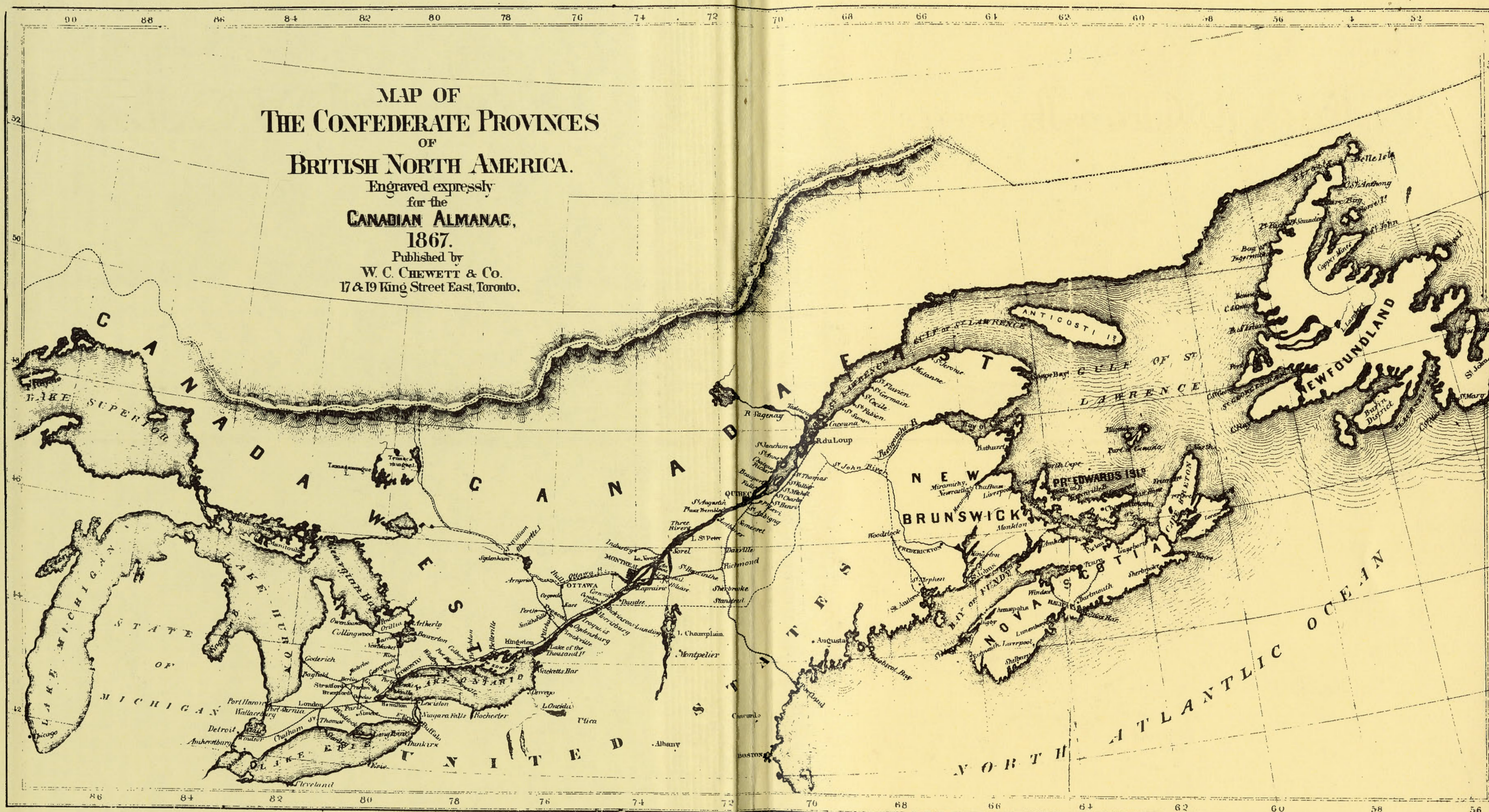
MAP OF
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OF
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Published by
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Air view of landscape near Gray, Saskatchewan, reflects the pattern of prairie land surveys.

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AND
MERIDIANS

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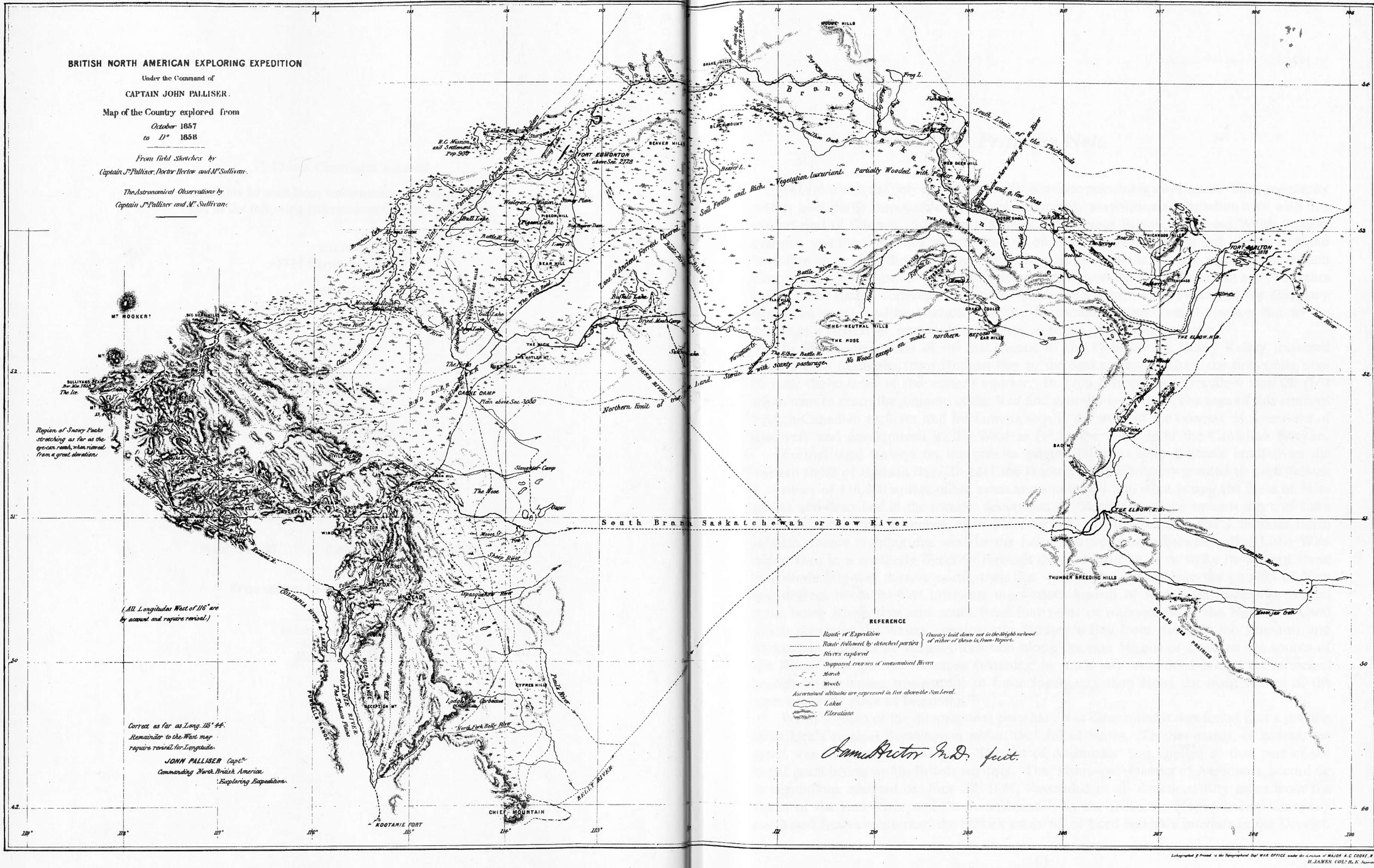

MAP 1. Map of the country explored by Palliser Expedition, 1857-58. The first accurate map link between the head of the lakes and the western interior.

Prefatory Note

Manitoba is the only Canadian prairie province possessing a sea coast. Thus geography was at least partly responsible for the relatively early association of the white man with this central part of Canada. So far as is known, Sir Thomas Button, the noted Welsh pioneer mariner, was the first white man to set foot on what is now Manitoba soil. From England he followed in 1612 the same route as Henry Hudson to the famous strait where Button discovered a small group of islands missed by Hudson on his ill-fated voyage two years before. The islands continue to bear the Welshman's name. In command of the *Discovery* (the same vessel used by Hudson) and the *Resolution*, Button crossed Hudson Bay to the mouth of a large river, naming it the Nelson in honor of his sailing master.

In the opening years of the last decade of the 17th century Henry Kelsey traversed what is now Manitoba from Hudson Bay to the Saskatchewan River, the first white man to view the prairies of the western interior. In 1738 Pierre de la Vérendrye was the first white man to reach the junction of the Red and Assiniboine rivers. The saga of this eminent French-Canadian explorer and his famous sons is the story of the opening of a new era of discovery and development in the West as far as the foothills of the Canadian Rockies.

Formal legal surveys on the prairies began 200 years after Button's landfall on the western shore of Hudson Bay. In 1811 the Hudson's Bay Company granted to Lord Selkirk a territory of 116,000 square miles, extending southward into what is now the State of Minnesota and described in the transfer documents as "Beginning of the western shore of Lake Winnipie, otherwise Winnipeg, at a point in fifty-two degrees and thirty minutes north latitude, thence running due west to the Lake Winnepigoos, otherwise called Little Winnipeg, then in a southerly direction through the said Lake so as to strike its western shore in latitude fifty-two degrees north, then due west to the place where the parallel of fifty-two degrees north latitude intersects the western branch of Red River, otherwise called Assiniboine River, then due south from that point of intersection to the Height of Land which separates the waters running into Hudson's Bay from those of the Missouri and Mississippi, then in an easterly direction along the said Height of Land to the source of the River Winnipie or Winnipeg (meaning by such last mentioned River, the principal branch of the waters which unite in Lake Saginagas), then along the main stream of the waters and the place of beginning."[1]

When the line of the international boundary was determined it was found that a portion of Selkirk's original domain was within the United States. To that extent, of course, the grant was inoperative. The term 'District of Assiniboia' was applied to that part of the initial grant laying within British territory. The 'Municipal' District of Assiniboia, according to regulations adopted on June 25, 1841, "extended in all directions fifty miles from the Forks of the Red River and the Assiniboine." In the 1830s the Hudson's Bay Company purchased from executors of the Selkirk estate all of Lord Selkirk's interests in the District.

On the original map of the grant there is a memorandum that reads: "Whereas the Surveys upon which this map has been drawn are not sufficient to ascertain with precision Whither Latitude 52° does intersect the River called Red or Assiniboine River, it is therefore agreed by and between the within mentioned Governor and Company and Thomas Earl of Selkirk that in case the Waters of Red River shall on more accurate Surveys be found not to extend so far North as Latitude 52° then the West boundary of the Tract of Land intended to be within granted shall be a Line drawn due North and South through the Post upon the said River marked on this Plan Carlton House the words 'Source of the said River' being deleted before delivery thereof."[2]

More accurate surveys showed clearly that the upper reaches of the Assiniboine River were below the fifty-second parallel and hence the description in the Memorandum applies to the western limit of the grant.

Miles Macdonnell led the first group of Selkirk colonists to Red River in 1811. By July 21, 1814 (a year before the defeat of Napoleon at Waterloo) a third group had arrived. It is reasonable to assume that these settlers were allotted parcels of land on a methodical basis and that this procedure entailed a system of survey. Earliest available records indicate that Peter Fidler was employed as a surveyor at £100 per year. In 1814 he laid out lots along the Red. In all, Fidler surveyed 36 lots that season. His next survey project involved,

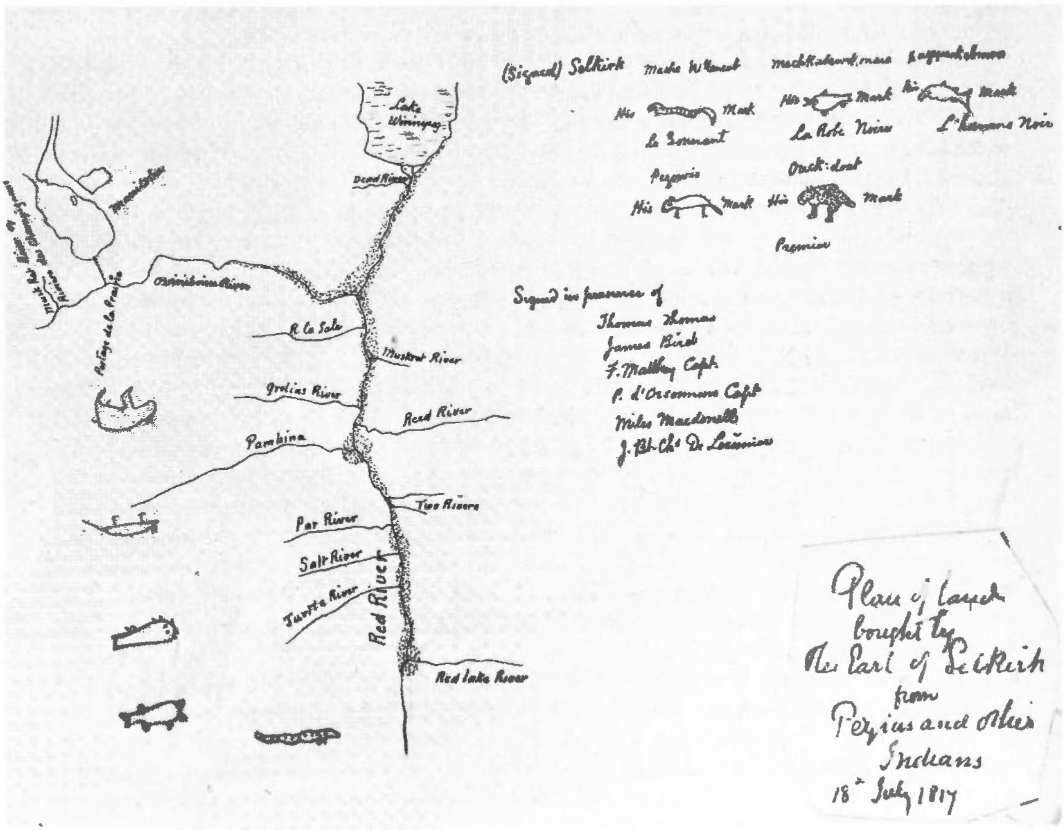

FIGURE 1. Plan of land purchased by Lord Selkirk from Indians, July, 1817.

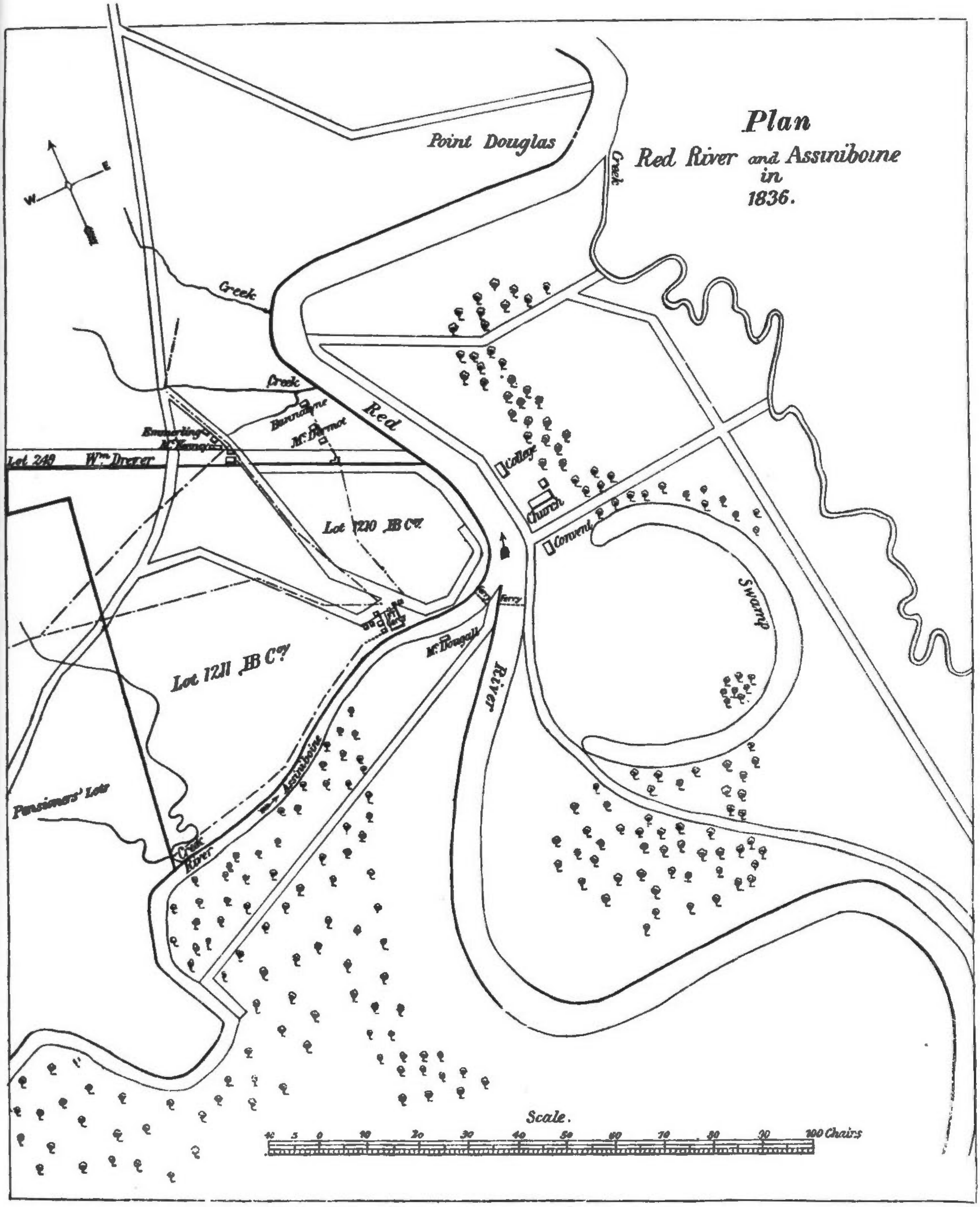

FIGURE 2. Map of Red River Settlement drawn by George Taylor, surveyor, 1836.

in 1817, the sub-dividing of Point Douglas into lots. This made possible the settling of more than 100 soldiers brought to the Settlement by Lord Selkirk for policing purposes, and disbanded there.

According to John Halkett, Lord Selkirk's executive agent in the Settlement "each (lot) containing a few acres and bordering on the river, a wide street running from the open to the highway being set apart for their common use, affording access to the common which lay beyond the road on which the settlers on the point had the right of pasturage and hay making". Peter Fidler died in 1822.

A Scotsman, William Kempt, succeeded Fidler as surveyor in the colony and was paid £100 per year for this work. In 1822 Kempt laid out lots on Image Plain, some 10 miles north of Point Douglas. Each of 8 lots contained 32 acres. Governor Bulger said of Mr. Kempt that he was "surpassed by no man that I have ever known, in zeal and industry in the performance of his professional duties."

Following Kempt, George Taylor was engaged as surveyor from 1836 to 1844. Taylor made what is now known as the "Old Settlement Belt Survey" laying out 1,542 lots along the Red and Assiniboine. Taylor's plan formed the basis of all subsequent Hudson's Bay Company land grants in the Settlement. The original plan, in the fashion of so many other early documents, disappeared without a trace. A copy is in the possession of the Department of Indian Affairs and Northern Development, Ottawa. An inscription on the map reads: "Plan of the Red River Colony, copied from that in the possession of the Hudson's Bay Company. Surveyed in 1836-7-8, scale 50 chains to the inch." Although unsigned the plan is generally acknowledged to be the work of George Taylor. An 1836 map in outline shows a part of the Settlement in the vicinity of the Forks (Red and Assiniboine rivers) in 1836, according to Taylor. The original of this map is in the Provincial Library of Manitoba, Winnipeg.

In June, 1855, William Inkster was named Public Surveyor at a salary of £25 per year and was authorized to charge for every day he was employed, a sum not exceeding 7 shillings, sixpence per day. In May, 1856, the Council of Assiniboia decided that there ought to be two surveyors in the colony. Roger Goulet, born in the Settlement in 1834, was appointed to work in that part of the colony situated to the south of the Forks. A few years later Herbert L. Sabine was also engaged on similar terms to operate on the north side of the Red.

One of the by-laws passed at a council meeting in 1862 stated: "Messrs. Goulet and Sabine shall be surveyors for this Settlement without salary from the public funds but they shall be entitled to be paid 10 shillings per diem each by any person who calls for their services." The usual practice in laying out lots was to make them approximately two miles in depth or the Indian measurement of two miles, the distance bounded on a level plain by a horizontal line of sight made under the belly of a horse. Much would depend, therefore, on the build of the animal.

A peculiar class of claims to land, deserving of some notice at this stage, was known as "staked claims". From about 1860 some of the settlers had been in the habit of wintering stock along the relatively well-sheltered banks of the Seine, Rat and LaSalle rivers. Numerous claims of this nature were staked by the métis along the fronts of these three rivers. Quite often one man would stake several such claims for himself and his family.

Lieut.-Governor Archibald asserted in a report to Ottawa in 1870 that all the early systematic surveys, conducted under instructions of the Hudson's Bay Company, extended to some 150,000 acres in all, involving a division into approximately 1,550 lots, averaging 96 acres each, commonly the quantity of farmland contained in lots 6 chains in width (river frontage) and extending back 160 chains. In actual practice, however, it would appear (from other records) that the depth of cultivated lots was considerably less than that, and the width in some instances considerably more.[3]

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Chapter

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NOTE: *By proclamation published in the* CANADA GAZETTE, *September 22, 1966, the Department of Mines and Technical Surveys was reorganized under the new title, Department of Energy, Mines and Resources, the change to have official force and legal effect as from October 1, 1966.*

1

CONFEDERATION AND THE RED RIVER SETTLEMENT

"You were the duke's surveyor, and lost your office on the complaint of the tenants:"
King Henry VIII, Act 1, Sc. 2.

Readers of the first volume of this history will recall that in the vanguard of the westward flow of European settlement in Canada during the 17th, 18th and 19th centuries were to be found pioneer surveyors and mappers, men indispensable to the sound, logical development of civilized communities and regions. By 1867 hydrographic survey work of basic significance had been carried out by the British Admiralty in the ocean entrances to British (continental) North America, both east and west. Land surveys had aided in the peopling and progress of Nova Scotia, New Brunswick and Prince Edward Island. Seigniory holdings had been laid out and subdivided into characteristic river-lot patterns along the banks of the St. Lawrence in French Canada. Much of Upper Canada from the Ottawa River to the Detroit Frontier and to lower Lake Huron had been the object of measurements and reports by land surveyors. These resourceful pathfinders had also established lines of highways and colonization roads. A good beginning had been made in the hydrographic surveys and the mapping of the Great Lakes. Much survey work had been accomplished in defining the Canadian-United States boundary from the Bay of Fundy to the North West Angle of the Lake of the Woods. Fundamental land surveys and road construction work had been carried out in British Columbia, mainly by the Royal Engineers. Only Canada's western interior, the prairie and parkland extending from the Red River to the foothills of the Rockies remained, for the time being, largely immune to the ever-advancing waves of newcomers and the onward sweep of white settlement.

At the time of Confederation few realized that Canada's western interior was on the threshold of formidable development involving, over the following four decades, an increase of population exceeding one and a quarter million and, in Manitoba alone, an increase approaching half a million. The purchase by the Canadian government of Rupert's Land heralded the approach of a new era in a region that soon came to be known as Manitoba and the North-West Territory and, much later, as Manitoba, Saskatchewan, Alberta and the Territories. This historic transaction also involved a drastic change in the way of life of many of the native-born inhabitants of the purchased territory. It meant the beginning of the end of a nomadic, carefree existence, particularly for the métis, mixed blood descendants of French-speaking Canadians and their Indian wives.

In the nature of things land surveyors were in the forefront of the impending influx, harbingers of the inevitable transformation of a land and its people. These pioneers of the chain and transit formed the advance guard of a vast host of property-hungry immigrants seeking new opportunities in life; a tiny group of trained men entrusted with the responsibility of preparing land boundaries in a pattern most suitable for the anticipated occupation and settlement. Indians in territories to the south had violently resisted encroachments by whites on what the native peoples regarded as their own domain. In Canada, Indians and half-breeds in areas tributary to the Red River Settlement and in the Settlement itself felt a deep and fully-justified fear that impending events would leave them aliens in a land that they and their progenitors considered their inalienable empire. These children of nature generally lacked the ability to adapt readily to new conditions. The routine of daily tasks, the necessity for being provident, for subordinating spontaneous pleasures of the flesh to the orderly demands of sustained industry; all these sober, if relatively dull, virtues were quite repulsive to these easy-going, freedom-loving extroverts. As long as the plains yielded ample harvests of buffalo meat, furs, fish and hay, their nomadic way of life was profitable, apparently secure and fully enjoyable. But the white man, with his acquisitive habits and ambitions and his lust for property with boundary lines protecting individual ownership, stirred feelings of distrust and even anger in the métis. These grim forebodings, together with the vagueness surrounding the perpetuation of Indian and métis claims to the lands on which they habitually wintered, created profound misgivings among these unsophisticated peoples of the plains. At about the same time the terrible depletion of buffalo herds, the growing scarcity of fur-bearing animals accompanied by a series of crop failures in the Settlement area continued to expedite the very changes the native peoples abhorred but somehow could do nothing to prevent.

Added impetus was given to the flow of immigration to the western interior of Canada by the cereal experiments of David Fife (1804-77) a farmer located near Peterborough in Canada West. In the mid-19th century Fife produced a new hard spring wheat strain, later known as Red Fife, that gave promise of developing into a high-yield grain on the fertile prairies. What was urgently required, however, was a wheat variety not only rich in protein but capable of maturing early enough in a land of limited rainfall to escape damage from early frosts, always a hazard of the region. It was not until some years later that the first substantially successful answer to this critical problem was found in Marquis wheat, discovered in 1904 by Charles E. Saunders (later Sir Charles) assisted by his brother, Arthur. Red Fife was one of the parents of the crossbreed that resulted in Marquis. The Marquis seed, widely distributed to Western farmers in 1909, served to open up millions of prairie acres to the cultivation of wheat.

Sir John A. Macdonald's satisfaction on July 1, 1867, over the accomplishment of Confederation would have been tempered somewhat had he possessed on that historic day the clairvoyance required to read correctly the immediate future of Canada. Here was a new nation brought into being by a combination of British support, American hostility and Canadian need. Despite his far-sightedness on some highly important issues of his day, Macdonald was spared contemplation in advance of the painful experiences that rapid national development would soon entail. From 1867 to 1871 Canada and its national government was called upon to endure and surmount a series of political crises. During this dangerous period not only the cherished hope of a nation stretching from coast to coast trembled in the balance but also the continuity of the newly-born English-French collaboration in government. In the damaging collision and subsequent slow reconciliation of aims and ambitions following the somewhat clumsy annexation by Canada of the western interior, land surveyors and their surveys played a prominent, provocative yet wholly indispensable role.

Expansion was taking place in areas other than the strictly political. The western world had entered a new economic age of steam and steel. By mid-century railways had begun to appear in the Canadian provinces. This development meant not only a new field for surveying activity but an increase in industrial enterprise generally in the areas served by them. By 1860 several hundred miles of track had been laid in the Maritimes and slightly more than 2,000 miles in the Province of Canada. The advent of railways, with the accompanying enlargement of trade and settlement horizons, led to strategic decisions of a high order. Doubtless the appearance of railways in North America helped turn attention to Canada's North West as a new land of opportunity. In part the growth of popular interest in the region was due to a desire to contain American expansionism towards the west and north of the continent. In addition, much of the good farmland of Upper Canada, or Canada West as it was officially known, had been occupied, whereas the western plains offered a vast empire of fabulously fertile acres. Minnesota's advance to statehood signalled the dynamism and direction of westward settlement in the United States. Minnesota became a state in 1858 and two years later claimed a population exceeding 170,000. Some Americans were beginning to examine the possibilities of incorporating within the United States the thinly populated areas of what was later to become the province of Manitoba.

As the frontier of American settlement moved swiftly and inexorably across the interior of the continent British and Canadian concern over the ultimate destiny of Rupert's Land mounted. This anxiety was not in the least allayed by the realization that as a result of its Civil War (War between the States) the United States of America had become a formidable world military power.

Such was the situation in the North West in particular and North America in general during the years immediately after Confederation. Sir John A. Macdonald was sufficiently far-sighted to realize that union of the four provinces in the East would need to be followed by an expansion of Canada into the vast and potentially rich North West if that extensive territory was to continue under the British flag and connection. Also it would be necessary to annex Rupert's Land in order to construct a rail link with British Columbia. The United States, caught up in a mood of buoyant expansionism, made no effort to disguise the fact that it was aiming to control as much of the middle west of the continent as it could absorb. It was a period of ambitious railway building in the United States also. Rails of steel were rapidly penetrating the West in the wake of railway surveyors, bringing what appeared to many Canadians as a serious threat of an extension of United States sovereignty north of the 49th parallel of latitude.

Sir John felt that he and his administration were engaged in a desperate race against time and the Americans, and that the stakes involved in this international competition were of the highest significance. Macdonald's policy vis-a-vis the West was two-pronged. First, to proceed with all possible speed to bring into Confederation the western interior north of the 49th parallel; second, to bring about the early construction of a transcontinental railway to serve the interior and to help maintain its British character and to make possible as well the entry of British Columbia into the Canadian union. It was this vision of a Canada extending from

FIGURE 3. Sir John A. Macdonald

the Atlantic to the Pacific that made Sir John unique among Canadian statesmen of his time.

On December 4, 1867, the initial step was taken by the newly-formed Government of Canada to bring the Midwest into Confederation. Hon. William McDougall (1822-1905) Minister of Public Works, a prominent spokesman for national expansion and widely known for his keen interest in the North West, introduced in the House of Commons, Ottawa, a series of resolutions. These were intended as a basis for an Address to the Crown asking for the transfer of Hudson's Bay Company territories to Canada. In July, 1868, the Rupert's Land Act was passed at Westminster. The date originally set for the formal transfer was October 1, 1869, but difficulties over financial arrangements resulted in a postponement of the date to December 1, 1869.[1] A second postponement brought about serious unforeseen repercussions.

Another important move by the Canadian government following Confederation, in anticipation of annexation of the western interior, was that of undertaking the provision of a road-and-water link between Canada and the Red River Settlement (Fort Garry). Simon James Dawson (1820-1902), a Scottish-born civil engineer, experienced in conditions of the region, was called in to supervise the survey and construction of this line of communication. Dawson had been appointed by the government of the Province of Canada in 1851 to plan and to superintend construction of works on the St. Maurice River in order to open up timber reaches on that river and its tributaries. In 1857 Dawson was appointed to explore the country between Lake Superior and the Saskatchewan River and to report on its suitability for settlement. Now, in 1869, Dawson's services were again requisitioned by government and he commenced work on what was later to become widely known as the "Dawson Route".

In the autumn of that same year McDougall sent John A. Snow with a small party of Canadians to Red River Settlement to commence road surveys and road construction on the western terminal portions of the Dawson Route. The Minister of Public Works, in taking this praiseworthy action, committed two rather serious errors. These missteps marked the beginning of a long series of blunders committed by Ottawa officialdom in carrying out federal government policies concerning the North West, and helped to make inevitable a dangerous clash of wills and of interests on the banks of the Red. Although the western interior, Rupert's Land, was still owned and controlled by the Hudson's Bay Company, McDougall failed to observe the fundamental niceties of the delicate situation. As representative of the Government of Canada, McDougall failed to apply formally to the Company for its permission for the party to enter the western region for the purpose of carrying out the instructions given them. The Company protested this conduct but allowed the work to proceed.[2] Snow, the surveyor associated with the construction of colonization roads in Upper Canada, did his best to remedy the oversight by approaching Hudson's Bay Company officers in the Settlement for their retroactive approval of the operation.

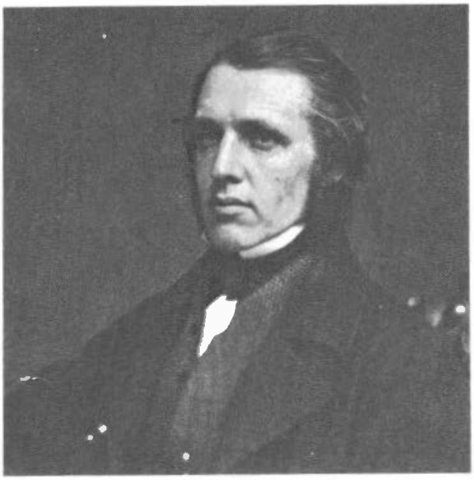

FIGURE 4
Hon. William McDougall

McDougall erred again when he attached Charles Mair to Snow's party as paymaster of the road crew. Mair, a personal friend of McDougall, was a native of Lanark village near Perth and had attended Queen's University. A poet of some prominence Mair was strangely insensitive to the depths of feeling and the strong motivations of the métis of the plains. Mair's ignorance and tactlessness in this area were surpassed only by his articulate enthusiasm for large-scale settlement of the West by Canadians from Ontario. Mair proved to be a major troublemaker during the tense period when political storm clouds hovered low over Canada's awkward acquisition of Rupert's Land.

What manner of man was McDougall, the individual mainly responsible for turning road and settlement surveys into such a contentious issue during this critical stage of Canada's national development? William McDougall was born at York (Toronto) on January 25, 1822, of United Empire Loyalist stock. In his late teens McDougall showed a marked talent for journalism. Aggressive in temperament and action he soon developed into a trenchant writer and made a name for himself in the newspaper and magazine field in Upper Canada. In addition he took training in the law and qualified as a solicitor in 1847. He was called to the bar in 1862. Possessed of an erect, commanding figure and a clear, sonorous voice, McDougall made rapid headway also in colonial affairs, entering public life in 1858. From 1862 to 1864 he was Commissioner of Crown Lands. Elected for North Lanark in 1863 he was invited, as one of the Fathers of Confederation, into Sir John A. Macdonald's cabinet in 1867 as Minister of Public Works.[3] At that time federal land surveys came under the jurisdiction of the Department he headed.

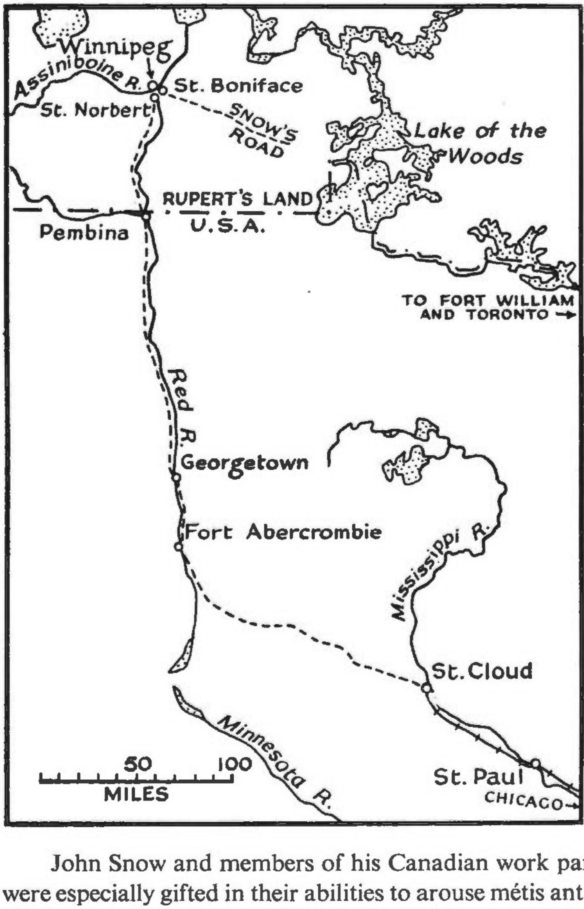

FIGURE 5
Railway approach to Red River country, 1869. Note projected route of John A. Snow's road.

John Snow and members of his Canadian work party, one of whom was Thomas Scott, were especially gifted in their abilities to arouse métis antagonism. Snow began his initial road surveys at Oak Point and his relations with métis assistants on the road crew speedily deteriorated. He was accused of overcharging them for provisions and for making underpayments on their stated wages. Charles Mair provided additional complications by striking up a close friendship with Dr. John Christian Schultz (1840-1896) (later Sir John), a physician and storekeeper in the Settlement. Born in Amherstburg, Schultz was educated at Queen's and Victoria (Cobourg) Universities.[4] Tall, powerfully built, intelligent and well-travelled, Schultz was a natural leader of elements in Red River Settlement favorable to the annexation of Rupert's Land by Canada. In time he became Lieut.-Governor of Manitoba (1888-1895) after serving in the House of Commons for 11 years and 6 years in the Senate. Like Mair, Schultz seemed bent on coming into conflict with those of the native-born population of the Settlement whose mother tongue was French.

There were other complaints against Snow and his associates from Canada. The métis fiercely resented efforts by Schultz, Snow, Mair and others to stake out for themselves lands near the Settlement for purely speculative purposes. This type of activity occurred at Oak Point and the métis claimed that the lands so staked were, in fact, their own. There were charges also that the Canadians were plying Indians with liquor to help induce them to sell lands to them. Archbishop Taché of St. Boniface testified to this effect before a committee of the House of Commons.[5] Incidents such as these helped to fan into flames the prejudices and fears of the native-born population, emotions and passions long smouldering because of continuing uncertainty over what would happen to them and their lands when the transfer of the North-West Territory to Canada finally took place.

McDougall, despite his blunders of 1868, had an opportunity to mend matters the following summer when he instructed Lieut.-Col. John Stoughton Dennis, P.L.S. (1820-85)* of Weston, Ontario, to proceed to Red River district and, after examining the area, recommend a system of surveys for that region. On this occasion permission to proceed with the project was formally sought in advance from the Hudson's Bay Company. One of Dennis's first acts on arrival in the Settlement was to call upon the Governor of Assiniboia, William Mactavish, senior Company official in that community.

En route to Fort Garry by way of the United States, Dennis interviewed S. G. Davidson, Surveyor General of Minnesota and General Nutting, a former Surveyor General of that State; Dennis also obtained information by correspondence with Hon. J. S. Wilson, Commissioner of the United States General Land Office. From these eminent Americans Dennis gained considerable insight into the theory and application in western areas of the States of the rectangular system of land surveys.

Dennis also acknowledged indebtedness to "Mr. Russell, Assistant Commissioner and Mr. Devine, Chief of Surveys of the Ontario Department of Crown Lands, for valuable information and suggestions."

Dennis was careful to obtain proper instruments for survey work in the North West and addressed himself to McDougall by letter in mid-July in the hope of securing ministerial aid in this connection.[6] Dennis found that instruments purchased by Snow from Potter, a Toronto supplier, were for the purpose of "noting atmospheric phenomena exclusively" and Dennis asked McDougall for authority to buy more instruments, although deputy surveyors would be expected to provide themselves "with a good theodolite transit". He pointed out, however, that it would be advisable to have a set of instruments that would remain the property of the Government. Out of this set Dennis himself proposed to use "a theodolite or transit" of a type that would be "thoroughly reliable in fixing the Meridional and Base lines which, in all probability, will govern the system of future surveys in that country". Dennis further pointed out that Potter had such an instrument, an "Altitude and Algimuth Transit Theodolite" for sale. Apparently this instrument had been imported for a Mr. Hawkins, P.L.S., for astronomical observations and cost $300. In spite of the fact that the transit had been used to a limited extent only, Dennis felt it could be bought for $125 or less.

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*Following political union of Upper and Lower Canada in 1840, surveyors qualified to practise in the new Province of Canada were entitled to add the initials P.L.S. (Provincial Land Surveyor) after their names. Dennis had so qualified in 1842 and had served continuously on the Board of Examiners from 1852.

He indicated to the minister that the following instruments would also be required: "an artificial horizon ($25); a good level ($80); a good field glass ($25); a supply of drawing instruments, protractor, scales, rules, etc.; a box of colors; a supply of drawing and tracing paper, stationery; a nautical almanac and tables and "one small seat for myself ". The cost of these miscellaneous items Dennis considered trivial.

This was an impressive start. But from the moment of his arrival in August in the Red River Settlement, Dennis's visit was ill-starred. The earnest and diligent surveyor did his best to avoid making errors of omission. He called upon the "right people" in the locality to explain the nature of his mission. Subsequent happenings revealed that even his presence in the Settlement at that particular time was premature. To the dissident elements the fact of his arrival spoke far more eloquently than any of his words, no matter how reassuring these might appear to be. In any event powerful forces were at work, locally and nationally, the nature and dimensions of which rendered Dennis's conciliatory efforts completely abortive.

Even a figure of the stature and leadership potential of Louis Riel was caught up in forces and events that proved well beyond his power to shape or effectively control. In July, 1868, Riel, like Dennis more than a year later, had arrived in the Settlement from Minnesota. Unlike Dennis he was not a newcomer to the place. Born 25 years earlier on the banks of the Seine (a tributary of the Red) this intense young man, son of Julie Lagimodière and Louis Riel, was destined to become one of the most fascinating, yet one of the most tragic, human figures in the long and eventful sweep of Canadian history. Louis' father was the son of Jean-Baptiste Riel, voyageur, and his wife, Marguerite Boucher, of Franco-Chipewyan blood. Julie, mother of Louis and daughter of the first white woman to reside in the North West, was a silent but deeply affected witness during the years of her son's stormy career as he became first, an outlaw, then an exile and, finally, a victim of the gallows in the land of his birth. Despite an unstable temperament, Riel, by the depth of his convictions, his educated eloquence and ability to win and hold a following, proved to be a natural leader. He possessed an almost mystical faculty for attracting dynamic elements in the primitive West to support, against considerable odds, some highly abstract political aims and objectives.

On the same day McDougall was appointed Lieut.-Governor of the North West (September 28), his commission to take effect "on and after the transfer", instructions were issued by the Secretary of State for the Provinces, Hon. Adams G. Archibald, asking McDougall to proceed "with all convenient speed" to Fort Garry to superintend preliminary arrangements for the organization of the new territory. McDougall moved swiftly enough. On the day of his conditional appointment he left Ottawa for his "kingdom" as Sir John A. Macdonald smilingly called the minister's new area of responsibility. As the train pulled away from the station, Sir John waved farewell to his colleague.

Dennis had intended that his survey party should consist of Mr. McGrath, P.L.S. of Ottawa, Milner Hart, P.L.S. of Brantford and himself. McGrath, however, took ill and was unable to join Dennis in Toronto, on the 27th of July as arranged. Prior to leaving Toronto Dennis was joined by "five gentlemen who had obtained permission to accompany my party through to Fort Garry, *paying their own expenses*" (author's italics). At St. Paul a disappointed Dennis got the word that McGrath would not be able to make the trip West at all. Dennis then wrote to Major A. C. Webb, P.L.S. of Brighton "in whom I have every confidence" to join him at Fort Garry without delay.

The most prominent participants in the drama about to be enacted had arrived on stage or were gathering in the wings. Few observers, however, were prepared for a spectacle in which this federal venture, marked by so hopeful and auspicious a beginning, would end in circumstances amounting to a near fiasco. One important actor managed to remain for a time in the background of events, performing (from his point of view) a heroic role without attracting too much official attention in Canada. He was James W. Taylor, by turns an American Consul lobbyist and undercover man. In the Settlement at Red River, which he visited often, he represented without ostentation the interests of United States annexationists. American agitation at the time in support of a takeover of the troubled Settlement by the United States, was centred in St. Paul. Even prior to the transition period in the Canadian North West the annexationists had powerful voices in their own nation advancing their cause. In 1867 Secretary of State William Seward stated publicly, "I know that Nature designs that *this whole continent*, not merely these 36 states, shall be sooner or later, within the magic circle of the American union."[7]

FIGURE 6
Lieut.-Col. J. S. Dennis, Surveyor General of Canada, 1871-78.

Taylor's subversive activities in Manitoba and elsewhere began, in time, to alarm Canadians. But in the end the sheer intensity of his propaganda efforts served to defeat his own purposes. Sir John A. Macdonald, blessed with a perceptive mind and large vision, grasped the principal danger and moved to thwart it, "The Hudson's Bay question must soon be settled; the rapid march of events and the increase of population on this continent will compel England and Canada to come to some arrangements respecting this immense country."

Following the successful negotiations in London, England, by Sir George E. Cartier and William McDougall, the Canadian Parliament passed a measure, given royal assent on June 22, 1869, providing a temporary government of Rupert's Land upon its union with Canada. The question of organizing the surveys of the western interior next had to be considered and dealt with. McDougall, as a former Commissioner of Crown Lands in the Province of Canada, was familiar with basic principles and aspects of public lands administration. As minister of the department having authority over, and responsibility for, federal surveys, he moved quickly. On July 10 he issued instructions to Dennis "to proceed without delay to Fort Garry, Red River, . . . to select the most suitable localities for the survey of townships for immediate settlement . . . to report the plan of survey proposed for adoption . . . and until receipt of notice of its approval or modification to proceed with such surveying operations at Oak Point and the vicinity of Red River as may appear to be necessary in any event."

Following his enquiries in the United States Dennis made his way to Fort Garry, arriving on August 20. He committed the tactical error, however, of arriving in the partisan company of Dr. Schultz. Immediately, therefore, Dennis was off on the wrong foot so far as Riel and the militant métis were concerned. In fact Dennis was not long in the Settlement when he began to be alarmed. In spite of his best efforts to establish a basis of understanding with leaders in the Settlement, he failed to make any real headway in the pit-strewn field of conciliation. He began to realize that his survey mission had not been helped by his open association with Schultz. This development together with the fact that he was, in the eyes of the métis, "English from Toronto" rendered him *persona non grata* with them. Dennis had heard of Riel's impassioned and provocative address to church-goers in St. Boniface after Sunday morning mass. In some haste he wrote to Ottawa to advise McDougall "of the considerable degree of irritation existing among the native population in view of the surveys and settlements being made" and particularly among the métis who "have gone so far as to threaten violence should the surveys be attempted to be made."[8] In this sentiment Dennis was echoing the sentiment of Governor Mactavish who had given reluctant permission for the land surveys, "It is unfortunate that any survey should be commenced until the Canadian government was in authority here, as the whole land question is fruitful of future trouble which it will take much time and great labour to settle. I expect that as soon as the survey commences the half-breeds and Indians will at once come forward to assert their right to the land and possibly stop the work till their claim is satisfied."[9]

Dennis continued to work conscientiously on the commission given him by McDougall and on August 28, 1869, forwarded by mail an outline of a proposed system of surveys and subdivision of lands in the West along with suitable illustrative sketches.* What, then, were the contents of the historic initial Dennis recommendations for long-range and large-scale western settlement? He submitted four principal points of his plan:[10]

"1. The system to be rectangular; all townships to be east and west or north and south.

"2. The townships to number northerly from the 49th parallel of latitude and the ranges of townships to number east and west from a given meridian, this meridian to be drawn from the 49th parallel at a point say ten miles west of Pembina, and to be called the Winnipeg Meridian.

"3. The townships to consist of 64 squares of 800 acres each, and to contain in addition 40 acres, or five per cent in area in each section, as an allowance for public highways.

"4. The townships on the Red and Assiniboine Rivers where the same had ranges of farm lots laid out by the Hudson [sic] Bay Company, to be surveyed, the broken sections abutting against the rear limits of such ranges, so as to leave the same intact as independent grants."

It is interesting to note here that this plan resembled the American rectangular system of survey in its basic pattern but was considerably larger in over-all size. Townships in the Dennis proposals would be 8 sections square rather than the prevailing American arrangement of six by six. Sections would contain 800 acres each, making them about 1.12 miles square instead of the traditional one square mile.

In the Settlement Dennis had been joined by two other Ontario surveyors of good professional reputation, Milner Hart, P.L.S. and Major A. C. Webb, P.L.S. Dennis, after submitting his report to Ottawa, decided not to wait for an answer, as the survey season was getting on. In any event Dennis had authority from McDougall to proceed, pending approval, with any surveys he considered necessary. With Hart and Webb working under

*Map on Mercator's Projection, illustrating the proposed division into townships of a part of the Territory. Plan of a township showing the proposed method of subdivision.

his direction, Dennis began laying out the Winnipeg or Principal Meridian, the initial line designed to govern surveys west and east on the wide plains, the meridian mentioned in his August recommendations.

By a series of careful observations for latitude to determine the position of the 49th parallel (Canadian-United States boundary), including chainage from the astronomical station at Pembina, Dennis commenced from a point thus established to another point on the 49th parallel 10 miles west of Red River. From that point he produced the Winnipeg Meridian northward to the Assiniboine River. Hart carried the meridian line as far as Township 11 then turned westward on the base between Townships 10 and 11. Major Webb produced the base line between Townships 6 and 7 east of the Principal Meridian.

Dennis's warning to McDougall had been a wise move on the surveyor's part. But it had gone unheeded in Ottawa. This neglect was just another error which McDougall would soon have cause to bitterly regret. Eventually, early in October, 1869, Dennis was instructed "to proceed with the survey on the plan proposed."[11] But Dennis had good reason to be cautious and he did not attempt to continue surveys from Oak Point as originally planned. He moved his crews south, as we have seen, where surveying activities would not be observed by métis often enough to disturb them. But the period of deceptive calm was about to end.

On October 11 when his party was operating slightly east of the Principal Meridian, Webb and his men were approached by a group of métis from the Settlement, headed by Louis Riel and Baptiste Tourond. The métis had become disturbed when they caught sight of these surveyors approaching an area of settlement and begin to run their lines over the "hay privilege", as the lands to the rear of the long, narrow river lots had come to be known. When Webb and his men arrived on the hay lands of André Nault, Riel and his associates made their historic, fateful move.[12] The métis were content merely to stand on the surveyors' chains and so prevent further prosecution of their work. There were no threatening words or gestures. Major Webb quietly departed from the scene with his men and equipment.

The action of the métis was a bold one and constituted the first overt act in the campaign of resistance to the importation not only of a whole new government for the region but an entirely new way of life for many in that domain. The act on the Nault farm signalled as well the beginning of a period of violence and near-violence in the Settlement over the impending transition and transformation in Western life and affairs. The time for brooding and argument was over: the time for action had come. In later days whenever Riel was queried about the need for this confrontation with the surveyors he would explain that the Canadian government had no right to make surveys in the Territory without the express permission of the people of the Settlement.[13]

Distressed over the obstructionist gesture by the métis, Dennis complained to Dr. Cowan, magistrate at Fort Garry. But neither his efforts nor those of Governor Mactavish or of the local surveyor, Roger Goulet, were effective in dislodging Riel from his hostile position. Federal surveys did not cease entirely, however. Hart had continued to produce the Principal Meridian up to Township 11. Then he turned west on the base line between Townships 10 and 11 but soon encountered Shoal Lake. Accordingly he returned to the meridian and, beginning on a line between Townships 9 and 10, produced it west across Range 1. Turning north Hart then produced the meridian between Ranges 1 and 2 to Shoal Lake. After the incident of October 11th, Hart spent the remainder of the season running exterior lines of townships between the Principal Meridian and the Red River, north of Township 8.

Webb's party was withdrawn under instructions to run "the exterior line of townships north of the Assiniboine and east of the Meridian to the Red River and to complete the same to connect up with the lines being run by Mr. Hart and then go on with the survey of settlement among English-speaking settlers along the Assiniboine."[14] Dennis observed at the time that the English-speaking people appeared "to understand and appreciate the necessity for the measuring and the boon it would be to have their titles perfected" and that they showed "every facility to the surveyors". With a view to economies, the survey parties, after finishing the work on township lines, were reduced by the release of horses and carts and by limiting party personnel to the surveyor in charge, two chainmen, two flagmen and two axemen and packmen, seven in all. In the winter weather the men got subsistence from farmhouses. By December 1st all field work was discontinued when the tempo of political developments began to increase. Federal surveys did not resume until

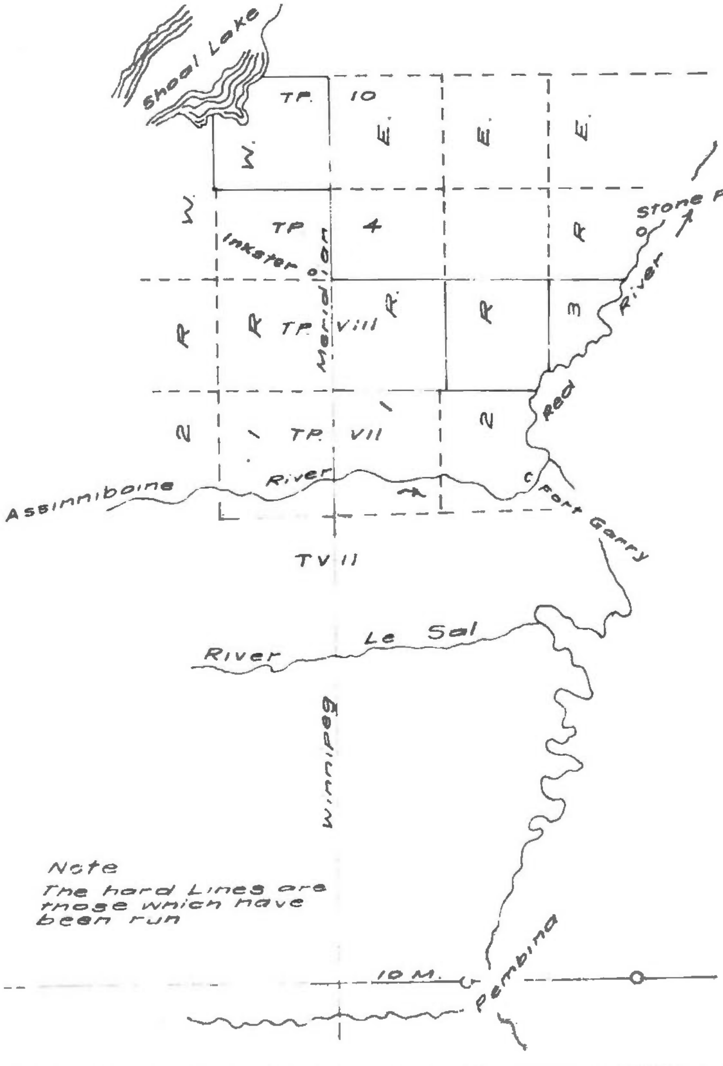


FIGURE 7. Principal (Winnipeg) Meridian and related lines surveyed in 1869 as depicted on page of Milner Hart's field book.

1871. During the 1869 survey season a total of 182 miles of meridian lines as well as of township exteriors had been drawn on the ground and marked by posts and mounds at quarter sections. A total of 20,000 acres of settled farms was surveyed along the Red and Assiniboine rivers.[15]

Dennis, during October, had commenced compiling a map of the country between Lake of the Woods and Fort Ellice and from the international boundary north for 125 miles, "to be lithographed in order to facilitate further surveys." He had intended to show on this map the projected townships in accordance with the recommended and approved system, indicating the method of providing for convergence of meridian lines. When nearly completed, work on this map was interrupted on October 30th by the eruption of serious political troubles in the Settlement. Dennis managed to prepare a plan on a scale of 60 chains to the inch showing Hudson's Bay Company grants on the Red and Assiniboine rivers; also a township plan on a scale of 40 chains to the inch as well as two finished tracings of Hudson's Bay Company maps depicting land grants recorded by the Company.

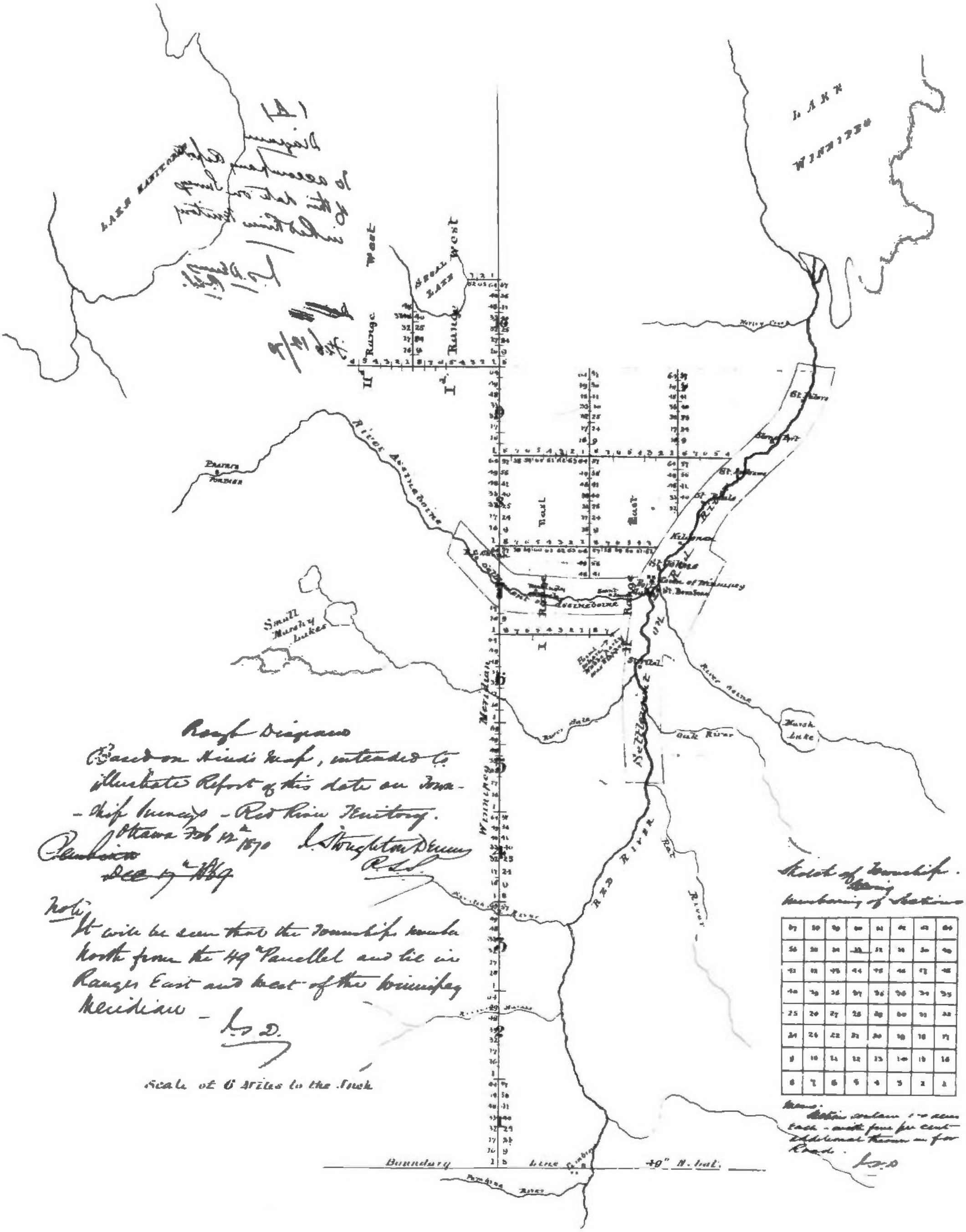
On the day that Major Webb's party was halted McDougall and his entourage from Ottawa detrained at St. Cloud, Minnesota. McDougall, on the dubious advice of Dennis, had taken with him 350 rifles and 30,000 rounds of ammunition. Word of this shipment quickly reached Riel. His response was definite and immediate. On October 16 at St. Norbert a National Committee of the métis was formed and Riel was named its secretary. Five days later an ultimatum addressed to McDougall was drawn up: "Le Comité-National des Métis de la Rivière Rouge intime à Mr. William McDougall l'ordre de ne pas entrer sur le Territoire due Nord-Ouest sans une permission spécial de ce Comité." (The National Committee of the Métis of Red River orders William McDougall not to enter the Territory of the North West without special permission of the above-mentioned Committee.)[16]

Upon McDougall's arrival at the United States customs post at Pembina, the frontier village located just south of the international boundary some 70 miles from Fort Garry, the ultimatum was delivered to him by a métis courier. McDougall angrily disregarded the warning and continued on his journey to the Hudson's Bay Company post two miles to the north. Attached to the staff of the Lieut.-Governor Designate was Capt. D. R. Cameron, son-in-law of Sir Charles Tupper, one of McDougall's cabinet colleagues. It was intended that Cameron would receive appointment to a high post in the new administration of the Territory, once it was formed. McDougall, however, came to consider Cameron as unco-operative—a "Sir John A. Macdonald man". Soon they were to quarrel and to shun each other's company.

After the encounter with the courier Capt. Cameron tried to force his way past a métis road barrier at St. Norbert but was accompanied back to Pembina by an escort of métis horsemen.[17] McDougall was subjected to a similar display of force. On November 2 a métis mounted patrol visited McDougall at the Hudson's Bay Company post and ordered him out of the Territory. McDougall complied very reluctantly. The Lieut.-Governor Designate had been thrust out of the land he had hoped to administer in the name of the Queen.

A section of the United States press was elated over this dramatic turn of events and made the most of McDougall's discomfiture and humiliation. The St. Paul *Press* in an editorial in its November 4 issue employed ridicule . . . "A King without a Kingdom is said to be poorer than a peasant . . . without one poor foot of territory is a spectacle sufficiently sad to move the hardest heart."

Despite Riel's patrols the English-speaking Canadians in the Settlement were in regular communication with McDougall. Snow and Mair pleaded with him quite unwisely as subsequent events proved, not to retreat from Pembina. They assured him that the English-speaking element would rise on his behalf if only called upon authoritatively to do so. The



MAP 2, Diagram of the commencement of Dominion Land Surveys, with the establishment of the Winnipeg (Principal) Meridian line, Red River Territory, 1870, drawn by J. S. Dennis.

month of November proved to be a tedious and trying time for McDougall as he paused in frustration on the threshold of his "Kingdom". Mactavish showed good judgment in advising McDougall at this juncture to return to Canada.

All this time a pattern of government conduct was being woven at Ottawa that would soon form a rug with which McDougall's feet would be figuratively swept from under him. On November 23 Sir John A. Macdonald, much disturbed over the reports from the North West, wrote to his close friend and confidant, partner in a private banking firm in London, England, John Rose (later Sir John), and who had served briefly as Minister of Finance in Ottawa. "I fear", wrote the Prime Minister, "that the people that McDougall sent up there, Snow, Mair and Dennis have not helped at all to smooth matters." Macdonald's view of the situation was that McDougall was instructed to proceed to Fort Garry to make preliminary arrangements for the organization of a government of the Territory *on hearing of the transfer of that region to Canada.* Until officially notified to that effect he was *not* to assume the function of Lieut.-Governor but to act as a private individual. In fact, in a letter to McDougall the Prime Minister had urged McDougall *not* to force his way into the North West but to let those in the Settlement know where he was (author's italics). Macdonald suggested in a letter to McDougall that "the (clever) Riel be retained as an officer of your police . . . as a proof that the half-breeds generally were not to be left outside the law . . . " "The course taken by Stoughton Dennis in pressing for strong measures to be taken against parties interfering with his surveys was exceedingly injudicious. He is a very decent fellow and a good surveyor, and all that, but he has got no head and is exceedingly fussy. He was in the country simply on sufferance, in anticipation of its future transfer to Canada; on finding any serious dissatisfaction amongst the natives or residents, he should have at once struck work and awaited your arrival. It is, of course, important to have land surveyed for settlement as soon as possible, but that is a secondary consideration of your entrance on your duties with the general assent and support of the people . . . ".[18]

On November 26, within a week of the previously fixed date of transfer, the Prime Minister cabled Rose: "Canada cannot accept the North West until peaceable possession can be given. We have advised the Colonial Office to delay issue of Proclamation . . . meanwhile money (£300,000 to H.B.C. as purchase price) should remain on deposit but not paid over." Granville advised Gladstone, "We could not force the territory upon Canada, if they put up their backs."[19]

Thus the December 1 date for the transfer of Rupert's Land became null and void. With the slowness of the mails in those early days of the West and the lack of any speedier communications with Pembina, McDougall remained quite unaware of this major revision of government plans. Dennis was not content to remain idle. In view of the delicate complexities and the high stakes involved it would have been wisdom on his part to have remained inactive during November and December. Dennis had been ordered out of the Territory by the métis on November 2 along with McDougall and his party. He remained with McDougall at Pembina until November 29. On that bitterly cold night he rode to Fort Garry to make public there a Proclamation issued in the Queen's name by McDougall, dated December 1, on the mistaken assumption that he would be, on and after that date, in fact and in law, the chief executive authority in the North West. Dennis arrived at his destination at 5 a.m. on the 30th. He had been appointed by McDougall "Lieutenant and Conservator of the Peace in Rupert's Land" and he meant to carry out instructions.

In a revealing memorandum submitted to the Minister of Public Works in Ottawa some time later, Dennis stated: It may be asked:

"1. Why, when I was sent to the Territory to take charge of surveys, I left to go to Mr. McDougall at all!

"2. Why I did not return, after seeing Mr. McDougall, and continue with my surveying operations? I answer as follows—

"I acted entirely from *a sense of duty* as the only officer or representative in any way of the Canadian government at the time in the Settlement, to prevent, if possible, a threatened outrage on the person sent to the Territory with a commission as Lieut.-Governor, which sense of duty was enhanced by the fact that as Minister of Public Works the same gentleman had, up to that time, *given me all my orders*—and from him also, as told me by himself, I was to receive all future orders in the event of his being appointed Lieut.-Governor. It was a time of much excitement—Mr. McDougall's life was endangered and time was pressing —with Governor Mactavish's warning dispatch I raced on horseback from Fort Garry at 3 a.m. October 30, and by detouring the camp of the malcontents rode through to Pembina to meet McDougall on the morning of November 1. It was necessary to allow the exhausted horses several days to recuperate . . . I acted in good faith throughout *not being aware* until December 23 while on my way to Canada that the Proclamation and Commission issued by Mr. McDougall *under a misapprehension of the facts* (the transfer of the Territory not having taken place on December 1st as supposed) were worth no more than *waste paper*." (author's italics).[20]

McDougall's blunder in issuing the Proclamation prematurely made his own position in the entire dispute not only untenable but exposed to harsh criticism. The only possible advantage gained for the Canadian case by his move was the widening of the wedge between English-speaking half-breeds and the métis. Riel had tried mightily for months to close this breach. From his point of view substantial unity of the two elements in the Settlement was essential to the success of the case against Ottawa.

Under his commission from McDougall, Dennis had authority to "raise, organize, equip and provision a sufficient force" including available surveyors and their assistants to deal with armed men unlawfully assembled to disturb the public peace. Dennis, however, failed to rally to his side any considerable number of the English-speaking half-breeds and a total force of not more than three-score were enlisted. Dennis decided, therefore, to retire with his tiny army to Lower Fort Garry, some 20 miles down river from the Settlement. He had failed also to induce Schultz and his band of 48 men to leave the Schultz residence and join the Dennis garrison. Riel and armed métis, thoroughly aroused and prepared for any eventuality, compelled Schultz and his following to surrender, marching them through the snow to Fort Garry where they were imprisoned. The debacle was completed when, two days later—on December 9—Dennis ordered his men at the Lower Fort to lay down their arms and disperse.

Now it was Riel's turn to issue a Proclamation and in the document he recited the reasons for métis intransigence. On December 10 the flag of the provisional government of the Territory, a fleur-de-lis on a white ground, appeared over Fort Garry.

McDougall took one more step to salvage something from the collapse of his ambitious project. He wrote to Riel on December 16 but in the absence of any response he, Dennis and Snow departed disconsolate from Pembina two days later. By way of St. Paul they began the long journey back to Canada. In his correspondence with Rose, Prime Minister Macdonald observed with considerable exasperation, "McDougall and Dennis have done their utmost to destroy our chance of an amicable settlement with these wild people, and now the probability is that our Commissioners (Thibault, De Salaberry and Smith) will fail and that we must be left to the exhibition of force next spring."[21]

The probability became a certainty as the spring of 1870 approached. As Macdonald had feared the efforts of his special commissioners, Thibault and De Salaberry, proved fruitless. A third emissary, Donald Smith (chief Hudson's Bay Company official in Montreal),

FIGURE 8. Louis Riel and his Council, 1869-70. *Standing:* (left to right) Le Roc, Pierre De Lorme, Thomas Bunn, Xavier Page, Andre Beauchemin and Baptiste Tereaux (Tourond?). *Second row:* Pierre Poitras, John Bruce, Louis Riel, W. B. O'Donoghue, François Dauphinais and Thomas Spence. *Seated in front:* Bob O'Lone and Paul Prue.

sent out to the Settlement in mid-December, made greater headway. Smith made a praiseworthy contribution to the cause of conciliation in an open-air address to a crowd of 1,000 at Fort Garry in below-zero temperatures. But the execution of Thomas Scott, one of Snow's work crew, on March 4 at the Fort under Riel's adamant orders, erased all hopes for measures by Ottawa short of a show of force in the Territory.

Macdonald was now fully convinced that a military expedition was essential as an assertion of Canadian authority and as a gesture of support of elements in the colony favorable to an early takeover of Rupert's Land by Canada. In this conviction Macdonald had the backing of Cartier. Two days after Scott's execution London cabled Ottawa promising British cooperation in any military mission to the North West. Col. (Sir) Garnet Joseph Wolseley, at the time a deputy quartermaster-general stationed in Canada and a veteran of the Crimea and of the Indian Mutiny, was appointed head of the expedition. Eventually he rose to the rank of field marshal in the British Army and in 1884-5 commanded the expedition to relieve Khartoum, including a considerable number of Canadian voyageurs to help in the navigation of the Upper Nile River.

The force placed under Wolseley's orders was of a mixed British-Canadian character. It consisted of 373 officers and men of the (British) 60th Rifles as well as militia units from Ontario and Quebec numbering 389 in all, supplemented by small detachments of Royal Artillery, Royal Engineers, Army Service Corps and Army Hospital Corps. On May 14 troops embarked at Collingwood for Sault Ste. Marie. By June 23, 1870, the last of the troops had arrived at Thunder Bay on the steamer *Arctic*.

In the meantime Dawson and his men had been laboring strenuously to prepare the road and water route out of Port Arthur for the expedition. Early in January, in fact, Dawson had been instructed to have a road ready by May 1st to admit the passage of horses and wagons.[22] The idea of providing a feasible route from Lake Superior to the Red River by land and water was not abandoned by the Government of Canada after Confederation in spite of the difficult nature of the country it was to traverse. But it never did prove to be a popular line of communication. Work on the Dawson Route commenced at its eastern terminus, Port Arthur, in 1867. Attached to Dawson's party was a young surveyor, Lindsay A. Russell, destined in time to become Surveyor General of Canada. J. F. Gaudet and Alexander Wells served as engineers.

The very first federal surveys to disturb the métis of the West were those under Snow designed to expedite the completion of the Dawson Route and thus eliminate any confusion that might otherwise attend a flood of immigrants. The Dawson Route was developed also as a matter of national policy to keep the flow of settlers moving within the boundaries of Canada.

By June, 1871, when the route was officially opened, a cart road from Thunder Bay to Lake Shebandowan, a distance of 45 miles, was reported to be in excellent condition by the federal Minister of Public Works. The road from Lake of the Woods to Fort Garry, some 95 miles, was passable. The 310 miles of broken navigation was made easier for travellers by the use of steamers. The fare for immigrants covering the journey from Thunder Bay to Fort Garry was $25. Freighting charges were fixed by Order in Council.

But a year earlier, when the greatest pressure for the use of the route was being exerted, the outlook was less promising. Forest fires and heavy rains had combined to delay construction work and by May 25, when Col. Wolseley arrived on the scene, only about 30 miles of road had been built. Throughout June and the first half of July men of the military units labored with Dawson's crews in an all-out drive to put the route in usable shape. The state of the road and some of the difficulties encountered in its building are contained in the account of an observer attached to the expedition:

"The road, properly so-called, does not extend far beyond the Matawin; the remainder, up to the Oskondaga, was intended to serve the purposes of the moment, and has not yet been ditched or treated according to the rules presented for road-making. When I passed over it six weeks ago, it was only partially cleared; the weather was dry; no wheels had gone over it and it afforded easy, pleasant walking. Wheels have now cut up the soft moss with which it was covered, the frost has come out of the ground, the rain has soaked in and, being in a valley, the traffic has churned it up until mud ponds and boulders combine to stop the way . . . The road beyond (the Oskondaga bridge) is very good. About four out of six miles are now ready for traffic . . . "[23]

Notwithstanding the general condition of the road the expedition made progress. Iroquois Indians and the whole force of the 60th Rifles were employed in levelling and draining. Other misfortunes struck hard at the expedition. Out of 150 horses sent to Thunder Bay, some of them for use with the artillery, 60 fell sick. No veterinary surgeon had been attached to the force. Disgusted with continual delays involved in overland travel Wolseley decided to rely on the waterways, so plentiful in this region of Canada, as far as Lake Winnipeg. From thence he travelled up the Red River from its mouth. By August 24 the force had reached Point Douglas, two miles from Fort Garry. Riel viewed its campfires that night and, alarmed by the appearance of the expedition so soon and so near his own headquarters, fled in great haste from Fort Garry to safety in the United States.

Meanwhile, the Manitoba Act had been passed by the Canadian Parliament on May 20 and on that same day Hon. (Sir) Adam George Archibald (1814-92) had been appointed

Lieut.-Governor of Manitoba and the North West Territories.* Later he served a term as Lieut.-Governor of Nova Scotia, his native province. As the first Lieut.-Governor in Canada's western interior Archibald laid the foundations of civil institutions of Manitoba and the territories. In order to take the post he had resigned from the portfolio of Secretary of State for the Provinces. Actually this federal cabinet office passed into history on July 1, 1873 when it was abolished (36 Vic. Ch. 1, Sec. 14). Hon. Joseph Howe was the last minister to occupy that position. On July 1, 1870, the long-postponed transfer of Rupert's Land to Canada was consummated by formal legislative action. On July 15, Manitoba formally entered Confederation.

Archibald reached Fort Garry on September 2 and on the following day the regular troops of the Wolseley expedition departed, their mission accomplished without a shot fired in anger. One unhappy incident marred the early days of the Archibald régime. Elzéar Goulet who, unlike his brother Roger, the surveyor, was an active supporter of Riel, was recognized on the street as a prominent rebel. He was chased by two militiamen and a civilian and in order to escape their fury, tried to swim the Red River. He was drowned in the attempt.

Under heavy pressure of other problems, including arrangements for taking a census of the new province, Archibald was delayed in making his study of the situation related to land surveys policy in the West. But on December 20, 1870, he forwarded his recommendations to Ottawa. Archibald, like Dennis, urged upon federal authorities that the rectangular system be adopted but disagreed with the surveyor over what was the most suitable size of township, section, and quarter-section. Archibald strongly advocated the American pattern of a 6-mile square township subdivided into 36 units of one square mile each, with a further subdivision into 4 square lots of 160 acres each. That system, Archibald pointed out, had been "adopted by the most practical people in the world and after 70 years' experience remains unchanged" and, he asked, why should we change it?

If events in the North West had taken a different course in 1869 and if McDougall had made a peaceful and successful entry into the Territory, it is entirely possible that the Canadian township would have remained at the initially recommended 64 sections, each 800 acres in size with an additional 40 acres for highway allowances (53,760 acres in all) and with 200-acre quarter-sections—the whole two and a third times the area of the present 36-section township (23,040 acres in all), and with the acreage of each section one-quarter as large again as in the existing 640-acre section.

McDougall had failed ingloriously in his enterprise and the reputation of Dennis was definitely not enhanced by the startling events of 1869. Riel, triumphant for a time, nevertheless after the execution of Scott began a gradual descent from his place of power and influence in the Settlement in 1870 to the gallows at Regina 15 years later. McDougall's career continued in the relative shallows of federal politics but Dennis recovered sufficiently in prestige and respect to enable him to occupy with distinction very high and very useful positions in the public service of his country until his retirement in 1881. Archibald, the new, duly-installed and able vice-regal representative in Manitoba made recommendations to Ottawa that met with favor in high places and in large measure constitute the basis of the pattern of land division in effect in the western interior ever since.

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*Following 1870 and until 1906 "North-West Territories" was the form of title commonly used in Canadian statutes. The unhyphenated version, "Northwest Territories" was introduced in the 1906 revision of Ch. 62 and has since been in general use.

2

EARLY SURVEYING AND MAPPING IN THE UNITED STATES

A knowledge of the story of surveying and cartographic developments in the United States is indispensable to a proper understanding of the history of settlement in Canada's western interior. The surveying practices in the United States have profoundly influenced the manner in which Canada applied principles of geometry to the task of subordinating large-scale physical geography to individual human needs. For many decades Canada and the United States have worked in constructive partnership to achieve the accurate completion of surveys and maps in a variety of fields, including hydrographic, geodetic, topographic and international boundary measurements as well as in outer-space studies. For this reason also a broad understanding of the American experience is vital to a sound grasp of certain Canadian decisions and trends.

Some of the more notable leaders of public opinion in the United States during the first hundred years of its nationhood were at one time or other in their careers either practising surveyors or closely linked with land survey and mapping activities. Washington, Jefferson, Franklin and Lincoln were interested in these fields to an extent not generally realized. George Washington (1732-99) wrote a book (unbound) in 1749 entitled *Early Survey Exercises* containing chapters, for example, on Geometrical Definitions, Surveying, the Art of Measuring Land, and Geographical Definitions. Forty years before he became first President of his country, Washington was actively surveying land. In 1749 he became, in what is now the United States of America, the first registered county surveyor (Culpeper county, Virginia).

In his diary Washington records on April 5, 1769, that he "Ran the back line of Spencer and Washington's Patent; and came home to Dinner." Again, on November 19, 1770, the following diary entry occurs: "At Ft. Pitt I got the distances from place to place down the Ohio as taken by one Hutchings* and which are as follows w' some corrections of mine."

*Thomas Hutchins (1730-89) was captain of the 60th Foot or Royal American Regiment of the British Army. In the Revolutionary War he joined the colonists and was a captain and geographer in the Continental Army. He later became Chief Geographer of the United States.

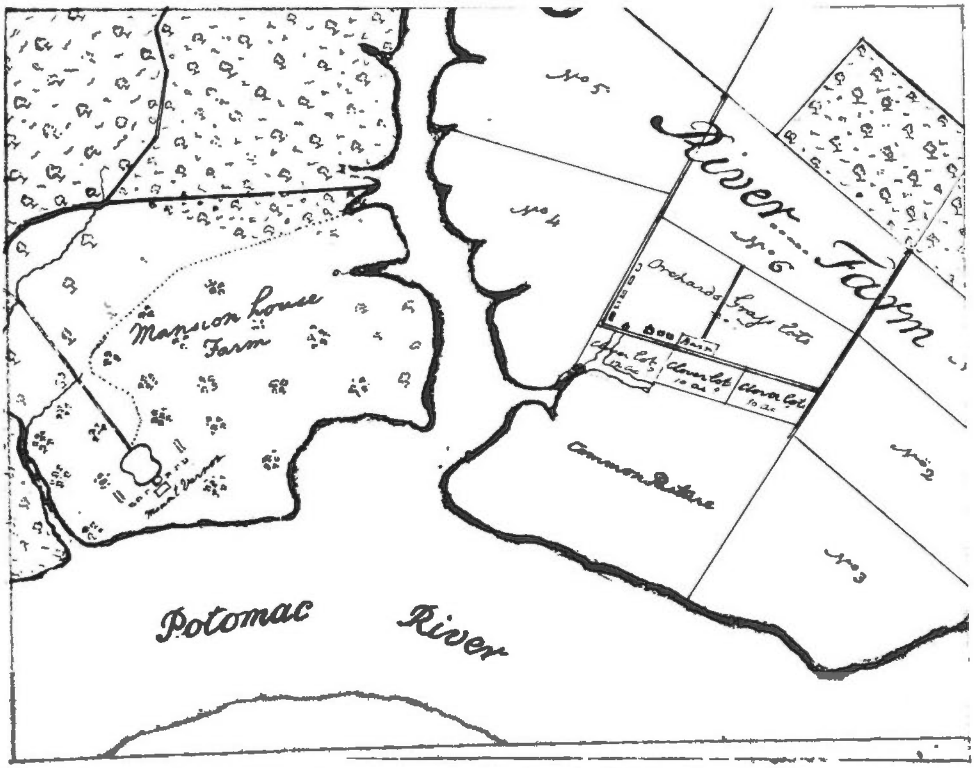


FIGURE 9. Mount Vernon estate, Virginia. Part of map drawn in 1793 by George Washington, based on his own surveys.

Visitors to Mount Vernon may view a map of that historic estate, drawn by George Washington and based upon his own surveys of the family property. His knowledge of terrain and of its significance in military operations taught him the value of reliable cartographic information. In 1777, as General of the Army, Washington established a central mapping corps with approval of Congress, the first federal mapping agency to be created in the States.[1]

In the pioneer stages of map making in the United States the name of James Wilson (1763-1855) looms large. This farmer-blacksmith of Bradford, Vermont, concluded at the age of 37 that he wanted to construct globes. In the first years of the 19th century globes were obtainable only from Europe and at a very high cost. Wilson sold some of his livestock in order to purchase an encyclopedia from which to gain information on cartography, mathematics, geography and astronomy. He learned copper engraving work from Amos Doolittle, one of America's first map makers. Wilson made all his own tools, mixed his own inks and prepared his own adhesives and varnishes. At one stage of his development in this exacting field Wilson worked 300 days engraving map sections on copper plate only to find that meridian lines were not converging properly. Accordingly he had to begin the operation all over again. He sold his first globe in 1810 and he became an immediate success. Subsequent Wilson globes sold at fifty-five dollars a pair.

As early as 1760 surveyors were occupied in locating on the ground the boundary between Maryland and Delaware. Between 1763 and 1767 this line was verified by two

English mathematician-surveyors, Charles Mason and Jeremiah Dixon. These men also established the Maryland-Pennsylvania border popularly known as "the Mason and Dixon line".[2]

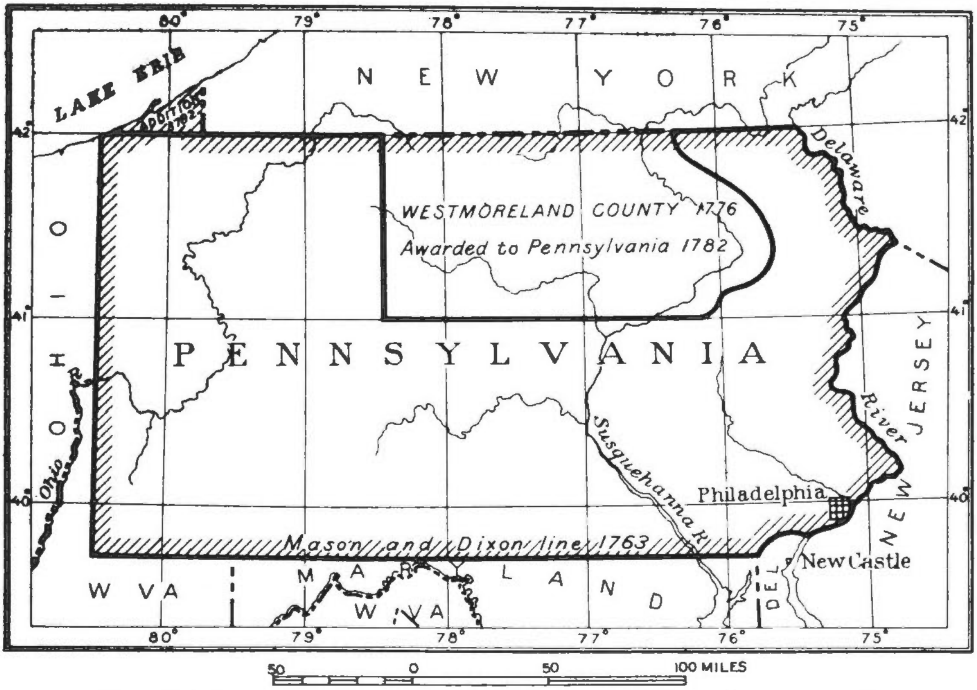


FIGURE 10. Mason-Dixon Line, one of the best-known surveyed lines in the western world.

Peter Jefferson, father of Thomas, was a land surveyor, as was Peter's grandfather. Thomas Jefferson (1743-1826) was appointed Surveyor of Albemarle county, Virginia, in 1773, the same county in which his father practised.[3] Jefferson, with Hugh Williamson of North Carolina (a former professor of mathematics), gave strong leadership to a committee of Congress that worked to produce a suitable system for surveying public lands. The committee recommended the adoption of the rectangular system and this plan was approved and incorporated by Congress in the Land Ordinance of 1785. Under this system township areas were made six miles square and every township was divided into 36 sections of 640 acres each. This plan became the standard basic pattern for measuring and apportioning public lands throughout most of the new territories of the expanding nation.

The three major stages in the creation and growth of the United States rectangular land-survey system may be cited as the Land Ordinance of 1785; the pioneer surveys of the Seven Ranges and the Land Act of 1796. The Seven Ranges (townships laid out south of a line running due west from a point on the Ohio River) are noteworthy in the history of the United States public domain as the first proving ground for the application of principles set forth in the 1785 Ordinance. The east boundary of Ohio, north of the Ohio River, known as Ellicott's Line, in longitude 80°32′20″ was used as the first reference meridian. From this meridian the ranges were numbered progressively westward and the townships progressively northward from the Ohio River in each range.[4]

After he became President of the United States in 1801 Jefferson pressed for the active exploration and mapping of the trans-Mississippian West. It was during his presidency also that the agency known as the Survey of the Coast was inaugurated and the famous Lewis and Clark expedition to the Pacific Coast was undertaken. Another notable development in this period occurred in April, 1812, when the General Land Office was brought into being in Washington, D.C. Edward Tiffin was appointed first Commissioner of the General Land Office and was authorized to prepare and issue land patents as well as to keep all records of public land transactions. Tiffin is credited with founding the first system of federal land management.

Later on in the development of the United States another president, Abraham Lincoln, could claim among other accomplishments, training as a land surveyor. Lincoln spent six highly formative years (1831-37) "among other things, traversing Sangamon County (Illinois) as deputy surveyor."[5] Lincoln had mastered, in a relatively short time, survey text books, the use of chains, circumferentors and horizons. One of the books he studied was *The Theory and Practice of Surveying* by Robert Gibson, published in 1814. For his field work in surveying Lincoln was paid at the rate of three dollars a day.[6]

As a blazer of witness trees and a carrier of surveyors' chains Lincoln contributed to the opening up of a new land to settlement and progress. But by the stroke of a pen after he became President, Lincoln made an immensely more significant contribution to the development of the United States. Hordes of prospective settlers came to the States during the first half of the 19th century. In the Old World men dreamed of free land in the New. Dancing constantly before their eyes were visions of boundless expanses of uncultivated, ownerless and richly fertile acres. On both sides of the Atlantic men nursed the assumption of an inherent natural right of individuals to a part of the then apparently unlimited supply of virgin land. The very existence of such land invited the appearance of squatters, men who located on land without first acquiring title thereto. This condition also provided momentum to popular agitation for free homesteads.

Between 1801 and 1854 Congress, recognizing practical difficulties in any attempts to control the practice of squatting, passed a series of laws regularizing preemption by individuals on public lands. Each successive law and series of regulations concerning squatting became more and more liberal until in 1854-55 preemption by individuals was permitted even ahead of survey! But the law did require an eventual nominal payment for the land before full title to it was issued.

The earliest United States federal land grants to help promote the construction of railways were made by Congress in 1850. The Illinois Central as well as the Mobile and Ohio were initial beneficiaries to the extent of millions of acres. This generous example set the pattern for subsequent and even more extensive land grants to railway corporations. The largest was a 20-million-acre grant to the Northern Pacific. During a period of several decades land grants authorized by Congress for such purposes were made to some 70 railway systems to a total of more than 90 million acres.[7]

Free grants of land, particularly to individuals, seemed to be the logical solution at the time to the problem of settling the American West. This policy, in fact, became the cornerstone of American development.[8] On May 6, 1862, after a lively congressional struggle over more than a generation, a free homestead bill received Senate approval following House passage and on May 20, 1862, President Lincoln signed the bill into law.[9]

By this single action, more than by any other, the American wilderness was prepared as a home for free private enterprise and a pathway for civilized endeavor in that part of the New World. The Homestead Act allowed, after January 1, 1863, ". . . any person who is head of a family or who has arrived at the age of twenty-one years, and is a citizen of the United States, or who shall have filed his declaration of intention to become such . . . shall . . . be entitled to enter one quarter-section or a less quantity of unappropriated public lands . . . ".

Because of this far-sighted action the economy of the United States took a great leap forward. Once homesteaders began producing grains and other farm products, American manufacturing invented and fashioned machinery to simplify and expedite the harvesting of crops. An almost incredible growth took place in farm-implement, milling, meat-packing and farm-fencing industries after 1862. Because it had become practically impossible to farm 160 acres profitably by one man, one plough and one animal, mechanization proceeded apace in agriculture. The reaper, twine-binder, threshing machine and, finally, the tractor and truck revolutionized farm life and production. Within 25 years after the Homestead Act became law the United States of America became the greatest producer of agricultural products in the world. Under the provisions of that law more than one and a half million persons in 17 western states were enabled to win title to a total of more than 270 million acres of virtually free land.

Many immigrant "sodbusters" accomplished their initial temporary farm boundary surveys by using a wagon with a cloth tied to a wheel spoke, each revolution of the cloth counting off a definite number of feet. The first great wave of western settlement reached its peak in April, 1889. On the 22nd day of that month some 20,000 land-hungry men arrived at the boundary of Indian Territory. They came on foot, on horseback, in covered wagons and in buggies. At the firing of a signal volley by United States troops the horde of land seekers poured over the line. Before nightfall of that day settlement had taken place on nearly two million acres!

Previous developments of a like nature, though not of such spectacular magnitude, had already ushered in an era of intensive railway construction. In 1853 Congress had passed a measure authorizing the Secretary of War to make surveys for a railway to the Pacific Coast. Army engineers invaded the western wilderness and laid out five routes. The planning and surveying of the right-of-way lasted for several years until the outbreak of the American Civil War. That civil strife erupted before a single spadeful of earth had been turned on actual construction of the transcontinental rail project.

President Lincoln had decided that the line would commence at Omaha and extend to Sacramento. The Union Pacific (working westward) fighting nature's formidable obstacles—and the Central Pacific (working eastward) fighting fierce Indians and outlaws, finally met on May 10, 1869, with a golden spike ceremony at Promontory Point, Utah. By this time most of the free land in the Midwest had been occupied. Between 1860 and 1880 the population of the trans-Mississippi West increased from 9 to 25 million.

Soon after the opening of the century of dynamic American growth the government of the United States had entered other important survey fields. The United States Coast and Geodetic Survey came into existence largely because of the dedicated efforts of Ferdinand R. Hassler (1770-1843). Known then as the Survey of the Coast the agency, formed on February 10, 1807, during President Jefferson's term of office, constituted the first technical bureau of the federal government. During its early career it functioned under various titles but in 1878 was formally christened the Coast and Geodetic Survey. This organization conducts surveys for the making of nautical charts, publishes and distributes the charts, which mainly concern United States coastal waters. It also carries on oceanographic and geophysical investigations and executes geodetic surveys as a foundation for topographic and cadastral surveys, mapping and many engineering works.[10]

But for most of the 19th century the challenge of the land mass of the North American continent north of the Rio Grande took precedence in men's minds. After explorers had probed the West the services of surveyors were enlisted to measure, subdivide and stake out the land, township by township. In both the United States and Canada these surveys were advanced by resort to the contract system, with the work being awarded to qualified surveyors

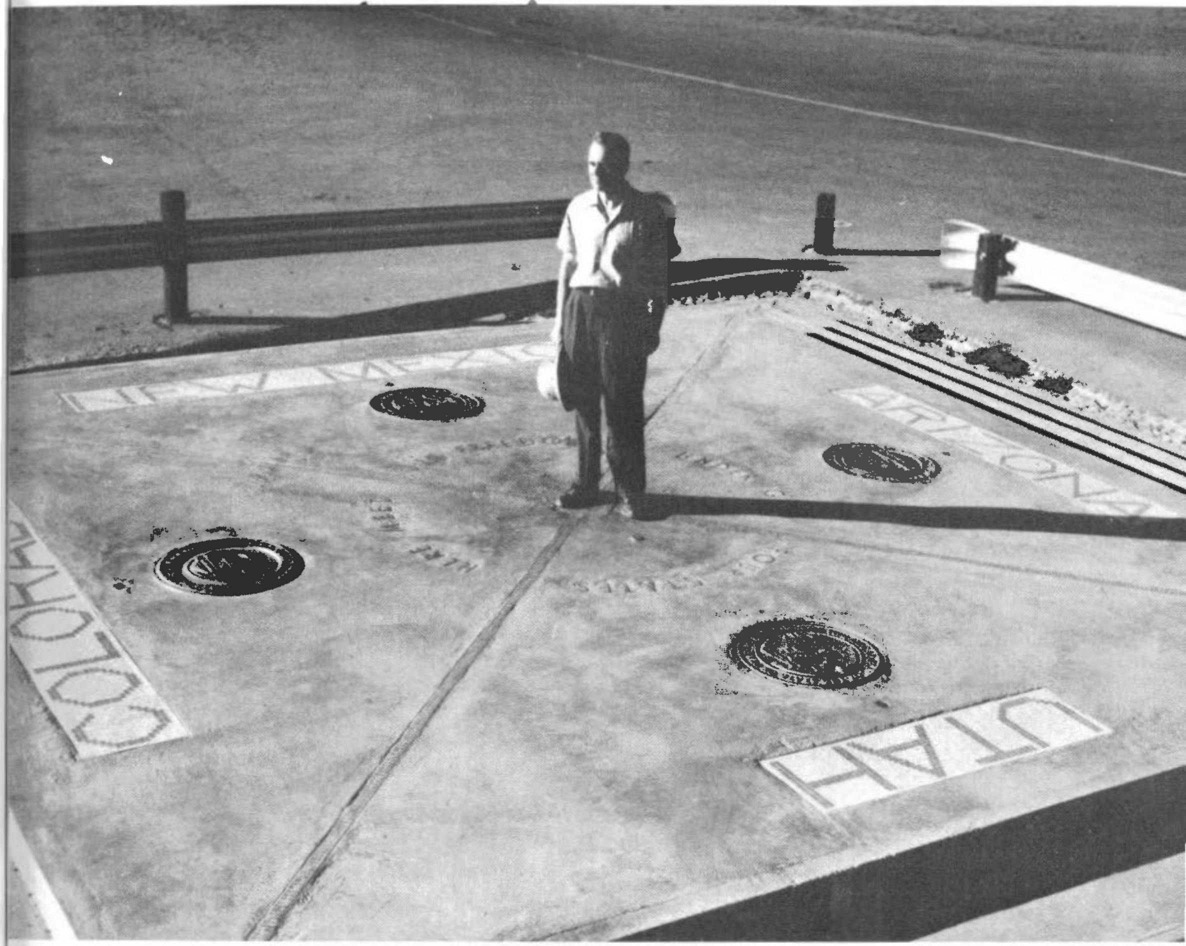


FIGURE 11. A boundary point common to four states, an intersection unique in the United States.

whose bid had been the lowest. In the United States this method prevailed until about 1912 when the federal government developed expert survey crews within its own organization. Surveyors, of course, were required to record detailed field notes covering their professional work and these notes are on file in Washington, D.C., in the keeping of the Interior Department's Bureau of Land Management. The description of almost any parcel of land not included in the original 13 colonies is thus made available for examination or study.

The vast and comprehensive rectangular survey system in the United States provided a simple, reliable, definite and easily understood form of land identification and legal description. This system has extended over a total of more than one billion, 300 million acres of the entire land area of the continental United States. In an amended but largely similar form this system supplied like advantages in connection with the surveying of Canada's western interior.

3

THE DOMINION LANDS SURVEY SYSTEM AND THE WESTERN INTERIOR

"Question surveyors, know our own estate."
King Henry IV (2), Act 1, Sc. 3.

An air traveller's first glimpse of the Canadian prairies in summer is an unforgettable one. Stretching out to far horizons in all directions fertile farmlands can be seen laid out in checkerboard fashion, some squares black with summerfallow, others green with crops, the whole brushed by racing shadows of the occasional cottonpuff clouds so characteristic of western skies. Such is the impressive, memorable spectacle that unfolds across hundreds of miles of landscape, challenging the viewer's imagination and arousing wonderment. That pattern of land division, so reminiscent of the checkerboard, is the visible signature of one of the great civil engineering triumphs of all time. The system of survey of which this panoramic tapestry is a striking by-product, constitutes one of the most outstanding accomplishments of the Canadian government in early post-Confederation years. As an example of a uniform plan of survey over an immense area the project is unsurpassed for precision of execution, permanence of marking and absence of subsequent litigation over property boundaries.

The introduction of the Dominion Lands survey system involved a method of speedily and conveniently identifying any block of farmland governed by it. By a distinctive code any unit of land in the western interior of Canada could be described in a complete and readily understandable form. To those acquainted with the system the code SW¼-28-49-22 W4th, for example, proclaims that the land so labelled is the southwest quarter-section of section 28, township 49, range 22, west of the 4th meridian. In this instance this property is a farm of 160 acres located near the village of New Sarepta, a short distance south and east of the city of Edmonton, Alberta.

But up until the survey season of 1871 the entire western interior, with the exception of

FIGURE 12. Prairie landscape viewed from the air near Moose Jaw, Saskatchewan.

a limited area centred on the Red River Settlement, was devoid of lines resulting from any systematic land surveys. It would seem that the advent in the North West of the first surveyors sent out by Ottawa in 1869 provided the occasion, though not the fundamental cause, of civil unrest in that part of the frontier region. But by autumn of that year these troubles had subsided to a considerable degree. The Manitoba Bill, by which the new province entered Confederation, had been passed following a lively debate in the House of Commons during early May.* On May 3, 1870, the *Globe* (Toronto) reported that the Prime Minister had read to the House a description of Manitoba's boundaries: "The region which is to form the new Province of Manitoba commences at a point on the frontier of the United States Territory: 96° West of Greenwich (passing near Whitemouth) and extends to a point 98°15′ West (passing near Portage la Prairie) being bounded on the south by the 49th parallel of latitude and in the north by latitude 50°30′ ."

The *Globe* reported also that Sir John at this point in his address "placed a map on the House (Clerk's) table showing the boundaries of the new province and members gathered around to examine it." As originally drawn the square-shaped, relatively miniature Manitoba

*Section 19 of the measure provided that "the survey . . . of lands in the N.W.T. . . . shall be under the direction and at the expense of the Government of the Dominion."

consisting of less than 13,000 square miles, gave rise later to the derisive description, "postage stamp province". But in 1881 the provincial boundaries were altered to embrace over 70,000 square miles and a further extension of its territory in 1912 increased Manitoba's total area to just under 250,000 square miles. In 1871 the population of Manitoba was found to be 25,228 and that of the North West Territories, 73,228. By 1881 both these totals had more than doubled.

By mid-summer, 1870, the formal transfer of Rupert's Land to Canada had at long last been accomplished, the new Province of Manitoba created and, by July 15, officially ushered into Confederation. Despite his excesses of conduct Louis Riel was not an annexationist and was, in fact, instrumental in preventing absorption of the North West by the United States during the critical period of métis unrest. Nor did he ever intend to lead a rebellion against the Crown. His principal purpose was to bring about a state of affairs in which free negotiations could take place between the people of Red River Colony and the government of Canada in regard to terms of union. For seven months Riel headed the only effective government in the North West. But now he was in exile and a new vice-regal representative, duly installed, had arrived in Manitoba and entered upon his onerous duties.

Archibald, less knowledgeable than McDougall about the North West, was much more tactful and of a more judicial turn of mind than his former cabinet colleague. But he needed all his natural and acquired skills to deal effectively with problems of civil government arising in the transition period. The native-born people of Manitoba did not relish the sight of immigrants, including some discharged volunteers from the ranks of the Red River expedition, acquiring choice lands in the absence of any satisfactory confirmation of Indian or métis land titles. Staking out property claims, in fact, became a popular mania.

In his written instructions to Dennis a year earlier McDougall had probably influenced the surveyor's approach to the formulation of a workable survey system for the entire West by indicating that "the American system of survey is that which appears best suited to the country except as to the area of the section. The first emigrants [sic] will probably go from Canada and it will therefore be advisable to offer them lots of a size to which they have been accustomed." [This latter phrase is reminiscent of the language employed by Governor-General Haldimand in his 1783 instructions to John Collins.] "This will require you to make the section 800 acres", McDougall observed, "instead of 640 as in the American plan; there should also be an allowance or excess sufficient for public roads."[1]

In making his August 28, 1869 report, Dennis stated that the American system was at fault in making no appropriation for public roads which, under that plan, was taken from the land acquired by the settler. Accordingly Dennis felt that an allowance of acreage for highways ought, rather, to be included within the boundaries of the Canadian form of township. He provided an additional five per cent in each section to ensure that the *net* area of the settler's quarter-section would not be less than 200 acres.

Dennis also came to the conclusion that the 640-acre United States township was unnecessarily small for adoption by Canada. "In a prairie country", he wrote, "where communication facilities are greatly in excess of those in a broken or heavily-wooded country the townships may well be larger, thus tending to economy in the administration of municipal affairs."

The Dennis recommendations concerning the pattern of numbering townships, ranges and sections represent the principal Canadian departure from the then current surveying practice in the United States. Yet this essentially original suggestion drew little or no comment in Ottawa. Townships surveyed in the decade 1860-70 on the north shore of Lake Huron had followed the United States pattern of numbering sections from one in the northeast corner to 36 in the southeast corner. This practice in the States is all the stranger because in the

Northwest Ordinance enacted by Congress in 1785 it was specified that "The Geographer shall designate the townships . . . by numbers progressing from south to north, always beginning each range with No. 1." Dennis would seem to have been more logical and consistent in advocating that not only townships but sections of the township be numbered from south to north, following the anticipated trend of Canadian settlement generally in the West.

Thus Dennis included in his report the recommendation that the "numbering of the townships (be) from one uniform base . . . the southern boundary of the Territory . . . and the numbering of the ranges of Townships east and west from one principal meridian is simple and will be therefore easily understood by all parties." The proposal to award numbers rather than names to new Canadian townships was considered to be the best course to follow as settlers, having in mind the standard practice in the western United States in this connection, would in all likelihood bestow names of their own selection upon these land divisions in the course of time.

McDougall had forwarded the Dennis recommendations to the federal cabinet and on September 23, 1869, these proposals had been formally approved and adopted by the government. Now in January following, a disgruntled McDougall and a somewhat discredited Dennis were back in Ottawa. The arrival of Dennis in the capital had been delayed by an accident he had suffered at Abercrombie en route from the North West and which had resulted in temporary lameness. In the Commons McDougall made a spirited defence of his actions vis-a-vis Red River Settlement but his obvious misconception of the duties vested in him drew sharply critical replies from the treasury benches. Nevertheless he fought hard as a private member for the retention of the 200-acre section in any survey system applied in the new land, firm in his belief that many Americans would be attracted to the Canadian West by a truly liberal land-grant policy.

In the summer of 1870 preliminary instructions were issued from Ottawa to Archibald, over the signature of the Under-Secretary of State for the Provinces, setting forth guidelines on those governmental matters to be advanced at an early date in Manitoba, including the system of surveys. In paragraph 7 of the instructions Archibald was asked "to report as to such lands in the Territories as it may be desirable to open up at once for settlement, transmitting such sketch or plan as may be necessary, with an estimate of the probable cost of survey, a statement of the conditions as to settlement or otherwise suggested for grants of land, such sketch or plan to show the number of Townships it is proposed to lay out at once, their size and situation, and the size of the lots, making the necessary reservation for churches, schools, roads and other public purposes."[2]

It is interesting to note that Archibald was required to include an estimate of the cost of survey. The fact was that as the Canadian government contemplated the establishment of a policy of free homesteads, with little or no revenue accruing to the Crown in the right of the Dominion for some years to come, it was considered essential, at the time, that the cost of surveys in the West be kept as low as possible.

In the West, Archibald's administrative hands were full. He had to attend to the organization of a population census, the appointment of court officers, the meeting of currency requirements, arrangements for collection of customs and excise taxes, meeting with delegations of discontented Indians and to the adoption of measures against a smallpox epidemic, all in addition to his normal daily business. Finally, however, he managed to win time enough to study the pressing needs for a comprehensive western land survey. By December 20, 1870, Archibald's well-considered recommendations were mailed to Ottawa.

In his report Archibald stated, after making introductory reference to the land-grant policy of the Hudson's Bay Company in Red River Settlement, that "the Company has plans of their surveys with a Registry Book referring to these Surveys with numbers of the lots marked thereon consecutively" and observed that "the title of an actual occupant of (such) land depends much on the same kind of evidence as his ownership of a horse or plough."[3]

FIGURE 13
Hon. A. G. Archibald, first Lieutenant-Governor of Manitoba.

As to the proposed new system of federal surveys Archibald wrote, "I take it for granted that the general principle sanctioned . . . September 23, 1869 . . . will be retained. The general principle I take it to be that the land shall be surveyed in rectangular blocks numbered consecutively from one upwards in each Block." But Archibald added that he felt Dennis had not acted judiciously in recommending a deviation from the system of 6-mile (square) townships.

Archibald recited some highlights of American survey history and then observed that in the light of nearly 75 years of practical application of the system without any departure therefrom, "lands of half a continent have been laid out and peopled." In Dakota, for example, their surveys would soon "approach our Boundary all along the line from the Lake of the Woods to the Rocky Mountains . . . the two systems will be coterminous and there are strong reasons for making ours analogous to theirs. The (United States) system is known all over the world to the emigrant classes . . . Why should we change it?"

A lot of 160 acres, he considered, is the "acknowledged extent" of an immigrant's requirements for farm purposes. "In laying out the boundless [sic] prairies to the West of us there might, perhaps, be some justification for liberality in the amount given for a farm lot. But with the limited Territory of Manitoba with Hudson's Bay grants and Hudson's Bay reserves, with squatter's rights and halfbreed rights and Indian reserves our little Territory is already to some extent forestalled, and this does not seem to be the occasion nor Manitoba the province where we should set the first example of prodigality in the allotment of lands . . .".

Then came the most convincing argument Archibald had thus far advanced. "But with 5,250,000 acres to grant and the question before us whether we shall lay it off in lots of 210 or in lots of 160 acres, there is just this difference . . . the system I should recommend would furnish 32,800 homesteads while that of Col. Dennis would give but 25,000 . . .".

"Then as to reasons assigned by Col. Dennis for throwing 10 acres into each lot as an allowance for roads, I cannot consider them sound. Roads required in a neighborhood", Archibald pointed out, "are for the benefit of the body of Settlers. Let those who enjoy the benefit bear the burden and let it not fall exclusively on the man who by accident may happen to be the owner of a lot through which the Road has been made." The United States title, he explained, is without any reservation for this purpose "and yet there is no difficulty among them, and there would be none among us on this point." In this conclusion he was somewhat over-optimistic.

Archibald made brief reference also to the possibility of government land grants in aid of railway building in the North West but this aspect of his recommendations will be considered in a later chapter of this volume.

An important aspect of the Dominion Lands survey system, as it came to be popularly known, was that basic surveys made under it were founded on principles of astronomy. There is mention of this as early as July, 1869, when McDougall gave written instructions to Dennis concerning the inauguration of surveys in the North West, "Mr. Snow will be instructed to assist you, and to place at your disposal any astronomical or other instruments . . . ". Even before 1869 the best surveyors in the Province of Canada were expected to be well qualified in astronomical principles as applied to land-survey work.

Archibald had carried out his assignment concerning western surveys but some member of the federal cabinet, competent in such matters, was required to expedite the transaction of documentary submissions into actions. In Ottawa at this time a new personage appeared in land-survey, policy-making circles. Hon. Alexander Campbell, Postmaster-General, had acquired first-hand experience and a considerable reputation in public lands administration. In Canada West, in addition to being a practising lawyer, Campbell had been Commissioner of Crown Lands from 1864 to 1867. He was now asked by the Prime Minister to formulate a practical, workable federal policy on western surveys, based upon the Archibald proposals.

Serious as were the amendments to his own 1869 recommendations, Dennis must have assented to them in the main. According to his son's account, Dennis submitted a memorandum as early as January, 1871, recommending that "the system of survey be altered, retaining the rectangular principle but making the townships six miles square, with road allowances on all section and township lines of 1.50 chains wide."[4] At any rate on March 1 Governor-General Lord Lisgar transmitted to the Commons a copy of the Order in Council of that date and a memorandum on regulations regarding "Public Lands in Manitoba". These documents enumerated the following salient points relating to survey policy:

"1. The system shall be rectangular.

"2. The Townships shall consist of 36 sections of one mile square each, and road allowances, in all cases 1 chain in width, shall be set out and allowed between all Townships and Sections. Sections shall be numbered thus:

31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

"3. The International boundary shall form the base line for Townships 1 and 2.

"4. The East and West lines between Townships 4 and 5, 8 and 9, 12 and 13, and 16 and 17, shall be base lines or standard parallels in the system.

"5. The meridian line run in the Autumn of 1869 some 90 miles north from the boundary, shown as "Winnipeg Meridian", shall be adopted and continued as the meridian from which the ranges of Townships shall number East and West in the province.

"6. The "jog" resulting from the convergence of meridians shall be allowed and set out as follows:

For Townships 1, 2, 3 and 4 on line between Townships 2 and 3;
For Townships 5, 6, 7 and 8 on line between Townships 6 and 7;
For Townships 9, 10, 11 and 12 on line between Townships 10 and 11;
For Townships 13, 14, 15 and 16 on line between Townships 14 and 15.

"7. In the survey of any and every Township the deficiency or surplus, as the case may be, resulting from the convergence of meridians, shall be set out and allowed in the quarter sections on the west boundary—the area of which shall in the survey be returned accordingly at their actual contents."[5]

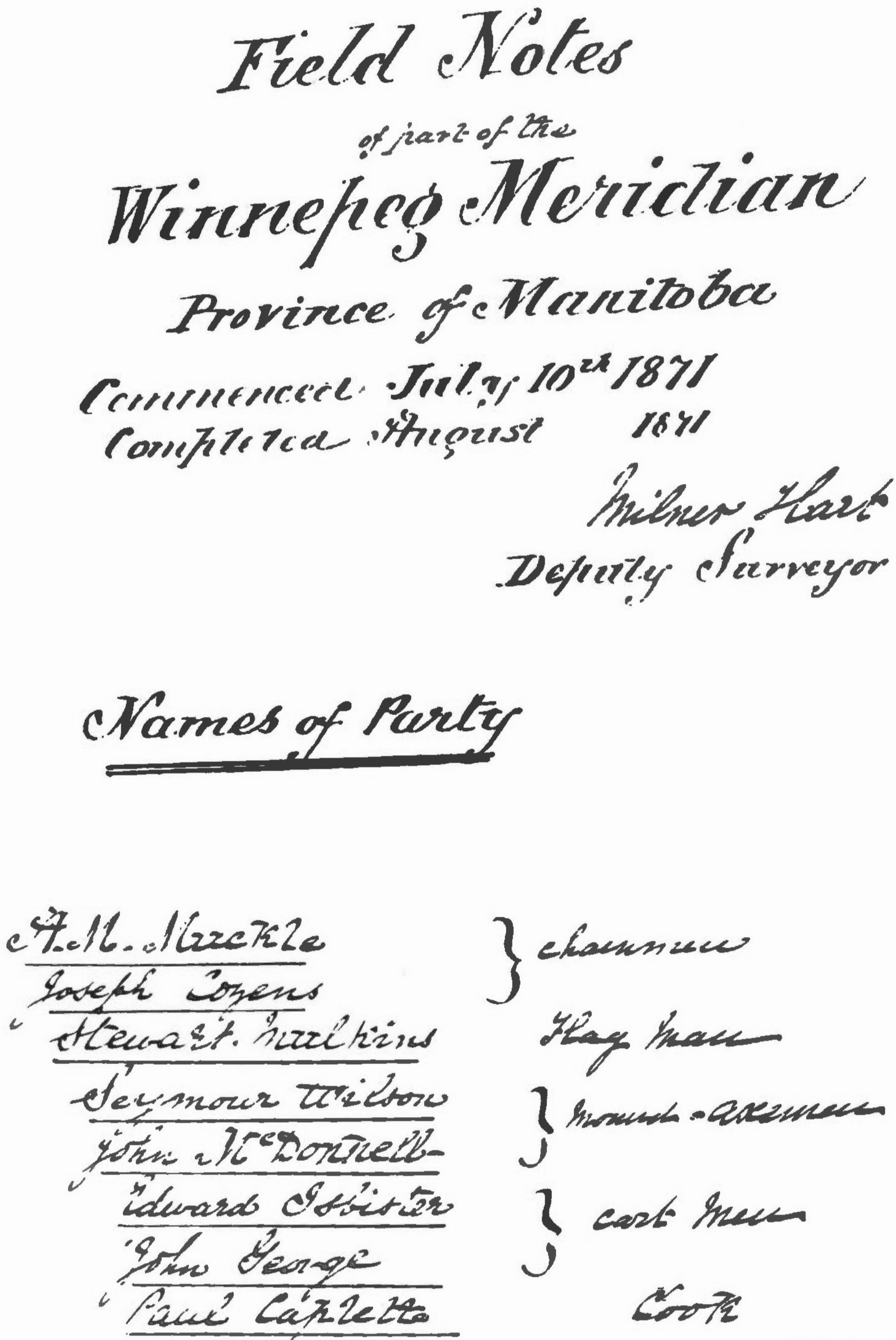
It is passing strange that if Dennis in January recommended that western road allowances be made 1½ chains (99 feet) wide, government proposals reaching the Commons in March should provide for such roads to be 1 chain (66 feet) wide. It was unprecedented in Canadian surveying practice to have road allowances 99 feet wide. In very early times roads in Central Canada had been made 40 feet wide but the more modern roads, by 1870, had all been made 66 feet, without exception.

Considerable asperity was displayed in the Commons debate on the government's proposals, especially on the reduction of the size of sections to 640 acres. On April 6, 1871, McDougall moved a set of eight resolutions in the Commons, the first three of which related to surveys. In these three propositions he complained that (1) the subdivision of townships in the North-West Territory had been materially altered to the disadvantage of intending settlers; (2) the area of townships had been reduced to six miles square and each quarter-section or lot reduced from 200 acres to 160 acres and (3) the allowance for roads . . . had been limited to one chain in width and ordered to be set out and allowed between all townships and sections . . . "without any reference to their utility or convenience."

McDougall concluded this presentation with a resolution "to provide for the issue of amended regulations for the survey, distribution, settlement and sale of lands in Manitoba . . .".

The answer from the government side in regard to road allowances was that the plan recommended to Parliament had worked most admirably in Quebec and Ontario and though not in force in the United States, many American surveyors had expressed approval of it and the government thought they could not do better than adopt a system that had proved so acceptable. Manitoba's Dr. Schultz intervened in the debate to assert his belief that the plan of survey submitted to Parliament for his home province was superior to that of Ontario. He thought that in view of the smallness of the province the lots (quarter-sections) should be small also. He gave cogent reasons in support of the proposition that roads ought to be 1½ chains wide. Existing roads in Manitoba, he pointed out, were 2 chains wide. He praised the durability of unpaved prairie roads but failed to suggest that one very good reason for making roads reasonably wide in that region was that when such roads became heavy from rains or melting snow, it was desirable for Red River carts to leave already deep ruts to shift to firmer surface. Also wide roads would make it easier for carts to make a complete turn-around. Summing up, Schultz stated his firm belief that it would please the whole of Manitoba if roads were made 1½ chains wide.

On April 13 McDougall withdrew his proposal for new regulations as, he said, the



Field Notes

of part of the

Winnepeg Meridian

Province of Manitoba

Commenced July 10th 1871

Completed August 1871

Milner Hart

Deputy Surveyor

Names of Party

A. M. Merkle	chainmen
Joseph Cozens	
Stewart Watkins	Flag man
Seymour Wilson	mound-axemen
John McDonnell	
Edward Isbister	cart men
John George	
Paul Caplette	Cook

FIGURE 14. Title page and names of 1871 survey party, from Milner Hart's field book. This book contains notes of the first mile run on Dominion Lands Surveys.

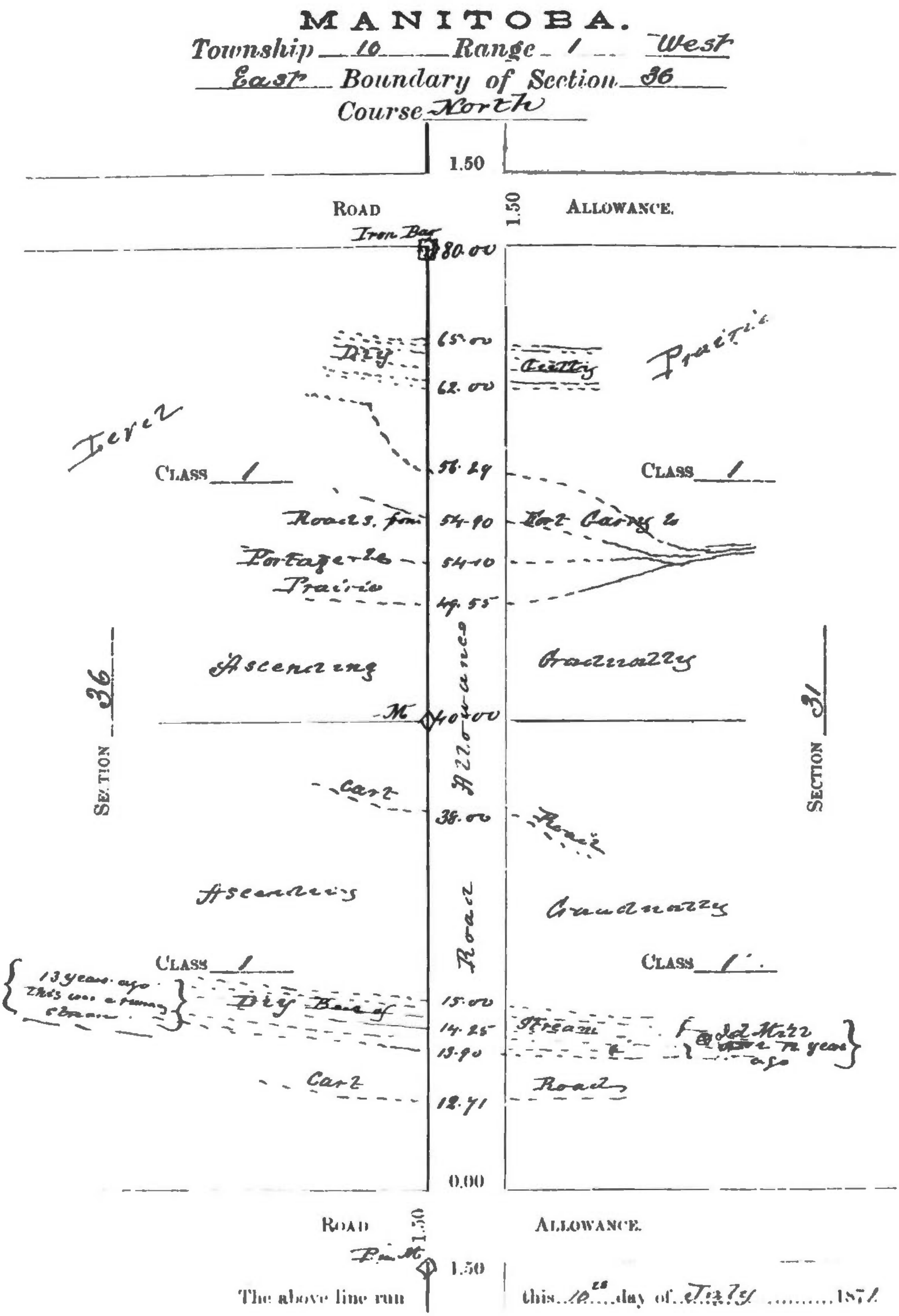


FIGURE 15. Sample page, Milner Hart's field book, 1871.

government had expressed readiness to adopt "the most important of them". Thus on April 25, 1871, for the First System of Survey, so-called, road allowances were increased to 1½ chains or 99 feet.

In regard to the distribution under Section 31 of the Manitoba Act of 1,400,000 acres appropriated for the benefit of the families of half-breeds, it was also provided that every half-breed resident of Manitoba at the time of transfer thereof to Canada (July 15, 1870) and every child of such resident, "shall be entitled" to participate in the acreage thus made available.

Events of considerable magnitude followed swiftly. On March 7 Dennis by Order in Council was made Surveyor General of Dominion Lands and at the same time appointed head of the newly-formed Dominion Lands Branch of the Department of the Secretary of State. On April 12, exactly 112 years after the battle of the Plains of Abraham, the Commons approved the government's submission concerning western survey policy and voted $100,000 to finance the prosecution of such surveys. On April 25 an Order in Council was passed, replacing the March document and making road allowances 1½ chains wide. Early in July of 1871 a staff of 13 survey parties was organized by Lindsay A. Russell, first assistant to the Surveyor General. These took the field in Manitoba, six parties to the settled parts and seven to the virgin lands. On May 1 a Manual of Surveys was issued by the Surveyor General, the first of a series of such manuals. These publications explained the Dominion Lands Survey System to deputy surveyors, as they were then known.

An aura of mystery and conjecture has, to some extent, surrounded the placing of the Winnipeg Meridian, ever since it was surveyed and marked on the ground. A meridian line is the trace of a plane passing through any given point on the earth's surface and through the two poles of the earth's axis as well. The records indicate that astronomical observations were taken at Pembina to determine the exact location of the international boundary in that vicinity. Thereupon the initial or starting point for the Principal Meridian was fixed 10 miles to the west on that boundary. The relationship of the Principal Meridian to the prime meridian passing through Greenwich, England, is expressed by the longitude description of the former line. This has been reliably ascertained to be 97°27′28″.41 West longitude.

Why then, it may be asked, was not this Principal Meridian not run at 98° West longitude? To have done this would have been more in keeping with the pattern of other initial meridians subsequently laid down and tied in with the Dominion Lands Survey System. Each was placed exactly 4 degrees apart, commencing at 102° West longitude, the location of the 2nd Initial Meridian. Astronomical observations were taken at Pembina in 1869 to determine the position of the international boundary after which the initial point of the Principal Meridian was fixed as already indicated. But why ten miles west of Pembina? All available evidence indicates that this particular point was selected in order to avoid the then settled, cultivated areas as well as a belt of timber spreading along the Red River. The point could not be fixed as far west of the river, however, as to be inconvenient for dependent surveys proposed for the vicinity of Fort Garry. It is also possible that, in the absence of any reliable map of the area, it was considered that the 10-mile margin would allow ample clearance of settled river properties as well as the wooded areas.

The Principal Meridian supplied the main backbone of the Dominion Lands Survey System. The Second, Third, Fourth, Fifth and Sixth Initial Meridians, west of the Principal Meridian, all marked on the ground, were lines only slightly less vital to the successful application of the entire western Canadian survey structure. As part of a special survey of meridians and base lines in the North West in the season of 1874 the position of the Principal Meridian was checked for accuracy in the field under the supervision of L. A. Russell. His report on that work is of particular interest.[6] He commences by making references to his survey work two years previously: "for the purposes of the British section of the International Boundary and those of the D.L.S. in 1872 Captain Anderson, R.E., Chief Astronomer of the British Commission at Pembina, in cooperation with myself at Chicago—determined by the electro-telegraphic method the difference of longitudes between the observatory at Chicago and his astronomic station (at Pembina). This, with the known relative positions of Chicago and Greenwich will give, by reference to the Pembina station, the necessary connection of all future surveys with Greenwich.

"Hence the adoption of the astronomic station on the 49th parallel at Pembina as the point of departure for the present survey.

"The accuracy of position, relatively to the 49th Parallel, of our bases can always be checked by carefully observed astronomical latitudes, therefore the actual measurement on meridians, northing and southing, does not require to be made with as minute precision as that along the bases in the east and west direction, on which no direct astronomic observation gives a check of any value.

"Until telegraph lines are constructed throughout the country traversed, the accuracy of differences in longitude will depend solely on that of survey measurement.

"For this reason it was necessary to employ the method of triangulation in carrying the survey westward. On the check survey of the Winnipeg Meridian careful double chaining was deemed sufficient. The interval of ten miles between the meridian and Pembina station was not triangulated, the circumstances being so favourable to accurate chaining, and the distance so short, that thrice measurement by that means was considered sufficiently accurate . . .

"I have reason to believe, from the close inter-agreement of the different measures of each mile, that the longitude of the Winnipeg Meridian from the Pembina astronomic station is determined to a couple of feet, or as closely as measurement with the ordinary chain will admit. The evenness of ground—perfectly level prairie—was in the utmost degree favourable to accuracy."

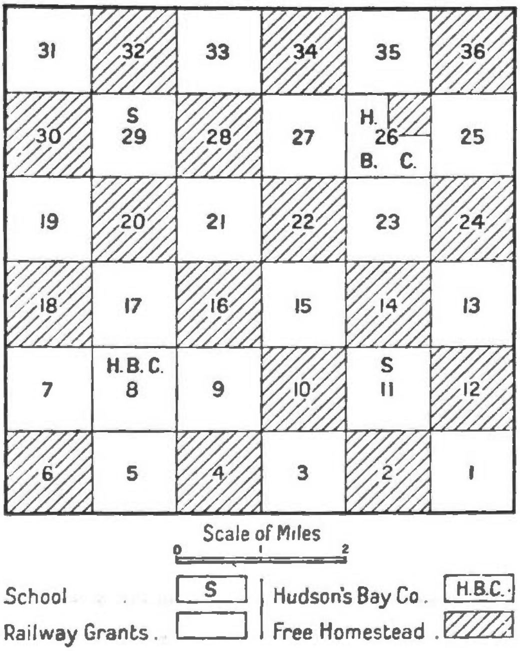


FIGURE 16. Diagram of a typical township in Canada's western interior.

Within a period of six years meridians and base lines had been established from Winnipeg to the Rocky Mountains and from the international boundary to the North Saskatchewan River, making possible the rapid and orderly expansion of regular surveys in the early 1880s and the resulting influx of settlers. This survey system is in marked contrast to the 35 principal meridians laid down in the United States, most of which lines extend over relatively short distances, are arbitrarily located and not in any way inter-connected or inter-related. In its newly-acquired territory Canada could apply "one vast system of survey uniform over the whole of it."[7]

The policy adopted in Canada of numbering sections from No. 1 in the southeast corner of a township upwards in criss-cross fashion to No. 36 in the northeast corner, was wisely adapted to the natural trend of settlement in the Canadian West. It will be recalled that Dennis in his 1869 recommendations provided that, as in the case of sections, the "numbering of the Townships (be) from one uniform base . . . the southern boundary of the Territory . . . and the numbering of ranges of Townships east and west from one principal meridian is simple and will be therefore easily understood by all parties." With his second paragraph of the 1870 recommendations Archibald included a diagram setting forth the now firmly established Canadian system of numbering consecutively *from one upwards* in each Block.

It is curious that the American and Canadian systems should differ in this matter of numbering land parcels. One great advantage deriving from the 1785 Ordinance (United States) was that the system thus introduced brought numerical simplicity, a result made possible by the uniform grid concept. Townships were to be designated "by numbers progressively from south to north, always beginning each range with number one". The ranges or north-south columns of townships were to be distinguished "by their progressive numbers to the westward." No mention, however, was made of any method of numbering sections.

Square-mile lots within townships were to be "numbered from 1 to 36, always beginning the succeeding range of the lots with the number next to that which the preceding one concluded." Under this rule the numbering could begin in any corner of a township.[8] Eleven years later the Land Act of 1796 failed also to give guidance on the proper method of numbering. Jared Mansfield, successor to Surveyor General Putnam, progressively numbered his ranges of townships eastward and westward from the meridian and the townships between each range, northward and southward from the base line.

Oddly, however, the 1796 Act specified a definite order for numbering sections within townships, "beginning with number one in the northeast section and proceeding west and east alternately . . . ". The Act merely indicated an expectation that townships would be identified by numbers.

All types of unforeseen difficulties hampered surveys in Manitoba during the 1871 season and slowed down the pace of the work. Forest fires were serious enough to cause frustrating delays. In several instances the equipment of entire parties was burned out completely. Fenian raids from across the international boundary also proved to be an interrupting factor. Lindsay A. Russell wrote to Surveyor General Dennis from Fort Garry on September 21, 1871: "With respect of the settlement surveys I find their progress discouragingly slow and yet cannot find fault as the surveyors seem to be doing their best . . . Nearly all the settlement surveys are hindered more or less by the woods. Indeed, in some cases I authorize the temporary employment of an extra man or two for a few days to get faster through a thick place, the allowance of one axeman and two chainmen being rather unprofitable in dense woods or thick shrubbery . . .

"For some cause, I know not, men seem to be continually leaving the surveyors. There is always one or other of them complaining that a man has left him and he has to look for another . . .

"With reference to Mr. Sinclair's survey I am sorry to say that it is again arrested in its progress through his having disagreed somehow with the surveyor [Mr. Grant] who has been conducting it for Mr. Sinclair. The latter is, I fear, likely to be unwell all autumn and though it pains me to do it, I shall be obliged to hand the survey over to someone else—or it will not be done in time to be united with the other surveys in the general plan of the settlement . . .

"Nearly all contract surveyors are complaining of the unexpectedly large proportion of wood on their lines and, of course, all bidding for the chance to get a township with much prairie. Some three or four of the sub-division contracts will be completed in a couple of weeks when I will, in accordance with my instructions and with the Lieut.-Governor's advice as to locality, give out some more to those of the surveyors whose work has been performed in a satisfactory manner . . . ".

Again, on October 6, 1871, from St. James, Russell wrote to Dennis, "Now we have the excitement and interruption . . . with respect to the Fenians. The Government Proclamation calling all to enrol themselves has necessarily arrested our surveys as many of the men were old volunteers. While I write [this] Mr. Doupe* has come in to say that the offer of all our services is accepted and that this afternoon the news of the Fenian advance across the [boundary] line has led to an immediate call to arms for the whole of us."

Practical experience gained in three field seasons, following the resumption of federal land surveys in the North West in 1871, led to the adoption of what has since become known as the Special Survey. Despite all efforts to make the basic surveys, as authorized in 1871, as accurate as possible, errors crept into the system from time to time. Accordingly some new measure had to be devised to supplement and to correct the general survey. Surveyor General Dennis, in drafting the first Dominion Lands Act, expected that discrepancies of the general survey could be kept within narrow limits and that is where he was wrong. As time went on discrepancies sometimes exceeded one-quarter of a mile when, according to the surveyors' field notes everything was perfect. In the extension of surveys west of Manitoba similar discrepancies, but on a smaller scale, occurred.[9] In passing judgment on such imperfections it is only fair to take into consideration the fundamental purpose of the Dominion Lands Survey System. A high degree of accuracy was not as important as the need to have measured land available to settlers on an orderly, workable basis of allotment. Urgency of performance was the order of the day. Account should be taken also of the types of surveying instruments as well as techniques developed up to that time. Nor was the survey system for the region intended primarily as a reliable basis for topographic mapping. Inspection facilities were also overstrained in those pioneer days.

To deal with the condition that had arisen, the Special Survey was instituted by Order in Council passed in February, 1874. By this step more refined and more scientific procedures and equipment were introduced. In part, these improvements were made for the purpose of checking on survey work already completed. But there were larger purposes to be served as well.[10] The Special Survey was designed to establish a practical basis for the extension of township surveys at any point along the proposed Canadian Pacific Railway route and thus contribute to the systematic settlement of the West. Secondly, the Special Survey was devised to assist in railway construction by facilitating locations of land grants along the line. In addition it would provide a reliable fund of information on the natural resources of the region, its soil and timber types, minerals as well as its flora and fauna.

The establishment of meridians and base lines, to be performed by a separate party under the supervision of the chief of the Special Survey, was to be checked periodically by

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*Joseph Doupe, D.L.S., father of Jacob Lonsdale Doupe, D.L.S.

means of astronomic stations set up for the purpose and by a continuous triangulation. This net of surveys was to be extended northward from the 49th parallel of latitude to the Peace River and Lake Athabasca. Errors in the original surveys west of Manitoba were to be located and corrected by astronomic observations. As Deville put it, "measuring on the earth by means of stars is a roundabout way of finding distances, and not a very accurate one but it was the best we could do. We thus managed to keep errors within bounds inside Manitoba".

Lindsay A. Russell (1839-1912), at the time Assistant Surveyor General for Canada, was appointed to direct this important special project.[11] He was the son of A. J. Russell, C.E., and had been an efficient assistant in charge of construction of the Dawson Route when it was being prepared for use by the Red River expedition of 1870. On July 26, 1871, Lindsay Russell was appointed Inspector of Surveys in the field and in February of the following year became Assistant Surveyor General. From that time forward, until the 1880s, he was in full charge of survey work in the field while the time and energies of his chief, John S. Dennis, were fully occupied by administrative duties in Ottawa.

FIGURE 17
Lindsay A. Russell, Surveyor General of Canada, 1878-1884.

In any serious study of Special Survey records it is necessary to distinguish constantly between two highly competent surveyors, L. A. Russell and A. L. Russell. Alexander Lord Russell, D.L.S.* was first assistant to Lindsay A. Russell in the Special Survey. He was from Port Arthur, Ontario, was not, as far as is known, a relative of the Assistant Surveyor General. He was the son of Andrew Russell (1804-88) who, as a civil servant, performed a significant administrative role during the formative stages of land survey work in what is now Ontario and also in Canada's western interior. A. M. Burgess, Deputy Minister of the Interior, in his 1885 report to the Minister of that department, paid a resounding tribute to Andrew Russell of the "inside [civil] service at Ottawa" who had held the post of Chief Clerk of the (Land) Patenting Branch, Department of the Interior, since its creation. After referring to Andrew Russell's 80 years of fruitful life, including more than half a century of faithful and efficient public service, Burgess pointed out that he had been "for the greater part of his long period of service Assistant Commissioner for Crown Lands in the old Province of Canada [prior to Confederation] . . . [and] that to him perhaps more than to any other man, living or dead, we owe the perfection which has been attained in our system of public lands surveys."

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*Surveyors of Dominion Lands appointed under the Dominion Lands Act, 1872 (such appointments made effective as from April 14, 1872) were admitted to practise as "Deputy Surveyors of Dominion Lands" but, by 1873 all were styled "Dominion Land Surveyors" (D.L.S.).

A year earlier, on March 20, 1884, Otto J. Klotz (1852-1923), D.L.S., D.T.S., had been equally laudatory. An address to Andrew Russell was drawn up bearing that date, written on behalf of all Canadian surveyors. It was signed by Klotz as president of the Association of Dominion Land Surveyors. In part the address declared, "It was you who introduced into Canada the use of the transit theodolite upon public surveys, displacing the less accurate and variable compass. It was you who pointed to the stars for a sure guide, instead of the fickle magnetic pole." But if Andrew Russell had much to do with the degree of accuracy developed in land surveys in Ontario and the new West, Lindsay Russell's skill, knowledge and wise direction served to lay solid foundations for the notable combination of speed and perfection attained under the Dominion Lands Survey System.[12]

Triangulation between the Principal and Second Meridians was completed in 1875 during the Special Survey. Lindsay Russell in his report of the season's accomplishments stated that "the greater part of next season's work will be in a country more thickly wooded than any yet passed through. On this account and (because) newly constructed telegraph lines afford facilities for frequent checking the differences of longitude it would be advisable to change the method hereto pursued, and, dispensing with triangulation, confine the active

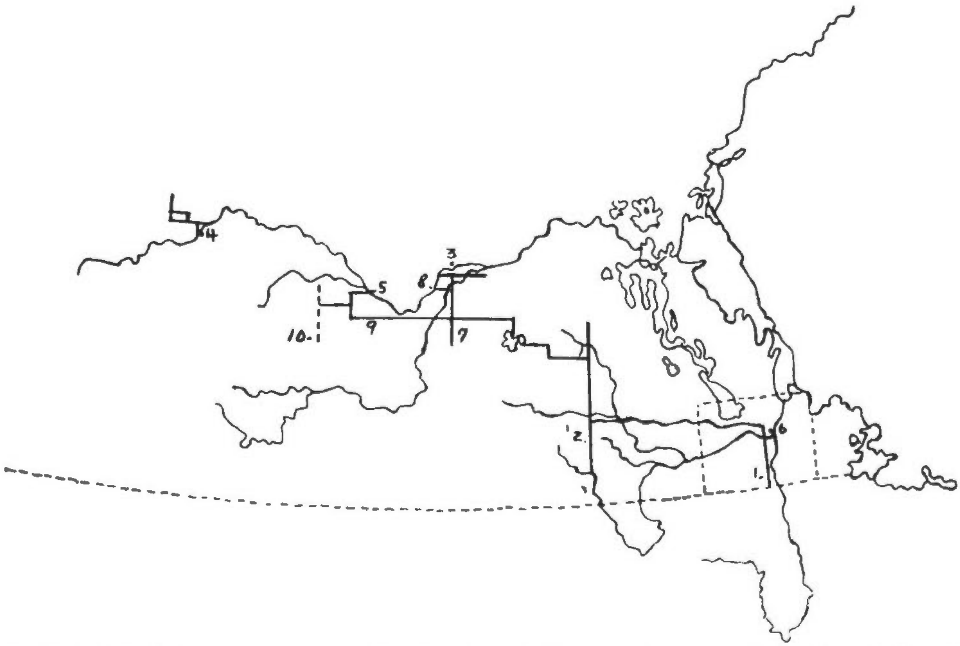

FIGURE 18. Sketch showing operations of Special Survey, 1878. Legend: 1. Principal Meridian. 2. Second Meridian. 3. Prince Albert. 4. Edmonton. 5. Battleford. 6. Winnipeg. 7. Third Meridian. 8. Carlton. 9. Tenth Base Line. 10. Fourth Meridian.

measurements in the field to surveying carefully in the ordinary manner the parallels and meridians that are to serve as a basis for the extension of any point desired of the block outline system. This would reduce materially the expenditure for the survey. A further economy may be effected by doing away with the levelling party which will, for some time, be unnecessary because from Fort Pelly to near Fort Edmonton the special survey will be in the vicinity of that of the Canada Pacific Railway. It would be an unprofitable repetition to level over country of which its engineers have in their locations of their line, already obtained

MAP 3. The earliest map of the Province of Manitoba, drawn by A.L. Russell, 1871.

profiles."[13] Incidentally, H. B. Smith, C.E., a leveller, had been employed by A. L. Russell in the preparation of profiles along the lines surveyed under the Special Survey.

An improved base measuring apparatus was designed by Lindsay Russell for use on the Special Survey. He visited England in the autumn of 1873 to supervise construction of the instrument. To meet the exacting technical requirements of the project it was necessary to devise an instrument, readily portable, yet sufficiently accurate to fill a pressing requirement between the rather rough measurements of the ordinary chain on the one hand, and on the other, the relatively complicated and cumbersome base-measuring apparatus then commonly employed on primary triangulation work. In practice this new instrument proved fairly equal to the demands made upon it. It was well adapted to rapidity of use and gave results sufficiently accurate for triangulation of a second order. Its employment in the field in the West demonstrated that one mile a day could be measured over reasonably level country with a remarkable degree of accuracy.

Lindsay Russell's keen concern over the costs of the Special Survey was not altogether surprising. Depressed economic conditions were widespread in the world of the 1870s and Canada was not then a wealthy nation. As the North West was to be opened up on the basis of Free Homesteads, with little or no revenue accruing to the Dominion for years to come, it was important for the government to keep survey costs to a minimum. Under the circumstances the Special Survey proved to be an undertaking rather too expensive for the federal treasury to bear and the project had to be abandoned. In all, the Special Survey extended over the span of six consecutive seasons. It was prosecuted as far as the Fifth Meridian by Lindsay Russell and his staff with the utmost care and precision. Set-backs and discouragements were numerous. Excess water on the plains from rapid spring thaws and lack of feed for horses early in the season were some of the hazards encountered. When Lindsay Russell met with an accident in the field in Manitoba in June, 1875, fracturing his ankle, progress of the Special Survey was hindered. Hon. David Laird, Minister of the Interior, had occasion to make official reference to this painful mishap and expressed regret that "the surveying party was deprived of the active cooperation and personal supervision of its able and energetic chief officer."[14] Nevertheless fair headway was made in that season under the first assistant, A. L. Russell.

The permanent value of the Special Survey cannot be easily over-estimated. The project made possible the rapid expansion of the general survey when time was of the essence, as well as the astonishing coverage by surveyors during the peak year of prairie surveys, 1883. Much of the credit for the high standard of excellence achieved by and under the Dominion Lands Survey System is due to those who conceived the Special Survey and to those who carried that concept into effect. In this manner Canada avoided extensive litigation and a variety of other troubles experienced in the United States as a result of settlers staking out property in advance of the official survey.

From 1871 to 1878, with the exception of only two seasons, there were, on the average, only a score of land surveyors employed on Dominion Lands survey work in the western interior of the nation. But in 1879 the numbers rose to 32, heralding a series of impressive annual increases in numbers until 1883 when a peak of 115 was reached, 21 on township outlines, 82 on subdivisions along with one Settlement Belt surveyor and one town-plot surveyor. In addition there were four examiners of contract surveys who were busy in the field. This period of expanded survey activity coincided with Sir John A. Macdonald's term as Minister of the Interior while also serving as Prime Minister. Sir John was succeeded in the Interior portfolio by Hon. David L. Macpherson, who remained only two years in that position. In 1884 there was a pronounced drop in the number of land surveyors employed in the West, to 71, and an even sharper decline to 13 in the troubled, fateful year, 1885.

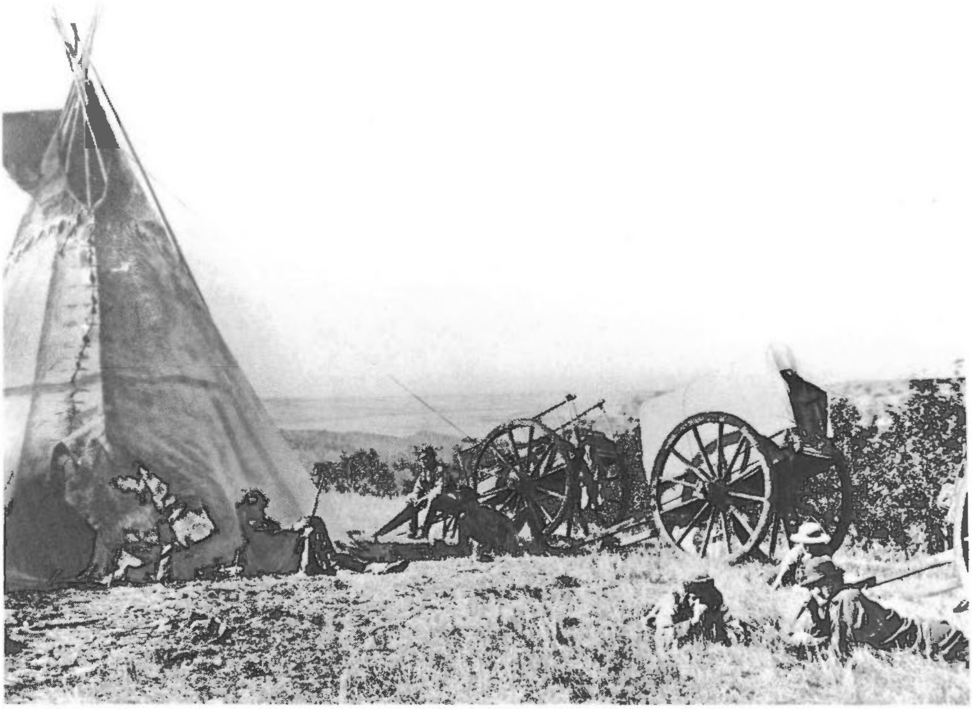

FIGURE 19. Surveyors encamped near the North Saskatchewan River in the 1880's. Note the Red River carts in the background.

John S. Dennis Jr., in his history of surveys under the Dominion Lands Survey System (1869-89) describes the 1883 surveys as having been conducted on "a gigantic scale". It is a fact that the exceptionally large number of surveyors in the field, along with assistants, laborers, teamsters and cooks constituted for those early days an impressive array of men, horses, carts and buckboards. A corps of mail carriers visited various parties in the field, transmitting ordinary mail as well as special despatches to and from survey headquarters. But why should there have been such intensive surveying activity at this stage of Canada's development? Probably the most important factor was the surprisingly rapid construction westward of the Canadian Pacific Railway main line that season. Steel reached the Rocky Mountains in the autumn of 1883.

A noted Surveyor General of Canada, nearly 30 years later, in addressing a gathering of fellow surveyors in Ottawa, shed light on the survey program decisions of the 1883 season.[15] Edouard G. D. Deville, D.L.S., D.T.S.,* in that year had become Chief Inspector of Surveys at Ottawa while William F. King, D.L.S., D.T.S., was made Inspector of Surveys in the field with his office at Medicine Hat. "The C.P.R. . . . wanted to make [the] surveys themselves; they wanted that [western] task transferred to them . . . They went to the Minister and explained to him that it would be impossible for the Department of the Interior to survey such an amount of land as (was) in their [railway] grant . . . 20 million acres! It was quite impossible . . . Well, I induced our Minister", Deville recalled, "to try us anyway and to give us a chance . . . [Sir John A. Macdonald was Minister then]. Well, the chance

*Dominion Topographical Surveyor, a title of special distinction bestowed on Canadian surveyors who have proved their knowledge of higher surveying theory and practice.

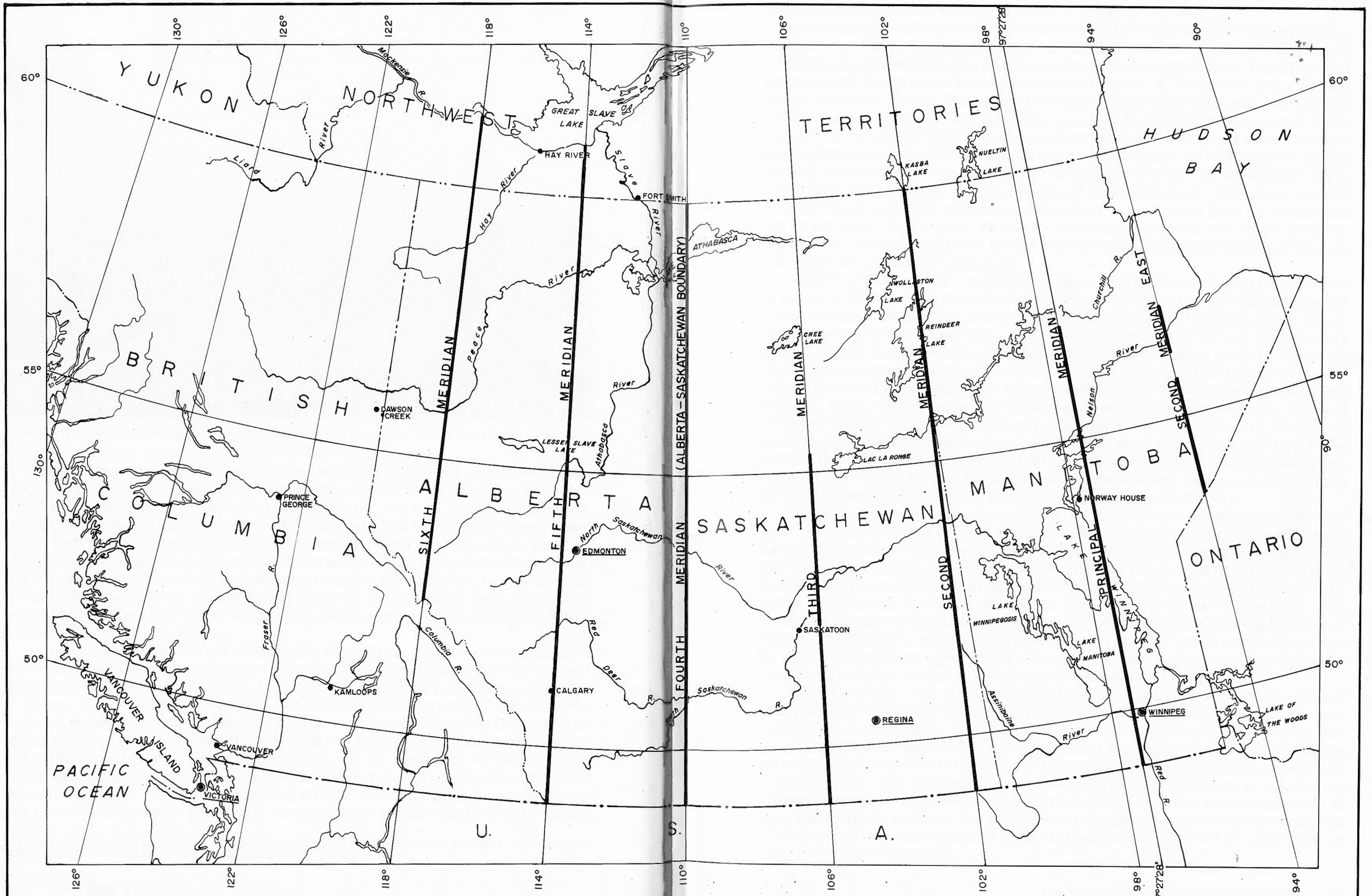

FIGURE 20. Prime meridians of the western interior of Canada.

was given and it was all surveyed within a year, but I would not say it was surveyed with the degree of accuracy that we are used to today . . . anyway it was done."

In the early part of the year and as a result of the formidable increase in business being handled by the Interior Department in Ottawa, the offices of Deputy Minister and of Surveyor General (combined in 1879 in the person of Lindsay Russell) were separated. Russell retained supervision of the Technical Branch as Surveyor General. A. M. Burgess was appointed Deputy Minister. During 1883 some 11,300 miles of township lines were surveyed and 1,221 townships were subdivided. This latter operation involved the survey of some 70,000 miles of line. In all, that single season's operations prepared for settlement about 27 million acres, compared with 10,574,915 acres during the entire period 1871-75 inclusive. (These totals do not include the activities of the Special Survey.) The 1883 accomplishment stands unrivalled in the long history of land subdivision in the western world. The surveys extended from the Touchwood Hills westward to the Rockies and northward from the second base line to the North Saskatchewan River. As an immediate dividend this survey enterprise made known to the general public the fact that only a relatively small portion of this vast area was land unsuitable for agriculture.

After eleven full seasons of extensive land measuring in the West, following the suspension of surveys in 1870, the pace of work greatly increased in 1882 and, as we have seen, reached a post-Confederation peak of activity in 1883. Thereafter the Dominion Lands Survey operated on a relatively limited basis. But all was far from well in the vast, newly-opening land. The hard lessons of history had not been completely learned either by officials in Ottawa or by the peoples native to the plains. Some of the grievous mistakes and miscalculations perpetrated by both sides of an issue smouldering since 1869-70 were to be needlessly repeated. Again, the fact and method of surveys lay near the heart of the unrest. But land surveying was not by any means the only factor contributing to discontent. It must be admitted that generally the land surveyors of the 1880s were more diplomatic in their public relations than their counterparts were in 1869. But the buffalo had vanished as an important source of food supply between the Red River and the Rockies. Indians, as well as many people of mixed blood, began to suffer from starvation and general misery.

The appearance of surveyors on the banks of the Saskatchewan River signalled once again to the people native to the region, the remorseless westward surge of white settlers and their civilization which the natives despised. The métis felt the nagging fear that had gripped their kind 14 years previously some hundreds of miles to the east. At St. Laurent near the South Saskatchewan and St. Albert, near the North Saskatchewan, they had settled on long, narrow, river-fronted farms. The prospect of any imposition of the rectangular or other form of land survey repelled them. Nor were the Indians consoled by the government offer of reserves. In addition free traders, selling demoralizing "fire-water" were a continuing problem for the authorities in spite of increasing control of their destructive activities by the North-West Mounted Police, formed in 1873 primarily to combat the prairie menace.

In 1878 petitions from English-speaking half-breeds and from the métis bombarded authorities from St. Laurent, St. Albert, Cypress Hills and Prince Albert. All these documents carried pleas or demands for land grants similar to those made under the Manitoba Act, involving the issue of land scrip.[16] Surveyor General Dennis, to whom the representations were ultimately conveyed in Ottawa, was mindful of his own bitter experiences on the banks of the Red River. He instructed Dominion Land Surveyors that in all cases of half-breed settlements along the rivers, the lands occupied by them were to be surveyed according to the existing river-lot principle. No attempt was made, therefore, to impose the rectangular form of survey on anyone opposed to it. In 1877 and 1878 at Prince Albert and St. Laurent surveys were made accordingly.

But the Council of the North-West Territories felt a continuing deep concern over the rising cannonade of petitions and memorials. The Council urgently suggested to Ottawa a solution to the problem through the issue to every half-breed head of family and child (resident in the Territories) location tickets for 160 acres as well as government aid in the form of farm machinery and seed supplies. Dennis did not completely agree and in proposals of his own, submitted to the Minister of the Interior, he tended to lump together métis and Indians as a single problem. He opposed the giving of scrip because of the marked tendency of the métis to sell such paper for trifling consideration.[17]

Dennis was warned in writing by Archbishop Taché of the delicacy of the situation and of the special sensibilities of the métis over being classed with Indians. All told, some 1,200 families of mixed blood were involved in the general discontent. Federal government action to relieve the unrest was agonizingly slow and thus largely ineffective. Sir John A. Macdonald as Minister of the Interior from 1878 to 1883 cannot escape some blame for the growth of the crisis in the western interior over that period. Possibly his duties as Prime Minister during that same span of time prevented him from giving due attention to matters coming within his purview as a departmental minister. But to some extent Sir John never learned from the Assiniboia tribulation which, in a political sense, he so narrowly survived in the late 1860s. Sir David L. Macpherson, who followed him in the Interior portfolio with senatorial dignity (and who remained in that office for only two years) brought indifferent talents to this exceedingly onerous administrative task.

By 1884 the western situation was ripe for revolt. Debts, poor crops and lack of adequate credit facilities for grain farmers, aggravated the dangerous trend toward the use of armed force. Newspapers were beginning to appear in the more populous settlements on the high plains and their strident, uninhibited editorial voices added to the agitation. All that was needed to fire the explosion among the more extreme elements was a dynamic, politically-minded leader. He did not fail to appear. As a result of the resolution, passed at a public meeting of aggrieved breeds and métis, three men, Gabriel Dumont, Moise Ouelette and Michel Dumas were sent from the valley of the Saskatchewan to find Louis David Riel in Montana and induce him to return as leader of the discontented in Western Canada.[18] They found him at Sun River and their mission proved a success. That was early in June, 1884. Riel showed up at Batoche near Prince Albert in July, eager to assume command and to help redress the grievances of "his" people.

In a sense the North West Rebellion was born at Batoche on March 18, 1885. But it was not until March 26 that any overt act of violence took place. On that day an unplanned clash occurred at Duck Lake between a number of métis, led by Gabriel Dumont, and a detachment of Mounted Police and Prince Albert Volunteers headed by Superintendent Crozier of the North-West Mounted Police. Nine out of 99 on the policing side of the affair were killed and 11 wounded. The métis lost five of their number. In some disorder the Crozier force left the field, retreating to Fort Carlton.

In the spring of 1885 the annual meeting of the Association of Dominion Land Surveyors, organized in Winnipeg in April, 1882, took place in Ottawa. Word of the hostilities at Duck Lake reached the capital while the association was in session and the news caused a considerable stir among those in attendance. Many of these men had surveyed in the North West and realized at once that the outbreak of violence would result in a serious suspension of western survey work for the 1885 season.

On April 1 an informal meeting of the surveyors took place in Russell House, a centrally-located Ottawa hotel, for the purpose of organizing a surveyors' militia unit to take an active part in any military expedition formed to quell the disturbances. After discussion it was decided to ask ten Dominion Land Surveyors to each provide four assistants (men who had seen survey service in the North West and who were familiar with conditions there) to form a corps of fifty men. The following day a deputation waited on Sir David L. Macpherson, Minister of the Interior, who strongly recommended the proposal to his colleague, Sir Adolphe Caron, Minister of Militia. A committee waited on the latter urging official acceptance of the offer of such a corps, armed and mounted, and to act as intelligence men, scouts or as mounted rifles. The scheme was approved after the Minister had consulted by telegraph with the Commanding Officer of the North West expedition, Major-General Federick Middleton. The surveyors were then advised to appoint a captain to command the proposed unit. Arthur Oliver Wheeler, who had qualified as a Provincial Land Surveyor in Manitoba in 1881 and as a Dominion Land Surveyor in the following year, was first offered the post. Although Wheeler had surveyed Canadian Pacific Railway townsites in the West in 1882

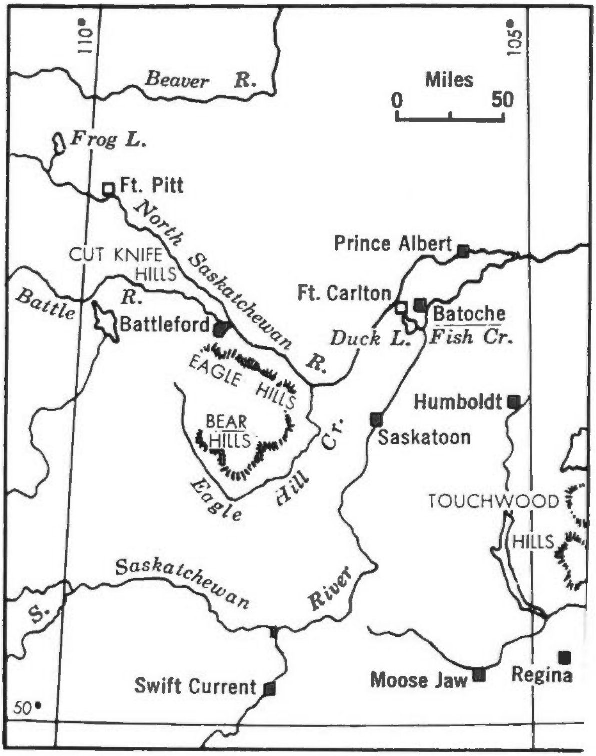

FIGURE 21
Scene of military action 1885 Rebellion.

and township outlines in the following season, he felt he was not experienced enough in conditions in the Midwest and declined the nomination. The command was next offered to Lewis R. Ord, who had been appointed a Dominion Land Surveyor three years previously. He, too, demurred and John Stoughton Dennis Jr. was then elected.[19]

The Dominion Land Surveyors' Intelligence Corps was quickly formed and proceeded by Pullman car to Winnipeg by way of Chicago and St. Paul, arriving in the Manitoba capital on April 11. At Winnipeg more surveyors were recruited for the unit and weapons were obtained as well as saddles and other equipment. The Corps then proceeded to Qu'Appelle where horses were supplied from the winter depot for survey horses. The sequel of this move is related in *Reminiscences of a Bungle*, the memoirs of a corpsman published anonymously but believed to be the impressions of Lieut. Lewis R. Ord:

"Our captain [then] prepared to put us through our drill... "Pre--paretomount! Mount!"

Some of the troopers get up so rapidly that they fall over on the other side; some crawl up like a boy up a greased pole at a fair; here a horse stands as if he had taken root; another pivots round and round on his own axis, and many signify their distaste for riders by bursting from line like lightning from a cloud, bucking strenuously . . . we are about as disorderly a lot as one could care to see . . . some were really good riders but a great many would have felt much safer on the ground where, indeed, several were violently deposited during the first encounter with their chargers."

Orders were finally received to travel on April 20 to Swift Current and from there to serve as a despatch-carrying unit, linking Swift Current to forces in the field. After the engagement at Fish Creek the Intelligence Corps joined the main column of the Expedition. In his special report covering the events of May 10, 1885, Major-General Middleton states: "The Land Surveyor's Scouts, 50 strong, under Captain Dennis, joined my force in the afternoon . . . ". The general, in his diary entries, seemed disposed to avoid use of the more impressive title "Intelligence Corps". Captain Dennis himself frankly admits that the latter name for the unit, though more official, was less correct than the term used by the general as the 'intelligence' it had dared to offer the high command on several occasions "was not looked upon with special favour". Another member of the Corps observed in this connection that "we were looked upon as very small potatoes by the gold-laced gentry of the regular militia". Derisively they were labelled as the "49 officers and one scout" because of the high proportion of commission-holders, 22 out of a total enlistment of 53. Twenty-two men of the Corps were Dominion Land Surveyors, including William Crawford of Milverton, Ontario, the first man to receive a Dominion Land Surveyor's certificate from a Board of Examiners (June 17, 1875). Two other Dominion Land Surveyors, Lieut. E. W. Hubbell and Capt. J. L. Reid, enlisted in the Midland Battalion for the campaign in the North West.

Another important Canadian unit in the Expedition was Boulton's Scouts, a mounted outfit raised and commanded by Major Charles Arkoll Boulton (1841-99), who had been a member of J. S. Dennis's survey crew of 1869 on the banks of the Red. Leader of the Portage Party in those earlier troubles Boulton had been captured by Riel's men and had been condemned to death. His sentence was reprieved by Riel following urgent representations on his behalf. Boulton became a senator in the last year of his life, 1899.

At Fish Creek (Tourond's Crossing), on April 23, Gabriel Dumont and his métis stalled Middleton's advance northward along the South Saskatchewan River. It was at Batoche that the Surveyors' Corps joined the main Middleton force. According to Ord, "Blankets under saddles, Johnson's fluid beef, feed of oats and a tin-billy tied on behind; small package of tea, some hard tack biscuits and corned beef in canteen [two of us] rode out on April 24 with orders for the other half of our unit. Soon [it was] rain and snow . . . "[20]

At the approaches to Batoche, where the métis had dug in for a last stand, the Surveyors' Corps finally came under fire. Renowned for their sharpshooting ability, the métis occupied a defensive ring around the town. The ring consisted of scattered, individual rifle pits. Riel held some ten prisoners in the basement of a Batoche store. On May 9 firing had begun. Fighting continued in this operation over a period of four days. Middleton, to the dismay of his Canadian militiamen, followed a most cautious policy. Soon after the first shots were fired in this engagement he sent his chief of staff, Lord Melgund, later Earl of Minto and Governor-General of Canada, in great haste to Ottawa to plead for the despatch of more men. He little knew the fighting calibre of men already under his command and, least of all, of the redoubtable Surveyors' Corps. Ord takes up the story of events:

"Wheeler suggested that we should go out and occupy one of the rifle pits that had been dug along the top of the river bank . . . and for want of better employment we did so." It was after this sally that Lieut. Wheeler was shot through the muscles of his arm near the shoulder.

May 12, a crucial day in the development of the battle, dawned bright and warm, "... were it not for the sight of the hospital tent and its wounded, and the crack of the skirmishers' rifles near the church, we could almost think it a survey." Middleton had continued in his careful ways and after ordering a partial advance, went to lunch. His repast was interrupted by an outburst of renewed firing and wild cheering. The Canadians, chafing for days under the tight rein of what they considered to be an excessively prudent command, had utilized the mild order to openly charge the rebel rifle pits.

"Handicapped by our heavy boots and spurs and encumbered by our useless revolvers—cheering, laughing, swearing, keeping up an irregular fire into the bush, and yet advancing at a rapid run we charged [if the rush of a lot of undisciplined ragamuffins can be called a charge]. Officers are needless, for we are unanimous in our attentions. There is no red tape to hold us back, the boys have their heads now. The crack, crack of the repeaters come thick and fast. The whistle of bullets tell us the enemy are not idle. Now and again the dull boom of a field gun sounds over the field, followed by the echo of a bursting shell."

In this stirring action, which resulted in the capture of Batoche, the surveyors did not emerge unscathed. Lieut. Thomas Fawcett and Lieut. J. F. Garden were wounded; Garden in the left arm and Fawcett "had buckshot in the chest muscles". The wounding of Fawcett does not appear to have been officially recorded. But the most grievous casualty suffered by the unit was the loss of Lieut. Alexander Walter Kippen. In Middleton's report (page 31) the General states, "I regret to say that one of the surveyors' Scouts was killed, having been shot through the head while lying with the rest of his troop in a bluff on our left". (Only 8 men in all were killed in the Expedition in its attack on Batoche.)

In the words of the surveyor-reporter, "We are a hard and careless lot as a rule, we surveyors, rough associates, hard work, and lack of women's society causes men to grow indifferent to the feelings of others, but I noticed that the troop was quiet and less joking carried on. The first gap had been made in our ranks and we could faintly imagine how Kippen would be missed in the little home circle in Eastern Canada [Perth, Ontario] . . . His quaint sayings and cheerful laugh are gone from No. 1 tent. We cannot realize the sorrow of his parents when the first warning of their loss reaches them in a brief telegram, 'A. W. Kippen, Surveyors' Corps, killed'."

On May 15 and for some days following, the Surveyors' Corps and Major Boulton's Mounted Infantry were ordered to round up hostile Indians (Big Bear and his followers) and any rebel fugitives. Riel was brought into camp by scouts and was received courteously by Middleton. The Surveyors' Corps moved into Prince Albert after the capitulation of Batoche and was then detailed to escort the transport train to Battleford. As part of the chase after Big Bear the Corps then moved on to Fort Pitt and into the wilderness near Beaver River and Cold Lake. It was during this stage of the campaign that the experience of surveyors and of surveyors' assistants proved most useful. Moving through rough country they opened roads, corduroyed swamps and muskegs and surmounted various kinds of natural obstacles. Returning to Battleford the Corps was detailed to establish a picket line along the south bank of the South Saskatchewan River to intercept hostile Indians heading south. During this period a number of Indians were arrested, among them some who had participated in the Frog Lake massacre and who were hanged for their crimes at Battleford.[21]

A memorable incident during the May 12 fighting is reported in Middleton's despatch of that day, "In the middle of our firing I saw a man riding towards me, waving a white flag. I rode forward to meet him and found it was Mr. Ashley [sic], a surveyor, one of the men who had been made captive by Riel. He told me he had just come from Riel, who was apparently in a great stage of agitation, and handed me a letter from him in which he said that if I massacred his women and children (by shellfire) they would massacre *their* prisoners . . .".

John William Astley faced the dismal task of returning to the distressed Riel with a reply from Middleton. In the outcome the prisoners were not harmed but Astley at the time could hardly have felt complete assurance of the safety of himself and his fellow captives.

Astley is described by Middleton and by others as a surveyor but his name does not appear in any professional list of the time, provincial or federal. He was a witness for prosecution at the Riel trial in Regina and was sworn as such on July 28, 1885. G. W. Burbidge, Q.C., asked of him the nature of his occupation. "Civil engineer, land surveyor and explorer", replied Astley, "I reside at Prince Albert, having been there about three years. During that time [I] engaged in land surveying and exploration . . . ". It is unlikely that Astley ever was in charge of a field party on survey work but he could have been one of a party serving under a qualified surveyor in any one of several capacities. He could not have signed a surveyor's plan that would carry any official validity.

On June 30 the Dominion Lands Surveyors' Intelligence Corps rode to Moose Jaw, there to disband.[22] In his report of May 12 Middleton paid a high compliment to the Corps commander, "Captain Dennis, commanding the Surveyors' Scouts, did excellent service and deserves great praise for the way in which he handled his men."

The Corps contained a number of men who later distinguished themselves in surveying and in public life. John S. Dennis Jr., later became assistant to the president of the Canadian Pacific Railway and chief commissioner of its immigration and colonization development activities. He was made a Companion of the Order of St. Michael and St. George. G. H. Brabazon became a member of parliament for Pontiac; Thomas Fawcett on three separate occasions was made a president of the Association of Dominion Land Surveyors; B. J. Saunders was named, in the course of time, honorary Lieut.-Colonel of the 101st Regiment, Edmonton Fusiliers, and A. O. Wheeler made a national reputation as a mapper and surveyor in the Rocky Mountains and other rugged regions of the Far West.

J. J. Burrows, appointed a Dominion Land Surveyor in 1878, served as quartermaster of the Corps and so distinguished himself in that post that on one occasion his commanding officer was paraded before Major-General Middleton to answer a complaint from the commissariat. The commissariat officers stated that Quartermaster Burrows and his detail would swipe the very fillings out of their teeth unless they slept with their mouths tightly shut![23]

The activities of the Corps in 1885, in the estimation of their commander, proved the special adaptability of men of the surveying profession. They were able to participate effectively in military operations and to care for themselves resourcefully in a new and somewhat unknown country. Most of the men forming the Corps had experience in prairie transport and camping as well as in the use of firearms. As Capt. Dennis put it, "the work performed [by the Corps] may, I think, be reasonably included in the statement of the important work done by the surveyors of Canada in the development of our great Western territory."[24]

The names of all those who served in the Dominion Land Surveyors' Intelligence Corps (with rank and home address) follow in alphabetical order:[25]

Land Surveyors' Intelligence Corps
North West Rebellion, 1885

Anderson, Robert	Tpr.	—
Ardesi, John Plummer	Lieut.	Ottawa
Beatty, Walter	Lieut.	Delta
Blanchett, Louis	Tpr.	Ottawa
Bourgeau, Francis	Tpr.	Aylmer, Que.
Brabazon, Gerald Hugh	Tpr.	Portage du Fort

Burrows, Josia Joseph	Lieut.	Ottawa
Campbell, Charles	Tpr.	Portage du Fort
Chaloner, Wilfrid Edouard	Tpr.	Quebec
Cornock, William Bromley	Tpr.	St. Thomas
Crawford, William	Lieut.	Winnipeg
Cumming, Frank William Chambers	Tpr.	Ottawa
Dennis, Henry Joseph	Tpr.	Toronto
Dennis, John Stoughton	Capt.	Ottawa
Denny, Herbert C.	Lieut.	Toronto
De Renzy, William Edward	Tpr.	Ottawa
Driscoll, Alfred, Jr.	Tpr.	Aylmer, Que.
Ellis, Henry Disney	Lieut.	Toronto
Fawcett, Adam	Tpr.	Gravenhurst
Fawcett, Thomas	Lieut.	Gravenhurst
Garden, James Forde	Lieut.	Toronto
Giles, Thomas	Tpr.	Prince Albert
Gore, Thomas Sinclair	Lieut.	Regina
Hawes, Albert	Tpr.	Winnipeg
Henderson, Thomas	Tpr.	Winnipeg
Hunt, John	Tpr.	Winnipeg
Johnston, James	Tpr.	Toronto
Kelly, Henry Diel	Tpr.	Elora
Kippen, Alexander Walter	Lieut.	Perth
Maddock, James Arthur	Lieut.	Lindsay
Martin, Frank	Tpr.	Toronto
McLatchie, John	Lieut.	Winnipeg
McLean, James Keachie	Lieut.	Elora
McVicar, James Malcolm	Tpr.	Winnipeg
Mills, George	Tpr.	Moose Jaw
Milne, James	Tpr.	Collingwood
Morrison, Malcolm	Tpr.	Winnipeg
Mowat, John	Tpr.	Regina
Ord, Lewis Redmond	Lieut.	Toronto
Ord, William Botsford	Tpr.	Toronto
Perry, Charles Bruce	Tpr.	Toronto
Popham, Charles	Tpr.	Winnipeg
Russell, Thomas Sinclair	Tpr.	Ottawa
Saunders, Boyce Johnston	Lieut.	Farmersville
Shna, William	Tpr.	Prince Albert
Small, Wolstan	Lieut.	Ottawa
Snow, John Frederick	Lieut.	Winnipeg
Sproat, John	Tpr.	Moose Jaw
Stephen, Arthur	Tpr.	Collingwood
Torrance, Wilfred	Tpr.	Ottawa
Wheeler, Arthur Oliver	Lieut.	Ottawa
Wolff, Charles Edward	Lieut.	Ottawa
Woodley, Richard Clifton	Tpr.	Ottawa

Surveying was one of the earliest manifestations of federal authority in the fast-developing western interior of Canada and because of this much unwarranted blame has been laid on the shoulders of surveyors for the civil troubles of 1885. A feature editorial entitled "Why Blame the Surveys?" in Volume One, Number 7 of the Journal of the Dominion Land Surveyors' Association, deals with various misconceptions arising from the key role played by land surveyors in the West. The editorial quotes from the statement made by the Deputy Minister, Department of the Interior, in the departmental report of 1885:

"As a matter of fact, in no case where settlers have been found on a river front in advance of survey, and desired that their holdings should be laid out with river frontages, has the privilege been refused. Details of this sort must necessarily be left largely to the discretion of the surveyors who are entrusted with the work of sub-division, and as the average cost of the river survey is about nine times as great as that of a rectangular survey, and the profits of the sub-divider are large in proportion, it is needless to say that there has been no desire on

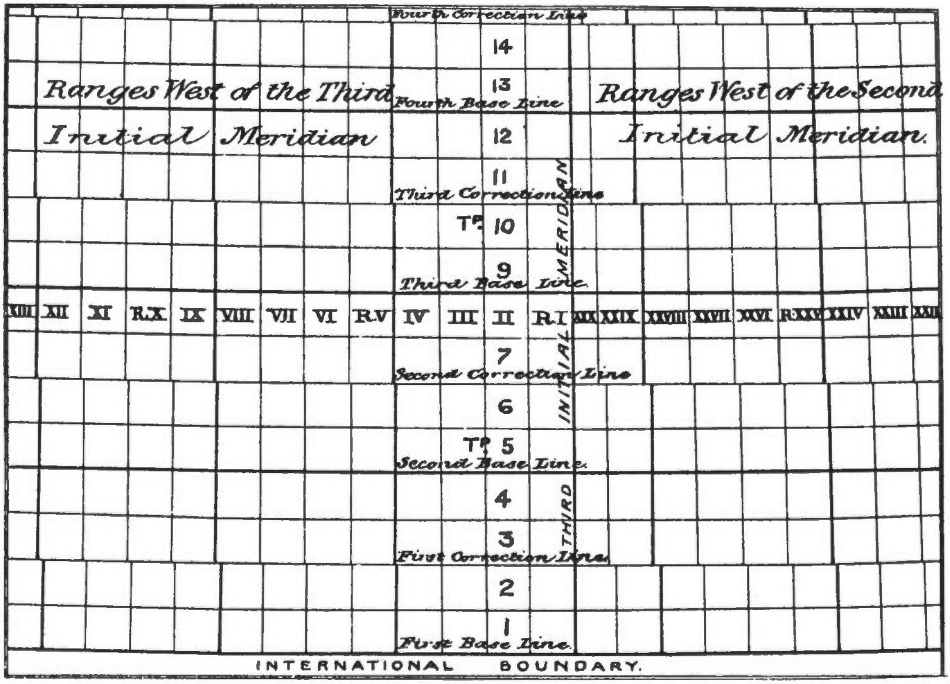

FIGURE 22. Diagram portraying method of subdividing western interior into blocks and townships. Note jogs in correction lines.

the part of the surveying profession to refuse to accede to the wishes of the settler in this respect. Indeed the only complaint which has reached the Department about surveys has come from the South Branch of the Saskatchewan and from French Half-breeds who went into possession of their holdings long after the land had been surveyed on the rectangular principle and in respect of these the Department has always been ready to practically meet their wishes by allotting to them their holdings in legal sub-divisions, which would give their lands with narrow frontages upon the river and extend them back one or two miles as the case may be, just as if they had been laid out on the river system from the beginning."

Land surveying procedure in the western interior of Canada in the 1870s and 1880s followed a well-defined pattern. In the 1883 manual, for instance, the procedure to be followed was that the country was laid out into blocks, each consisting of 16 townships, 4 in longitude and 4 in latitude, bounded east and west by broken meridians, the lines of which were separated by jogs at the correction lines.* Each township, as we have seen, was 6 miles square, and each row of townships northward was known as a range, and ranges were numbered consecutively westward. In outlining one of these blocks the surveyor first ran the base line across two ranges, adjusting his bearings at the midway township corner by a stellar observation. He next ran the meridian lines northward and southward to the correction line, noting the closure. Provided that the meridian line from the other direction had been surveyed to the correction line, any error in closing was distributed equally between the two quarter-sections immediately adjoining the correction line. In running base and correction lines or meridian exteriors, instruments of the best make available were used, graduated to at least ten seconds of an arc. The transit-theodolite without vertical circle and with six-inch limb was recommended for use in this connection. For township subdivision or traversing a transit-theodolite or solar compass accurate to two minutes, was regarded as sufficient. The chain used was the standard Gunter's chain, 66 feet long (100 links) tested and corrected frequently during use.

The astronomic meridian was determined by observation of the elongation of Polaris at night. A point was fixed not less than 150 yards distant from the transit directly below the star at elongation. The line through this point and the point directly underneath the transit made an angle with the true meridian equal to the azimuth of the star. On block outlines an observation was required at least on every township outline. Both banks of all navigable rivers and on all lakes and deep ponds extending more than 25 acres, together with any islands, were traversed.

In 1872 a map was issued at Ottawa showing the surveys completed in Manitoba and the North-West Territories. This constituted the first official map of the newly formed province and depicted the results of surveys of Dominion Lands.

A history of Dominion Lands surveys would be incomplete without a description of methods of monumentation employed. Various types of monuments or markers were used, depending on whether open prairie or bushland was being surveyed. From correspondence in old files in Ottawa it would seem that surveyors in the field were not always aware of changes in regulations concerning boundary posts, or were not always in a position to abide strictly by formal instructions given them.

In bushland from 1871 to 1880 if a tree was found at an exact corner of a section it was required to be squared and marked on four sides. It might, in some instances, be cut down and a survey post substituted. During that same span of time wooden posts, squared at the top and marked on four sides, could be used. In regions where stone was plentiful township corners would be denoted by a single marked stone with a pyramid of smaller stones alongside. On open prairie, township corners were usually marked by iron post, mound, trench and pit, the entire monument being an exact duplicate of monuments erected on United States public lands surveys from 1871 to 1880. In the 1880s iron posts were used in stone mounds and pits.[26] After 1886 earth mounds were to be discontinued on prairie rangelands where cattle often tended to paw them down. Surveyors' field notes of those days, however, reveal that some mounds were erected after that year in such areas. From 1871 to 1915 on township corners only, iron posts, 5 feet long and 1⅜ inches square, marked on four sides, were used in conjunction with regulation pits and mounds. Smaller iron posts were used on section corners. For a time, on open prairie, a wooden post in a stone mound would suffice, if stone was readily available.

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*Correction lines absorb the convergence of meridians and are intermediate to base lines.

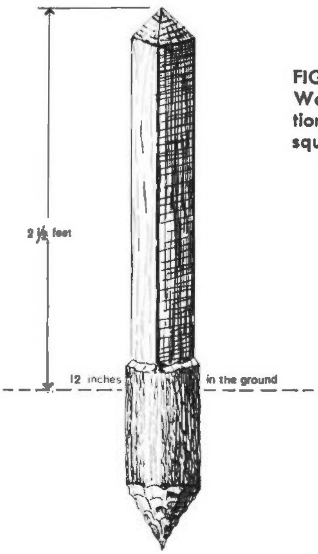

FIGURE 23
Wood post, marking section corner. 5" diam., 3½" squared.

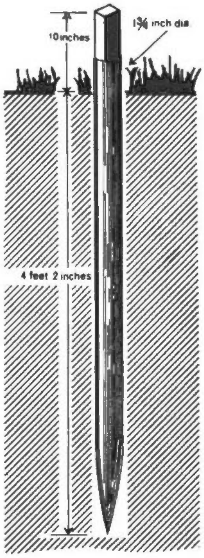

FIGURE 25
Iron post marker, township corner.

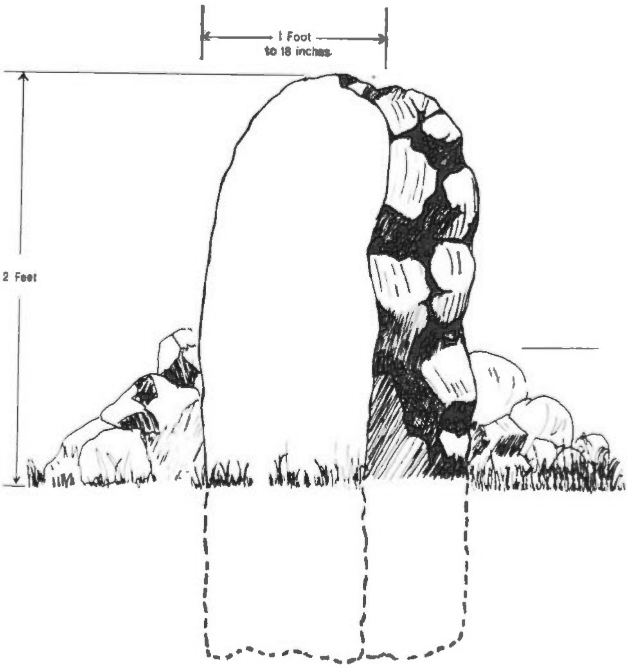

FIGURE 24. Stone marker, township corner.

Generally speaking, the chronological order or progress in the use of boundary markers was from the early wooden and stone posts to solid iron posts at township corners, to small-diameter iron tubes (44 inches long by ½ inch diameter) with flat tin plates, 6 inches square, and then to iron pipe posts (3 feet long by ¾ inches diameter) with upper end squared and stamped with a crown on one face. It also bore the following inscription: "Penalty for Removal, Seven Years Imprisonment". By 1915 standard iron posts with bronze caps were in use.

Deville has provided a telling glimpse of some of the difficulties he faced in his efforts to improve survey monumentation on Dominion Lands.

"Now that was one of the first things I did when I joined the Service [1880]—it was to urge the substitution of iron posts for the wooden posts hitherto used. The posts in that [western] country were mostly of poplar and those were of no use whatever as the numbers disappeared from them in a few years, so I asked that we be allowed to use iron posts. Well, the Minister [Sir John A. Macdonald] did not believe in accurate surveying or any permanent surveying or anything like that—he had a notion of his own and would not listen about iron posts at all—the wooden posts were good enough for him. I tried to bring forth all the arguments I could for iron posts and among them I pointed out that in surveying the open prairies there was no wood there and we would have to carry our cumbersome wooden posts with us. I pointed out the convenience of the iron posts in comparison, and the Minister said to go ahead and use them, but the surveyors would have to pay for them. Well", Deville concluded with a disarming smile, "we got the iron posts anyway and I don't think the surveyors paid for them!"[27]

But in 1882 when iron posts began to be used at section corners these were planted in the centre of mounds with two inches projecting above. On top a square tin plate with appropriate markings was slipped over the post and held in place by wire or nail. Inscriptions on wooden posts were usually made by knives or scribing irons; on iron posts by cold chisel and on tin plates by special dies. On township corner iron posts dies were used also.

When a township corner occurred in a shallow marsh or swamp, requiring a witness monument more than 5 chains distant from the true corner, the latter had to be marked also by a long wooden post, marked on one side. A witness monument was one serving as a marker for a corner removed an even number of chains from the witness. The latter marker was made necessary whenever a corner was located in a road allowance, lake or other body of water or in any position where it might be destroyed by human or natural action. Usually the witness post carried the inscription "Wt." together with details of distance and direction from the true corner, measured in an even number of chains. A bearing tree could serve as a witness and, on the basis of convenience, could be in any direction from the true corner. For example, in the August 20, 1872 field notes of Deputy Surveyors David and Walter Beatty, the following record is found in relation to Swan Lake Indian Reserve No. 7 in Manitoba: "Bearing tree (0.11 chains S 67°W of the NE cor., sec. 5, Tp. 5, R 11 WPM) blazed by Walter and David Beatty, DS, on 20 day of Aug., 1872, when it was a 6″ oak."*

Deville's account of his encounter with Sir John was his characteristic, off-hand way of describing his own inflexible determination and ability to win a point despite disapproval in the highest quarters. He might also have mentioned in this account the frustrations experienced by some pioneer surveyors on the Portage Plains in this matter of posting. Indians would follow the survey parties at a respectable distance, and lift the wooden stakes for use as firewood in their camps. If the white man was foolish enough to leave such stakes behind him in a treeless land, what else could a wise Indian do?

*Part of tree trunk is on exhibit with permanent collection of Canadian landmarks in possession of Legal Surveys, Department of Energy, Mines and Resources, Ottawa.

On March 7, 1871, Dennis was made Surveyor General of Dominion Lands and in the same month the control and administration of those lands were transferred from the Department of Public Works to the State Department. In April, by Order in Council, the new survey system for the West had been approved officially and legally adopted. With the formation of the new Dominion Lands Branch and the publication on May 1st of the initial edition of the *Manual of Survey, Dominion Lands*, the measurement and bounding of

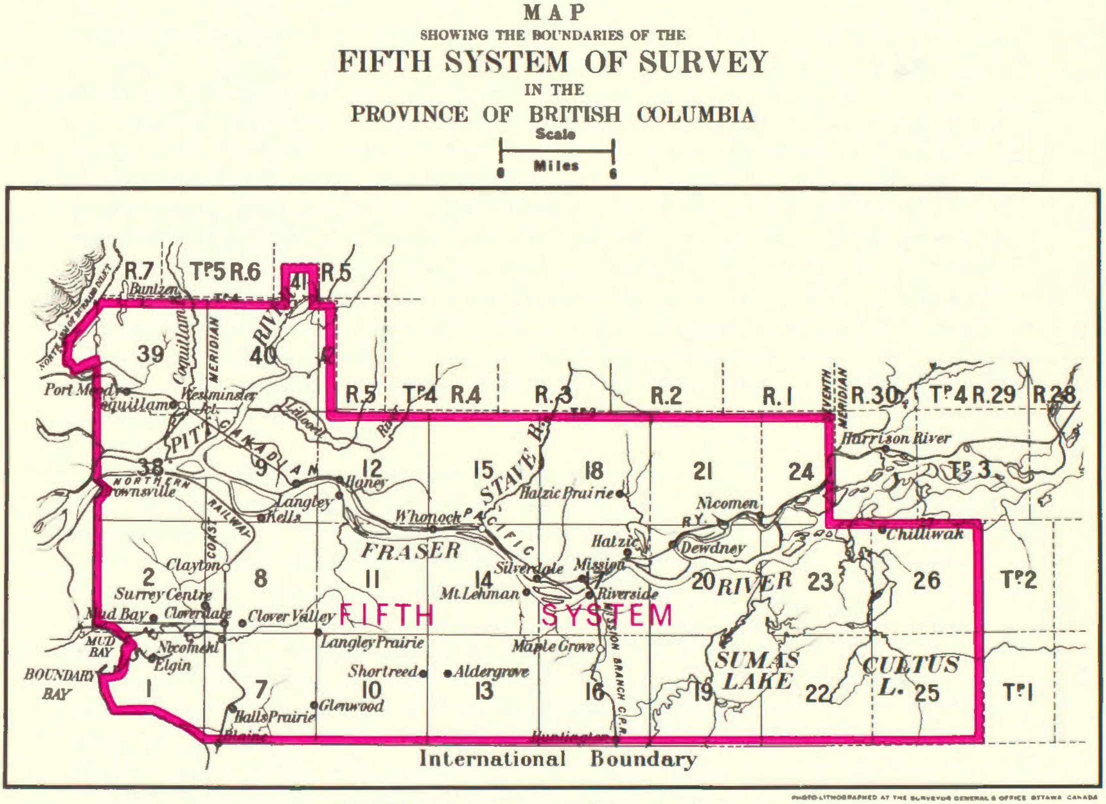

FIGURE 26. Boundaries of Fifth System of Survey.

townships, sections and quarter-sections of the western interior of Canada could formally commence.

In his prefatory note in the initial 32-page Manual the Surveyor General explained that "in preparing the accompanying Instructions to Deputy Surveyors, use had been made, where the same would apply to the system of Survey adopted by the Dominion, of the very complete Manual published by order of the Commissioner of the United States Land Office, dated 1855; and subsequent instructions to Surveyors General of the United States by that officer, dated 1864."

The 1871 Manual, with its collection of eight diagrams rather inelegantly tipped in at the back of the book, remained in use for 10 years. Under its provisions a large part of the Canadian West was surveyed. It formed the basis for succeeding editions issued to cover various systems of survey as these evolved over the years. For example, the reduction in 1881 in the width of road allowances and the abolition of three east-west roads in a township survey were changes that led to the issue on March 17 of that year of the second (86-page) edition. A third edition of 117 pages appeared two years later, on June 1, 1883.

Each of these three early publications constituted a book of detailed instructions for the guidance of surveyors as well as a source of general information on the nature of the surveys to be undertaken. As the title pages of the second and third editions declared, "Manual shewing the System of Survey of the Dominion Lands with Instructions to Surveyors." Each manual explained various features of the survey system to be followed, and indicated ways of obtaining maximum accuracy as well as methods of defining a meridian line. It described monumentation and the designation of boundaries, types of corner posts and markers required, instruments to be used as well as the manner in which surveyors' plans and field notes were to be submitted to headquarters. Each plan was to provide a clear record of the nature and position of all boundaries in the survey as well as topographic features serving as references to such boundaries. Field notes were to show exactly how lines were run.

The 1883 Manual stated that the Second System of Survey "is similar in all respects to the First System except in regard to the deficiency or surplus from converging or diverging meridians, which is distributed equally between all quarter-sections as in the actual system." But there were other important differences. In the 1881 edition Lindsay Russell as Surveyor General stated that the (second) edition had been prepared by Deputy Minister Dennis of the Department of the Interior. Incidentally, in 1876, William F. King had become astronomic assistant to Lindsay Russell. Russell explained that this second edition of the Manual had become necessary because the first edition was out of print and also because of changes in the width of road allowances (from 1½ to 1 chain) and "certain other modifications of the processes of the survey" so that appropriate alterations of text were necessary. "These", he wrote, "have been made under my direction by Captain E. Deville, D.T.S., F.R.A.S. Several useful tables have been added in this edition." Russell indicated that these tables had been compiled by Deville and King, names that came to sparkle brightly in the wide firmament of Canadian surveying and mapping.

Both the second and third Manuals, published by Maclean, Roger and Company of Ottawa, included two plans in color. The third edition, in particular, contained numerous diagrams and featured a large increase in the number of mathematical tables used "to facilitate necessary calculations" by surveyors in the field. Each Manual emphasized that all these surveys were to be astronomic and therefore performed independently of the magnetic needle. The surveyor was to carry a sidereal pocket chronometer, preferably a lever watch, to aid him in this connection. All measurements were to be made with a four-pole chain, tested at the Dominion Lands Office, Ottawa, as well as in the field every other day in order that any adjustments might be made because of temperature changes.

Field notes were required to be faithful, distinct and a carefully minute record of everything officially done and observed by the surveyor and his assistants "pursuant to instructions". The notes were to include descriptions of creeks, the nature of the water in lakes, the type of land surface observed, types of soil and timber stands, details of waterfalls, coal deposits and minerals—in brief, a general description of the entire township being surveyed. Plans were to show, on a scale of 40 chains to the inch, precise measurements of quarter-sections, topographical objects, direction of streams, location of ponds, swamps, ravines, muskegs, lakes and hills.

The cost to the federal government of early land surveys in the western interior is a matter of considerable historical interest. On May 11, 1871, an Order in Council was passed at Ottawa providing for daily rates of pay for members of survey parties working in Manitoba and the North West, as follows:

One Deputy Surveyor	$ 4.00
Two chainmen ($1.00 each)	2.00
Two axemen or flagmen	2.00
One cook	1.00
One horse and cart	1.00
Allowance of 60 cents per day to surveyor to cover cost of rations	3.60
Daily cost of survey party	$13.60

The camp equipment allowance for a season totalled $150.00 in these early days. Such equipment included tents, hardware, cooking utensils, dishes, plates, cutlery, candles, oil and soap, towelling, cooking stove, camp stove, blankets, tools, rope, twine, wire, axes, brush-hooks, spades, grindstones, whetstones, scythes, pack-straps, survey pickets, chain-pins, scribing-irons and instrument boxes. There was a standard allowance of $10.00 for stationery. Anything other than these supplies had to be provided by the surveyor in charge or by the men themselves. William Pearce, D.L.S., claimed in his reminiscences that as late as 1874 men of a survey party supplied their own blankets.[28]

The 1871 Order in Council was amended by an Order dated March 1, 1872. Under this revision the pay of surveyors on settlement and timber limit surveys was raised from $4.00 to $5.00 per day in addition to the provision of the actual cost of hiring men. The surveyor, in addition, received for himself and each man of his party 60 cents per day as a ration allowance as well as a reasonable charge for camp equipment and the transport of men and supplies.

All Dominion Lands surveys in 1871 and 1872 were performed under the contract system at so much per mile as follows:

Type of Survey	*Open Prairie*	*Poplar Woods*	*Other Woods*
Block outline	$ 9.00	$15.00	$25.00
Township subdivision	7.00	11.00	18.00

Note: "Other Woods" included heavy timber or windfall, dense bottom scrub with vines or thick willow, or hazel.

For the purpose of making necessary measurements and placing section and quarter-section corners on one side of the road allowance on a correction line, the other limit of such road allowance having been run and marked, it was understood that the surveyor would be paid at a uniform rate of $8.00 per mile.

Towards the end of the 1872 season in the western interior, surveyor-contractors engaged on block outlines became bitterly discontented over the poor financial rewards attending their heavy work and heavier responsibilities. They described to Lindsay Russell the magnitude of the difficulties under which they labored in comparison with the stipulated rates of pay. The pay scale, in fact, was represented as being so low, and the need for accuracy in surveys so great as to make daily progress anything but rapid. It was claimed that in these circumstances surveyor-contractors could not possibly break even financially on a season's operation. It was all they could do to meet daily expenses of their survey parties, let alone secure any compensation for their personal services.

Russell became convinced, in the light of actual experience in the field, that it would be fairer to both the government (through the production of accurate results) and the surveyor-contractor if the latter worked on the basis of daily pay and allowances. Accordingly Russell, in a memorandum dated April 17, 1873, made representations along these lines to the Surveyor

General. Dennis agreed with the submission and five days later new regulations became effective on the subject. The 1872 Order in Council was amended and block outline surveyors were accorded daily pay, such payments not to exceed $6.00 per day. Contractors, however, were given the option of accepting the new system of remuneration or payment at rates specified in their contracts. On May 12, 1875, rates for subdivision work were again amended and new rates based upon distances of surveys from certain specified fixed points were introduced.

In the meantime a new department of federal government had been created, the Department of the Interior. In May, 1873, the Act of Parliament creating this department received royal assent and on June 30 the management and control of Dominion Lands was transferred from the Department of the Secretary of State to the Department of the Interior. The office of Minister of the Interior was created by 36 Vic. c. 4 which came into force on July 1, 1873. The first occupant of the Interior portfolio was Hon. Alexander Campbell, the Ontario statesman who had had so much to do with the Dominion Lands Survey regulations of 1871. A general election and the subsequent arrival in office of a Liberal administration cut down Campbell's term of office to a few months only. The first Deputy Minister of the Interior was E. A. Meredith. On August 13, 1873, an Order in Council recommended that the organization of the new department consist of 29 persons including the Deputy Minister, a Deputy Superintendent General of Indian Affairs, a Surveyor General, a Commissioner of Ordnance and Admiralty Lands, 20 clerks of varying grades and 3 messengers. The Geological Survey of Canada was attached at this time to the Interior Department and its Museum moved from Montreal to Ottawa. In 1872 Milner Hart and A. H. Whitcher had been appointed Assistant Inspectors of Surveys in the Dominion Lands Branch taken over by the Department of the Interior a year later.

Allowances to surveyors were again revised by Order in Council dated May 17, 1887. Under this authority the rates for "board" for one season were set out as follows:

Board for one season for block surveyors,-	
Manitoba and North-West Territory	$250.00
British Columbia	300.00
Township outline surveyors and examiner of contracts,-	
Manitoba and North-West Territory	200.00
British Columbia	250.00
Explorer and surveyor of trails, Manitoba	160.00

Payment for surveying traverse lines was fixed at the rate of $9.00 per mile east of the Fourth Meridian and $10.00 for lines west of that meridian.

In making cost comparisons between Crown Land surveys in Upper and Lower Canada on the one hand, and Dominion Lands survey work in the 1870s on the other, it must be borne in mind that in the case of the former only one boundary of a lot—the front line—was surveyed whereas in the Dominion Lands Survey System all four lines were drawn. The average cost of surveying block outlines in the West, according to the 1876 annual report of Surveyor General Dennis, was $36.83 per mile. The average cost of surveys in Central Canada from 1841 to 1876 was $6\frac{1}{10}$ cents per acre, each mile bounding 200 acres. The Dominion Lands township surveys cost was 3.83 cents per acre, each mile bounding 160 acres.

In reading the records of the Allison Commission of the United States Congress in the mid-1880s one realizes that American authorities were greatly impressed by their discovery that Canadian land survey costs in the western interior were substantially lower than similar survey work in the western states. One witness of status testified before the Commission that the rectangular system of survey in the United States but adapted to Canada's western interior "had been executed by refined methods, so that the land office surveys will ultimately constitute the basis of a topographic map and of cadastral maps, and many millions of dollars will thereby be saved. This superior work has been accurate at less expense than corresponding work in the United States."[29] On at least one occasion of note, the difference in cost of the land surveys in the West of each country was estimated at eighty millions of dollars!

Red Fife, the first wheat strain to combine hardiness with good milling quality, as already indicated, was an important key in the opening up of Manitoba and the North West to rapid settlement. Two other keys essential to swift development of the freshly-surveyed inland empire were the free homestead system and the railway land-grant policy. Grain production soon began to mount on the western plains. The first shipment of wheat from Western Canada was in October, 1876. It began its epic journey from Winnipeg by Red River steamer and consisted of 857½ bushels of Red Fife at 85 cents per bushel. The shipment was consigned by Higgins and Young, Winnipeg, to Steel Brothers, Toronto, for use in Ontario as seed.*

If some of the growth troubles arising out of the transformed West can be attributed to land survey policy or activities, many of the benefits of settlement and economic development can also be accorded to the courage, endurance and enterprise of surveyors and their assistants. Difficulties with métis and Indians, lack of rail or telegraphic communications, long, rough and very trying rides in Red River carts, rigors of the climate, encounters with swamps, muskegs, foul water and insect pests, all failed to repel the land surveyor. With patience, persistence and occasional bursts of bad language, he triumphed, with his men, over adversities that must have taxed his stamina to the utmost. Yet he gave a most excellent account of himself. The prosperous, occupied lands of the western interior today stand as a lasting memorial to his resourcefulness, dedication and almost unlimited capacity for hard, accurate and sustained work.

In July, 1930, at a time when the natural resources were being transferred to the three provinces of the western interior by the Dominion, a monument was erected by the Historical Sites and Monument Board of Canada on a plot of land donated by two prominent citizens of Manitoba.** That site is located on what is now the Trans-Canada Highway at a point near Headingly, west of Winnipeg. The inscription on that monument reads:

"The first Monument on the Dominion Lands Survey was placed July 10, 1871, on the Principal Meridian, about half a mile north of this site. The system, then inaugurated by Lieut.-Col. John Stoughton Dennis, Surveyor General, extends across the Prairies and to the Pacific Coast. It now embraces more than 200 million acres of surveyed land in Manitoba, Saskatchewan and Alberta and parts of British Columbia."

These millions of acres constitute, in all probability, the largest block of land ever surveyed under a single, integrated system. In the words of W. F. King, uttered when he was Inspector

*A plaque in the Legislative Buildings, Manitoba, commemorates this event.

**Senator J. T. Haig and Hon. A. Benard. The monument was unveiled on July 14, 1930, on the occasion of the 50th anniversary of the Association of Manitoba Land Surveyors.

of Surveys, "the surveys of the North West as regards accuracy, economy and rapidity of their execution, can compare favorably with those of any country in the world."[30] The Headingly monument is a fitting, permanent tribute from the Canadian nation to the authors of a plan of land division and subdivision exceptional in its concept and immense scope. It is a standing salute as well to the surveyors who, despite many formidable natural obstacles and severe physical trials, efficiently and with a high degree of accuracy carried that ambitious plan into practical effect.

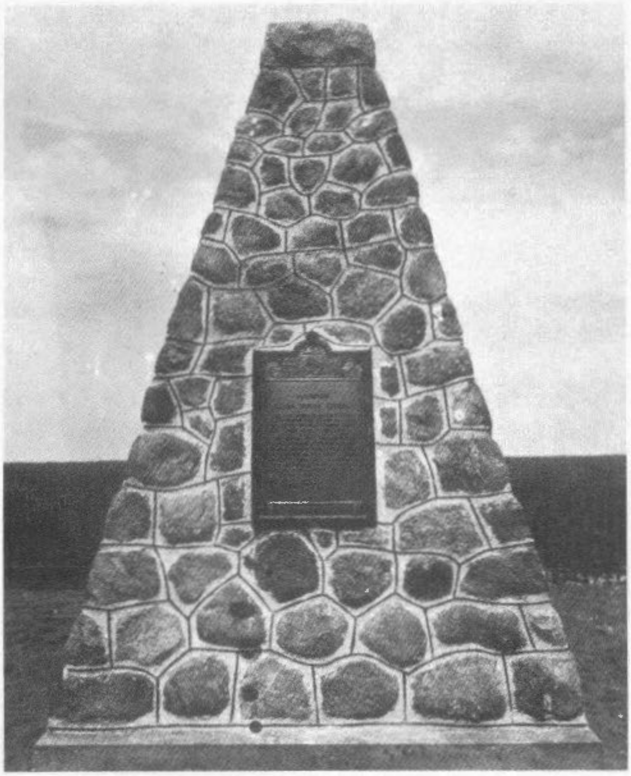

FIGURE 27
Monument to Dominion Lands Survey System at Headingly, Manitoba, on the Trans-Canada Highway just west of Winnipeg.

4

ORIGINS AND EARLY YEARS OF SURVEYORS' ORGANIZATIONS

"The Duke of Buckingham's Surveyor? ha? Where's his examination?"
King Henry VIII, Act 1, Sc. 1

Before the close of the 19th century four important organizations of land surveyors had been formed in Canada. Three of these were duly incorporated by legislative enactments in their respective provinces, bodies "politic and corporate, with perpetual succession and a common seal." Strangely enough the first such organization came into being in the newly-created province of Manitoba. On April 24, 1874, a group of surveyors met in Winnipeg. There were eleven present: Charles-J. Bouchette, C. P. Brown, O. B. Davidson, John Grant, J. W. Harris, A. F. Martin, George McPhillips (1848-1913), John L. Reid (1841-1911), A. L. Russell, Duncan Sinclair and Amos H. Vaughan (1809-97). The meeting passed a motion that "it is advisable that the Land Surveyors resident in Manitoba and the North West Territories form themselves into an Association for the better organization of the profession and that the Association be composed of Deputy Surveyors employed under instructions of the Dominion Land Office and duly qualified Land Surveyors from any of the Provinces of the Dominion." A telegram was sent from this meeting to Surveyor General Dennis as follows: "Land Surveyors formed Association. If the Land Act is before Parliament please propose to change Deputy Surveyor to Dominion Land Surveyor." Dennis at Ottawa complied with the request and as a result federal government surveyors were granted the title borne by them ever since. This transaction had a far-reaching effect on western surveying as it marked the beginning of personal responsibility on the part of the individual surveyor for his work.

A committee of this initial meeting was instructed to draft a bill designed to regulate land surveys in Manitoba and to authorize incorporation. For six years, however, nothing much happened in this regard. But in 1880 a second meeting of surveyors was held at which A. H. Vaughan was named president and J. S. Dennis Jr., vice-president. It was in this same year that the Dominion Land Surveyors' Board of Examiners held a meeting in Winnipeg and gave Dominion Land Surveyor commissions to some 30 provincial land surveyors.

Federal

A. H. Whitcher, Inspector of Surveys, Dennis and Robert Bourne (1844-1905) formed a committee empowered to draft a constitution for an Association and in mid-December, 1880, a constitution was adopted and officers elected. There is evidence that the first name proposed for the new organization was "The Association of Dominion Land Surveyors of Manitoba and the North-West Territories". In the bill of incorporation passed on May 25, 1881 (44 Vic. ch. 29) the name, however, appeared as "Association of Provincial Land Surveyors".

At the first annual meeting after passage of the bill, namely, on June 20, 1881, J. S. Dennis Jr., was elected president and George McPhillips, vice-president. The secretary-treasurer, J. W. Harris, held that post from 1881 to 1904. The executive committee consisted of W. Wagner, T. Breen and Joseph Doupe. By 1882 the Association claimed 80 members. From 1890 to 1900 only two new members were added to the roster. Among those who joined in 1883 were O. J. Klotz, Thomas Fawcett, W. F. King, Milner Hart, P. R. A. Belanger, C. -J. Bouchette and A. O. Wheeler.

J. S. Dennis Jr. (1856-1938) has related how, during this formative period in the career of the Manitoba organization he achieved distinction by being jailed in his capacity of Association president.

Dennis tells the story of his imprisonment with considerable relish: "When our bill passed the Manitoba legislature a clause was sneaked into it without the knowledge of the Association committee looking after it. The clause provided that any man who had served under articles for a period of two years should be entitled to his diploma without examination. Naturally we were very much concerned about that, and very much surprised to find it in the bill. But there it was, it had become law and immediately after there was a demand made upon Association officials and upon me as President to sign the diploma for a man who had served only two years and had not passed any examination. After serious consideration we decided we would not do it, and I refused to sign the diploma. A writ of mandamus was applied for and issued and I, as President of the Association, was ordered under the writ to sign the diploma. Being young and reckless I continued to refuse and in consequence a husky policeman came and escorted me to jail. After I was in jail a few hours some citizens thought it well to bail me out and subsequently the case came on for hearing. It was tried before a very explosive gentleman, Chief Justice Wood, known in the House of Commons where he once served as "Big Thunder". He had only one arm but he had a very powerful voice and when I was paraded before him to explain why I had refused to obey the order of the court, I nearly expired when, in his characteristically explosive way, he outlined to me what was going to happen as a result of that refusal. Fortunately we were represented by a very able man of the legal profession, Mr. Killam, who subsequently became a judge and then chairman of the Railway Board.* After he got the judge calmed down to the point of listening to his story, the explanation was duly made. The Chief Justice then indicated I

*Later Mr. Justice A. C. Killam and Chief Commissioner (1905-08), Board of Railway Commissioners for Canada.

was dismissed, that it was no use of these complaining people coming to him, and that there would be no further writs of mandamus in this matter and that we would not be compelled to issue a diploma to any man until he had passed the necessary examination. We were able to get along under that *obiter dictum* until we got the act amended."[1]

After graduating from Trinity College School at Weston, Ontario, not far from the Dennis family estate "Buttonwood", Dennis had joined H. B. Smith, C.E., in 1872, at the age of 16, on an exploratory survey party in the lakes district of Manitoba. In 1873 he was head chainman for John Lestock Reid on base-line surveys in northwestern Manitoba. For the following three years he worked on the Special Survey with Lindsay Russell. In 1878 he was appointed to take charge of a survey party instructed to establish the Fourth Meridian in the North West. In the following year he joined the Canadian Pacific Railway as surveyor and engineer, and during a period of three years with the railway company Dennis surveyed and laid out town lots at Winnipeg, Prince Albert, Edmonton and also in what is now known as Kenora, Ontario.

FIGURE 28. Association of Provincial Land Surveyors (Manitoba) at Winnipeg, 1882. Surveyors who participated in the meeting in Winnipeg in April, 1882, at which the Association of D.L.S. was first organized. *Standing:* (left to right) J. K. McLean, T. R. Hewson, L. R. Ord, J. F. Garden, H. C. Denny, C. E. Wolff. *Second Row:* C. F. Miles, F. W. Armstrong, Tom Kains, C. A. Magrath, H. Proudfoot. *Seated in Front:* A. F. Cotton, Thomas Drummond, Edgar Bray. *Also present at the founding meeting but not pictured:* Walter Beatty, J. Doupe, T. Fawcett, R. W. Hermon, W. F. King, Otto J. Klotz, J. J. McArthur, W. Ogilvie, E. J. Rainboth, G. C. Rainboth, J. G. Sing, A. C. Talbot, W. T. Thompson, L. Traynor.

Spring was tardy in its arrival in Manitoba in 1882. The winter had been exceptionally severe with a record snowfall of 98 inches. The spring thaw combined with heavy rains to transform the countryside into a morass. Roads and railway lines occasionally became impassable. Many Dominion land surveyors found it impossible to undertake any field work. A number of them gathered in Winnipeg to await improved conditions. It was during this period of enforced inactivity that the Association of Dominion Land Surveyors came into being. In his notable diary, kept over a period of 56 years with the lapse of only one day's entry, O. J. Klotz referred to some of the early steps in the life of the organization:[2]

"*Saturday, April 22, 1882*—In the evening a meeting is held of the Dominion Land Surveyors in the service of the government for the purpose of discussing the advisability of asking for an increase of pay. I was elected chairman, and after some discussion a committee was appointed to draft a memorial. Bray, J. Garden and A. Cotton came to my room afterwards and we had several bottles of beer.

"*Sunday, April 23, 1882*—I drew up the memorial to the Government.

"*Monday, April 24, 1882*—The men started off on the train but shortly returned on account of a washout on the road. In the evening the memorial which I drew up was laid before the meeting of surveyors who approved thereof and all signed it. Thereupon it was proposed to form an Association to further our mutual interests and to meet in Ottawa next winter. Whereupon I was unanimously elected president and A. F. Cotton, secretary-treasurer, and we immediately formed a fund for current expenses of two dollars per man."

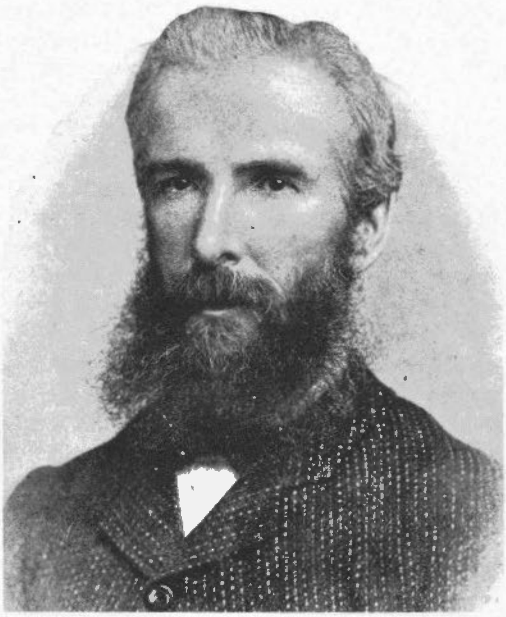

FIGURE 29. Joseph Doupe, President, Manitoba Land Surveyors, 1906.

Official records of these initial meetings have never been found but the following is a partial list of surveyors who attended them: J. Doupe, T. Fawcett, R. W. Hermon, W. F. King, O. J. Klotz, J. J. McArthur, E. J. Rainboth, G. C. Rainboth (1846-1910), J. G. Sing, A. C. Talbot, W. T. Thompson and I. Traynor. Klotz remained as president of the Association until 1886 when Thomas Fawcett succeeded him. Cotton was secretary-treasurer until 1887 when he was followed in that office by A. O. Wheeler.

Entries in the Klotz diary for February, 1883, disclose the nature and scope of some of the Association activities in that year:

"*February 20, 1883*—Arrived in Ottawa, Stayed in Russell Hotel. D.L.S. meeting in P.M. Congratulated on address.

"*February 21, 1883*—Drafted memorial [re financial betterment of D.L.S.] to Sir John A. Macdonald. Interviewed Sir John A. at House of Commons. Sir John non-committal. Afterwards the boys got together.

"*February 22, 1883*—Called with E. Deville and W. F. King. It is well that such a gathering of D.L.S. in Ottawa occurs but once a year for it is a severe test upon one's internal area and capacity."[3]

On February 19 and 20, 1884, the Association held its first annual meeting of which proceedings were published. It was held in Ottawa and relevant entries in the diary indicate that Klotz did not always enjoy clear sailing in his bids for the Association presidency:

"*February 19, 1884*—Arrived at Ottawa. D.L.S. meeting in p.m. Exciting contest for president. The contractors wanted J. A. Snow, the first ballot was a tie 17 to 17. [Note: Klotz was elected on a further ballot.]

"*February 20, 1884*—Saw Deville who gave rather a discouraging outlook for surveyors this season. Same afternoon another meeting of the D.L.S. Association when I delivered a paper on projections . . . ".

Of 11 honorary members elected, five (Selwyn, Macoun, Bell, Dawson and Harrington) were professors. The others were Lindsay Russell, Deville, King, Andrew Russell, E. E. Taché and Bolton Magrath. On June 30, 1884, Lindsay Russell retired owing to failing health.

A highlight of the presidential address by Klotz in February, 1885, was a reference to a triangulation survey designed to cover all Canada. Such a survey, according to Klotz, was urgently required and was a responsibility of the Dominion. So impressed were his fellow members by this need that during the March, 1887, meeting a strongly worded 'memorial' to that effect was submitted to the Ottawa government urging the establishment of a Canadian geodetic survey. The need for a more ambitious hydrographic survey of Canadian waters was also pressed. Another matter that inspired serious discussion in the early day of the Dominion Land Surveyors Association was "the injustice done to Dominion Land surveyors by allowing civil engineers to sign plans of right-of-way surveys for railways in the North West Territories and [asking] that the Department refuse to accept or file any plans signed in this way." Deputy Minister Burgess of the Department of the Interior replied in March, 1888, that with regard to government railways "legal opinion indicates that the Government is under no obligation to employ Dominion Land surveyors to survey the right-of-way or to prepare the necessary plans."

Still another matter of importance to receive attention in those early days was the possible affiliation of the various provincial surveyors' associations, namely those of Quebec, Manitoba, Ontario and British Columbia with the Dominion Land Surveyors' Association. At its 1891 annual meeting President William Ogilvie of the latter organization stated, "Quebec and Manitoba, for the present at least, do not see their way to the accomplishment of the [affiliation] scheme."

At this same meeting note was taken officially of the fact that a member of the Dominion Land Surveyors' Association, Henry Irwin, assistant engineer, Canadian Pacific Railway Company, Montreal, in competition with fellow professionals from the United States and Canada, had won the first prize of $400. This contest had been sponsored by the University of Pennsylvania and was organized to obtain the best paper on road-making and maintenance.

In 1885 President Klotz, Secretary-Treasurer Cotton and the executive committee of the Dominion Land Surveyors' Association called on the Minister of the Interior to urge that the Railway Belt in British Columbia be surveyed in accordance with the Dominion Lands survey system and by Dominion Land surveyors only. In the same year, marked by the death on July 7 of Surveyor General Dennis, another committee of the Association was empowered to draft a bill to incorporate the Association. At the 1886 annual meeting President Klotz confessed that "regarding incorporation, as I anticipated, nothing effectual was done, for the Government did not look favorably upon the scheme, especially that part relating to the power of examining and granting commissions. In this respect we are placed in a far different position from Provincial Land Surveyors seeking incorporation; to the latter, undoubtedly, such rights belong and should be given." So far as can be discovered, the Dominion Lands Surveyors' Association was never incorporated.

In 1886 Dr. W. F. King and Dr. R. W. Bell acted as a committee to inquire into the best means for having a uniform system of map making in the various departments of the government at Ottawa. In 1888 standing committees of three members each were appointed to consider and report upon such topics as instruments, geodetic survey, publications, land surveying, natural history and geology, permanent marking of surveys, topographic surveying and photography as applied to topographic surveying.

In 1890, under the presidency of J. S. Dennis Jr., the Association declared that it would be of great benefit to the profession and the public if the work of Surveyor General Deville on the use of photography in surveying ('Photo-Topography' was the term used) were published. Undoubtedly this motion referred to Deville's notable book entitled *Photographic Surveying* of which 50 copies were lithographed and issued in 1889. This volume was published by the Government Printing Bureau, Ottawa, in an edition dated 1895. In the preface of the work Deville acknowledged the valuable assistance he had received, as author, from Klotz and King.

The first annual dinner of the Dominion Land Surveyors' Association took place in February, 1890. It was served in the dining room of the House of Commons and was attended by 44, including the following invited guests: A. M. Burgess; Professors Selwyn, Dawson and Macoun; Doctors Deville, Bell and King; also A. T. Drummond. The Association had voiced objection to the authorities in Ottawa over the fact that surveying in Indian Reserves of the Railway Belt in British Columbia had been performed by others than Dominion Lands surveyors. The 1890 meeting was advised by the Deputy Minister of Justice that all such surveys should have been made by duly qualified Dominion Lands surveyors.

The 1890s brought a decline in the fortunes of the Association. Economic depression was widespread, immigration fell off, the future for federal land survey work appeared more and more obscure and, in addition, there had been a considerable drain of members away to provincial associations. The 1894 annual meeting, held on February 19, was brief and poorly attended. The entire business of the gathering was devoted to ways and means of suspending the organization. On February 24 Secretary-Treasurer Dufresne circularized the membership, conveying advice of the decision to suspend.

In addition, as Klotz had aptly remarked in his presidential address to the Association in 1886, "we have surveyed our heads off". He added, "Block and outline surveyors [in 1883] vied with each other in doing a big season's work . . . [We] devoured . . . the whole country with instrument and chain." With obvious regret Klotz saluted 'the old days' when he commented, "The days of outfitting in Winnipeg and camping at Moose Jaw are things of the past, never to return." But when he went on to observe that "the functions of the Dominion Land surveyor are just about over . . . " he was unduly pessimistic. Actually the future held in store many good years of constructive surveying activity in the field of federal surveys.

With the advantage that always comes with hindsight it is now quite clear that a fundamental error in administration was made in starting surveys in the western interior too abruptly and with an excess of surveyors, rather than in beginning the task gradually with a relatively small number of men, then building up the total employed year by year. Under the plan actually adopted, when the program of work was restricted, good men were laid off. It would seem that there was not any well-established rule to be followed in the provision of employment in the field. From season to season, especially after 1880, the numbers of surveyors in the western interior varied considerably.

A perusal of annual reports of the Minister of the Interior discloses the short-sighted character of the government's policy and attitude on the surveying of new territories. Such surveys seem to have been regarded during the 19th century as a generally unpalatable but unavoidable factor in contributing to the peopling of western farmlands. Seldom did Ottawa authorities appear to realize the close connection between survey work and effective settlement programs. Dr. Deville remarked as late in the day as 1912, "In the past surveys were always wanted in a rush, and then when immigration fell off or general business failed, the whole thing fell down." As these conditions fluctuated the fortunes of the Dominion land surveyor rose and fell and it was not until 1907 that the Association experienced a revival of interest and a renewal of its activities.

FIGURE 30. Convention group, Dominion Land Surveyors, at Ottawa, 1912.

In its earlier days the proceedings at annual meetings could be quite exciting. In his diary entries covering the 1888 gathering Klotz referred to "objectionable remarks" on February 19 reflecting indirectly on the Government and the Interior Department, the Minister and Deputy Minister by the then Association president, E. J. Rainboth.

"*February 20*—Before attending the D.L.S. meeting in the evening I hurriedly consulted Dr. Ferguson on parliamentary rules as I was bound to have the President's address discussed and the objectionable parts repudiated. With 'blood in my eye' as Webb saw, I went to the meeting and after the presiding officer made a motion that 'the President's address be now received and open for discussion', I, as expected, was ruled out of order but there was no baffling me this night. I demanded to have the question put to the meeting whether I was out of order. The president refused to do so—Chaos reigned. I finally put the question myself and found only three dissenting voices . . . Some threatened to sever their connection with the Association on account of the arbitrary proceedings . . . In fine the President re-read his address and a vote to repudiate certain clauses carried . . . Mr. Lightfoot, a visitor, said that the proceedings of the House of Commons weren't a 'patch on this'."

Quebec

In Quebec the formation of a provincial organization of land surveyors took place soon after the appearance of such bodies in Manitoba and in the federal sphere. The first move in French Canada in the matter appears to have been made by C. E. Gauvin who wrote to Hon. E. J. Flynn, Commissioner of Crown Lands on this project early in 1881.[4] Gauvin, in this initial letter, drew attention to the fact that surveyors were becoming more numerous in the province and that they ought to form themselves into an incorporated association as in the case of other professions. By incorporation, he pointed out, desirable standards of ability, conduct and knowledge could be established and enforced. The so-called "parish surveyors", unofficial and inadequately trained land surveyors of that time, would soon disappear once incorporation was achieved. The menace of litigation would fade as increasing reliance could be made upon the accuracy of title deeds to properties. Discipline within the profession could be enforced more effectively.

Gauvin's arguments carried much force. In any event those who gave support to the idea of incorporation received official encouragement. A lawyer was retained and formal notices of filing for incorporation were duly published in the Official Gazette, the Montreal Gazette and other organs. A draft bill setting forth proposed terms was distributed. One of the sources of official encouragement of this project was Commissioner Flynn. His continuing interest in and guidance of their organizing activities in this formative period won the admiration and gratitude of Quebec surveyors.

On May 27, 1882, the Quebec Legislature passed the bill that marked the birth of the organization by incorporating the "Corporation des Arpenteurs-Géomètres de la Province de Quebec" (45 Vic. ch. 16). The Corporation has continued to function and flourish ever since that event. The first general meeting took place in the newly-erected Legislative Building on July 4, 1882, with 41 surveyors present. P. N. Dorion presided on this occasion and C. E. Gauvin acted as secretary. Fifteen surveyors were elected to the first board of directors of the Corporation, its Board of Management. These were: James Addie, Charles Baillairgé, W. A. Ashe, J. N. Gastonguay, P. P. V. Du Tremblay, P. Horace Dumais, E. T. Fletcher, C. S. Lepage, F. M. Lachaine, J. H. Leclair, J. J. McArthur, David C. Morency, Antoine-Étienne Painchaud, W. McL. Walbank and J. E. Vannier. Also at this meeting Charles Baillairgé was elected president, James Addie and Antoine-Étienne Painchaud were made vice-presidents, E. T. Fletcher was named secretary and F. M. Lachaine, syndic. At this July meeting Commissioner Flynn was formally thanked for his important assistance in obtaining incorporation and, in 1890, his advice concerning regulations of the organization won him a modest fee. At that time he appeared to be serving as a legal advisor to the Corporation.

In July, 1882, the board of management, through a small committee, drew up a code of regulations to govern the activities of members of the profession practising in the province.[5] The new rules debarred unqualified surveyors from practice in accordance with section 44 of the statute of incorporation. Gauvin was authorized to communicate with the government of Australia and the governments of the various Australian states for the purpose of obtaining authentic information on the status of the profession in that Dominion and on the management of land-survey matters in that federal system. When Fletcher was made curator of the Corporation museum in July, 1885, Gauvin succeeded him as secretary of the Corporation.

On April 10, 1889, the board decided to submit a new code of regulations to a general meeting and a year later by-laws were given approval. By this time Corporation members were deriving benefit from learned colleagues through the presentation of papers at regular meetings. W. A. Ashe, for example, addressed his fellow professionals on *Compass and*

FIGURE 31. Board of Management, Corporation des Arpenteurs-Géomètres, at Quebec City, 1882. *Standing:* (left to right) H. B. Tourigny, J. N. Gastonguay, J. H. Sullivan, J. P. B. Casgrain, J. E. Sirois, J. E. Mailhot. *Seated:* P. C. Talbot, G. P. Roy, D. C. Morency, Arthur Smith, C. E. Gauvin, T. Breen.

FIGURE 32
Charles P. F. Baillairgé.

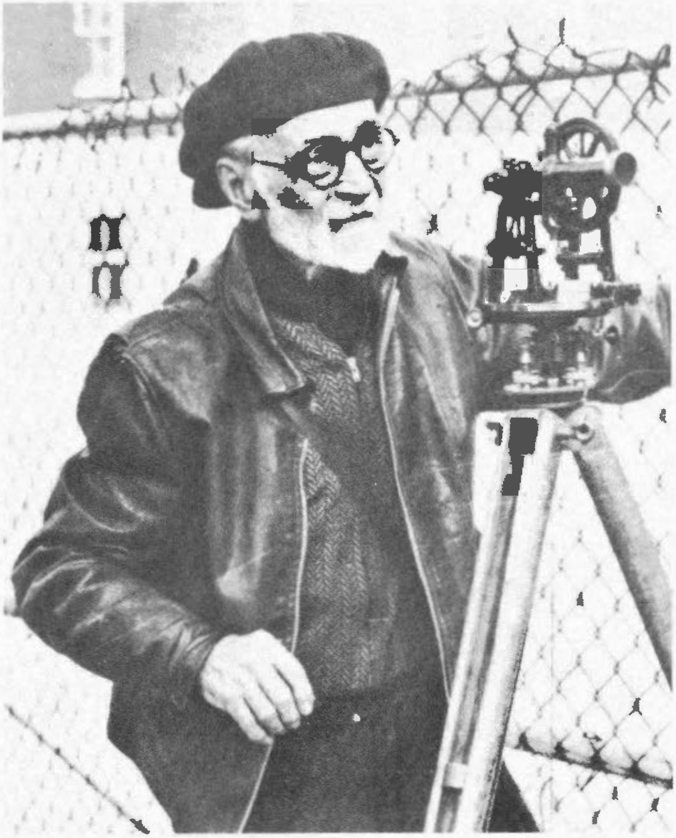

FIGURE 33
F-X. Thomas Berlinguet, surveyor of Trois Rivières still active at 96 years of age, in his profession. He was admitted to practice in 1877.

Magnetic Meridians; J. N. Gastonguay gave a paper on *Surveying and Its Origins*; and L. A. Dufresne on *Geodetic Surveys*. During the July, 1887, meeting the board of management recommended that "a Chair of Civil Engineering be created in Quebec City". Twenty years later, in March, 1907, an act of the Legislature provided for the establishment of a Chair in Land Surveying at Laval University. The first director of the School of Surveying at that institution was J. N. Gastonguay.

Long before incorporation, boards of examiners had functioned in Quebec. In 1855 the board in Lower Canada, formed to pass applicants for the title of Provincial Land Surveyor, included J. Bouchette, Andrew Russell, Adolphus Larue, Charles-F. Fournier, William Ware, Joseph Hamel, John Ostell and E. T. Fletcher (secretary). In the two following years the board remained the same except that Ware was dropped. In 1868 the board consisted of Bouchette, Larue, Fournier, Hamel, Baillairgé, Fletcher and Gauvreau, with F. W. Blaiklock as secretary.

When incorporation took place members of the board of examiners were chosen from among members of the board of management of the Corporation. On July 5, 1882, a sub-committee of the Corporation was authorized to establish a form of examination for articled students and for candidates seeking to practise surveying. The sub-committee reported that five (later amended to seven) members be appointed examiners and that they report to the board of management on the aptitudes of candidates. It was stipulated that for the current sitting of the board of examiners half of the money paid as fees by candidates be distributed among the examiners as remuneration but that no examiner should receive for himself more than five dollars per day in this regard. In the following year it was provided that should a candidate be a relative of any examiner, the latter should not act in that capacity.

In 1882 the following surveyors served as examiners: Baillairgé, Fletcher, Vannier, Lachaine, Morency, Lepage and Du Tremblay. During the following decade either five or six members of the Corporation board of management acted in that capacity. On April 8, 1890, there was an attempt to have the examiners chosen from sources outside the board of management but this proposal was defeated. In 1883 it was resolved that any member of the board of management could forward any question considered desirable, within the intent of the act governing surveys and surveyors, for submission to candidates. It is of interest to observe that in that same year Mgr. Joseph-Clovis K. Laflamme was invited to attend as an examiner in geology, mineralogy, botany and history. Mgr. Laflamme (1849-1910), at the time a lecturer in geology and mineralogy at Laval University and at the Seminary in Quebec, became Dean of the faculty of arts in 1891 and Rector of the university two years later.

Up until 1921 when Senator J. P. B. Casgrain was elected president there had been only five presidents of the organization in the 39 years of its incorporated existence. W. McL. Walbank had succeeded Painchaud in 1897 and, in turn, he was followed by J. N. Gastonguay. The latter occupied the presidency until 1912 when J. E. Sirois was elected and held office for 9 years.

Senator Joseph Phillippe Baby Casgrain (1856-1939) was a man who contributed much to the advancement of this provincial organization over a period of nearly 60 years. He brought distinction to the profession of surveying in Quebec and in all Canada. A member of one of the oldest Canadian families of French origin, Casgrain received his commission as a Quebec land surveyor in 1877. Four years later he was commissioned as a Dominion land surveyor. In addition, in the course of time, he received commissions to practise his profession in Ontario and Manitoba. Named to the Upper Chamber at Ottawa in 1900 he was made an honorary member of the Canadian Institute of Surveying in recognition of the high regard in which he was held from coast to coast as well as in tribute to his enduring accomplishments on behalf of fellow surveyors.

Gauvin occupied the office of secretary of the Corporation for 23 years and was followed by Arthur Smith in 1909, another long-term occupant of the important post.

Ontario

The formation of organizations of surveyors in Manitoba and Quebec as well as of Dominion Land surveyors spurred Ontario action in the same field. Willis Chipman of Brockville was one of the leading advocates of incorporation of an Ontario association. There had been previous but abortive efforts in this regard as early as 1878. In that year, on October 21, a letter was circularized among members of the profession in the province envisioning such an organization. Nothing seems to have developed as a result. At long last a meeting took place in the Private Bills Committee Room of the Ontario Parliament Buildings in Toronto on February 23, 1886. A total of 36 surveyors attended. The proposal to form an Ontario Association of Provincial Land Surveyors was discussed. Klotz, who had been so prominently identified with the creation of the Manitoba and Dominion bodies, was first speaker. He warmly supported the proposal to bring an Ontario association into being, but warned that if it was thought that incorporation would be the sole remedy for all the ills of surveyors, considerable disillusionment would follow. He pointed out that organization and unity were the first steps to success. Then Klotz concluded by reading a letter written by Lindsay Russell, evidently in reply to the circular letter of October 21, 1878, including the following excerpt:

"I sympathize", Russell wrote, "in all efforts to raise the standard or status of our profession but I cannot see that it is practical to do anything by legislation . . . The only legitimate means of raising the status of the profession consists in the effort of each individual thereof, by the evidences of conduct, acquirements and ability to win for himself a good opinion of those of his fellow-citizens with whom he comes into contact. The more as individuals the members of the profession succeed in this, the higher as a class they will stand . ."[6]

Thomas Fawcett of Gravenhurst thought otherwise and wrote to the meeting in his capacity of newly-elected president of the Dominion Land Surveyors' Association in this

FIGURE 34. Board of Management, Corporation des Arpenteurs-Géomètres, Quebec City, 1897. *Standing:* (left to right) Ant. Painchaud, P.P.V. Du Tremblay, Mgr. Laflamme, W. McL. Walbank. *Seated:* Addie, Morency, Chs. Baillairgé, W. A. Ashe, C. S. Lepage, E. T. Fletcher, F. M. Lachaine.

wise, "Although I have not been engaged for a number of years in making surveys in the Province to any extent, yet any move to raise standards of the profession meet with my entire approval . . . In a profession concerning so wide a field as that of land surveying it's next to impossible for any one person to become an expert in all its branches; through the medium of papers prepared by different persons . . . facilities would be offered for gaining information . . . and all members of the profession would be benefitted by attending meetings."

Alexander Niven, P.L.S. (1836-1911) of Haliburton also thought it desirable to form an association and pointed out that the Surveyors Act of the province required amendments.

(Probably Niven had reference to the 1849 Act—12 Vic., ch. 35—and subsequent amendments including those of 1851 and 1855.) "To the very clever surveyor", Niven pointed out, "we would say that you will undoubtedly become a 'crank' unless you occasionally rub up against your professional brethren and get 'corners' polished off. To the 'rusty' brother we think there is probably no better way of brightening you up than by forming the new Association."

P. S. Gibson, P.L.S. of Willowdale, who had been named chairman of the meeting (with Willis Chipman as secretary), had indicated that such an organization might well suggest to the board of examiners lists of subjects on which candidates could be examined, including amendments to any existing lists. A committee of three was appointed to draft a constitution and by-laws, consisting of Klotz, Chipman and Gibson. The meeting, in all, occupied three days, February 23 to 25 inclusive. This is regarded as the first annual gathering of Ontario surveyors. George B. Kilpatrick, P.L.S., of the Crown Lands Department, Toronto, was named first president of the organization, John Galbraith, vice-president and Willis Chipman, secretary-treasurer. The executive committee consisted of Peter Silas, P. S. Gibson, Alex. Niven, William Ogilvie, Charles Unwin, A. C. Webb, G. B. Abre, T. C. Keefer, Thomas Fawcett, D.T.S., O. J. Klotz, D.T.S., J. McAree, D.T.S., Villiers Sankey, P.L.S., and A. J. Van Nostrand, P.L.S.

At the fourth annual meeting of the Association of Provincial Land Surveyors held, according to circular No. 19, in the Canadian Institute, 46 Richmond Street East, Toronto, February 26 to 28, 1889, the officers for 1888-89 were Niven as president, Sankey as vice-president and Chipman as secretary-treasurer. Councillors included John McAree, H. B. Proudfoot, W. R. Aylsworth, P.L.S. (Deseronto). There were standing committees on legislation, publication and instruments. Papers dealt with such widely varied topics as "City Surveys", "Timber Exploring" and "Railway Right of Way Surveys". In 1892, the Association requested the Ontario government to pass a bill incorporating the Association of Ontario Land Surveyors and this was done that same year.*

By its continuing efforts the Association in those early years of its existence did much to elevate the status of surveyors generally and to correct conditions such as those exemplified in the advertisement in an Ontario newspaper in 1864 that announced "Mr. Blank, P.L.S., Conveyancer and Issuer of Marriage Licenses. In returning thanks to his numerous friends begs leave to remind all in Kent and Essex that he is always on hand in the above line of business—all orders either verbal or written promptly attended to . . . Can boast over all for cheapness and can adjust all difficult lines with the aid of old field notes of Samuel Smith, Esq. No extra charge for travelling, as he keeps a conveyance of his own. Charge: $4.00 a day. Silver at par for issuing marriage licenses."

Alberta

Although Alberta had been carved out of the westernmost part of the Territories lying south of the 60th parallel, it was not until the spring of 1910 that a meeting of surveyors took place in Edmonton, the provincial capital, designed to bring about the formation of a provincial land surveyors' association. That initial gathering was closely linked in time with the passage of chapter 21—The Alberta Land Surveyors' Act—of the Alberta statutes, on March 19, 1910. The first regular annual meeting of the organization thus incorporated was held on January 17, 1911, also in Edmonton and was attended by 20 surveyors. R. W. Cautley, then surveyor to the Land Titles Office, Edmonton, acted as chairman. He was elected secretary-treasurer and registrar of the new body. William Pearce became first president of the organization and Lionel Clare Charlesworth its first vice-president. Mr.

*The organization, under this name, regards 1892 as the year of its founding.

Pearce was a well-known western surveyor and a former inspector of Dominion lands. In 1875 he had been appointed to the original Dominion Land Surveyors Board of Examiners. He was particularly noted for his pioneering work in land settlement and irrigation.

The first council of the association consisted of J. L. Coté, M.L.A., A. P. Patrick, D.T.S., R. H. Knight, Maurice Kimpe, B. F. Mitchell and A. J. Latornell. All of these men, with possibly one exception, were both provincial (Alberta) land surveyors and Dominion land surveyors.[7] For the next two years Charlesworth served as association president. A. P. Patrick was vice-president. The membership at this time totalled 85. Charlesworth was succeeded by R. W. Cautley whose brother, R. H. Cautley, replaced him as secretary-treasurer and registrar. Subsequent presidents of the association, up to 1920, were A. C. Talbot, J. L. Coté, H. H. Moore, A. S. Weekes and P. N. Johnson. First elected to the Alberta legislature in 1909, Hon. Jean Leon Coté (1867-1924) had a distinguished career in public life. He became Provincial Secretary in 1918 in the cabinet headed by Premier A. L. Sifton. Named a senator for Alberta in 1923, he died little more than a year later. Charlesworth became Alberta's first Director of Surveys in September, 1905, and Deputy Minister of Public Works, serving from October 15, 1915, to March 21, 1921.

At the 1911 meeting the first item of business on the agenda was a discussion of the admissibility of Dominion land surveyors to membership in the Alberta association. It would appear that a certain amount of professional friction continued to exist between these two classes of surveyors and the unhappy controversy over the membership status of the Dominion land surveyors in relation to the provincial organization is reflected in the following extracts from the 1911 minutes:

"Mr. Cautley was able to inform the meeting that the Deputy Attorney-General, after consultation with the Hon. Mr. Mitchell [Attorney General], had definitely decided that any Dominion Land Surveyor resident in the Province on the 16th of December, 1910, was entitled to be registered under subsection 25 (1) of the Act.

"Mr. Cautley also read an adverse recommendation made by the Hon. Mr. Aylesworth, Minister of Justice, on complaint of the Surveyor General of Canada and communicated to the Lieutenant-Governor of Alberta, with a view to demanding that the Act be changed or that it be vetoed."[8]

Special references were made in the early official proceedings of the association to the deaths of two illustrious pioneer Alberta land surveyors, namely Robert Watt Lendrum, D.L.S., who died in 1912, and Archibald W. Ponton, D.L.S., who died in 1915.

British Columbia

The roots of the surveying profession in British Columbia reach deeply into the early history of that province. Government supervision of land surveys exerted a constant influence on survey activities in British Columbia from the time of the appointment of Joseph Gaspard Pemberton as Colonial Surveyor of Vancouver Island Colony in 1851. In the formation of the first organization of British Columbia surveyors Dominion land surveyors played a prominent part, men of the calibre of W. S. Gore, A. F. Cotton, Tom Kains and E. B. Hermon.[9] In the list of authorized land surveyors published in the British Columbia Gazette dated January, 1891, out of a total of 82, 23 were Dominion land surveyors.

Prior to 1890 some 140 men constituted the group of unorganized land surveyors in the province, including two who had risen to the post of Lieutenant Governor of British Columbia, Sir Joseph W. Trutch and Hon. Edgar Dewdney. But the need to come together in a professional association was being widely felt. A preliminary meeting of seven land surveyors took place in New Westminster on October 16, 1890. Out of this gathering of W. S. Jemmett, J. A. Kirk, A. F. Cotton, J. McKenzie, A. J. Hill, C. E. Woods and N. B. Gauvreau came the initial proposal to form a provincial organization of surveyors. Members of the profession in various parts of British Columbia were canvassed to ascertain their views on the idea. As a result, a meeting of 22 surveyors took place in City Hall, Victoria, on December 1, 1890. The Surveyor General, W. S. Gore, was in the chair. On this occasion, which lasted two days, The Association of Provincial Land Surveyors was duly launched. In a form of primary election, the results of which were made subject to confirmation at the first regular annual meeting of the embryo body, Edward Mohun was nominated for the presidency, T. S. Gore (brother of W. S. Gore) was named vice-president, and Tom Kains, secretary-treasurer. An executive committee of three was set up, consisting of J. A. Kirk, E. B. Hermon and E. A. Wilmot. An interesting but rather optimistic motion was passed at the final session of this gathering to the effect that "the proceedings of the meeting be kept as secret as possible until after the annual meeting."[10] Also at this meeting it was decided to petition the provincial government asking "for the introduction of an act to protect authorized surveyors in the performance of their duties, to prevent unqualified persons acting as surveyors and to provide for duly qualified persons from time to time being admitted to practice."

The once-postponed annual meeting occurred on April 27, 1891. The initial choices, in the main, were confirmed. But there were a few alterations. J. A. Kirk was substituted for T. S. Gore in the post of vice-president. Mr. Gore, however, was made a member of the executive committee consisting of E. B. Hermon, R. Hyland and himself. E. A. Wilmot, who became vice-president of the association in 1892, was dropped from the pioneer executive committee. Incidentally, J. A. Kirk was named association president in 1892 and served a two-year term. Tom Kains served as Surveyor General of the province from 1892 to 1898 inclusive, to be succeeded by W. S. Gore, serving a second term.

A significant motion passed at this April, 1891, meeting was addressed to the Chief Commissioner of Lands and Works, and to every land surveyor in the province. It declared that "it is the opinion of The Association of Provincial Land Surveyors that a P.L.S., when entrusted with a survey, is at liberty to employ competent assistants to perform the work *under his direct supervision* but the surveyor must in his own proper person satisfy himself *on the ground* that the work is correctly done and that a surveyor would not be justified in certifying to surveys made by any other person." (Author's italics.) Attempts to enforce this reasonable requirement were to be attended by troublesome repercussions.

On April 20, 1891, an Act respecting Land Surveyors (chapter 17) became law. Undoubtedly this measure was passed by the provincial legislature in response to pressure exerted by surveyors who had become increasingly conscious of the importance of their functions in the life of the growing province. As a consequence of the 1891 Act, land surveyors in British Columbia became known as Provincial land surveyors with the right to add "P.L.S." after their names. It was not until the passing of a measure in 1905 that the letters "B.C.L.S." came to supersede the former letters of entitlement. Up to the time of the 1891 Act the issue of authority to practise surveying was vested in the Chief Commissioner of Lands and Works for British Columbia and with the Surveyor General of the province. In the biography of a pioneer civil engineer in British Columbia (C. H. Busk, L.S.), who arrived in Victoria in 1883, the following passage occurs:

"I established myself in a couple of rooms on Yates Street until I could work around and learn something of the country and opportunities in my profession. As a preliminary I called on Sir Joseph Trutch and the Surveyor General [W. S. Gore] and from both I learned that as I owned a theodolite and level and allied instruments it was to be presumed I knew how to use them, and accordingly no examination or licence was necessary—all I had to do was to get the offer of some work and then go and do it."[11]

The 1891 Act endowed a board of examiners with disciplinary powers over practising members of the profession. A schedule of fees payable by surveyors to the provincial treasury was established. No provision was made, however, for incorporation of an association of provincial surveyors. Subjects for consideration at the 1892 annual meeting included the questions: "Should the period of apprenticeship be lengthened?" and "Are surveyors paid for the work they do in proportion to the pay received by members of other professions for professional services?". The 1891 meeting had appointed a committee to formulate a tariff of rates and a schedule of prices for surveys in the province and in April, 1893 a schedule of minimum fees and charges was adopted for Vancouver Island. This included the provision of ten dollars per day of not more than ten hours! The minimum rate for work in timber limits was $30 per mile. For surveys of city lots: for one lot, $15, for 2 lots adjoining, $20. For the preparation of original plans and field notes, $10 per day; for a description of metes and bounds, $10.

The failure to obtain incorporation and the resulting absence of complete autonomy by surveyors in their own affairs brought about a gradual decline in interest in the work of the organization. From 1899 to 1905 there are no existing records of any association meetings or elections. Incorporation finally was achieved when chapter 7, An Act respecting Provincial Land Surveyors became law on April 8, 1905.

Following Mohun and Kirk the association presidents up to and including 1898 were E. B. Hermon, H. B. Smith, J. F. Garden, A. F. Farwell and F. C. Gamble. Ernest Bolton Hermon and James Ford Garden were Dominion land surveyors.

Saskatchewan

At the opening session of the first legislature of Saskatchewan an Act respecting Public Works (chapter 10) was given royal assent on May 26, 1906. This measure re-enacted sections 27 to 30 inclusive of the 1901 Public Works Ordinance already mentioned in this chapter. Incidentally, section 2 of the latter legislation had defined terms such as "surveyor", "district surveyor" and "engineer". Chapter 24, 1906, "The Land Titles Act" established the Torrens system of land titles in the province. Certain sections of this legislation provided for survey plans of roads and Indian lands among other subjects.

The history of the Saskatchewan Land Surveyors' Association may be said to have developed in three principal stages. The first stage ended with incorporation of the association in 1913. The completion of the second stage was marked by the affiliation of the profession with the University of Saskatchewan, authorized by chapter 50 of the provincial statutes of 1923. The third stage is still in progress. Curiously enough the initial talks concerning the formation of an association of land surveyors in Saskatchewan took place in Alberta. Early in 1906, in Edmonton, several Dominion land surveyors met and discussed the possibility of creating such an organization. Among those present was F. J. Robinson, at the time Deputy Commissioner of Public Works in Saskatchewan. Some at the meeting voiced hopes that a professional organization could be brought into being embracing all three provinces of Canada's western interior.

Following this informal exchange of views Robinson, in somewhat humorous vein, wrote to his friend, J. Lonsdale Doupe of Winnipeg, " . . . since Manitoba was mentioned I see no reason why they [Manitoba surveyors] should not be consulted and, if agreeable, I think a good association could be formed in the three prairie provinces. I understand, however, that the Manitoba surveyors are very conservative and very select and may object to any action that would make possible the over-running of their postage stamp* with a lot of promiscuous surveyors who hitherto have been precluded from their presence."

*Manitoba's original shape was that of a relatively small square.

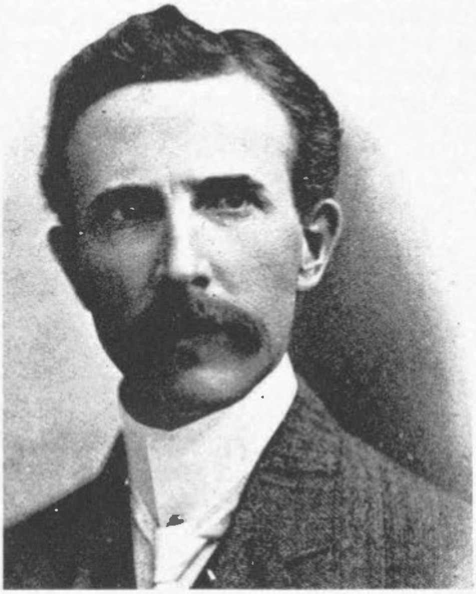

FIGURE 35
J. Lonsdale Doupe, President,
Manitoba Land Surveyors, 1912-13.

Many surveyors resident in the western interior were sympathetic to the formation of a prairie-wide association but inability to formulate a workable constitution, acceptable to all concerned, led to the abandonment of this ambitious concept. But the special need for organizations of surveyors in each of the two newly-formed western provinces could not be long neglected if high professional standards were to be maintained. "I consider that the registration of sub-division plans", Robinson wrote to a fellow surveyor in Edmonton in 1906, "should be protected in order that everyone who can squint through a transit will not be entitled to file plans in the Land Titles Office."

At a meeting of district surveyors of the Saskatchewan Department of Public Works in Regina on May 27, 1909, the question of forming an organization of provincial surveyors was discussed and a committee of four named to deal with the matter. This committee consisted of A. J. McPherson, H. S. Carpenter, E. H. Phillips and E. W. Walker.[12] Some three months later all Dominion land surveyors active in Saskatchewan, totalling 21, were circularized by the committee. The letter drew attention to the necessity for such an organization and referred to certain desirable legislative goals. In the meantime a draft bill, prepared by A. J. McPherson, seeking to establish proper controls for the profession in the province, had been submitted to the government of Saskatchewan and on December 18, the last day of the 1909 session of the legislature, The Land Surveyors' Act, based on the McPherson draft, was passed. The measure became chapter 13 of the provincial statutes of that year. By this enactment a new creature was born and clothed with statutory legality, namely, the Saskatchewan land surveyor. However, he was without any rights of self-government in the internal affairs of his profession. All authority to enforce disciplinary measures was vested in a board of examiners appointed by the Lieut.-Governor-in-Council. This first board consisted of F. J. Robinson, A. J. McPherson and E. J. Phillips. Secretary to the board was H. S. Carpenter. The board's first meeting was held in Regina on December 31, 1909.

In 1910 the district surveyors met again and considered the report on the committee appointed in the previous year. On the basis of that report it was decided to seek the incorporation of an association, particularly for the purpose of obtaining for the profession itself, some degree of autonomy. The 1910 meeting was held in the office of the District Surveyor in Regina and was attended by A. J. McPherson, H. S. Carpenter (elected to the chair), W. W. Meadows, E. H. Phillips, W. R. Reilly, J. D. Shepley, W. M. Stewart, Cyrus Carroll, W. T. Thompson, C. W. Clarke, M. B. Weekes (secretary of the meeting), E. W. Walker and A. C. Garner. A motion 'that an Association of Saskatchewan Land Surveyors be formed' was passed. The first president of this voluntary, rather than officially incorporated, organization was J. L. R. Parsons; W. R. Reilly was elected vice-president and an executive committee of three was appointed, A. C. Garner, H. K. Moberly and M. B. Weekes. The latter served also as secretary-treasurer of the embryo organization.

On December 19, 1913, a new Saskatchewan Land Surveyors' Act was passed (chapter 24), replacing the 1909 legislation. Under this statute the incorporation of the Saskatchewan Land Surveyors' Association was formally achieved. The powers granted to the organization were related, in the main, to the disciplining of members, control of examinations leading to a surveyor's commission and the right to practise in Saskatchewan. Provision was made for a board of examiners appointed by the executive council of the association. On December 26, 1913, this council met and appointed E. H. Phillips (chairman), R. H. Montgomery and M. B. Weekes as a board of examiners, supplanting the 1909 board. These men served continuously until 1923. The council also by motion, requested the provincial Minister of Public Works to deposit with the Association all records of the former board of examiners. Some 26 years later this request was met, somewhat indirectly, through a decision of the then Director of Surveys of the province, Weekes, to dispose of certain old, out-dated documents.

These developments in Saskatchewan were duly noted by fellow surveyors in Manitoba. In his 1914 presidential address to the Association of Manitoba Land Surveyors J. Lonsdale Doupe remarked that "congratulations to our sister association of Saskatchewan are in order, their act of incorporation having received legislative sanction on the 19th of last month, particularly as they have paid us the compliment of framing their act largely on the same lines as our own . . . as the control of examinations for commissions is now vested in the Saskatchewan association, instead of in a board appointed by the government, as formerly."[13]

In March, 1914, A. C. Garner was elected president but in November of that year enlisted for military service overseas. His place as association president was taken by W. A. Begg.

The emergence of North America from a period of economic depression in the closing years of the 19th century resulted in a definite upswing of public interest in the settlement of Western Canada and in a resumption of large-scale subdivision surveys in the western interior. In turn these burgeoning developments brought in train a marked revival of the Association of Dominion Land Surveyors. The initial meeting of the reorganized surveyors occurred in Ottawa in 1907, the first such gathering since 1894.

As the new provinces of the West achieved momentum in growth it became increasingly evident that the control of the natural resources of these western areas, including ownership of public lands, would pass in time from the Dominion government to the governments of the provinces. Consequently the fear grew among Dominion land surveyors that they would be eliminated from survey work on lands so transferred. They felt that all too soon their commissions would be restricted, in effect, to the Yukon and Northwest Territories, Indian reserves and national parks. The attitude of the newly-formed provincial associations of surveyors did little to allay their fears.

Some Dominion land surveyors held strong views on the supremacy of their commissions vis-a-vis any provincial commissions. For example when R. W. Cautley, on behalf of the infant Alberta Land Surveyors' Association, wrote in June, 1911, to P. R. A. Belanger, the Dominion land surveyor, he received in the following month an indignant reply to the offer that Belanger be accepted, on payment of regular annual dues, for registration as an Alberta land surveyor:

"Being a director of the Dominion Land Surveyors' Association, a great number of whose members have been denied the right of membership in your Association, according to your Act of Incorporation, and having personally unsuccessfully applied for redress, I consider it would be derogatory to the position I occupy as Vice-President of the D.L.S. Association to accept for my personal interest a privilege that is denied to so many of my fellow brethren in the profession. Under the circumstances I have no other alternative than to decline the offer made to me."[14]

Deville endeavoured to sound a note of reason in the rising clamor:

"Dominion land surveyors . . . had been put out of private business in the western provinces by the legislatures. That was, perhaps, unfair but they had to put up with it, for the provinces were within their rights."

Thomas Fawcett, in his presidential address in 1912 to the Dominion Land Surveyors' Association, sagely pointed out:

" . . . we might draw the inference [from the trend to eliminate the Dominion land surveyors as such from doing provincial surveys] that after being a Dominion land surveyor it would be wise policy on the part of any young man to pass also the additional examination or examinations required to become a Provincial land surveyor for the province in which he expects to reside . . . and the sooner he does this . . . the easier he will find it. A man who passes the Dominion Land Surveyors' Board of Examiners can pass the board of any of the provinces in all the subjects which are covered by both examinations." This would have been the sane approach in the involved situation that had developed. After all, as Fawcett tried to explain, compliance with the requirements of the provinces would be little more than a formality. Yet even the mere acknowledgment of this rather routine obligation was apparently regarded by the more sensitive Dominion land surveyors as an affront to their professional dignity and status.

Garner, writing from Regina on February 20, 1912, to the annual meeting of the Association of Dominion Land Surveyors in Ottawa, added some fuel to the fires of debate by submitting a questionnaire for convention discussion, including a query on the attitude to be adopted by the Association concerning the absence of any provincial government rule or directive that only Dominion land surveyors could perform legal surveys on public lands in those provinces.[15] There does not appear to have been any official record made of the position taken by the Association executive on Garner's questionnaire. Not for many years to come would the feelings of distrust and bitterness engendered by this jurisdictional dispute dwindle and finally disappear.

Board of Examiners

Ottawa's decision to resume land surveys in Manitoba as a prelude to the re-opening of the western interior to settlement brought about an increase in the number of applicants for commissions as Deputy Surveyors of Dominion lands, as they were initially known. This increase demanded the establishment of an examining and admitting body. Accordingly, under section 74 of the 1872 Dominion Lands Act the appointment of a federal board of examiners was authorized. It was provided that the board consist of the Surveyor General and eight other competent persons to be appointed by Order in Council. Oaths of office were to be administered by a judge. The board would appoint its secretary. This method of appointing a board secretary was followed until 1951 when, under section 5 of the Canada Lands Survey Act, it was provided that the secretary be appointed by the Minister of Mines and Technical Surveys for Canada. In 1899 the act was amended, reducing the membership of the board from 9 to 3 persons, namely, the Surveyor General and two Dominion topographical surveyors. But at the outset the board, as established by Order in Council dated May 7, 1875, consisted of Surveyor General Dennis as chairman, Assistant Surveyor General Lindsay Russell, Andrew Russell, A. C. Webb, A. H. Whitcher, Milner Hart, William Pearce, Bolton Magrath and Pierre N. Dorion.

The first meeting of the board was held in Winnipeg in June, 1875, mainly because so many surveyors were in the field in Manitoba at that time. But considerable difficulty was experienced in obtaining a quorum of board members. The meeting was postponed several times from May 27 to June 10 when at last a bare quorum assembled. Present were Lindsay Russell as chairman along with A. H. Whitcher, Inspector of Surveys, and William Pearce. The meeting was held in the Dominion Lands Office.[16]

Seven candidates appeared at this historic first meeting of the board. Two of these, Frank McPhillips and L. S. Vaughan, withdrew during the examination stage. Commissions were granted to William Crawford and G. M. Kingston, P.L.S., both of Ontario and to George McPhillips, John Francis and Robert Bourne, all from Manitoba. Under provisions of the 1872 act, candidates had to be at least 21 years of age and were required to pass examinations in Euclid (first six books), Plane Trigonometry, Mensuration of Superficies, Plotting and Map Drawing, Spherical Trigonometry, Astronomy, Geology, the keeping of field notes, the performance of practical surveying operations and use of instruments. Nor would a commission be granted unless the applicant "shall be perfectly conversant with the system of survey as embodied in the Dominion Lands Act" and with the manual of instructions and regulations issued at Ottawa for the guidance of Deputy Surveyors of Dominion lands.

No person was entitled to be examined for a Dominion land surveyor's commission unless he had served three successive years under articles as a pupil of a Deputy Surveyor. The only exceptions to this rule included qualified Provincial land surveyors, who were not required to serve any period in articles before taking the examinations; university or college graduates, who were required to serve one year only in articles and, finally, any qualified surveyors from the British dominions other than Canada who were required to serve only six months in practice with a Deputy Surveyor before writing the examinations.

It is greatly to the credit of Surveyor General Dennis that he was so acutely aware of the magnitude and basic importance of the surveying task in the West, and of the technical factors involved, that he strongly urged upon the Minister of the Interior the desirability of inviting surveyors who held Dominion land surveyors' commissions to subject themselves to more exacting tests of their knowledge and abilities. The Surveyor General recommended that such tests be even more probing and extensive than those normally imposed in regard to subjects specified in the 1872 legislation. Accordingly examinations for Dominion topographical surveyor (D.T.S.) came into being and the award of this relatively rare title was made following a showing satisfactory to the board of examiners. During the entire period, 1876 to 1965, only 32 have qualified for this distinction.

In 1877 the following received Dominion topographical surveyors' commissions: E. Deville, J. S. Dennis, Jr., T. Fawcett, O. J. Klotz, W. A. Ashe, A. P. Patrick, John Galbraith and W. T. Thompson. The year previously W. F. King had received his Dominion topographical surveyor's commission, the first of these awards. All of these men were required to first pass examinations for their Dominion land surveyors' commissions. Up until 1951 Dominion topographical surveyors were commissioned as qualified for performing extensive topographic surveys or geographic explorations. After passage of the Canada Lands Survey Act, certificates only, rather than commissions, were issued to testify to the possession of knowledge of the higher branches of surveying.

Sidney F. Austin, a federal government employee in Winnipeg, acted as secretary pro tem of the board of examiners. He was followed by Robert Lang, who served from 1875 to 1884. During Lang's period there were two men who acted as temporary secretaries, C. D. Rickards in 1878 and again in 1882; also T. Fawcett in 1883. P. B. Symes was board secretary from 1884 to 1906 with G. W. Paterson substituting on a pro tem basis for him in 1885. F. D. Henderson served as secretary to the board from 1906 to 1914.

The first person to be commissioned as a Dominion land surveyor after due examination before the board was William Crawford of Milverton, Ontario. Commission number one is dated June 17, 1875. It must be borne in mind, however, that under the 1872 legislation, Provincial land surveyors were entitled to be "blanketted in" as Deputy Surveyors of Dominion lands without first taking formal examinations.* By 1875 all such surveyors became Dominion land surveyors.

The first session of the board of examiners extended over seven days. Under section 85 of the 1872 act each board member was entitled to receive five dollars for each day's sittings as well as actual travel and living expenses. In the years to follow, board meetings took place in Ottawa although there were some early exceptions to this custom. For example, board meetings took place in Winnipeg in June, 1875 and June, 1878; in Victoria in May, 1885; and in Toronto in May, 1903.

At the second meeting of the board, held in Ottawa and beginning on November 13, 1876, Surveyor General Dennis was in the chair with Lindsay Russell and Andrew Russell also in attendance. It was at this meeting that King received both his Dominion land surveyor's and Dominion topographical surveyor's commissions. Thomas Fawcett and A. G. Cavana withdrew from the Dominion topographical surveyor's examination but both were awarded their Dominion land surveyors' commissions.

By an amendment in 1899 the board membership was reduced to three, including the Surveyor General (Deville) and two Dominion topographical surveyors (King and Klotz). Even with the reduction in board membership quorum difficulties continued to be encountered. In 1903 a meeting had to be held in the absence of King in England on Alaska Boundary business, and of Klotz in Australia on longitude determination. In order to provide a quorum John Galbraith, D.T.S., of Toronto, was appointed by Order in Council of April 6, 1903, to temporarily fill the place of any board member unable to attend a meeting.

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*Existing records indicate that at least 436 Provincial land surveyors availed themselves of this opportunity.

ASSOCIATION OF DOMINION LAND SURVEYORS

Past Presidents

1882..............................Otto J. Klotz
1883..............................Otto J. Klotz
1884..............................Otto J. Klotz
1885..............................Otto J. Klotz
1886..............................Thomas Fawcett
1887..............................Thomas Fawcett
1888..............................E. J. Rainboth
1889..............................J. S. Dennis
1890..............................William Ogilvie

1891 .... J. S. Dennis
1892 .... John McLatchie
1893 .... John McLatchie

1907 .... E. W. Hubbell
1908 .... E. W. Hubbell
1909 .... R. E. Young
1910 .... R. E. Young
1911 .... Thomas Fawcett
1912 .... P. R. A. Belanger
1913 .... C. F. Miles
1914 .... C. F. Aylsworth
1915 .... A. H. Hawkins
1916 .... A. H. Hawkins
1917 .... J. J. McArthur
1918 .... J. N. Wallace

Secretary-Treasurers

1882 to 1886 .... A. F. Cotton
1887 to 1890 .... A. O. Wheeler
1891 .... J. I. Dufresne
1892 .... S. Bray
1893 .... J. I. Dufresne
1907 and 1908 .... T. S. Nash
1909 and 1910 .... E. W. Hubbell
1911 and 1912 .... E. M. Dennis
1913 to 1918 .... E. W. Hubbell

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SURVEYS OF THE FIRST TRANSCONTINENTAL ROUTE AND ITS RAILWAY LANDS IN THE WEST

In negotiations leading to the creation of Manitoba the retention of public lands of the new province "for the purposes of the Dominion" was regarded by both Sir John A. Macdonald and Sir Georges E. Cartier as one of the most significant aspects of the terms of union. This provision, however, was not without its price. Part of the true cost of this arrangement can be found in the provision that ungranted lands, to the extent of 1,400,000 acres, were to be set aside for the benefit of the families of half-breed residents. Nevertheless federal control of the public lands was a prominent factor in the negotiations, about a decade later, for the building of an all-Canadian transcontinental railway line. The relative isolation from central Canada in which the first Riel troubles flourished demonstrated the wisdom of undertaking this ambitious project at the earliest possible time.

The government of that day felt it necessary, in view of the serious financial risks involved in constructing a line across hundreds of miles of thinly-populated territory, to give outright to the railway-building company blocks of land tributary to trackage. These properties could be held for unearned increment or sold by the company and resulting revenues applied against construction and operating costs.

In his 1870 recommendations to Ottawa Archibald made a trenchant and farseeing observation on the probable need for land grants to railway companies in aid of line construction:

"In computing the area at the disposal of the Crown I have not made allowance for any tracts which should be laid aside for railway subvention. Yet it will be necessary not to lose sight of this important service. Alternate townships or alternate lots on the line of the transcontinental railway and on the line of a junction between it and the railway system of Minnesota will probably be required for the encouragement of the companies by whom these enterprises may be prosecuted."[1]

The rectangular system of land surveys and the device of granting land subsidies to new rail companies were practices borrowed by Canada from the United States. As in the case of the pattern of surveys so it was in the matter of these land grants. The basic concept in each case was modified in certain important respects in order to make it more applicable to Canadian conditions.

Curiously, when the concept of the land subsidy in aid of railway building was formally introduced in Canada by the "Act respecting the Canadian Pacific Railway" (35 Vic. ch. 71) of June 14, 1872, such subsidies had been largely discredited and virtually discarded in the United States.* The practice had spread corruption in politics and instability in the realm of public finance in that country. It is not likely, however, that the action of the government of Canada was taken either in defiance or in ignorance of the American experience. Rather it would appear that in the light of circumstances prevailing in Canada at the time, not much choice remained to the government in the matter. "If we could get the railway and keep our public lands", observed the Manitoba Free Press on May 24, 1873, "we would prefer such a course, but that is impracticable."

In 1862, in the midst of the Civil War, Congress had chartered the Union Pacific Company to build across the American West. In 1853 Congress instructed the Secretary of War to have surveys made for a transcontinental railroad. But the question whether government or private enterprise was to build the line remained open. Delays resulted from the absence of any general agreement on this point of high policy. But as early as 1852 Commissioner Butterfield of the General Land Office recommended to Congress that land grants be made in aid of construction of a transcontinental railroad. Congress, in 1862, passed the Transcontinental Railroad Land Grant Act. Under this legislation nearly 19 million acres of public land were granted to the Union Pacific Railroad Company. The Northern Pacific and other rail lines were to receive even larger grants. President Lincoln decided that the east and west terminals of the transcontinental road would be Omaha and Sacramento respectively. On January 8, 1863, just seven days after the Declaration of Emancipation, the first shovelfull of earth was turned at Sacramento by the Central Pacific. Nearly a year later the Union Pacific commenced construction at Omaha. The two lines met at Promontory Point, Utah, and on May 10, 1869, a golden spike ceremony took place to mark the epoch-making event. Americans were properly jubilant over this magnificent achievement which was to be matched, if not surpassed, by Canadians sixteen years later when they staged their own final spike ceremony at Craigellachie, British Columbia.

Though the policy of land subsidies undoubtedly helped to get railways built in the United States, the administration of the policy resulted in a train of grievances. The grants of large acreages aroused hostility among settlers who feared the creation of giant monopolies. In addition there was an inflexibility in the American pattern of land grants to railroads that resulted in social tensions. Finally public revulsion over the practice led to its abandonment but not before nearly 150 million acres of United States public lands had been alienated in this way. In Canada, while the policy remained in force, about 32 million acres were transferred from the public domain to railway firms in aid of line construction.

In the American West, railways and settlers advanced together. In the Canadian West the railway company soon became a colonizing agent of great importance. Developments over the years, particularly in regard to the Canadian Pacific Railway Company, demonstrated that, on the whole, the land subsidy system was justified on the grounds of national interest. It served to bring together a group of dynamic men who completed a transcontinental railway in five years instead of the expected ten, and it made the rail company an agency of land

*The last land grant made to a U.S. railroad was in January, 1873.

settlement second only to the Dominion government. Its vigorous encouragement of immigration and land occupation far outweighed the dollars and the acres the railway company received in subsidies.[2]

Improvements to farm machinery also helped to stimulate the flow of settlers to the Canadian West. Mechanical grain elevators that revolutionized methods of storing and grading cereals not only speeded up the settlement process but helped railway business immeasurably. These advances, along with the timely discovery of early-maturing Red Fife wheat added to the pace of progress.

There is considerable evidence that public statements by Professor John Macoun (1831-1920), probably Canada's greatest botanist-explorer, did much to attract people, as well as the Canadian Pacific main line, to the more southern and low-precipitation areas of the western interior. Macoun who, in the 1880s became Assistant Director and Naturalist with the Geological Survey of Canada, was criticized for deliberately popularizing the more southerly region of the Prairie West. In his own writings Macoun acknowledges the fact that such complaints were being made.[3] Consciously or otherwise Macoun, with others, was instrumental in transferring enthusiasm for the country through which the original Canadian Pacific Railway surveys led, to those parts of the interior which, to some extent, had been described by Palliser as "a central arid desert".[4]

In addition a new policy of land disposal was desperately required if the West was to be speedily opened up for development. Huge acreages had been transferred to single ownership. Under the terms of the 1872 Dominion Lands Act the Hudson's Bay Company received section 8 in each township and section 26 in each township whose number was divisible by 5, along with the south half and northwest quarter of section 26 in all other townships.*

After abortive federal government efforts in 1872 and 1878 an agreement for the construction of a transcontinental railway in Canada was made with a small group, mainly Montrealers, led by George Stephen, a financial wizard, and William Cornelius Van Horne, an American railway builder and administrator of great ability, drive and resourcefulness. In consideration for the promise to construct, equip, maintain and operate such railway the government, by sections 9 and 11 of the agreement concluded on October 21, 1880, and ratified by Parliament in February 1881, agreed to grant to the company a cash subsidy of $25,000,000 and a subsidy in the form of land amounting to 25,000,000 acres. This land grant was to consist of alternate sections carrying uneven numbers and consisting of 640 acres each. These grants extended to a width of 24 miles on each side of the main rail line from Winnipeg to the Rockies. By far the largest proportion of these grants came from the territories now contained within the boundaries of Alberta and Saskatchewan.

At this point in the terms of the agreement a conditional phrase was inserted, the far-reaching implications of which apparently escaped the grasp of the contracting parties at the time. The condition was that should any of the land so granted consist in a material degree of land "not fairly fit for settlement" the company should not be obliged to accept same as part of such grant. Any deficiency so created was to be made up from other portions (to be selected by the company) in the tract known as the fertile belt, that is, land between the 49th and 57th parallels of latitude. Such grants were to be areas including alternate sections extending back 24 miles on each side of any branch line or lines of railway and these lands were to be shown on a map or plan to be deposited with the Minister of Railways at Ottawa.

Although the terms of this agreement might, at first, appear overgenerous and were in fact severely criticized on this ground in Parliament at the time, it is altogether possible that a company any less endowed could not have avoided insolvency in seeking to carry to a con-

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*35 Vic. ch. 23, sec. 17.

clusion such a highly expensive project. Nevertheless, to an extent not originally contemplated, vast acreages in western areas were alienated from government control. Of the 25,000,000 acres promised to the Canadian Pacific Railway Company (less about 7,000,000 acres returned by the company to the federal government in satisfaction of an emergency loan from Ottawa) only 5,255,870 acres were found, after surveys along the main line, to be "fairly fit for settlement" in the opinion of the railway company. Accordingly more than 12,000,000 acres had to be found elsewhere in the western interior in order to fulfil the total federal commitment. Nearly 9,000,000 additional acres were provided in two northern reserves and a southern reserve along with Lake Dauphin lands in Manitoba. Even so, the total thus available fell short of the 1881 obligation by 3,300,986 acres.[5] It was not until 1903, by Order in Council No. 1434, August 22, that the federal commitment in this respect was completely discharged. All these land transactions were dependent upon accurate surveys and reliable reports of surveyors.

It is quite impossible to pay adequate tribute to the remarkable endurance and solid accomplishments of pioneer railway surveyors. The task of locating the main line of the Canadian Pacific Railway between the Ottawa Valley and Red River was arduous in the extreme. It was a job undertaken in country largely unknown to civilized man and never traversed by him. The rugged land consisted of rock formations, uncounted lakes, unbridged streams and heavy forests cluttered with areas of formidable windfall. A wilderness of swamp and muskeg, insect pests, fierce summer heat and bitter cold all combined to test to the utmost the stamina and resourcefulness of the individual surveyor.

Occasionally there were periods of compensation in this otherwise arduous life. After days of tramping through thick underbrush, wading in swamps, climbing hills or fording rivers, there were long evenings in front of camp fires when good-natured banter, laughter and song supplemented the consolations of pipe tobacco and memories of home. In the words of one nostalgic, if somewhat amateur poet among them:

> "The shades of night were falling fast
> When 'long the C.P. railway passed
> Four wanderers with a forward stoop
> Thinking of friends at home—and soup."[6]

Rail route surveying consisted of five main divisions of activity. The first stage was that of general reconnaissance, followed by a preliminary phase involving the narrowing of various possibilities to a few alternatives—the fascinating task of selecting the particular from the general. The third stage was even more detailed in nature. This stage included the location surveys to determine, once a definite choice of route was made, the position of the right-of-way and a definition of the land needed for this purpose. Construction surveys constituted a fourth phase in the course of which the findings of the location survey were applied, and marks provided on the ground to guide line construction.

In 1871 a reconnaissance of the country west of the Great Lakes was made at the instigation of the federal government in order to explore the possibilities of building a railway to the Pacific Ocean. These surveys were made under the direction of Sandford Fleming as chief engineer in charge of a staff of surveyors and engineers. During a six-year period they traversed the country in various directions in search of the most promising route for a transcontinental line. In all they scouted an area 2,700 miles by 500 miles, extending over 54 degrees of longitude and 10 degrees of latitude. This comprised an area larger than France, Belgium, Holland, Germany and European Russia combined. Fleming was left to his own resources, the government being content to urge upon him all possible speed in completing his task.

Fleming laid down several basic principles to govern his reconnaissance staff in their activities:

1. Every effort should be exerted to discover a line through the wooded region (Ottawa Valley to Red River) and thus the shortest and best possible rail link between central Canada and Manitoba.
2. That line, when discovered, should reach Lake Superior by a spur line or otherwise and so provide the most economic outlet for products of the prairies through the navigable St. Lawrence River system.
3. Exploration of the Rocky Mountains should be designed to discover the most practicable line through the mountains and leading to the most advantageous Pacific port.
4. The line across the western interior was to avoid formidable river crossings and also afford access to large tracts of land available for settlement.[7]

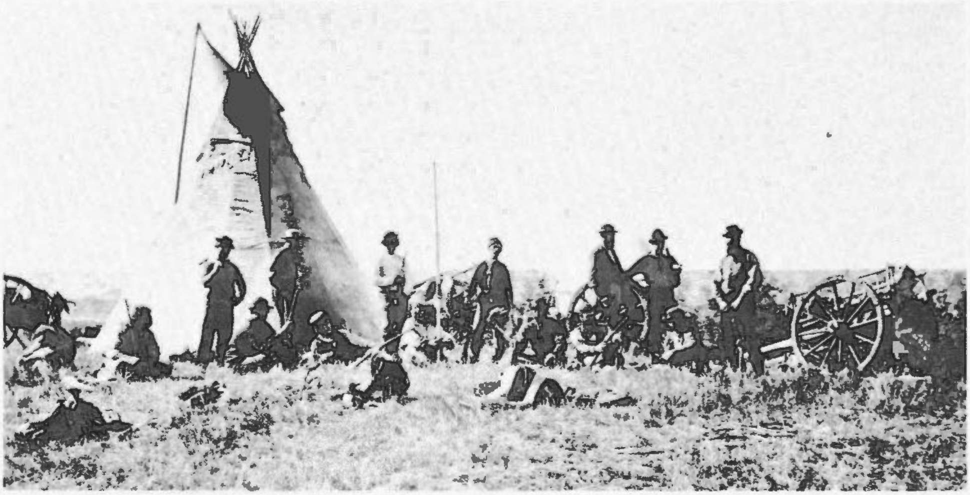

FIGURE 36. C.P.R. surveyors in camp on the western plains.

As circumstances dictated, railway surveys under Fleming varied in nature and chronological order but included explorations, exploratory surveys, revised surveys, trial locations, location surveys and revised locations. For explorations or preliminary examinations in advance of regular surveys the barometer was used to ascertain altitudes. Horizontal distances were computed on the basis of time elapsed in passing from one place to another. In some instances distances were "measured by the micrometer" or, in 20th century terminology, by the vertical angulation method. In contrast to the Gunter's chain of 66 feet used by cadastral surveyors, railway surveyors used a 100-foot chain.*

On instrumental surveys the chain, transit and theodolite, compass and spirit level were used. In densely wooded sections these surveys might consist of a series of straight lines connected by angles. These lines would be cut through tree growth and underbrush in order to obtain both horizontal and vertical measurements as a basis for future operations. Revised surveys would be made to avoid difficulties initially discovered and to shorten distances wherever possible to prepare for location work. Trial locations would involve staking

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*S. Bray, *Survey of Railway Lines* Ann. Rept. 1891, Assoc. of D.L.S., p. 65.


MAP
OF THE COUNTRY TO BE TRAVERSED BY THE
CANADIAN PACIFIC RAILWAY
TO ACCOMPANY PROGRESS REPORT ON THE EXPLORATORY SURVEYS
1876.
Sandford Fleming, Engineer-in-Chief
EXPLANATIONS.
Line located for Construction, shewn thus:—
Carlyle
Cottonwood
Acadie
Cowper
Norma
Line of location in progress
Lines of Surveys & Explorations made & in progress
Distances:
(Intermediate Distances)
Ottawa to Eastern Terminus (assumed) 160 620 Miles
Fort William (assumed) 800 113
English River 913 177
Keewatin 1,090 114
Selkirk 1,204 171
Poutrincourt 1,375 100
Livingstone 1,475 196
Saskatchewan 1,671 90
Battleford 1,761 230
Edmonton 1,991 283
Yellow Head Pass (summit in Rocky Mountains) 2,274 260
Stewart River (15 miles from Fort George) 2,534
Dean Canal 2,774
Bute Inlet 2,822
Gardner Channel (not ascertained)
Telegraph Line under Contract:
Fort William to Selkirk 404
Selkirk to Livingstone 271
Livingstone to Edmonton 516
Edmonton to Stewart River (15 miles from Fort George) 543 1,734
Railway under Contract
Fort William to English River 113
Selkirk to Keewatin 114 227
Preliminary Location Survey completed.
Selkirk to Battleford 557 557
Location Surveys in Progress
English River to Keewatin 177
Battleford to Stewart River (15 miles from Fort George) 773 950
Total 1,734
PEMBINA BRANCH:
Line Graded 63
Balance of Line located 20 83
NORTH WEST TERRITORY
TERRITORY OF KEEWATIN
ONTARIO
QUEBEC
NORTH PACIFIC OCEAN
WASHINGTON
MONTANA
DAKOTA
MINNESOTA
WISCONSIN
MICHIGAN
LAKE SUPERIOR
LAKE HURON
LAKE ONTARIO
JAMES BAY

out the line for construction, the tangents (straight lines of track) being laid down and, when required, curves set out. First location surveys were rarely fully satisfactory and it was only after re-surveys had been made that the revision constituted the location survey proper. In broken, hilly country where additional examinations and alterations were required, the term "revised location survey" would be employed.

In his 1877 progress report on surveys to Prime Minister Alexander Mackenzie, the frontispiece map of which (showing the country to be traversed by the Canadian Pacific Railway) was drawn by J. Johnson of the Dominion Lands Office, Ottawa, Sandford Fleming stated, "It was found that the valley of the North Thompson would, in all probability, admit of a line being built from Yellowhead Pass to Kamloops, a distance of 255 miles with grades not exceeding 50 feet per mile. . . ."[8] Further, it was found possible to reach the Pacific coast from Kamloops by the "course and outlet of Rivers Thompson and Fraser, the line terminating in an excellent harbour on Burrard Inlet."

Fleming in this report commented also that for 1,300 consecutive miles there was no altitude so low on the railway between San Francisco and New York City as the highest summit of the line through Yellowhead Pass and that such a Canadian line as he proposed would be 633 miles less than from San Francisco to New York City.

In January 1875, a survey party despatched by Fleming eastward from Fort George travelled 900 miles by snowshoe, suffering unusual hardships. For 20 days the temperature averaged 39 degrees below zero, the minimum registered during that period being 53 below zero. Many of the dogs perished and dog teams were completely disabled. By the time the party reached Fort Edmonton many of the men were suffering from cramps and dysentery. A member of the group recorded, in an official report, the emotions of the weary surveyors on the concluding stage of their epochal journey:

"Passing Portage la Prairie on May 19th we reached Winnipeg on the 21st, having been five and a half months on the [entire] trip. At White Horse Plains we met a gay cavalcade going westward. It consisted of Mr. McLeod and his two survey parties just starting for Edmonton and the Rocky Mountains, and their shining shoes, glittering spurs and well-groomed horses contrasted with our battered and weather-worn appearance. But we could afford to suffer by comparison. They would soon be as ragged as we were, and all their troubles were before them while we were just reaching the goal over many a weary mile of mountain and plain, and could take our well-earned repose in the happy consciousness of having fulfilled the task allotted to us and earned the approbation of him we are proud to acknowledge our Chief."[9]

Surveys of the entire route of the proposed main line, conducted with energy and relentless determination, had involved the loss of 34 lives and an expenditure of $3,136,000 before these necessary preliminary tasks were completed.

In British Columbia survey developments during the immediate post-Confederation period (1867-85) were primarily concerned with finding a route for Canadian Pacific tracks through the mountains to tidewater. As soon as preliminary agreement on terms of union with Canada was forthcoming in July 1870, preparation for surveys of possible routes proceeded apace. Marcus Smith was Sandford Fleming's deputy for the British Columbia section of the reconnaissance. Survey operations began in earnest in 1871 and were soon under way in various regions under eminent engineers and surveyors.[10]

Smith, in a report of activities in the Homathko Valley of British Columbia, gives a graphic account of how a typical problem in field transportation was solved. ". . . we commenced to construct," he related, "an Indian fly bridge but as we had only one axe left and but little spare rope, we had to make lashings from the inner bark of cedar, so that it took seven hours to complete the bridge which looked like a fishing rod and line hanging over the torrent, the butt end resting on the ground and loaded with boulders. We managed to crawl over this and drop down safely on the other side of the stream. Six hours more of a hard struggle among tangled creepers, over huge trunks of fallen trees and masses of detached rocks brought us to the camp of Division X. This party had completed 18 miles of trial location. I remained with them two days, examined their plans and profiles which showed the line to be generally satisfactory and a great improvement on the preliminary survey of 1872."[11]

One of the most able of the reconnaissance surveyors was Walter Moberly (1832-1915), a civil engineer, explorer and author who had arrived in the coast province from Toronto in 1859. Moberly had performed surveys for Col. Moody along English Bay, Burrard Inlet and near Port Moody. After a period of partnership with E. Dewdney on road location and construction, Moberly became Assistant Surveyor General of British Columbia in 1864 (Mainland Colony). By his subsequent surveys he helped to a considerable extent in the unfolding of the map of progress in his adopted province.

"I prospered for some time," Moberly wrote in a volume of reminiscences of his 1871 surveys, "until I received a telegram from Ottawa informing me that the Canadian Pacific Railway was to be commenced and requesting me to leave for Ottawa at once. . . . There I met my old friend of early days, Mr. Sanford [sic] Fleming and Sir John A. Macdonald [at that time Premier of Canada] and gave them full information as to the feasibility of a line for a railway through that country, and which is the one now adopted."[12]

Moberly and Fleming probably first met during the period prior to 1858 when both worked with the Ontario, Simcoe and Huron (later Northern) Railway. Moberly was employed on construction. By 1857 Fleming had become chief engineer on the project. Now both were engaged in the pioneer task of selecting the most feasible route for a trans-continental line through the mountains of British Columbia.

Soon Moberly was active in the field. "Here we formed our depot, intending it to be the main depot on the Columbia River for the surveys I proposed making through the Howse and Kicking Horse Passes; along the valley of the Columbia River, around the 'Big Bend' from Kicking Horse and Eagle Pass and across the Selkirk range by the valley of the Ille-cille-waet River and its southeasterly branch, which latter and proposed part I should make after the completion of the Eagle Pass survey. On October 2 I gave orders to open a trail and make a preliminary survey through the Howse Pass, and set the party at this work.

"I now returned and met the party a short distance from the valley of the Blaeberry River. . . . The weather was now colder and it began to snow. I found the levels taken by me with a very good aneroid barometer corrected with a 'boiling thermometer' both of which were of the very best make, corresponding closely with those taken by the leveller of the party; one making the difference in height, from a common point on the Columbia River, to another on the 'Flat' 1,607 feet, and the other 1,610 feet.

"I now felt quite certain that the railway would be built through the country I had examined and every possible provision was made by me to complete the exploratory surveys and follow with the location ones."

In addition to Marcus Smith and Walter Moberly the name of Henry John Cambie (1836-1928) ranks high among pioneer railway surveyors. In 1958 The Engineering Institute of Canada placed a polished steel plaque in the terminal passenger station of the Canadian Pacific Railway in Vancouver, bearing Cambie's name and commemorating his explorations and surveys in British Columbia as well as his supervision of Canadian Pacific Railway construction through the Fraser River canyons from 1880 to 1884.

Across the four western provinces the finally-determined route of the Canadian Pacific Railway in part followed, and in part deviated from, that which Fleming and his staff had

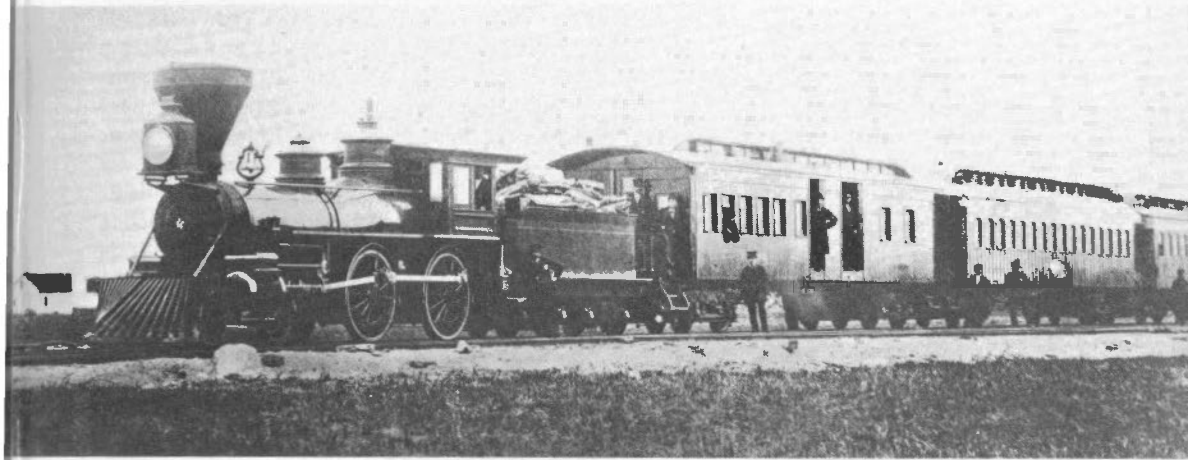

FIGURE 37. One of the first C.P.R. trains to operate on the prairies.

recommended. That a differing line was ultimately chosen does not, in any sense, reflect upon the investigations or judgment of Fleming and his colleagues. In fact that choice was governed by a variety of factors not necessarily concerned with surveying or engineering considerations. In the Ontario section, from Lake Nipissing to Manitoba's eastern boundary, the line followed Fleming's advice and hugged the north shoreline of Lake Superior in spectacular sweeps around wide bays, rather than using the height of land farther to the north. The science of logistics may have dictated this decision. It provided the opportunity for much cheaper transportation of construction supplies to the railway building site by the Great Lakes water route. Westward from Lake Winnipeg Fleming had projected a route that would cross the "Fertile Belt" of the western interior, reaching the Pacific by way of Yellowhead Pass.

Fleming, in his report of the exploratory surveys of the 1870s stated, "It is difficult to convey an accurate impression of the magnitude of the work executed, which has every year employed the best energies of not far short of one thousand men of all grades. The length of the various lines surveyed and explored aggregate to close on 46,000 miles, of which no less than 11,500 miles have been laboriously measured, yard by yard, through mountains, prairies and forests, with the spirit level, chain and transit. Much of the work has been carried on amidst the severities of winter, frequently in an exceedingly low temperature. The surveying parties were far removed from all habitations and were supplied with but inadequate shelter and diet, although both were the best that circumstances would admit of."

Fleming's skilful examination of the topography of the route he recommended confirmed the favorable opinions of earlier explorers and travellers in the Canadian West concerning the fertility and general promise of the lands that would be served by such a railway.[13] But when the transcontinental project was entrusted to the Canadian Pacific syndicate in 1880 it was announced, to the astonishment of many, that the main line would cross the prairies some 200 miles to the south of Battleford and Edmonton. The newly-chosen route through the western interior did not, in fact, stray very far from the 50th parallel of latitude except between Medicine Hat and Calgary, at which latter point it reached the 51st parallel.

The original survey of the Canadian Pacific crossed the Red River at Selkirk rather than at Winnipeg. This prospect aroused the greatest indignation in Winnipeg and the syndicate was persuaded to bring the main line directly into the capital of the province.[14]

Considerable mystery continues to shroud the reason or reasons for the syndicate's decision to depart from Fleming's expert and well-considered advice, including his report upon the favorable gradients available through the Yellowhead route. Various theories have been advanced. The alleged relative nearness of the Northern Pacific to the international boundary with the consequent threat of United States intervention in Canadian railway territory; the optimistic Macoun reports on the agricultural resources and possibilities of the southern prairies; and the desirability of the shortest, most direct route from Winnipeg to Pacific tidewater irrespective of gradients en route, all are factors mentioned by historians dealing with this puzzle. It is quite likely that each of these considerations played a part in bringing about the final determination on the direction of the main line. But a more plausible reason is that real estate developments in connection with completely new or relatively new railway townsites offered greater opportunities for profit-making by the railway company than did communities more or less well-established at that time. It was in the best fiscal interests of the railway to avoid, so far as possible, places where land would need to be purchased by

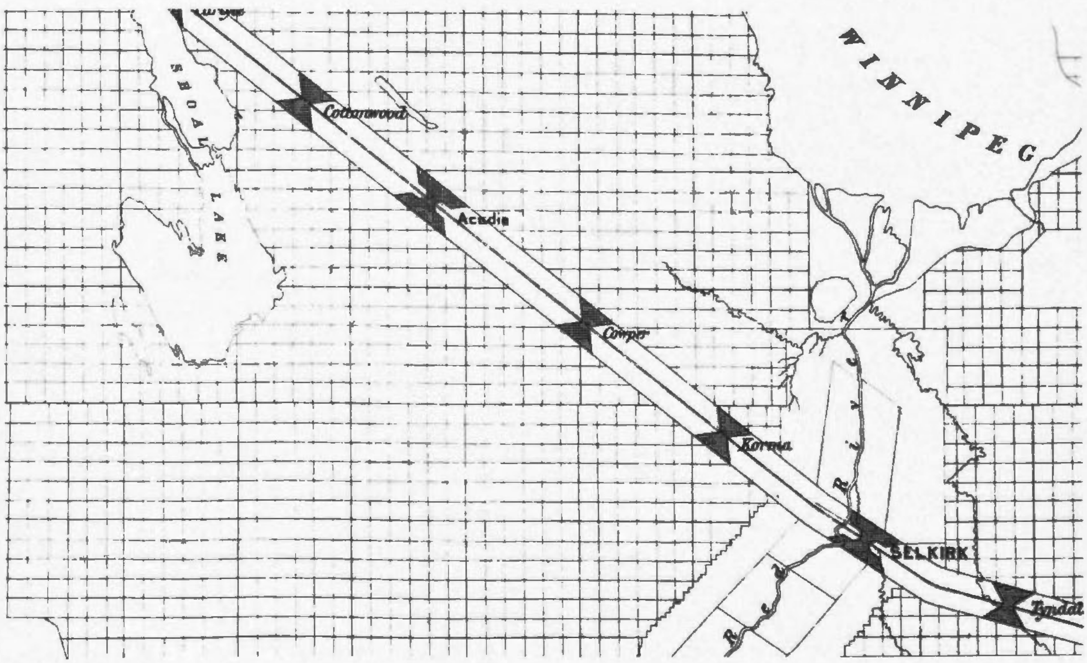

FIGURE 38. Plan of town plots, showing reservations for railway purposes as mentioned in the C.P.R. report on surveys, 1877. (Sandford Fleming)

the company as compared to places in which properties would have to be bought from the railway's land department.[15]

In all, some 800 villages and towns were fostered in the three prairie provinces by the land department of the Canadian Pacific Railway Company. The most profitable venture of the company in townsite promotion was, however, in Vancouver. By 1889 proceeds of town lot sales in that community exceeded those of all other company towns combined during that year.[16] A railway company report during this period mentions that "the townsites along the line, which have as far as possible been secured for the benefit of the company, are contributing handsomely to its revenue . . . total sales to December 31, [1887] have been

$1,399,327. Only a small portion of the company's interests in townsites have been disposed of, and its receipts from this source will rapidly increase as the country increases in population. . . ."[17]

It was only provident for the Canadian Pacific Railway Company to seek to derive the maximum financial benefit from its new townsites. If it had done otherwise it would have been quite unlike other land-grant railways who were not backward in securing for their treasuries any major profits arising out of the promotion of new towns. In the placing of towns in the western interior the Canadian Pacific Railway Company had complete cooperation from Ottawa. On March 11, 1882, the Department of the Interior withdrew from homestead entry "all even-numbered sections next to and along both sides of the Canadian Pacific Railway and its branches" thus creating a mile-wide belt reserve. Actually this was not done so much for the purpose of withholding lands from settlement until railway station sites could be located, as to forestall land speculation in the sections at the disposal of the government near the main line.

Not all townsites along the rail line were, in fact, monopolies of the company. At divisional points, for example, towns were laid out both on railway and on government land. Regina included two railway and two government sections. Moose Jaw comprised one railway and one government section. In most cases, however, main-line towns were originally provided for by the reservation of one section of railway land.

The belt of railway land grants in British Columbia presented surveyors and administrators with problems differing considerably from those encountered in railway belts in the western interior. In section 11 of the terms of union of British Columbia with Canada, and further formalized by 43 Vic. ch. 14 of 1880 and the Settlement Act of December 19, 1883 (47 Vic. ch. 14), a strip of land 40 miles wide, extending 20 miles back on each side of the Canadian Pacific Railway Company's projected main line, was transferred by the province to the Dominion. This grant applied to somewhat more than 500 miles of the rail line built from the summit of the Rocky Mountains to tidewater—actually from the present boundary with Alberta to a line drawn mainly north and south through New Westminster. In all, this strip, or British Columbia Railway Belt as it came to be known, contained 17,150 square miles or 10,976,000 acres. Terms of the settlement included provision for an annual payment by the Dominion to the province of $100,000.

Although the original intention was that this land should be given to the railway company in the form of a subsidy to aid construction, it was actually retained by the Department of the Interior until the return of the natural resources to the four western provinces in 1930. The areas of federal and provincial jurisdiction in the Belt were not, by any means, clear-cut. Both in the political and administrative spheres the Railway Belt of British Columbia continued to be a bone of contention for almost half a century. The wording of terms in the statutes of transfer were sufficiently vague to give rise to varying constructions of what was in the mind of the negotiators and legislators. The legal history of the Belt is an underbrush of statutes, orders in council, negotiations oral and written, and references to the courts, topped by an investigation of a Royal Commission in the late 1920s. It became impossible to ascertain precisely what lands in the Belt belonged to the Dominion and what lands to the province. In some instances where the lands clearly belonged to the Dominion, these had to be surveyed and dealt with by the provincial authorities.

One early result of this confusion over jurisdiction was that surveying operations in the Belt came to a standstill. When a surveyor arrived at a place where lands had been laid out or occupied under provincial authority he had to abstain from making any surveys in that vicinity. If he decided to proceed anyway his surveys could not be confirmed because such were not made as directed by regulations governing him. About 1897, after new negotiations, the representatives of the two governments worked out a compromise that ended the deadlock and allowed surveys to continue.[18]

It must remain a matter for conjecture whether the Canadian Pacific Railway Company was ever prepared to accept any land, to be administered by it, along the main line in British Columbia as part of a land grant in aid of construction. In any event, lands in the Belt conveyed to the Dominion were never turned over to the Canadian Pacific Railway Company except for its right-of-way, station grounds and ancillary purposes. At one stage the Dominion government reported that it had made very large expenditures for surveys and railway construction, totalling about $63,000,000.[19]

Jurisdictional controversies in regard to lands situated within the Belt as well as governmental disputes over the outer boundaries of the grant raged over this strip of territory for many years. A discussion about the precise extent of the Belt took place in Victoria in 1886 between the Surveyor General of Canada, E. Deville, and the Chief Commissioner of Lands and Works for the province, Hon. W. Smith. It was pointed out by the latter that a boundary 20 miles on each side of the main line of railway, from and following its sinuosities, constituted a most inconvenient arrangement. Following further deliberations and much correspondence, an agreement was reached to the effect that a boundary line following township boundaries should be adopted in order to achieve a definition of Belt limits clearer and more satisfactory than that contained in the Settlement Act.*

Later on the province objected that the Surveyor General of Canada, in drawing the new limits of the Belt, had measured the 20 miles from the extreme outward angle of the rail line, thus embracing a belt in many places very much in excess of 40 miles in total width. This method of measurement, it was claimed, gave about one million acres more in the grant than would an area contained in a ribbon of land 40 miles wide "having for its centre the average course of the line of railway." It was not until 1895,** after a series of proposals and counter-proposals that the two governments formally agreed upon a compromise solution.[20]

As early as 1880 there were overtures from the government at Ottawa to the British Columbia authorities, urging that land suitable for settlement in that province outside the Belt be granted to the Dominion in lieu of acreages already alienated by the province within the Belt. But the province, at the outset, took the view that it was under no obligation to do so.† A proposal from Ottawa by telegram in 1883 to its agent in British Columbia in these early negotiations, J. W. Trutch, that lands in the Peace River district of the province be so conveyed, marked another stage in these inter-governmental discussions. Later that year the province agreed to comply with the federal request and formally conveyed to Canada 3,500,000 acres in one rectangular block in that fertile area, lying between the 20th and 23rd base lines.[21] The final selection by the Dominion of this acreage was ratified in 1907.†† About the same time the terms of the Dominion Lands Act were made applicable to the Peace River Block. In 1930 the Crown in the right of Canada returned this block of land, along with the British Columbia Railway Belt, to the Crown in the right of the province.‡ At the time of this restoration considerably less than one million acres had been homesteaded in the Belt and only about 250,000 acres in the Block, where nearly 800,000 acres remained unsurveyed.

For purposes of surveys and general administration the British Columbia Railway Belt

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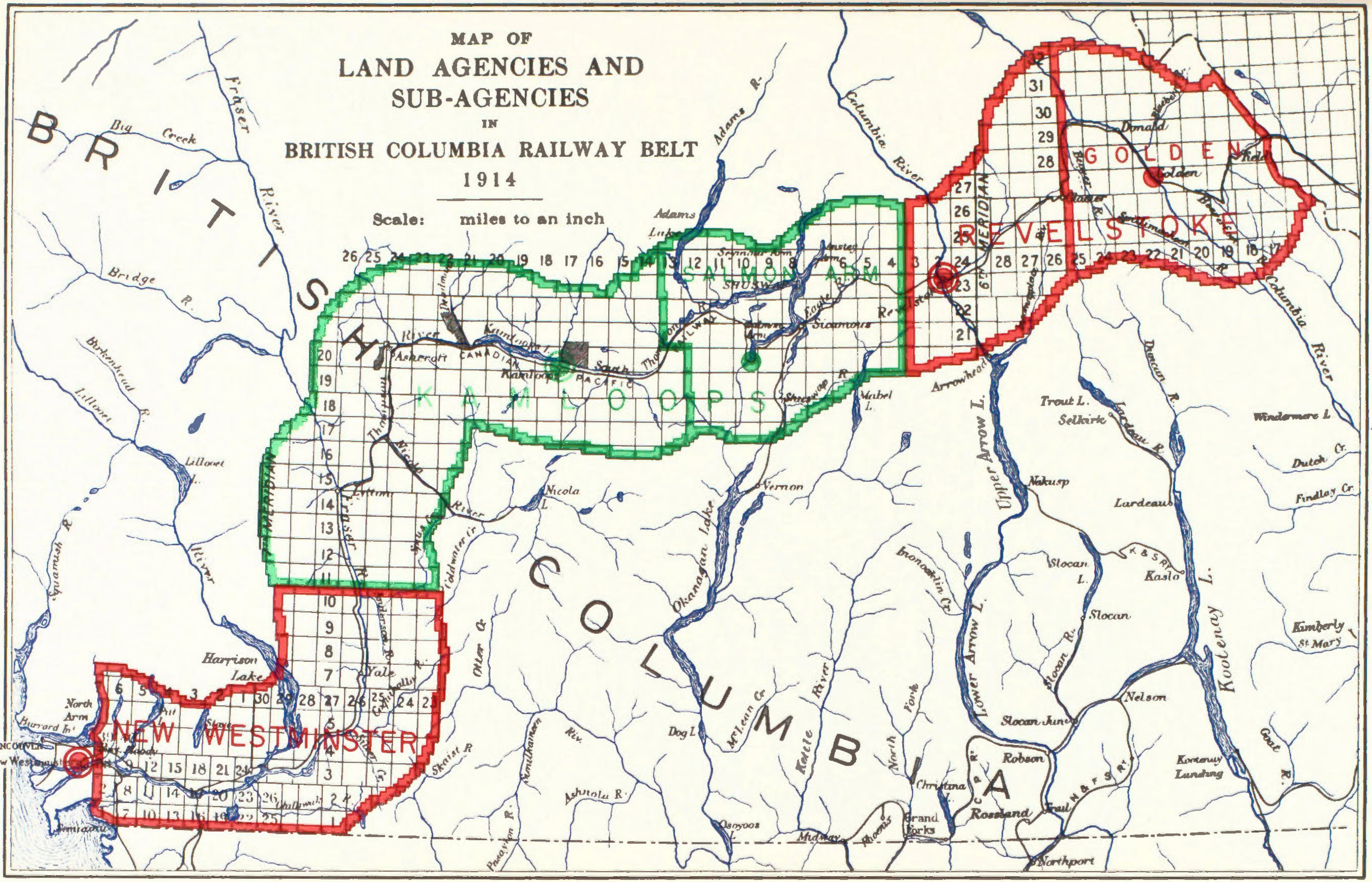
*Order in Council (Can.) May 27, 1887.

**58-59 Vic. ch. 4, July 22, 1895.

†Order in Council (B.C.) May 4, 1880.

††Order in Council (B.C.) May 15, 1907.

‡20-21 Geo. V. ch. 26, sec. 3.



MAP 5. Map of the British Columbia Railway Belt, 1914.

had been divided into five principal districts, namely, Upper Columbia Valley, Lower Columbia Valley, Shuswap Lake, Kamloops and the Coast District. Conditions varied greatly between most of these areas. In the Kamloops region, for instance, annual rainfall was light whereas in the Coast District it was heavy. Purposes of the survey in the Belt were to extend land measurements in the area and to classify lands considered suitable for settlement. For many years these surveys were performed by Dominion land surveyors commencing with preliminary work by William Ogilvie and Thomas Fawcett in 1885 as well as by O. J. Klotz in 1886 and W. S. Drewry, commencing in 1889. From 1906 to 1909 P. A. Carson carried out triangulation surveys of eastern areas within the Belt, covering a total of some 3,000 square miles. Morrison Parsons Bridgland (1878-1948) performed triangulation over some 2,000 miles in western parts of the Belt from 1910 to 1912. In the 1914 season Bridgland was instructed to retrace Drewry's work and to mark permanently all survey stations not previously marked. Bridgland has recorded that in order to establish accurate known points throughout the Railway Belt from which new surveys could be commenced and corrections of former surveys checked, a triangulation survey was essential.[22] In this work a direction theodolite made by T. Cooke and Sons of York, England, was used by him. One serious difficulty faced by these pioneer surveyors in mountainous regions of the West was the lack of sufficient time to reach survey positions on mountain tops. In the mornings these climbs often required 4 to 6 hours to complete and descents usually consumed several hours in the early evenings. Under the most favorable circumstances three hours were required to set up instruments and read a set of angles. Any delay due to clouding, smoke haze from forest fires or in the interpretation of indistinct signals added to time pressures on the surveyor. To help offset this his camp was nearly always taken to the timber line below the peak being scaled.

The survey of lands in the Belt was conducted under the Fourth System which comprises a slight modification of the Third System of the Dominion Lands Survey System. The departure consisted in adding to each quarter-section of 160 acres, an allowance of three acres for roads rather than locating roads along section lines as on the prairies. Among those federal and provincial surveyors who accomplished important work in the Railway Belt of British Columbia from 1906 to 1912 were J. A. Fletcher, A. O. Wheeler, E. W. Robinson, R. D. McCaw, J. E. Ross, J. A. Kirk, N. C. Stewart, T. H. Plunkett, W. J. Deans, A. J. Campbell, A. V. Chase and D. Alpine Smith.

The nature and extent of the special problems faced in surveys in the Belt is revealed in an 1887 report to Surveyor General Deville by Chief Inspector of Surveys W. F. King.[23] King pointed out that although much of the Belt consisted of mountain ranges, it included many fertile valleys as well. But in some instances areas of good farming lands were rather widely separated. Two survey methods were applicable to this type of terrain, namely, either to lay out isolated townships regardless of any regular system or to follow the prairie system of rectangular, adjoining townships. The advantages of the latter method, with its easily decipherable designation of land parcels, as well as in extending or re-establishing original surveys, resulted in its adoption. As it was clearly impossible to follow customary procedure in projecting base lines and township outlines in such rugged country, resort was had to the survey of the Canadian Pacific Railway Company's main line. Its right-of-way afforded a relatively easy survey route and formed a suitable base of operations for surveyors throughout the Belt. Instrumental stations were usually established on the railway roadbed and were not permanently marked on the ground, though many of them have been perpetuated by witness or reference posts. From these posts it was possible for surveyors to locate the nearest section corner with as much accuracy as if the base and other lines had been projected all the way from the Principal Meridian in Manitoba.

Field work was performed by William Ogilvie in 1885 from Port Moody to Revelstoke and in the same year in the Kamloops District by Thomas Fawcett, D.T.S. Astronomic survey work from the summit of the Rocky Mountains to Revelstoke was accomplished in the following year by O. J. Klotz, D.T.S., assisted by Thomas Drummond. In his diary on April 21, 1885, Klotz makes this entry:

"This evening I received the most agreeable news that I was appointed by the Dominion Government as Chief of the Astronomical Observations to be conducted in British Columbia and the North West. This is the highest honor I have received yet and I hope I will prove worthy thereof". By the time Riel was being captured at Batoche, Klotz was on his way across the continent to begin work on the west coast.

The Seattle Chronicle of June 8, 1885, records the presence of the eminent Canadian surveyor in that city,

"Otto J. Klotz of Ottawa, Canada, astronomer for the Canadian government, has been in the city since last Sunday and has established an observatory . . . Mr. Klotz has one assistant,* who is now at Victoria. As soon as the nights are favorable he will ascertain the longitude of that place . . . .

"The determination of the longitude of a place is made from a base station. From this point, as well as from that whose longitude is wanted, observations of the transits of certain stars are taken, and the times of the transits carefully noted by a chronometer. The astronomers then go to the telegraph offices at their respective stations and compare the times of the transits by means of telegraph. The difference in time between the base station and that whose longitude is desired is ascertained and verified by frequent repetitions and comparisons. Having once ascertained accurately the difference in time, the determination of the longitude becomes a mathematical matter of easy accomplishment.

"Mr. Klotz will ascertain, after having found the longitude of Victoria, that of Kamloops, which he will make the base station for determining the longitude of points in British Columbia. The purpose of this work is to obtain the accurate location of points to which to refer land surveys hereafter to be made by the Canadian government".

Klotz was keenly sensitive to the grandeur and majestic beauty of British Columbia scenery but occasionally indulged himself in over-pessimistic entries about the coast climate in his diary. On September 17, 1885, for example, one reads:

"Seven weeks and not one single continuous clear night or 4 hours [consecutive]. Port Moody [at the head of Burrard Inlet] may become a vast city, she may have churches, mansions, colleges, universities but never, never a field observatory".[24]

In contrast there were light-hearted moments in the field: "[Sept. 24] I observed the partial [4/5] eclipse of the moon this night. I set up tripod and zenith telescope and at night observe for time and set in azimuth. Drummond brings a guitar and we spend some time pleasantly together in my tent therewith, alternately playing and singing . . . ."

On November 4, 1885, Klotz commented, "Today is memorable in marking the completion of the lesser metallic girdle, the telegraph [line] that now encircles fair "Canada" to be followed in a few days by the greater one, the Canadian Pacific Railway". (Author's note: The final spike was driven by Donald Smith in the ceremony at Craigellachie in Eagle Pass on November 7 at 9.22 a.m.) "I was the first aboard the directors' train, saw Mr. Van Horne, the C.P. vice-president, also H. J. Cambie, C.E., and Major A. B. Rogers, the discoverer of the Pass through the Selkirk range". "[Nov. 17] Ogilvie's traverse has not reached Farwell [Revelstoke] yet either".

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*Thomas Drummond, D.T.S.

In Ottawa, early in the following year, Klotz was introduced to a very human but rather dismaying aspect of bureaucracy in the capital city:

"In forenoon [Feb. 17] called on W. Pearce, also [Deputy Minister of the Interior] A. M. Burgess, also [Surveyor General] E. Deville and Chief Inspector of Surveys W. F. King. In afternoon called on Amos Bowman, Dr. Bell, Prof. Macoun, all of the Geological Department. What has struck me this time . . . is the extreme jealousy that exists between officers of the same department . . . Prof. Macoun told me that the geologists' [topographical] surveys are unnecessary, that we [land surveyors] should do all that . . . ."

On the evening of July 31, 1886, William Ogilvie reached the site of Klotz's camp from Kamloops and the two surveyors went to work at once on the contents of the former's field books, checking the azimuths. Later in the summer Klotz consulted his conscience in the matter of naming a summit in the Rockies after himself: "In the afternoon [August 12] I triangulated three mountains, the largest, Mount Begbie. I named the other two, Mount Klotz and Mount McArthur. It is probably a delicate matter to name a mountain or lake after oneself but when I ask myself candidly who has the first right, the appropriate one to claim the name, it certainly is the explorer, the man who measures them, locates them, climbs them. My eyes are not the first to gaze upon these mountains but they have been nameless, and I am the first to give them their geographical and topographical position".

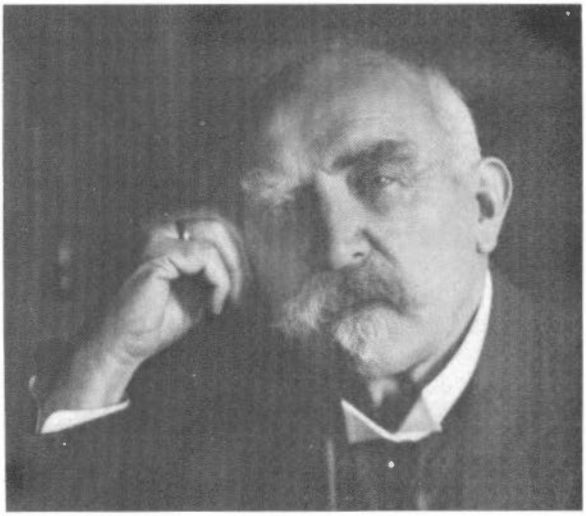


FIGURE 39
Dr. O. J. Klotz.

As matters turned out Klotz was unnecessarily anxious over the long-term consequences of his action. His superiors in Ottawa must have discarded the name "Mount Klotz" at that time. It was not until December, 1957, that a peak in the southern mountains of British Columbia was named for him with official approval. In the meantime, in August, 1945, a mountain in the Yukon was given his name. James Joseph McArthur (1856-1925), the fellow surveyor in whose honor Klotz named a Kootenay peak, shares the distinction with Klotz in having both a British Columbia and a Yukon summit named after him. Born in Aylmer, Quebec, McArthur was commissioned a Dominion land surveyor in April, 1879. He then engaged in meridian, base-line and subdivision surveys until 1886 when he began work in the southern Rockies. All these activities constituted an impressive prelude to a distinguished later career in international boundary surveys and related affairs.

Surveying in the Rockies involved the running of risks of a kind not encountered in other parts of Canada. Klotz, in a diary entry dated May 19, 1886, describes in graphic language a major occupational hazard in mountain regions: "Continue the traverse. This forenoon was almost one continual thundering of snow slides—these are always accompanied by rocks which have been loosened by frost. While we were at dinner a slide occurred from the mountain [Mount Stephen] adjoining us. The snow flowed like water and the huge rocks poured down like an immense hail storm. What a noise—what a sight as it leaped from ledge to ledge and over precipices until it reached the base in front of us, the thunder reverberating amongst the adjoining mountains. Some of the slides came to and over the track and I was glad when I got away from there with my instruments".

There were other dangers to one's health and general welfare. But in regard to one of these menaces Klotz disclaimed any ill effects. He had no difficulty in breathing in the rarified atmosphere of the high Rockies but confessed to near-exhaustion on reaching camp in the evenings. He acknowledged that he was so physically tired at the end of a day's work that he had little or no appetite for food.[25]

Some of the most notable land surveyors in Canada's history developed their talents and reputations through their connection with the early railway surveys in the western interior. Lauchlan Alexander Hamilton (1852-1941), who became a qualified surveyor in Manitoba and British Columbia, was commissioned as a Dominion land surveyor in April, 1879. The following year he joined the Department of the Interior, empowered to organize its timber, mineral and grazing lands branch. Late in 1880 Hamilton was summoned to the office of his deputy minister and introduced to a group of men, including George Stephen and R. B. Angus of Montreal. It was explained to him that the matter under consideration was strictly confidential because the group he had met was about to enter into a vitally important contract with the Dominion government. As only one draft of the contract was available in the office Hamilton was asked to read it so that he would be cognizant of the background of future discussions involving him. After reading the draft Hamilton withdrew from the meeting. This brief encounter with leaders of the Canadian Pacific enterprise led in time to the offer to this Penetanguishene-born surveyor by the Canadian Pacific Railway Company of the post of assistant land commissioner to that company. In accepting this appointment Hamilton began a connection with the railway that lasted for 20 years. By 1888 he had been elevated to the land commissionership. During the period of that office he administered one of the largest estates of land holdings in North America. He was the executive officer responsible for the selection of lands out of government land subsidies to the Canadian Pacific and its subsidiary lines.

Hamilton's initial work with the railway company was the selection, in advance of actual construction, of locations for stations and townsites on the main line west of Winnipeg. In this connection he became the godfather, if not the father, of Regina, Moose Jaw, Swift Current, Medicine Hat and Vancouver. The first subdivision in Calgary is known as "Plan A, Calgary" and is signed by A. W. McVittie, Dominion land surveyor, on January 1, 1884. In 1884 Hamilton went to the Pacific seaboard to help create the new settlement of Vancouver at a time when cedar forest largely covered the site near Coal Harbour, a community then bearing the name of Granville. Clearing the site in preparation for the extension of the railway around the south shore of Burrard Inlet from Port Moody was an undertaking of considerable magnitude. J. W. Stewart, who as General Stewart was in charge of Canadian railway construction in France in the First World War, was an assistant to Hamilton in those formative times on the West Coast.

Today, on a bank building at the corner of Hamilton Street and Hastings Street West (Victory Square) is a bronze plaque bearing the inscription: "Here stood Hamilton, first land commissioner, Canadian Pacific Railway, 1885. In the silent solitude of the primeval

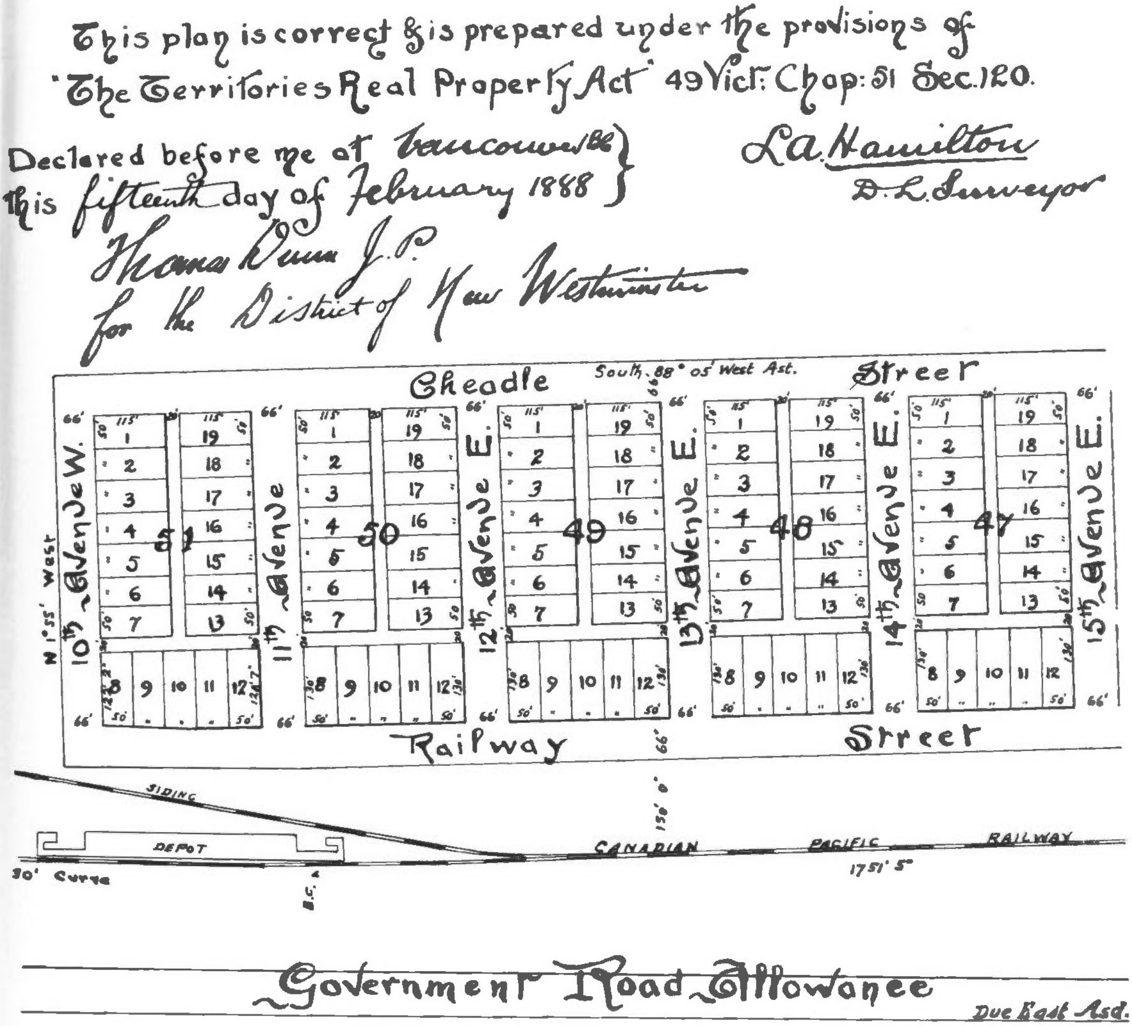


FIGURE 40. Plan of Swift Current, Saskatchewan.

forest he drove a wooden stake in the earth and commenced to measure any empty land into the streets of Vancouver".

In order to bring about the transfer of the Canadian Pacific Railway Company's terminal from Port Moody to Vancouver the British Columbia government agreed to grant to the railway 6,000 acres for what became known locally as the "C.P.R. Townsite." Out of this area the railway company selected sites for the railway station, hotel, yards and water-frontage property on which to build docks. All these developments were on land first surveyed, to some extent, by the Royal Engineers under Col. R. C. Moody. But it was on the spot now marked at Victory Square that Hamilton stood 22 years later, as surveyor in charge of a party consisting of transitman, leveller, rodman, chainmen, picketman and axemen. They commenced the survey of an area 5 miles long and 2 miles wide, now constituting the central core of a metropolis extending for many miles on both sides of Burrard Inlet.

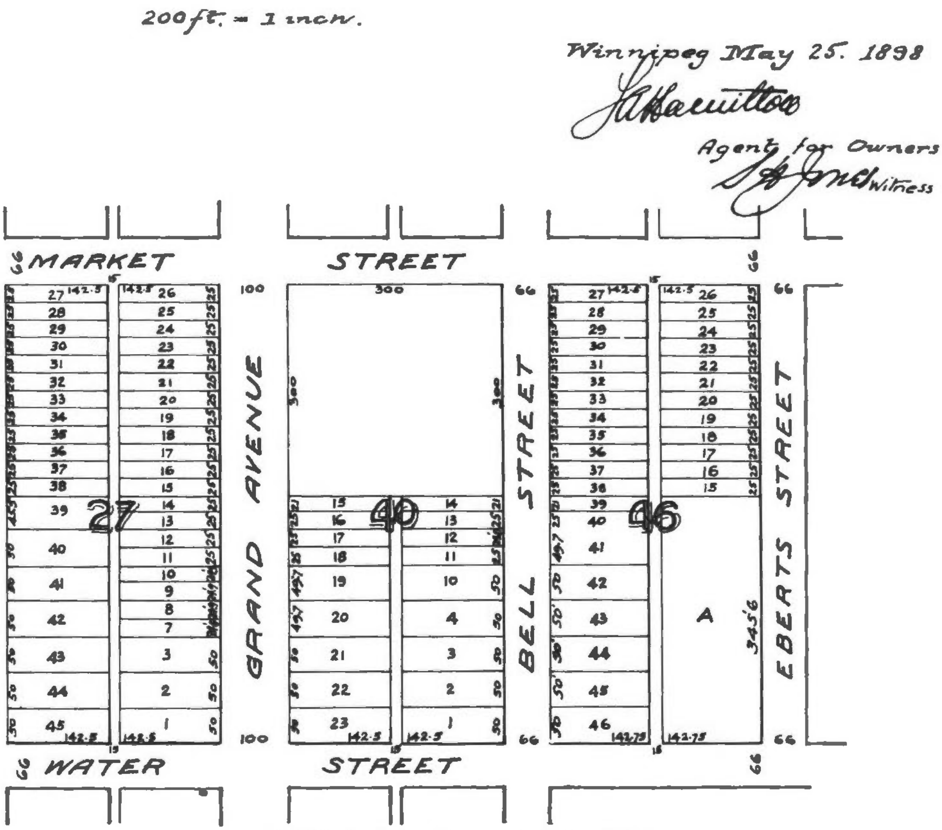


FIGURE 41. Plan of Indian Head, Saskatchewan.

In 1886 what is now known as The Great Fire swept the tiny community and struck savagely at the ambitious survey project. Preliminary plans for laying out streets and blocks in Vancouver were destroyed. Heat from the holocaust was so intense when Hamilton managed to escape from the doomed Ferguson Block that a number of valuable documents were burned under his arm and the lens cracked in a survey instrument he was carrying.

In April, 1938, on his golden wedding day, Hamilton was made the First Freeman of the City of Vancouver. In part, an illustrated address presented to him on that occasion stated: "You saw this great metropolis and world port as a silent wilderness of forest . . . and with your hands marked its place, planned its streets and named them, served without reward as our senior alderman on our first Council, strove to acquire for us our magnificent Stanley Park, preserved our Cambie Street Grounds and succored the distressed in the Great Fire. All Vancouver acknowledges your worthy services in laying the foundations of this beautiful home for a happy people".

On May 24, 1887, amid banners with slogans such as "From Ocean to Ocean" and "Confederation Accomplished" and to the cheers of enthusiastic crowds the first train reached Vancouver sharp on scheduled time. As Van Horne had declared to the land commissioner-surveyor three years previously, "Hamilton! Hamilton! This is destined to be a great city, perhaps the greatest in Canada, and we must see to it that it has a name commensurate with its dignity and importance, and Vancouver it shall be if I have the ultimate decision". At the time Hamilton died in 1941 he was the last surviving member of the first Vancouver City Council. Mrs. Hamilton was the first woman member of the Toronto City Council.

Another notable figure in the early western railway surveys was Major Richard Carney Laurie (1858-1938) a graduate (gold medallist) from Royal Military College, Kingston, and commissioned a Dominion land surveyor in April, 1883. But in 1881 Laurie was engaged as topographer to a survey party headed by W. E. Secretan, C.E., working on locating the main line of the Canadian Pacific Railway from Brandon to near Broadview. Today a small community, upwards of 90 miles west of Regina, commemorates the name of the chief of that particular railway survey party.

FIGURE 42. Inscription on bronze panel, Victory Square, Vancouver, southwest corner of Hamilton and Hastings streets, marking the place where the initial survey stake was driven during the winter of 1885-86.

Also a graduate of Royal Military College, Walter Beatty Young (1880-1965), surveyed for the Canadian Pacific Railway in the first years of the twentieth century in the establishment of new townsites on branch lines then being opened up in what is now the province of Saskatchewan. Young was named after Walter Beatty (1836-1912), a well-known Dominion and Ontario land surveyor. In time Young became Examiner of Land Titles for Manitoba, retiring from that post in 1950, after 40 years service in that capacity. Young also served under P. A. Wilkin on railway right-of-way surveys.

Another Winnipegger, Wilfred Humphreys (1891-   ), became Chief Surveyor of the Canadian Pacific Railway Company in 1932. He began his surveying career in 1912 with

Wilkin on right-of-way surveys in Manitoba and with W. J. Deans in Manitoba and Saskatchewan the following year. He performed similar work in British Columbia under two surveyors, J. Lonsdale Doupe and N. C. Stewart. One task allotted to him was the determination of the number of D.L.S. monuments lost under the destructive Frank Slide of 1903. Humphreys, in addition to being a Dominion land surveyor, became a Provincial land surveyor in Manitoba, Saskatchewan, Alberta and British Columbia.

The man mainly responsible for the selection of the site of the City of Regina was Hon. Edgar Dewdney (1835-1916), the surveyor who arrived in British Columbia in 1859 and made a splendid reputation for himself. Highly successful as a Conservative candidate he served, in between two terms in the House of Commons at Ottawa, as Lieut.-Governor and Indian Commissioner of the North West Territories from 1881 to 1888. After a three-year term as Minister of the Interior, Hon. Mr. Dewdney became Lieut.-Governor of British Columbia, occupying that high post from 1892 to 1897.[26]

As early as May, 1888, Dewdney was on record as favoring the crossing of Pile of Bones Creek for the site of a capital of the North West Territories. The vicinity of this place possessed few natural features to commend it as a future urban settlement. Water sources, hills and trees were practically nonexistent but in all directions stretched some of the best wheat-growing lands on the North American continent. For administrative purposes it was a central location and, as another advantage, there were few speculator-squatters in the area.

The opportunity to reap substantial profits from real estate transactions arising out of the development of the new townsite was highly tempting. Dewdney and his business associates formed several land syndicates in 1882, purchasing upwards of 30 sections of Hudson's Bay Company lands adjacent to the future route of the Canadian Pacific Railway in what is now southern Saskatchewan. One parcel of land a Dewdney group owned was the south half and northwest quarter of Section 26, Township 17, Range 20, west of the Second Meridian. This property later became part of central Regina. However, the Canadian Pacific Railway Company to some extent thwarted the syndicate's hopes for dividends on its investment by building their railway station two miles east of Section 26. Newly-arrived immigrants tended to settle near the station rather than travel eastwards to the intersection of the main line with Wascana Creek. Thus, for a time, there were two settlement sites in Regina.

Arrangements were made in 1882 for a survey of the town and to have the lots put up for public sale. The survey included the station area and a strip adjoining but not including that part of Section 26 from Prince Albert to Pasqua streets. This was a Canadian Pacific Railway Company's victory over its rivals in the race for townsite development. By 1883 only a negligible number of lots in Section 26 had been sold, but at least $500,000 worth of land had been sold from the officially surveyed site.

A group of townsite trustees authorized the subdivision of the new townsite into lots. Today the names of those trustees, E. B. Osler, W. B. Scarth, Donald Smith and R. B. Angus, are commemorated in the names of well-known city streets. So also is the name of the surveyor who acted in 1882 on their instructions, L. A. Hamilton. J. H. McTavish, then Canadian Pacific Railway Land Commissioner, and Hamilton as assistant, signed the plan, known as "Old 33" and drawn to a scale of 200 feet to the inch.[27]

The plan of Regina was quite orthodox in concept, being a rectangular grid with few crescents, circles or large irregular lots. Residential lots generally were 50 feet by 125 feet. Lots in the business section were 25 feet by 125 feet. Main streets were made 100 feet wide, others 66 feet wide. In six weeks what had been but a few frame homes and a scattering of tents became a thriving community graced by 8 hotels, 18 stores, 2 livery stables, 2 laundries, 4 lumber yards and 3 billiard halls supported by a population approaching 9,000.

In 1882 Hamilton also surveyed the townsite of Moose Jaw and drew up the first plan of subdivision for that community.[28] Swift Current, Grenfell and Medicine Hat owe their original subdivision plans to the same man, the first plan of the latter settlement being signed by Hamilton in January, 1888.[29] Plan A of Calgary was signed by A. W. McVittie on January 1, 1884.[30] Indian Head was first laid out by G. A. Stewart in 1884. It was resurveyed 14 years later by J. Lonsdale Doupe. All three men were qualified Dominion land surveyors but Hamilton was surveying for the Canadian Pacific Railway Company at the time. The railway company had done well in its efforts to produce the greatest possible profits from its townsite projects. But the day of railway land grants was slowly coming to an end. In 1894 Parliament voted the last of these subsidies when the Minister of the Interior, Hon. T. M. Daly, asked for approval of a grant of 6,400 acres per mile in favor of the Rocky Mountain Railway and Coal Company in west-central Alberta and the same amount of acreage for a Canadian Pacific line from near Souris to Pipestone Valley. These were free grants to the companies, subject only to the payment by the grantees of the cost of surveying the land plus incidental expenses. Sir Clifford Sifton once remarked that the railway land-grant system came to an end in Canada for the reason that the federal government had come to the end of eligible land reserves that were acceptable to the railway.[31]

It is interesting to note that during the same session of Parliament Daly introduced a measure of three short clauses providing that where a person could prove that he squatted on what turned out to be school lands in a township, prior to surveys, such person would be offered a quarter-section elsewhere in substitution for the land he surrendered. This arrangement only applied to school lands.[32]

Partly because of their dramatic feuding with the elements and other challenging aspects of nature, surveyors in the field in Canada have generally won more widespread recognition of their accomplishments than have their fellow professionals engaged in the less glamorous but nonetheless essential duties of departmental administration. This imbalance of credit is also found in the realm of railway surveys. Men like Robert Evans Young (1861-1911) laboring at office desks in Ottawa or elsewhere, contributed in an important way to the advancement of Canada during the era of transcontinental railway construction. Born in Georgetown, Ontario, Young arrived in Winnipeg in the early 1880s. In 1882 he became a Manitoba land surveyor and a Dominion land surveyor. Better known, perhaps, for his special survey of the city of Winnipeg, nevertheless the years he spent in Ottawa were of solid value to the nation. Early in 1901 he was appointed Superintendent of Railway and Swamp Lands, Department of the Interior. His function was to examine titles to lands held by railway companies in receipt of land subsidies from the government. Young devised a system of making prompt transfers of titles and lands to the companies entitled to these patents. He was highly praised by the Deputy Minister of the Interior for his methodical and efficient administration of this special project as well as in the supervision of transfers of swamp lands to Manitoba.

The vision of government leaders, the courage of explorers, the enterprise of financiers, engineers and builders, the labor of nameless workmen, the exertions of pioneers in surveying as well as in land policy concepts and administration, had combined to make physically and financially possible this initial rail connection between Central Canada and British Columbia. This triumph over almost endless adversities and obstacles meant also that Canada was at last linked by ribbons of steel from ocean to ocean, Confederation, long a vision of statesmen, had become a living dynamic, unifying reality.

The directors' train, the first to travel over the new route officially, rolled westward on November 7, 1885 from Eagle Pass on the final 340-mile lap to the Pacific Coast. On the following day this history-making caravan had reached Pacific tidewater at Port Moody.

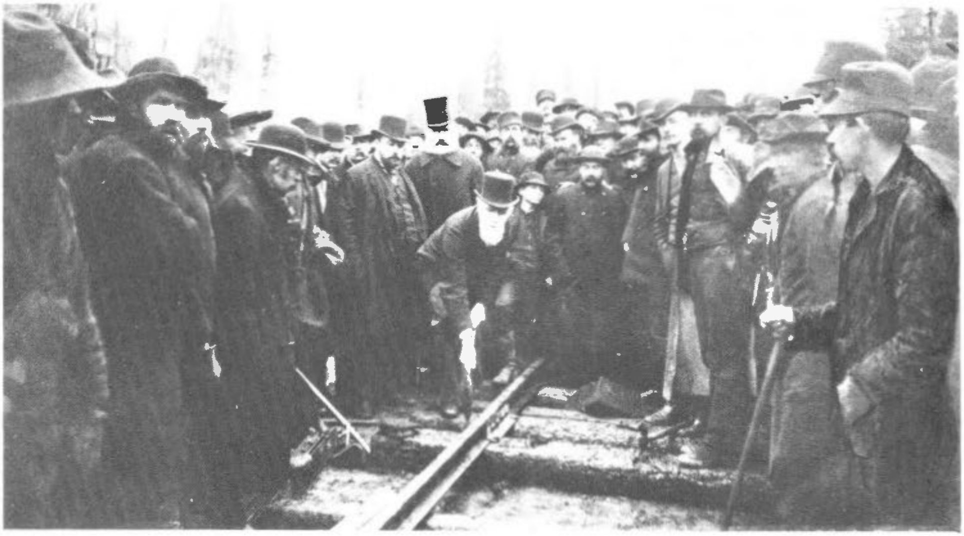


FIGURE 43. Driving of the last spike by Donald A. Smith (later Lord Strathcona) during the completion ceremony on the C.P.R., Nov. 7, 1885.

Its running time from Montreal, exclusive of stops, was a creditable 5 days at an average speed of 24 miles per hour. When Donald Smith had driven home the last spike in the main line of what was to be the first transcontinental railway system in Canada, someone called upon the general manager of the Canadian Pacific for a speech. Van Horne was content to reply, happily and concisely, "All I can say is that the work has been well done in every way." Those simple, telling words of deeply-felt appreciation, voiced on behalf of all Canadians, could well resound indefinitely among the British Columbia mountains whose names commemorate the services to Canada performed by men who helped unlock many of the secrets of the high ranges, surveyors such as Bridgland, Campbell, Dennis, Deville, Fleming, Jarvis, King, Klotz, McArthur, Ogilvie, St. Cyr, Wheeler and White. Among these names of eminent surveyors of the early West none shines more brightly than that of Arthur St. Cyr (1860-1923), born at Ste-Anne de la Pérade, Quebec, and who served as articled student with Henry O'Sullivan of Ancienne-Lorette before embarking upon his long, active and distinguished professional career as a Dominion land surveyor.

6

CANADIAN IRRIGATION SURVEYS 1885-1900

The introduction in the mid-1890s of large-scale irrigation in Canada's West came a number of years after the practice had become well-established in several western states of the American Union. To some extent Canadians were able to benefit from hard lessons below the border in this special branch of agriculture.

The so-called "arid region", or area of light rainfall, in the North West Territories was defined in 1895 as an area bounded on the south by the international border, on the east by the 2nd Initial Meridian, on the north by latitude 51°30′, and on the west by the summit of the Rockies. Generally the soil in this region was regarded as being exceptionally fertile. By far the most extensive developments in Canadian irrigation have taken place in the western part of this 50-million acre empire, extending from Medicine Hat to the foothills. The region is watered by nine principal streams, the Red Deer, Bow, Elbow, Highwood, Waterton, South Saskatchewan, Old Man, Belly and St. Mary's rivers and their tributaries.

The first important attempt at irrigation in this part of Canada was made in 1879 by John Glen, a squatter near Fish Creek, a few miles south of Calgary. Glen constructed a small ditch and diverted water from the creek to irrigate some 15 acres of crop.[1] In 1882 an irrigation ditch was completed near Lethbridge. In 1883 an experimental ditch was constructed at High River but results from this project were not satisfactory. Reports of Dominion land surveyors over a span of years frequently stressed the need for irrigation in this region. But it was mainly the persistent advocacy of surveyor William Pearce (1848-1930) that finally produced a public awareness of the problem and the opportunity. In 1891 an irrigation ditch, designed to water 160 acres, was constructed by John Quirk to take water from the North Fork of Sheep Creek to Township 20, Range 4, west of the 5th Meridian. So successful was this effort that Quirk's neighbors at once constructed similar ditches and by 1894 nine irrigation systems were being supported by that diversion.

In the 1885 annual report of the Department of the Interior, Burgess, as deputy minister, stated, "Mr. Pearce raises what is practically a new question when he discusses the irrigation

FIGURE 44
Col. J. S. Dennis.

of completely dry tracts in the grazing country . . . It will be a long time before the regular system of settlement which commenced at Red River in 1870 . . . will reach the class of country to which [his] suggestions relate . . . ". The period of time Burgess had in mind in this regard is conjectural but, in any event, within ten years of his prophecy extensive Dominion land surveys had been made in this area and some sizable irrigation works constructed on the framework of those surveys.[2]

In the late 1880s irrigation projects in the region were given strong impetus by the arrival in what is now the Cardston area of Alberta, of a group of Mormons from Utah. These immigrants were familiar with irrigation practices and possibilities. Within a few more years several Canadian companies came into existence whose objects, wholly or in part, were to promote and extend irrigation facilities in these southern areas of the high plains. Among these corporations were the Calgary Irrigation Company and the Alberta Railway and Irrigation Company.

The need for Canadian legislation that would place irrigation activities on a sound legal and statutory basis became more and more pressing. During the visit to Calgary of Hon. T. M. Daly, Minister of the Interior, in the early winter of 1892, the necessity of a complete topographic survey in preparation for large-scale irrigation in the region was brought to his attention. As a result departmental officials at Ottawa were asked to prepare a bill authorizing irrigation suitable to the conditions of the south country. During the 1893 session the bill was introduced in the Commons. Owing to the absence from Ottawa of the Prime Minister, who was in Paris attending meetings of the Bering Sea Commission, it was decided to advance the bill to second reading stage only. It was also thought advisable to postpone further parliamentary action until there was an opportunity for wide public discussion of the measure. The draft bill was circulated among interested parties and constructive criticism invited. During this interval J. S. Dennis, Jr. was sent on a tour of western United States in order to study and report to the government at Ottawa upon American irrigation laws and practices. On his return Dennis, in December, 1893, submitted a full report and in the light of his recommendations together with other suggested changes, the bill was re-drafted and introduced in the 1894 session. A delegation from Calgary, Lethbridge, Medicine Hat and Fort Macleod made the trip in May of that year to Ottawa to press for passage of the bill. The Canadian Pacific Railway materially aided the delegation by providing free transportation for the purpose.

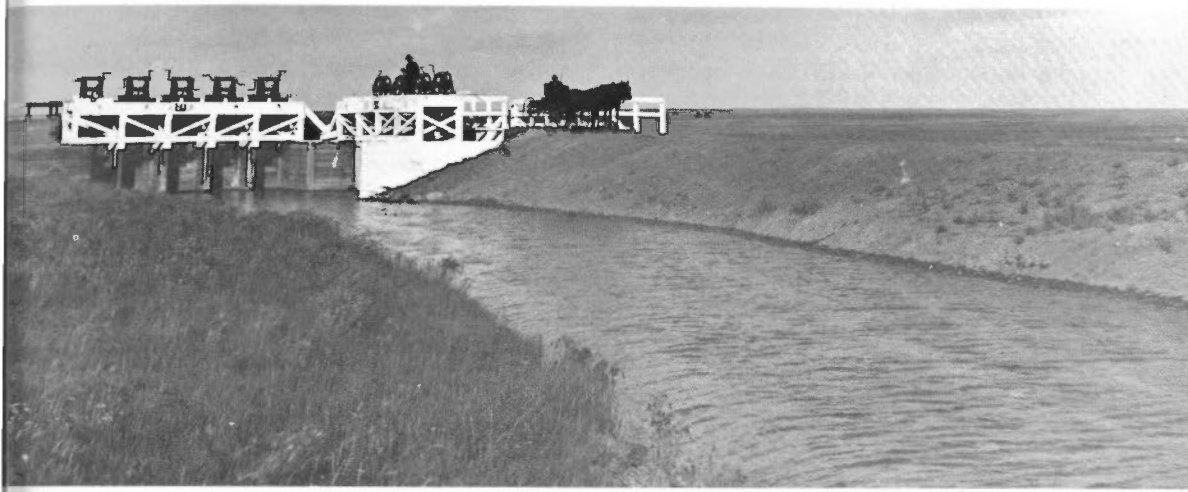


FIGURE 45. Head gates and reservoir on C.P.R. irrigation system in Southern Alberta.

Dennis, in his report, had recommended total supression of all riparian rights in irrigation water and urged that these rights be transferred to the Crown in the right of Canada, for the benefit of the greatest number of users. Secondly, he advocated measures of protection of individual consumers of irrigation water and, thirdly, the imposition of safeguards covering all types of water transactions within distribution systems. The vesting of control of irrigation water in one strong central authority was made a cardinal principle of the new bill.

A general topographic survey of the dry area of the Far West was considered essential. In outlining a suitable method of survey Dennis observed that "to determine limits of the drainage basins and prevent the diverting of water from the district to which it properly belongs and the attempt, so disastrous . . . in the United States of America, to bring more land under irrigation in a certain district than its water supply would warrant . . . the work to be undertaken by the Canadian irrigation survey covers widely different branches of both engineering and surveying. We have to deal with questions of geographical and topographical surveying, hydraulic engineering and the structural branches of civil engineering".

The North-West Irrigation Act (57-58 Vic. ch. 30), based on these fundamental principles, became law on July 23, 1894. By an order in council in the following October rather extensive additions were made to the regulations concerning the manner of surveying and preparing returns of surveys of the right-of-way for irrigation ditches and related works. Right-of-way surveys were classified as (1) preliminary and (2) final. Preliminary surveys were those made with proposed locations of main ditches and laterals staked out to enable applicants to file preliminary plans. Final plans were those drafted when ditch routes had been finally located and construction was under way, thus permitting plans to be filed and title to the rights-of-way formally conveyed.

In the summer of 1895 Parliament passed a supplementary measure (58-9 Vic. ch. 33) section 7 of which provided that all maps and plans in connection with irrigation works had to be signed and certified correct by a Dominion land surveyor. Three years after passage of the first federal law on irrigation the existing acts of parliament on the subject were amended and consolidated in one piece of legislation (61 Vic. ch. 35).

Four years previously William Pearce, in his report to the Department of the Interior, had observed in describing a visit to what is now southern Alberta, "When in the neighborhood of the Mormon settlement I took occasion to go over a stretch of country that I had not seen before, to the east of St. Mary's River, township one, to Lethbridge. I found an extensive tract of slightly undulating country with a strong clay soil. I think that St. Mary's River could be cheaply brought on to irrigate this tract and, if this were done, it would be second to none in Canada".

Just prior to the introduction in Parliament of the pioneer bill on irrigation in Canada, Pearce reported upon the western rainfall areas located along the main line of the Canadian Pacific Railway.[3] Pearce advised that "Examination . . . of the physical conformation of the country between Medicine Hat and the Fifth Principal Meridian [which passes through Calgary at 114° west longitude] leads . . . to the conclusion that there are large areas in that region which could be satisfactorily and profitably irrigated by waters of Bow River . . . about 3 million acres could thus be reclaimed from comparative aridity and rendered productive for all purposes of mixed farming . . . in order to induce a company organized . . . to undertake the work of irrigating all or any of these tracts, it will be necessary that the sectional system of survey should be abandoned, that the road allowances provided for in the Dominion Land Act should be closed up [and] that the area falling to the school endowment should be provided for in a single block. . . ".

In 1894 the Canadian Pacific Railway Company made some preliminary surveys to determine upon the feasibility of diverting water from Bow River near Calgary to serve lands adjacent to the Canadian Pacific main line east of that settlement. Apparently the result of this examination was favorable and the prospects of transforming these areas into acreages of benefit to the company and the nation at large seemed good.

Early that same year Burgess and Pearce joined in a submission to Interior Minister Daly concerning government policy in the western area of light rainfall. They urged extensive irrigation from Bow River, suggesting the reclamation, in this way, of upwards of three million acres.[4] When Van Horne was approached and concurred in another key recommendation in this report, namely, that large compact blocks of railway subsidy lands be substituted in the arid region for the regular provision of alternate sections only, the way was cleared for the passage through Parliament of the statutory approval necessary to the advancement of this immense irrigation project.[5]

Daly spoke briefly on this bill in the Commons in July of 1894, indicating that the measure was being introduced to enable the government to convey to the Canadian Pacific Railway Company, as part of the original main line grant, tracts of land composed of whole townships, i.e. both odd- and even-numbered sections. The minister explained that this bill concerned land requiring irrigation and that the millions of acres involved would be "fairly fit for settlement" in the view of the company, only if it was artificially watered. Roughly the land under discussion covered an unbroken tract 100 miles by 25 miles. To help make these lands entirely Canadian Pacific property the company purchased about 101,000 acres from the Hudson's Bay Company. The entire block was situated between the Red Deer and Bow Rivers and extended from the eastern boundary of Range 11, west of the 4th meridian, to the 5th meridian running in the vicinity of Calgary. This area was considerably larger than the whole of the State of Connecticut.

The country farther south in what is now the province of Alberta was soon undergoing intensive examination. In each season from 1894 to 1897 A. O. Wheeler (1860-1945) headed irrigation survey parties into that part of Canada. The first of these annual investigations covered the period from mid-June to the end of October and moved in the high benchland skirting the foothills as far south as the international boundary. The line of levels followed township outlines previously established under the Dominion Lands Survey System in order to obtain an estimate of the volume of water available for irrigating the plains to the east, as well as to discover facilities afforded by the nature of the topography for carrying the water supply to points of distribution.[6] By following this procedure the need for triangulation was avoided and instead an accurate base of reference, extending in a network over the country, was permanently established on the ground. On both sides of the line of levels the topography necessary to the compilation of a map was obtained, the operations of the topographers being regulated by the speed with which the levelling party advanced. The average rate of progress was 3½ miles a day. Instruments used included a vernier pocket compass with tripod, pocket prismatic compasses, a 4-inch Troughton and Simms transit and a Chesterman steel band, 66-foot chain. An odometer attached to a buckboard as well as pacing were used to check distances traversed. For vertical measurements an 18-inch Y level with a 17-foot telescope rod were employed. Profiles of these lines, with sea level as datum, were plotted as work progressed. All other elevations were obtained by aneroid barometer readings.

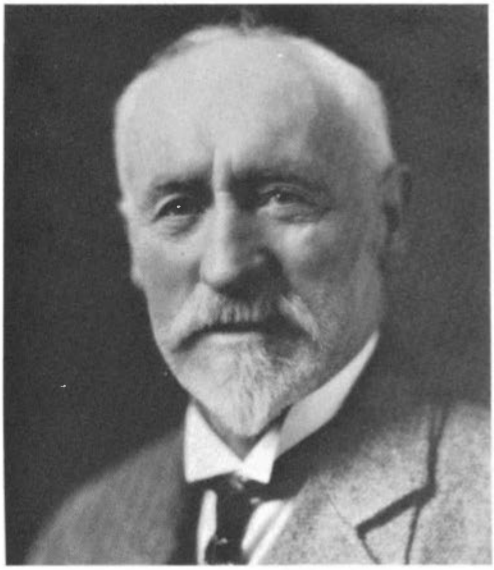


FIGURE 46
A. O. Wheeler.

Dennis, early in 1895, was placed in charge of irrigation surveys and the administration of provisions of the newly-passed federal irrigation legislation. "I left Ottawa on the 16 May", he reported later, "and immediately on my arrival in Calgary I opened my office in a vacant room in the Government block which I had occupied during the previous season and made it known that I was prepared to deal with applications for water rights under the Irrigation Act. . . ".[7] The wisdom of opening such an agency was soon made apparent by the large number of applications and inquiries received. In September, 1895, Dennis, along with Burgess and Pearce, attended sessions of the Fourth International Irrigation Congress at Albuquerque, New Mexico. At that convention Dennis presented an address of consequence on the subject of Canadian irrigation laws and administration.

In the 1895 field season a radical change was made in the operations of Wheeler's survey party. It was decided to conduct these surveys in such a manner as to obtain a reliable concept of the topography and hydrography of the region. To that end work was commenced on a general trigonometrical survey. This task was continued in the two following seasons. In 1897 the survey operation lasted from mid-May to early October. Wheeler headed a party of 8 men, equipped with horses and buckboards. Instructions from Dennis called for a continuation of triangulation as well as of photographic surveys on the eastern slopes of the

Rocky Mountains south of Calgary.[8] "You will continue the work . . . of locating suitable points for the creation of reservoirs at the heads of the streams . . . the map to accompany each report being prepared from your photographic survey of such locations . . . you will make the usual gauging of all streams, confining your work to determination of actual discharges at date of measurement."

A camera and transit theodolite were not received, however, by the Wheeler party until the end of July, by which time the micrometer traverses of Jumpingpound Creek and Elbow River had been completed. The photographic survey was extended eastward sufficiently to cover elevations coming within the contour interval of the proposed final topographic map. It was at first intended to construct the map with 100-foot contour intervals but it was found that this interval was too wide and that the ground configuration was better suited to a 50-foot interval. A tie-in was made at the mouth of the Bow River Pass with the Rocky Mountain region photographic survey by J. J. McArthur. During the early part of the 1897 season smoke haze from forest fires proved troublesome, obscuring the landscape.

During these surveys Wheeler stated that he found settlers in the area traversed greatly distressed over the very high mortality rate among the cattle in the region. They thought the deaths were due to the eating of some kind of poisonous weed. Wheeler's representations to Ottawa in this regard resulted in the speedy despatch of Professor Macoun, then in Calgary, to the scene. Macoun soon traced the poisonings to a plant bearing the name, Rocky Mountain larkspur. The toxic juices in its shoots became most virulent following the first rains of spring.

In 1897 George G. Anderson, an irrigation engineer from Denver, was engaged to report to the Alberta Railway and Irrigation Company on the feasibility and cost of a system of irrigation to serve company lands. He encouraged the proposition of diverting water for this purpose from St. Mary's River. In the following years Mormon settlers, under Anderson's direction, worked to build such a system. Irrigation water reached Lethbridge on July 4, 1900. Earlier it had already been brought to the smaller communities of Sterling and Magrath. Two years later the Canadian Pacific Railway Company opened a headquarters establishment in Calgary to supervise irrigation activities and appointed Dennis in charge as Superintendent of Irrigation. Thus after more than a quarter of a century, most of that period in the employ of the Department of the Interior, the son of confederated Canada's first Surveyor General began a new career with the railway company, a connection that was destined to continue for another 28 years. The company could not have recruited a more experienced or more able man to prosecute the great task allotted to him. Before long he had become assistant to the Second Vice-President of the Canadian Pacific Railway. In 1904 Pearce followed the example of Dennis and left the government service to join the Canadian Pacific Railway organization in connection with administration of irrigated and other lands owned by it.

For administrative purposes the entire Canadian Pacific Railway dry-land domain was divided into three districts, Eastern, Central and Western. Dennis, in his policy-making role with the company, was responsible for many innovations in the realm of irrigation and agriculture in general. He promoted the idea of crop payments in the settlement of land purchases; he energetically supported the cause of livestock improvement and initiated the practice of a touring train devoted to encouraging the production of better stock and poultry. He brought about the first meeting, in July, 1912, at Winnipeg, of the federal Minister of Agriculture and the ministers of agriculture from the three prairie provinces along with leading men of the business world. They were brought together to discuss and study means of improving livestock in the West. Dennis was also a strong and unwavering driving force behind Canadian Pacific Railway colonization and publicity programs.

Dennis never forgot that the Canadian Pacific Railway in its colonization efforts was not so much interested in profits, important as these were to its enterprise, as in people. He was quick to realize that without people there could be no real profits. By 1912, in his unique role of assistant to Canadian Pacific Railway President Shaughnessy, Dennis had risen as well to the position of administrator responsible for the operations of the newly-created Canadian Pacific Railway Department of Natural Resources, located at Calgary. Over the years he made this agency into one of the most active and productive publicity and sales projects in the entire history of the railway.

FIGURE 47
Hon. Clifford Sifton.

In 1896 Hon. Clifford Sifton, newly-arrived Minister of the Interior in the Laurier cabinet formed in that year, agreed to the consolidation of the land holdings of the Alberta Railway and Irrigation Company (A.R.I.C.) in one compact block. This, as in the prior case of the Canadian Pacific Railway, was in the interests of more efficient administration. By the first of January, 1908, the Canadian Pacific Railway had absorbed the Canadian Pacific Irrigation and Colonization Company (C.P.I.C.) and by 1912 it had also taken over the A.R.I.C. In the meantime, in 1909, the Canada Land and Irrigation Company (C.L.I.C.) commenced construction of canals in a project designed to serve some 46,000 acres east of Vauxhall. With the advent of the First World War financial difficulties were encountered and progress impeded. Nevertheless by 1927 some 15,000 acres were "under the ditch" in the C.L.I.C. scheme.

During the first quarter of the present century nine separate irrigation districts were established in Alberta, sanctioned by the provincial legislature. This arrangement enabled irrigation farmers to co-operatively finance their operations. Nearly all these districts were formed on the basis of surveys and reports by the Dominion Reclamation Service. Although not the first one to come into being, the Lethbridge Northern Irrigation District, created in 1919 and expanded somewhat in the following year, covered the largest area of any.

Irrigation has proved to be an immense boon to a large and important segment of Western Canada. The growth, prosperity and promise of the light-rainfall region of Southern Alberta,

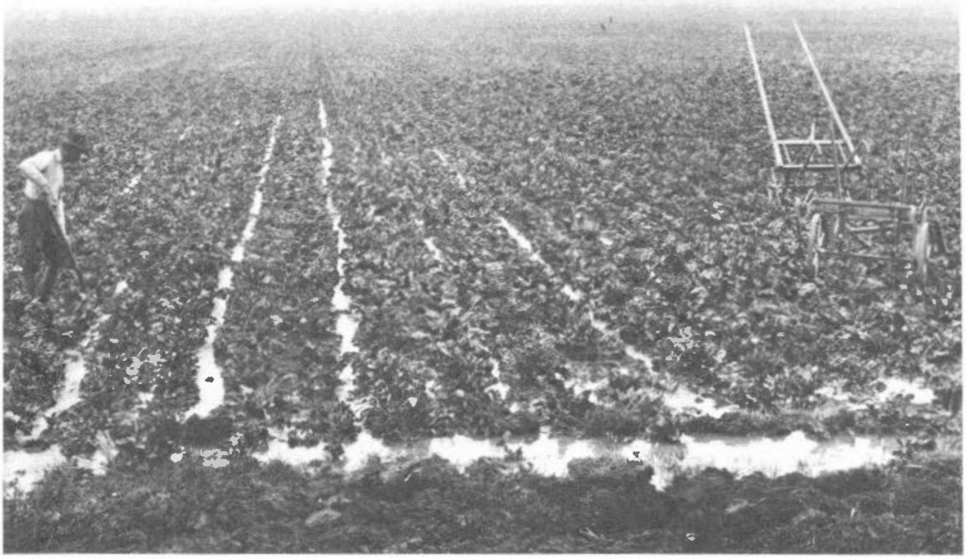


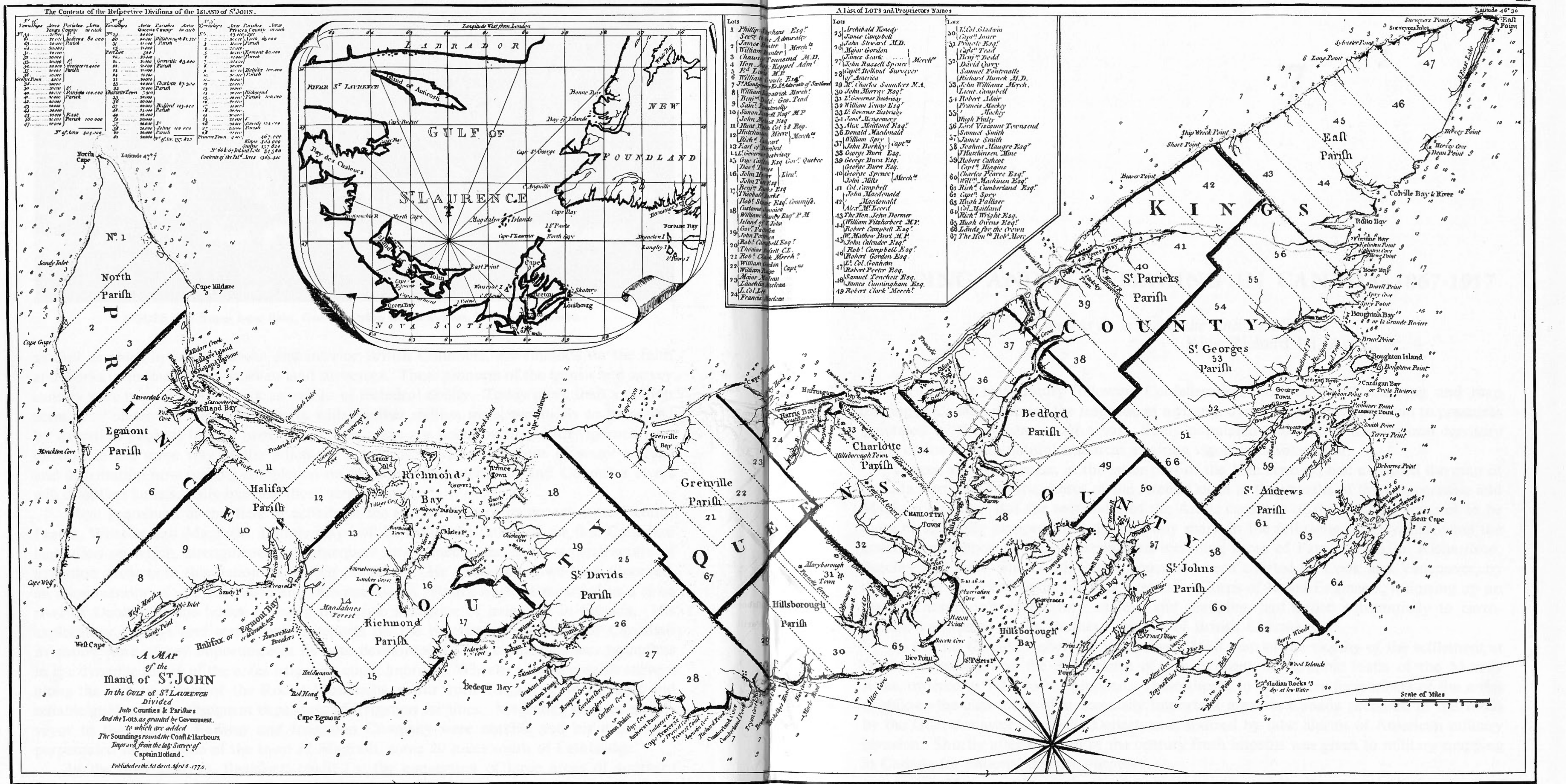
FIGURE 48. Sugar beet field, Galt Irrigation Canal System, Raymond, Alberta.

as well as areas in Saskatchewan and interior British Columbia, are founded on the faith and works of indomitable Canadian land surveyors. These pioneers of the transit and survey camera were men of public spirit as well as of technical ability. Today more than a million acres are "under the ditch" in Alberta with another million acres eventually to be served by irrigation projects in that province. Lesser areas are being brought into vigorous production in the same way in the adjoining provinces.[9] Giant programs of water storage and distribution now nearing completion on the South Saskatchewan and Columbia rivers will doubtless substantially increase those acreage totals.

Most prominent in this field of activity in the earliest days of its growth were Dennis, Pearce, Wheeler and Magrath. Dennis may well be called the father of the first Canadian legislation on which, strengthened by subsequent amendments, the entire superstructure of irrigation projects in this nation have been developed. He was also, as we have observed, an administrator of unusual vision and resourcefulness. Pearce must be regarded as a close rival of Dennis for the honor of being the prime instigator of irrigation in Canada. His exploratory surveys and statesmanlike reports on the practical possibilities of Canadian irrigation were of key importance in its wise development. His confidence was boundless in the dynamic future of the areas irrigation could improve. Wheeler's indispensable surveys along the eastern slopes of the Rocky Mountains, south from Calgary, gave valuable and reliable guidance to subsequent expansion of irrigation facilities. Magrath's services as surveyor to the Alberta Railway and Irrigation Company were notable and his memory is perpetuated in the name of the town of Magrath, some 20 miles south of Lethbridge.

In the final analysis, therefore, credit for the conversion of large areas of southern Alberta, otherwise suitable for grazing only, into productive farmlands by the provision of irrigation, is largely due to the vision, foresight and constructive action of Dominion land surveyors.

XIII



MAP 6. Captain Holland's map of the Island of St. John (Prince Edward Island), published in 1775.

7

MAPPING AND MAP MAKING IN CANADA 1867-1917

"I see, as in a map, the end of all . . ."
King Richard III, Act 2, Sc. 4

In the first half-century following Confederation the progress of mapping and map making in Canada reflected the response of a young, dynamic, expanding nation to pressures generated by the possession of a vast, thinly populated and largely unorganized territory richly endowed with natural resources awaiting vigorous development.

Hearne and Mackenzie, in the latter part of the 18th century, had extended the map of Canada northward to the shores of the Arctic Ocean at the mouths of the Coppermine and Mackenzie rivers. But the remainder of the Arctic coastline of this country was not to be more or less fully mapped until the half-way mark in the following century, following the government-supported British expeditions including those of Parry, Franklin, Richardson, Beechey and Rae. The North Pacific coast had been charted by Cook and Vancouver, by the latter in considerable detail. Much later the Corps of Royal Engineers, following up on David Thompson's exploratory surveys and mapping, had added substantially to cartographic knowledge of the southern interior of British Columbia.

In central Canada Robert de Villeneuve's 1688 map of the vicinity of the settlement at Quebec foreshadowed the appearance of the excellent topographic maps of the Murray Atlas, ordered in 1760 to be compiled. These sheets, in turn, were forerunners of the series of mile-to-the-inch maps of strategically important areas in Canada prepared in the 1860s by the Quartermaster General's Department, spurred by false alarms of American military invasion. Shortly after the turn of the century fresh impetus was given to military mapping in Canada for national defence purposes.

In the Maritimes the early chart-making activities of DesBarres and Cook as well as land mapping by Holland and, subsequently, by international boundary surveyors, contributed greatly to cartographical knowledge of the Atlantic provinces and their coastal waters. In the western interior, soon after Confederation, Dominion land surveyors commenced to produce topographic maps that were more detailed and more accurate than any previous cartography representing the high plains. In the days of early exploration, both east and west, travelways such as Indian trails, canoe routes and buffalo trails exerted a distinctively Canadian influence upon map construction in this country.

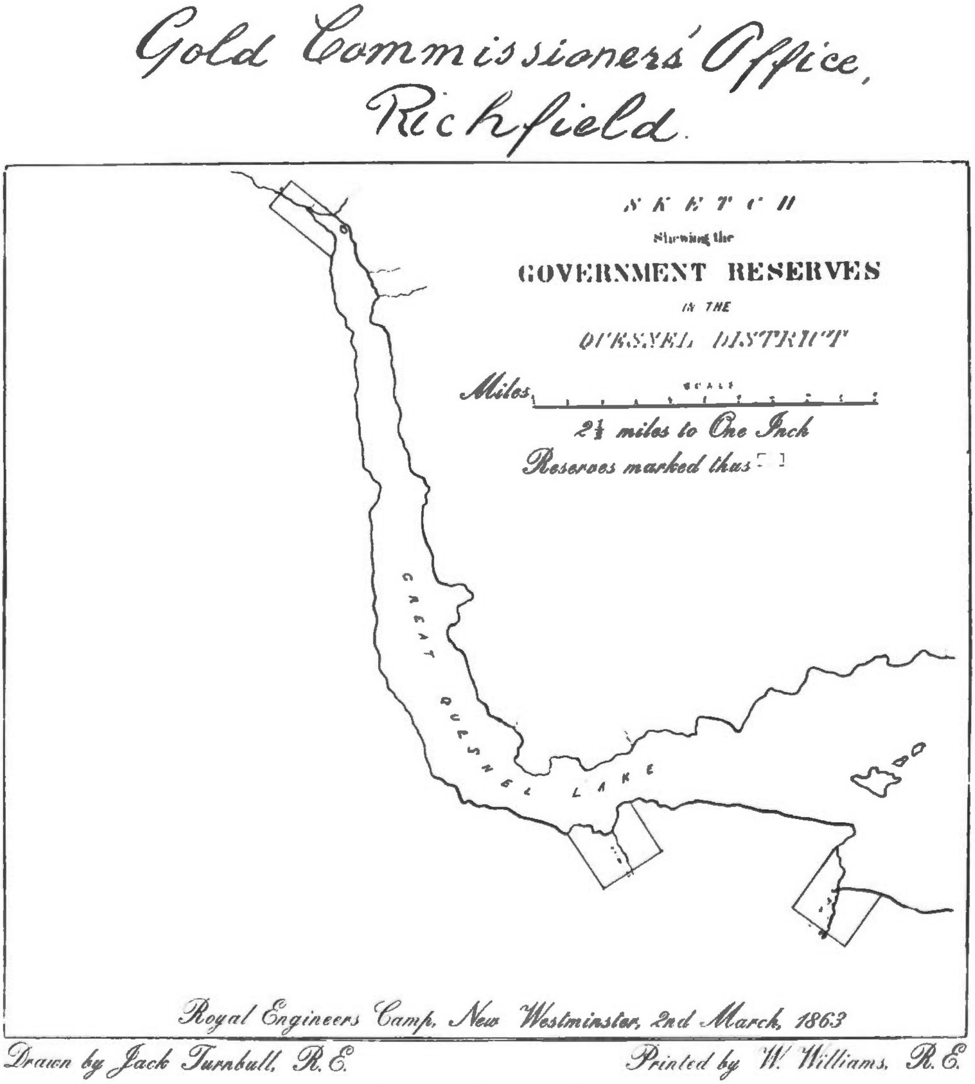


FIGURE 49. Sketch by Royal Engineers of Quesnel, B.C., goldfield, showing government-reserved lands, 1863.

In every part of the new Dominion there was a growing demand for easily readable, reliable cartographic representations of the land, maps drawn to a uniform scale, properly oriented and embellished by readily understandable legends, including symbols identifying drainage, cultivation, communities, elevations and ground cover. Maps issued in Canada in the period 1867 to 1917, when considered together, constitute a visible, graphic record of Canada's development during the first half-century of its nationhood. These portrayals on paper reveal the swiftness with which settlement and communications expanded westward across northern Ontario to span the wide prairies and, after penetrating the massive mountain barrier, to make contact with progressive communities in British Columbia. Maps were required to meet the needs of railway building, land settlement, irrigation and reclamation, road construction, power developments and general engineering projects as well as for boundary delineation and national defence. With the establishment in 1871 of the Astronomical Branch, Department of the Interior, a new source of accurate geographical data for map making came into being.

A variety of factors, political, economic and international, combined to spur mapping and map making from coast to coast in Canada. The fundamental new political fact of Confederation, in itself, provided a marked impetus as did the concomitant policies of railway building and of increasing immigration. Sandford Fleming, in his exploring and engineering activities with the Intercolonial and Canadian Pacific Railways, produced maps not only of immediate usefulness but of long-term value. Surveys of the Railway Belt in British Columbia resulted in the publication of maps descriptive of that area. In addition maps were issued to indicate administrative compartments of the western interior. In 1883, for example, a map of political divisions of the prairie west, on a scale of 50 miles to the inch, was published by Dawson Brothers of Montreal and printed by Bartholomew of Edinburgh, Scotland. Surveys in connection with the marking of boundaries between Canada and the United States as well as between Ontario and Manitoba required the issuance of new maps. Electoral maps were made available to publicize the limits of federal and provincial constituencies. Maps of counties, of postal routes and of Mounted Police stations and patrols came into existence to meet the need for information along these particular lines. Demand grew also for maps as aids in the development of Canada's natural resources of timber and minerals. In the western interior grain soon became the principal agricultural resource and its large-scale production depended to an important extent on a steady inflow of settlers. This process was based, in turn, on satisfactory land surveys and accurate mapping. In 1872 a map was published by the Department of the Interior, Ottawa, showing land surveys completed in Manitoba and the North-West Territories.[1]

County atlases and maps were a homely but highly popular form of cartography in the United States and Canada during the second half of the 19th century. A total of 29 Ontario counties or groups of counties were portrayed in atlas style. But only a few copies of these publications are still in existence, partly because their large size made them awkward to store or to preserve. Most of the atlases appeared in the six-year period, 1875 to 1881. Page and Smith, a Toronto firm, published an atlas of Brant county and one of Wentworth county in 1875. In the following year H. R. Page of Toronto published an atlas of Lincoln and Welland counties combined. In the same year Walker and Miles, also of Toronto, published an atlas of Oxford county.

The name "Beers" in this field of map publishing was a conspicuous, if not dominant, name in the United States during this period. Firms bearing names such as "David G. Beers", "Frederick W. Beers", "J. B. Beers", "Beers, Ellis and Company" flourished in various states. The first atlas of Ontario county, in fact, was issued by J. H. Beers and Company in 1877.[2]

But single-sheet maps of Canadian counties appeared much earlier than any of the atlases. In 1856 the Toronto firm of surveyors, Dennis* and Boulton, produced a map of Bruce county, printed by Sage and Sons, Lithographers, Buffalo, N.Y.[3] Two years later, George C. Tremaine published a map of Brant county. In the early 1860s several maps of

*J. S. Dennis of this partnership became Surveyor General of Canada.

Carleton county were published, some as a result of surveys by H. F. Walling, C.E. In 1860 Putnam and Walling of Kingston, Ontario, published a map of the United Counties of Frontenac, Lennox and Addington, on a scale of 40 rods to the inch. In 1861 G. C. Tremaine published a map of Durham county. R. W. Hermon's map of Huron county, issued in 1862, was lithographed by W. C. Chewett and Company, Toronto, on a scale of 80 chains to the inch. In 1878 four county maps were published by H. Belden and Company, Toronto.

These atlases and individual maps were, for the most part, embellished by sketches consisting of stylized representations of public buildings, private residences, schools and churches of the period. The atlases were financed by subscribers, sometimes as many as 1,200, whose names appeared in a box on the map face. On some county maps the name of the farm owner was placed in the property space ascribed to him. But the real value of the publications is found in the cartography displayed. Some maps were compiled and drawn from information supplied by private surveys, others were copies from official plans and surveys already in existence. These county maps and atlases, rich in geneological information, have become a most popular type of archival material among students and writers of local histories.

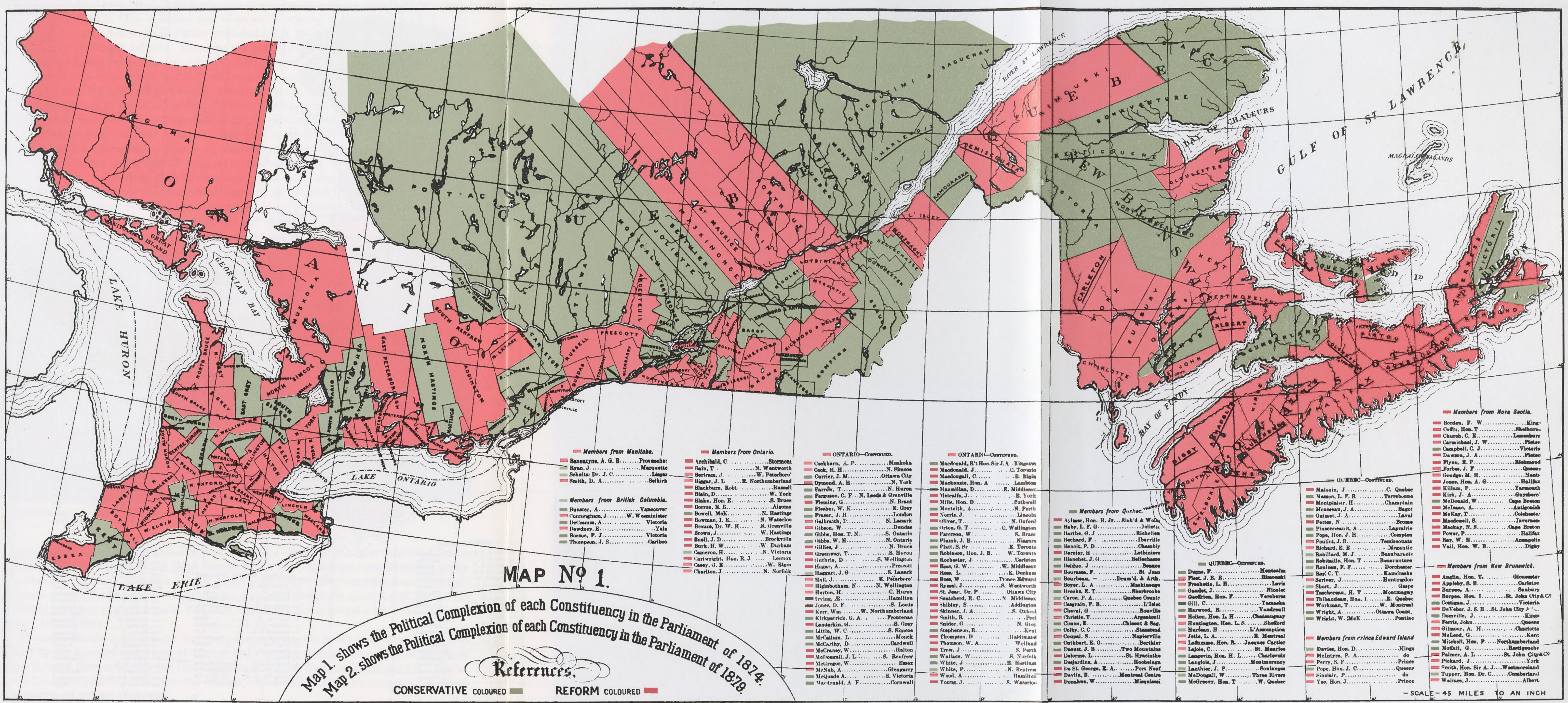
Canadian firms, other than those already mentioned, that were prominently associated in early days with county map designing and publishing included the Ontario partnership of the brothers, G. R. and G. M. Tremaine, also George N. Tackabury of Montreal and the Toronto institutions of Thomas Maclear, and Miles and Company.

Tackabury's Atlas of 1875 and Belden's Illustrated Atlas of 1880 were outstanding Canadian pioneers in the general atlas field. The former volume was printed by the Burland-Desbarats Lithographing Company of Montreal. It had been the intention to publish the Tackabury Atlas in 1871 but the event was postponed in order to include county maps of Quebec. The enlargement of the project entailed much more work than had been anticipated. Available survey plans differed to such an extent in reliability, scales and in details that the compilation of these discordant elements into a harmonious series of maps proved to be, in the words of the editors, "extremely perplexing and difficult".

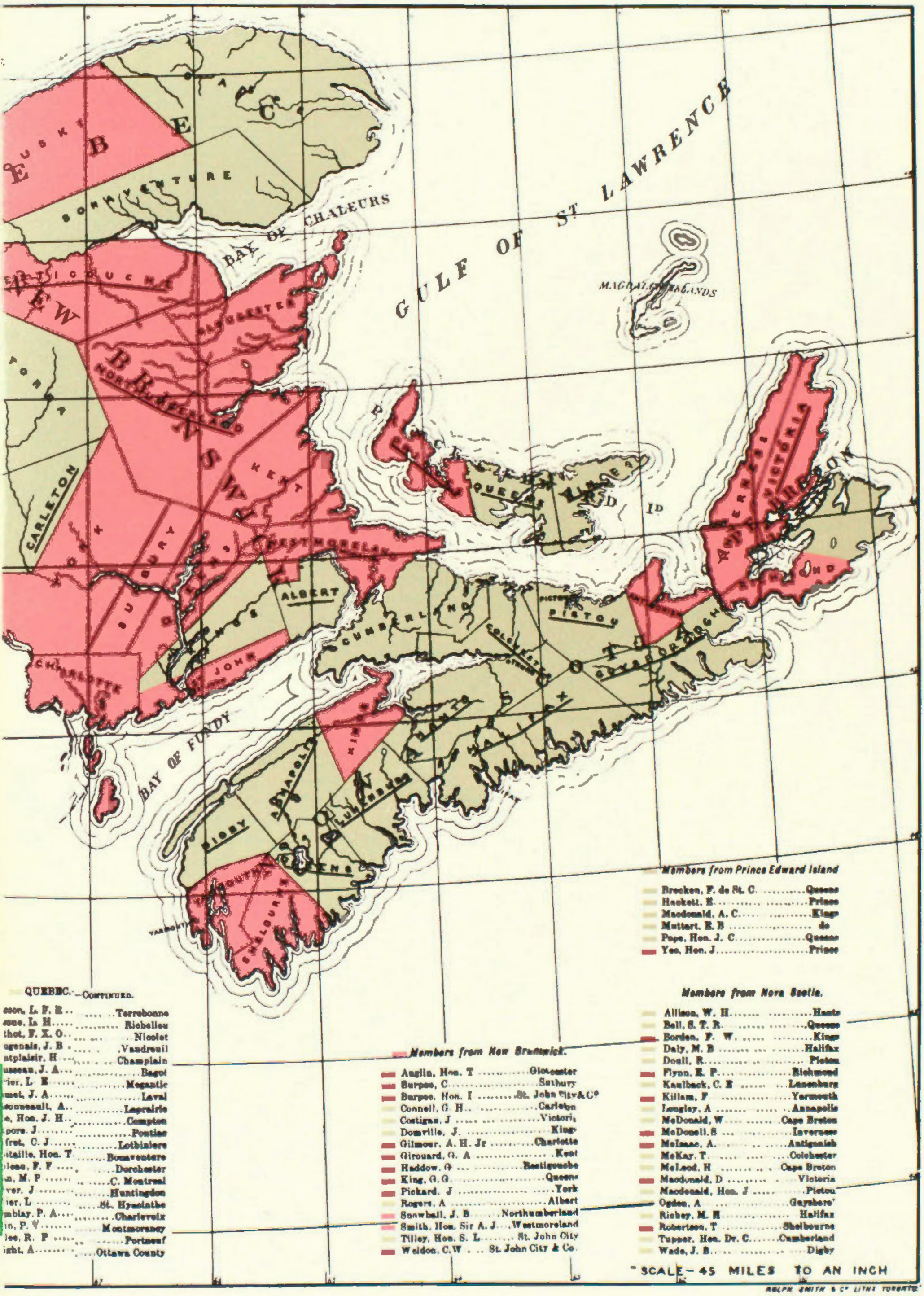
Postal-route maps appeared in Canada early in the 19th century. These were published by the Post Office Department, Ottawa, to help inform departmental officials on mail distribution arrangements. County and interprovincial boundaries were shown along with post office locations, railway lines and, occasionally, railway stations and road systems. In order to economize on costs and because only a few hundred copies of any one of these maps were required, blueprinting from linen tracings was developed as a process suitable for the purposes. Revisions were required constantly as new post offices were established and new distribution channels created.

As early as 1832 a map of Upper and Lower Canada, along with parts of New Brunswick and Nova Scotia, was issued by the Post Office Department and bore the name of John Dewe, post office inspector. In 1860 a map of Upper Canada depicting mail routes by dotted lines was published on a scale of 7 miles to the inch by Maclear and Company. In 1916 a 9-sheet map of Ontario and part of Quebec was issued, bearing the name of the chief draughtsman of the department at the time, L. A. (Lefevre Anstruther) Maingy.

The origin of electoral maps in Canada remains obscure but as early as the 1870s privately published atlases and separate map sheets were in circulation in this country for the purpose of showing constituency boundaries. Tackabury's Atlas of 1875 contained a map on a scale of 20 miles to the inch of Ontario showing 88 provincial districts.[4] Four years later William R. Robins designed and published his colorful electoral map No. 1. A green strip opposite a House of Commons member's name denoted, in a map box, a Conservative and red, a Reformer. The map also showed the political complexion of each riding in the 1874



MAP 7. Robins' Political Chart of Canada, 1879.


QUEBEC
NEW BRUNSWICK
GULF OF ST LAWRENCE
BAY OF CHALEURS
BAY OF FUNDY
MAGDALEN ISLANDS
BONAVENTURE
GLOUCESTER
NORTHUMBERLAND
KENT
CARLETON
WESTMORELAND
ALBERT
JOHN
CHARLOTTE
CUMBERLAND
PICTOU
COLCHESTER
GUYSBORO
HALIFAX
HANTS
KINGS
ANNAPOLIS
DIGBY
LUNENBURG
QUEENS
SHELBURNE
YARMOUTH
VICTORIA
QUEENS
KINGS
SCALE – 45 MILES TO AN INCH
QUEBEC.—CONTINUED.
…eson, L. F. R. ……Terrebonne
…esue, L. H. ……Richelieu
…thot, F. X. O. ……Nicolet
…ogenais, J. B. ……Vaudreuil
…ntplaisir, H. ……Champlain
…usseau, J. A. ……Bagot
…rier, L. E. ……Megantic
…met, J. A. ……Laval
…eonnesault, A. ……Laprairie
…e, Hon. J. H. ……Compton
…pore, J. ……Pontiac
…fret, C. J. ……Lotbiniere
…taille, Hon. T. ……Bonaventure
…leau, F. F. ……Dorchester
…n, M. P. ……C. Montreal
…ver, J. ……Huntingdon
…ier, L. ……St. Hyacinthe
…mblay, P. A. ……Charlevoix
…n, P. V. ……Montmorency
…lee, R. P. ……Portneuf
…ight, A. ……Ottawa County
Members from New Brunswick.
Anglin, Hon. T. ……Gloucester
Burpee, C. ……Sunbury
Burpee, Hon. I. ……St. John City & Co.
Connell, C. H. ……Carleton
Costigan, J. ……Victoria
Domville, J. ……Kings
Gilmour, A. H. Jr. ……Charlotte
Girouard, G. A. ……Kent
Haddow, G. ……Restigouche
King, G. G. ……Queens
Pickard, J. ……York
Rogers, A. ……Albert
Snowball, J. B. ……Northumberland
Smith, Hon. Sir A. J. ……Westmoreland
Tilley, Hon. S. L. ……St. John City
Weldon, C. W. ……St. John City & Co.
Members from Prince Edward Island
Brecken, F. de St. C. ……Queens
Hackett, E. ……Prince
Macdonald, A. C. ……Kings
Muttart, E. B. ……do
Pope, Hon. J. C. ……Queens
Yeo, Hon. J. ……Prince
Members from Nova Scotia.
Allison, W. H. ……Hants
Bell, S. T. R. ……Queens
Borden, F. W. ……Kings
Daly, M. B. ……Halifax
Doull, R. ……Pictou
Flynn, E. P. ……Richmond
Kaulback, C. E. ……Lunenburg
Killam, F. ……Yarmouth
Longley, A. ……Annapolis
McDonald, W. ……Cape Breton
McDonell, S. ……Inverness
McIsaac, A. ……Antigonish
McKay, T. ……Colchester
McLeod, H. ……Cape Breton
Macdonald, D. ……Victoria
Macdonald, Hon. J. ……Pictou
Ogden, A. ……Guysboro'
Richey, M. H. ……Halifax
Robertson, T. ……Shelburne
Tupper, Hon. Dr. C. ……Cumberland
Wade, J. B. ……Digby
ROLPH SMITH & Cº LITHS TORONTO

Parliament. Robins' map No. 2, contained on the same sheet, provided similar information on the Parliament of 1879. The publisher was Miles and Company of Toronto.[5]

Included in the 1880 illustrated atlas published by H. Belden and Company was a map showing federal electoral districts. However, the resemblance of this map to maps of that time showing all the counties, was striking. In 1891 a map was issued under the authority of the then Lieut.-Governor of the North-West Territories and published by the Department of the Interior, showing electoral districts for the Territorial Legislative Assembly. This map, a copy of which is to be found in the Map Division, Public Archives of Canada, Ottawa, also showed railway systems built or projected for the western interior.

The first federal electoral atlas was published at Ottawa in 1895. Queen's Printer S. E. Dawson, in his foreword, deplored the absence until that year, of any suitable Canadian electoral maps. This initial official atlas was patterned along the lines of a New South Wales, Australia, publication. Canadian postal maps were also used as a basis for this project and Mr. Maingy of the Post Office Department assisted in correcting proofs. The maps in this first official atlas in Canada pertained to six provinces, Quebec, Ontario, New Brunswick, Nova Scotia, Prince Edward Island and Manitoba.

FIGURE 50. Typical river conditions facing surveyors at high water. View of survey crew working upriver on Finlay River, B.C.

Maps were issued almost annually from 1886 to 1906 under the title "Mounted Police Stations and Patrols in the North West Territory." In the 1880s these were published under the authority of Prime Minister Sir John A. Macdonald and in 1906, when the word "Patrols" disappeared from the map title, the sheets were published under the authority of Sir Wilfrid Laurier as President of the Council. The 1906 map in this series bore the inscription "James White, Geographer."

Considerable chart production work was being performed in the latter part of the 19th century by the federal Department of Marine and Fisheries through the agency of the Great Lakes Surveys, later re-named the Hydrographic Survey of Canada, and since 1927 known as the Canadian Hydrographic Service. This aspect of mapping will be considered in detail in a chapter on marine charting.

The lack of topographic maps of Canada up to the middle of the 19th century compelled geologists, as has been noted, to study and to practice this type of map making in order to provide themselves with a base sheet on which to convey the geological information they had gathered. This unwelcome but necessary addition to labors already heavy proved costly in time and money. Topographic mapping duties drained away hours and energy that otherwise would have been devoted to geological investigations. Nevertheless early geologists made a highly valuable pioneer contribution to Canadian cartography. A high mark in this regard was reached with the publication in 1866 of Sir William Logan's large geological map of Canada. In 1877 the Geological Survey of Canada published with its report of that year G. M. Dawson's map of the southern interior of British Columbia, one of the first Canadian sheets on which the hachure technique was employed to help depict land forms on paper. Drawn on the scale of 10 miles to the inch this map was one of the first large contributions to geographical knowledge of that part of Canada.[6]

In post-Confederation years mapping developments in the United States had a profound impact upon cartographic progress in Canada. From 1819 to 1843 the rapid increase in population in the American west resulted in increasing demands for road, canal and port surveys in the east. At the same time engineers of the then newly-organized Army Topographic Bureau made large-scale maps of the Gulf of Mexico coast, the Upper Mississippi basin and on the prairies between the Mississippi River and the Rocky Mountains. The acquisition of new lands in the far west and the discovery of gold in California emphasized the need for reliable mapping of transportation routes west of the Rockies.[7] The period 1861-1879 began with the Civil War and the resulting needs of military cartographers spurred notable advances in mapping techniques. With the coming of peace four western land survey projects were undertaken by the War and Interior Departments. In this way more than 600,000 square miles of the western interior of the United States were mapped. With the establishment in 1879 of the United States Geological Survey as the main mapping agency of the federal government, the systematic topographical and geological mapping of the United States was carried forward by a well-trained, competent group of professionals in the field. At that point in history it may be stated that topographic mapping in the United States came of age.

In the 1880s, through the formation of the Canadian Hydrographic Survey along with the creation of a Topographical Surveys Branch, in succession to the Technical Branch in the Department of the Interior, fresh stimulus was given to the growth of Canadian cartography. In 1886 a notable forward stride in land mapping took place when Deville introduced the survey camera in mountainous areas of the Canadian West. This experiment proved eminently successful. In the field survey of 1901 A. O. Wheeler commenced survey camera work in the Selkirk Range. He had been instructed to prepare a map of that region. The Canadian Pacific Railway line was used as a survey base line *pro tem* and a secondary triangulation was undertaken for the purpose of fixing camera stations and locating peaks.

In 1886 Dr. Robert W. Bell, a member of the Geological Survey of Canada caused a flurry in high official circles in Ottawa when a paper he delivered at the Dominion Land Surveyors' Association annual meeting drew attention to some glaring shortcomings in the map-making policies and practices of federal government departments.[8] Dr. Bell pointed out that departments active in the mapping field made no attempt to work on a uniform scale. He urged that a base map common to all departmental cartographic work be adopted. In addition to uniformity of scales and projections he proposed that there be uniformity in map nomenclature. For example he listed variations he had detected in the spelling of Nipigon, namely Nipegon, Neepigon, Neipegon and Nipeegon.

Bell advocated as well the establishment of a central map bureau in Ottawa, a place where cartographic information from all government sources could be pooled for reference purposes. He pressed for a proper trigonometrical survey of all Canada and emphasized that unless such a survey was made it would be impossible to map correctly even the well-known tract between Lakes Huron, Erie and Ontario. This probability had come to Bell's attention while he had been preparing a geological map of that region. When all existing survey plans of large townships had been placed together he discovered these could not be made to fit into one another or into the represented space between the lakes. Rail lines would not cut township survey lines where they ought to do and townships would not conform to the lake-shores as laid down in charts, no matter what system of projection was employed.

The stir caused by this surprise attack resulted in the appointment by the Association of a standing committee of two experts, W. F. King and Robert Bell himself, to inquire into the best means of applying a uniform system of map making in the various federal agencies most concerned. The committee report was not optimistic over prospects for standardization.[9] The departments mainly involved were Public Works, Railways and Canals, and Interior. The latter department possessed two organizations engaged in topographical mapping, the Technical Branch and the Geological Survey. Other departments in Ottawa produced maps and charts but in a relatively minor way. These were the Post Office, Marine and Fisheries, Agriculture and Indian Affairs Departments.

It was found by the standing committee that surveys by Public Works and by Railways and Canals were usually undertaken in connection with engineering projects in which basic measurements were made by a 100-foot chain. Accordingly, plans of those departments were constructed on scales representing multiples of 100 feet, that is, 200, 300 or 2,000 feet to the inch. On the other hand, in standard land surveys under the Interior Department, 66-foot chains were employed. Thus for larger maps the 6-miles-to-the-inch scale was used, or some multiple thereof, as this was the natural scale for the 6-mile-square township. Moreover the use of that scale in the western interior made it possible for map makers to put the whole width between two successive initial meridians on one sheet of convenient size.

In exploratory surveys of the Geological Survey of Canada the unit of measurement was one mile. In constructing his earliest maps Logan consulted maps of Crown Land surveys, Admiralty charts, rail surveys, county maps produced by private enterprise, military maps and hydraulic surveys. The scale that Logan adopted for his special purposes was that of 4 miles to the inch or multiples thereof. On the whole the committee was compelled to conclude that only the scales used by the Geological Survey and the Dominion Lands Branch were conformable and that it was practically impossible to adopt any uniform scale to mapping done by other federal departments or agencies. Each department, having its own special purposes to serve, selected the scale best suited to the accomplishment of its objective.

In March, 1886, Thomas Fawcett, as president of the Dominion Land Surveyors' Association, addressed a memorial to the Minister of the Interior on behalf of that organization. He cited the mapping activities and advances of various European nations and the United States and pointed out that all of these were based on triangulation surveys. He advocated the immediate establishment of a chain of primary triangulation along the St. Lawrence River from the Gulf to the Great Lakes, a system that would provide a foundation for the extension of surveys into the western interior and which could be readily connected up with existing nets of the United States Lake Survey, conducted by the Corps of Engineers, United States Army.

Up until 1889 maps issued by the Technical Branch, Department of the Interior, Ottawa, depicted the progress of surveys and settlement on the western plains. These maps bore three color tints to portray land that had been patented, land entered upon by settlers but not yet patented, and land reserved from settlement. Each map sheet showed an area of about 50 by 80 miles and was drawn on the scale of three miles to the inch. Such maps were founded on various sources of information: official Dominion land surveys, locations of railways and railway stations, post offices, Indian Reserves, forest reserves, federal parks as well as roads and trails. Latitudes and longitudes were given to minutes, altitudes in feet above sea level. Sheets were numbered to a regular pattern and each sheet was named after some important community or physical feature contained within the area covered. In the spring of 1890 a map of Manitoba and the North-West Territories was prepared by the Department of the Interior for display at the Bremen (Germany) Exhibition. The purpose was to illustrate the development of Canada's natural resources, especially agriculture. The map excited considerable interest.

FIGURE 51
J. E. Chalifour.

In the spring of 1892 Deville reported that "a map of the Railway Belt in British Columbia, on a scale of 3 miles to the inch, had been completed and printed in 8 sheets. A small map of the North West Territories, showing electoral districts, was prepared for photo-lithography. Mr. Johnson was supplied with information for a new edition of the large map of Manitoba and the North West."

James White (1863-1928), who came to be acknowledged as a prominent Canadian geographer of his day, began his career with the Geological Survey of Canada in 1884 as an assistant topographer. Born in Ingersoll, Ontario, White graduated from Royal Military College, Kingston, at the age of 20. During the following 10 years he served on field parties in central Canada and with G. M. Dawson in the Rocky Mountains. In June, 1894, he succeeded Robert Barlow, officer in charge of topographic work for the organization. White continued as a geographer and chief draughtsman in the Geological Survey until June, 1899, when he was appointed Geographer (later, Chief Geographer) in the Department of the Interior. He held this position until 1910 when he became secretary to the federal Conservation Commission. James White became a specialist in boundary questions and wrote prolifically in this field and on matters related to the geography of his country.[10] His most important contribution to Canadian cartography was his *Atlas of Canada*, the first edition of which was published in 1906. This work was revised and enlarged in 1915 by Joseph Epiphane Chalifour (1863-1953), a successor to White in the post of Chief Geographer. Born in Rimouski, Quebec, Chalifour came to Ottawa in 1881. He entered the federal civil service in 1884 and continued in map-making work until his retirement in 1931. The Roquette Gold Medal of the Geographical Society of France was awarded to White and Chalifour as co-authors of these early federal government atlases of this country.

White left a fairly complete record of topographical map-making work by Canadian geologists from 1842 to 1896.[11] For example, White referred to the general reconnaissance made in 1877 by G. M. Dawson in the southern interior of British Columbia. "The geological intricacies of the region", he pointed out, "necessitated the doubling of the scale of the original map [of the area] and, consequently the re-delineation of the topography." There was a re-survey in 1888-90 by Dawson and his topographical assistant, James McEvoy. A loose network of triangulation, based on the Canadian Pacific Railway line and other surveyed lines, was constructed between points, and elevations determined barometrically. Other details of topography were filled in from paced and track surveys checked by latitude observations. The topographical mapping work of Sir William Logan, Murray, Richardson, Low, Bell, Selwyn, Tyrrell and McConnell was also described by White in his writings in considerable detail.

Mount White, on the upper Red Deer River in Alberta, was named by Dawson in honor of his former field assistant whose subsequent surveying, mapping and writing added significantly to the general fund of knowledge of Canada's geography. In 1899 Hon. Clifford Sifton authorized White to commence compilation of a new map of Canada, excluding the northern islands, in eight sheets on a scale of 35 miles to the inch. This was published in 1903. When that task was completed a series of topographic maps of the more settled parts of Canada was undertaken in the same year. Some of these maps were on a scale of 1:500,000 (7.89 miles to the inch) but most were 1:250,000 (3.97 miles to the inch). White observed that as these maps were engraved on copper plates, corrections of them could be made from time to time by hammering out from the back of the plate, then re-surfacing the work side of the plate.[12]

FIGURE 52
Reverse of French medal given to James White and J. E. Chalifour, 1917.

From 1890 to 1920 annual reports of the Surveyor General of Canada reveal a steady growth in government mapping work carried out under his authority and direction. In 1890 the Topographical Surveys Branch, Department of the Interior, produced 49 map sheets and printed 5,640 impressions. By 1909 these production totals had increased to 93 map sheets and 139,850 impressions. The staff of the mapping section of the Branch, scattered about Ottawa in four downtown office buildings, had grown to 51 men, headed by a chief draughtsman. Four of the staff specialized in compiling sectional maps.

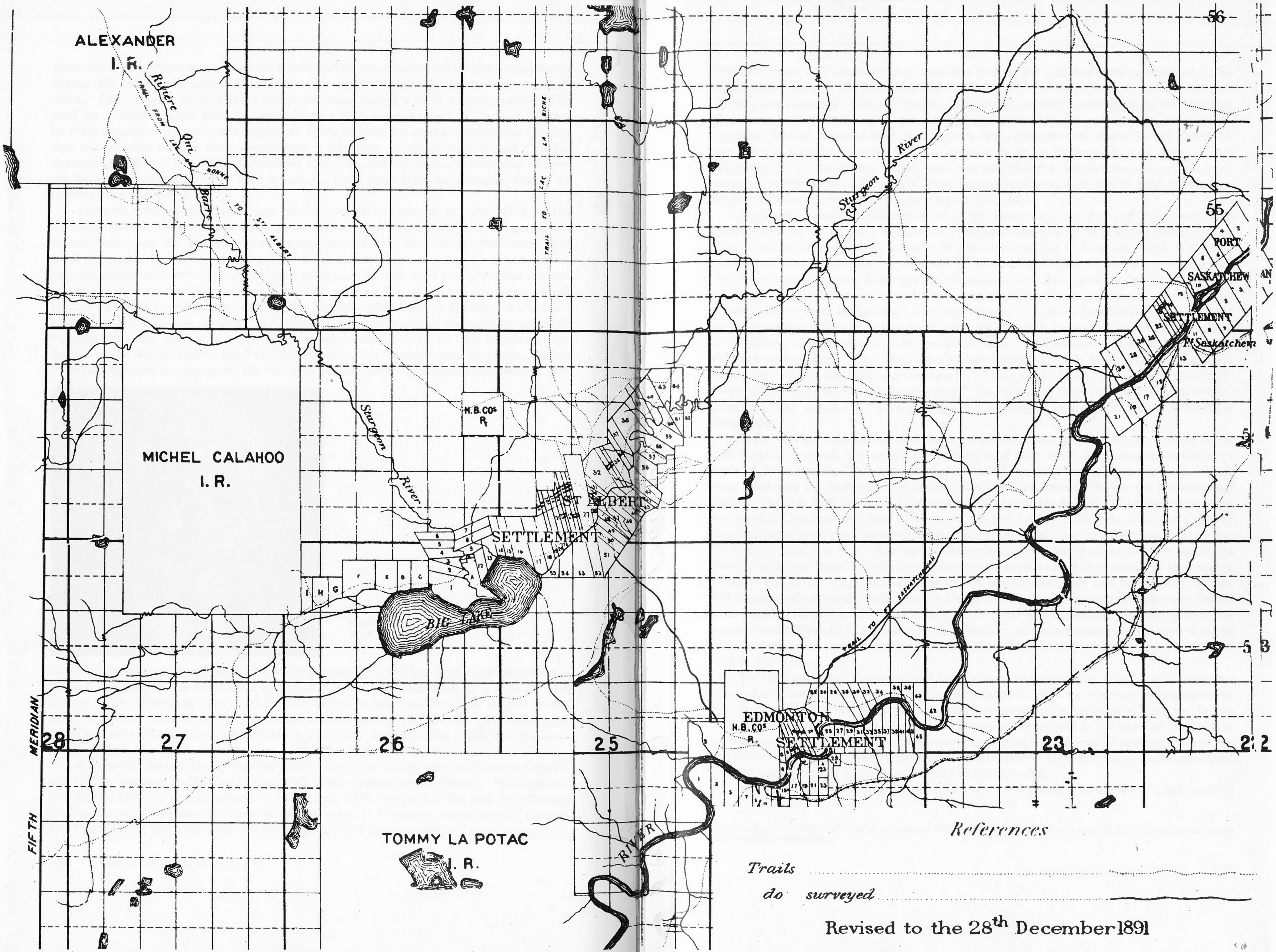
But this generally cheerful picture was not without some blemishes. In his 1904-05 report Deputy Minister Cory of the Interior Department sounded a critical note when he stated that "existing maps of Canada, to a large extent, are based on imperfect surveys or upon surveys that, while individually accurate, are not properly coordinated. In mapping, when these surveys are joined to one another, errors tend to accumulate until serious discrepancies appear: the individual pieces of the map can no longer be fitted together without an adjustment." Cory seemed to echo Bell's complaint made almost a score of years earlier. The need for a more accurate basis for topographic mapping, emphasized by Thomas Fawcett in 1886, became more and more apparent. Early in 1905 the federal government decided that triangulation surveys should commence in the more settled parts of central Canada. Accordingly, in that year Chief Astronomer King was authorized to establish near Ottawa the point of commencement of such a system. Four years later the Geodetic Survey of Canada came into being.

Mapping work in the Department of the Interior was carried on, after 1873, in the Technical Branch, directly under the Surveyor General. On July 5, 1890, this organization became known as the Topographical Surveys Branch and this title persisted until 1922 when it changed to the Topographical Survey of Canada. By adopting this title a clearer line was drawn between federal government surveys on the one hand and provincial government or private enterprise surveys on the other. A rival federal government organization functioned under a similar title, namely, the Topographical Surveys Division of the Geological Survey of Canada. In order to relieve individual geologists of the growing burden of topographical map making, it was decided at policy-making levels in 1908 to form a new division under Walter Halcro Boyd (1878-1960) as its first Topographical Engineer. Nearly three decades were to pass before the two main civilian mapping organizations became one.

FIGURE 53
W. H. Boyd.

But at the time this step represented a notable advance. For the first time mapping and mapmaking functions of the Geological Survey of Canada were organized as a separate unit and the work undertaken by a corps of men trained in map making rather than as geologists. High standards of work were observed and mapping placed on a more systematic basis, generally utilizing the mile-to-the-inch scale on a sheet covering either 30 minutes of longitude and 15 minutes of latitude or 15 by 15.

A third parallel but less competitive government organization was the Mapping Department of the Intelligence Division at Canadian Militia Headquarters, Ottawa. The organization of this Division was completed in November, 1904, and part of the task of collecting intelligence was the procuring of reliable military maps.[13] Previously, small areas of Ontario and Quebec lying along the International Boundary had been surveyed by army surveyors in



MAP 8. Portion of map of the Edmonton area, 1891, the first sheet issued in the federal government's Sectional Map Series. Scale: 3 miles to the inch.

1904 and maps with contours on a scale of a mile to the inch had been constructed, to be lithographed early in the following year. The British War Office loaned, by arrangement, six non-commissioned officers of the Royal Engineers trained in surveying to the Mapping Department. In 1909 this title was changed to Survey Division and, in 1926, to the Geographical Section, General Staff. In time this unit developed into Army Survey Establishment, Royal Canadian Engineers, Department of National Defence. As a complete photo-mechanical and lithographic section had been established at Ottawa for military mapping purposes in Ottawa as early as 1914, there was no need after that date to send map manuscripts to Ordnance Survey in England for reproduction.

During the years of rapid settlement of the western interior, maps of that region were difficult to keep up to date. Successive revised editions had to be printed. Sometimes so many revisions were required, an entirely new drawing had to be made. After 1905 zinc plates gradually replaced the use of stones in the printing of map engravings, partly because the plates were much more easily stored and because of the development of photo-mechanical processes. By 1916-17 some 128 sectional map sheets had been published covering about 500,000 square miles of Canada. An index map of Dominion land surveys was included in the departmental report of that fiscal year. In 1918-19 a change was made in the method of producing original drawings for sectional maps. Information on township plans was stamped with printer's type rather than by hand lettering. This new procedure dispensed with much tedious, exacting and slow work. "Three young ladies", it was officially noted, "were added to the staff to do the stamping." By 1919 some maps of interprovincial boundaries had been drawn for "photozincographic printing"—an awesome technical term for those times.*

In the course of the half-century under review four principal map series of major scope and purpose featured the output of topographical map work by Canadian government agencies, including the Department of National Defence. In order of their appearance these were known as the Sectional Map Series, the Chief Geographer's Series, the Geographical Section, General Staff Series, and the National Topographic System. In 1891 the first sheet was issued of the Sectional Map Series on its scale of 3 miles to the inch. This was a map of the Edmonton area, subsequently identified under an initial numbering system as Map No. 79, later as Map No. 315. These sheets were printed by authority of the Department of the Interior and were based on office compilations of surveys under the Dominion land survey system. The earlier maps lacked contours but showed highways and homesteads. About 134 sheets in all were published in this series up to 1922, although some of these maps underwent revision more than 25 years after that. In 1905 it was provided, in theory, that this series would include all of Canada. In fact, however, this series never covered more than the three provinces of the western interior, British Columbia and a single map of Dawson, Yukon Territory.

The Sectional Map Series suffered from several disadvantages. First, it did not cover areas of uniform size; second, the arrangement failed to allow for coverage by a progressive system of numbering and, third, no provision was made for including other than the 3-mile-to-the-inch scale. About 1919 these sectional maps were improved by the addition of contours. In subsequent field operations a new technique, employing batteries of aneroid barometers, for obtaining elevations, was adopted. Before this series of Canadian maps was discontinued the 134 sheets covered a total area of 536,000 square miles.

Partly because the Sectional Map Series was limited largely to areas in Canada west of

*This is likely a misuse of the term because by 1919 rotary offset presses and normal photographic procedures were in effect generally.

Winnipeg, a new map series was introduced in 1903. This became known as the Chief Geographer's Series. Contours were not shown but elevations at railway stations were indicated. Up to the middle of the 1930s 60 maps of this series had been issued on scales of 1:250,000 and 1:500,000. These scales were apparently chosen in order to fit in with the decimal system and yet keep close to the conventional English scales of 4 and 8 miles to the inch. The first sheet of the Chief Geographer's Series portrayed part of southwestern Ontario. No provision was made for expansion of this series on the basis of other scales, nor did the sheets join properly with the most easterly sheets of the Sectional Map Series.

Several attempts were made to bring Canadian topographical mapping under a single comprehensive system. An index system was initiated in 1912, based on the three-mile sectional sheets but this was never put into effect. In 1923 another abortive attempt was made to inaugurate a national topographic system, based on numbered primary blocks corresponding to the "Carte du Monde" or Millionth Map; numbered primary blocks being 4 degrees of latitude by 6 degrees of longitude.

In 1927 the present National Topographic System, which was designed to include Newfoundland if and when its government agreed to this participation, was instituted. This series of maps derived some of its attributes from the Survey of India System, mainly in respect to layout of sheets and the relationship of various scales used. Though provision was made for 1-mile, 2-mile, 4-mile and 16-mile-to-the-inch scales in this National Topographic System, there was a definite lack of any 8-mile-to-the-inch scale. The National Topographic System maps have continued to be issued and represent the latest stage of advancement reached in the production of accurate Canadian topographic maps of practical application.

After the First World War a decline in public demand for land surveys in the west enabled the Topographical Survey Branch to use the special training and knowledge of Dominion land surveyors on staff to work in the western interior on topographic surveying and mapping. Information previously gathered by surveyors in the prairie region of Canada had become out of date or was incomplete. Since original surveys had been made, some streams had altered their courses, certain lakes had dried up, swamps and marshes in many instances had drained, bush in various places had given way to cultivation, railways had been built and small settlements had grown into thriving towns and cities. With the aid of these post-war surveys, sectional maps were transformed into topographic maps of a high order of representation. In open country a field survey party could revise one sheet covering 4,300 square miles during a single season.

With sectional-sheet revision it became necessary to introduce township-outline levelling, consisting in each case of a line of levels coinciding with the boundaries of a township.[14] Every material undertaking by man for the advancement of the human lot involves the determination of levels whether it is a homesteader seeking to drain his land or a civil engineer designing the route of a new railway line. As soon as office records concerning levels within a country begin to accumulate it becomes necessary to refer or relate these findings to one common surface so that the difference in altitude between two points can be calculated. In a country such as Canada the ideal datum is one which can apply to various places, independently of any fluctuations in land surface. Mean sea level, the surface the ocean would assume at the coastline, if not acted upon by external forces, supplied the only reference surface that could meet this requirement. The determination of mean sea level can be made authoritatively from continuous tidal observations over a period of years.

A great stride forward in levelling aspects of surveying and mapping in this new nation was taken in 1901 when James White's book, *Altitudes in the Dominion of Canada*, was published at Ottawa as a report to the Geological Survey. The book constituted the first general compilation of altitudes undertaken in this country, a project that began as a private investigation. Incidentally this volume included a geological relief map of Canada and the United States, printed in brown tints, and bearing the name of C. O. Senécal, Chief Draughtsman of the Geological Survey of Canada. A second (revised) edition of the book was published by the Commission of Conservation, Ottawa, in 1915. White's supplementary work, *Dictionary of Altitudes in the Dominion of Canada*, first published when he was Chief Geographer, was followed by a second edition in 1916.

In the introductory notes in his first volume on altitudes White pointed out that with the exception of the work of R. Steckel of the federal Department of Public Works, very little had been done in Canada in the form of levelling up to the end of the 19th century. The first precise levels in this country were those run by Steckel in 1883. These originated at a United States Coast and Geodetic Survey bench mark at Rouses Point, near the International Boundary south of Montreal, and were carried along the Richelieu River to Sorel on the St. Lawrence River. The purpose was to establish accurate vertical control for harbor and river improvements. All the levels run by the Public Works Department were adjacent to waterways and mainly confined to eastern Canada along the St. Lawrence and the Great Lakes. The Department continued to run levels until 1931, at which time its system comprised in all about 5,600 miles of such levels and about 3,800 bench marks.

In 1884 J. W. Spencer, in a bulletin of the United States Geological survey included elevations on a number of railway lines in eastern Canada. Five years later W. Upham published tables of altitudes relating to the southern parts of the North-West Territories.[15] But these activities constituted all of the precise levelling work attempted in Canada up to the turn of the century and until White's volume appeared. In compiling his tables White used railway and canal profiles, elevations of railway stations and sidings, river crossings, depressions and summits, canoe routes, lakes and mountain passes.

In 1931 the Department of Public Works transferred to the Geodetic Survey of Canada all original field books and records based on its precise level operations, activities that had commenced nearly a half-century earlier. By 1934, when amalgamation and coordination of these functions within a single organization were completed, all precise levelling in Canada became consolidated into one national system, referred to one datum. This datum, mean sea level, was to be determined at coastal points by the Canadian Hydrographic Service and extended inland by the Geodetic Survey of Canada.[16]

Not all the mapping and map making in Canada between the time of Confederation and the First World War took place under federal government auspices. The governments of Ontario and British Columbia, for example, encouraged these important activities within their own boundaries.

Ontario

The mapping of what is now Ontario under instructions of provincial authorities had its origins prior to 1856. In that year Commissioner of Crown Lands of Canada, Hon. Joseph Cauchon, reported that a map of [the Province of] Canada was being prepared in his office on a scale of 2 miles to the inch, showing lots and ranges of townships. The Commissioner indicated that "several maps of the Province have been published but none on so large a scale as to meet the requirements of the Department". He paid tribute to the excellence of Joseph Bouchette's 1846 map but explained that it required a scale so small that subdivisions of townships could not be represented. As early as 1831 Bouchette's map of the Montreal district, Lower Canada, included a number of counties in Upper Canada (Eastern Ontario) along with an insert showing the route of the then newly-completed Rideau Canal, with elevations marked at points along its course. This map was published in London, England, by James Wyld.

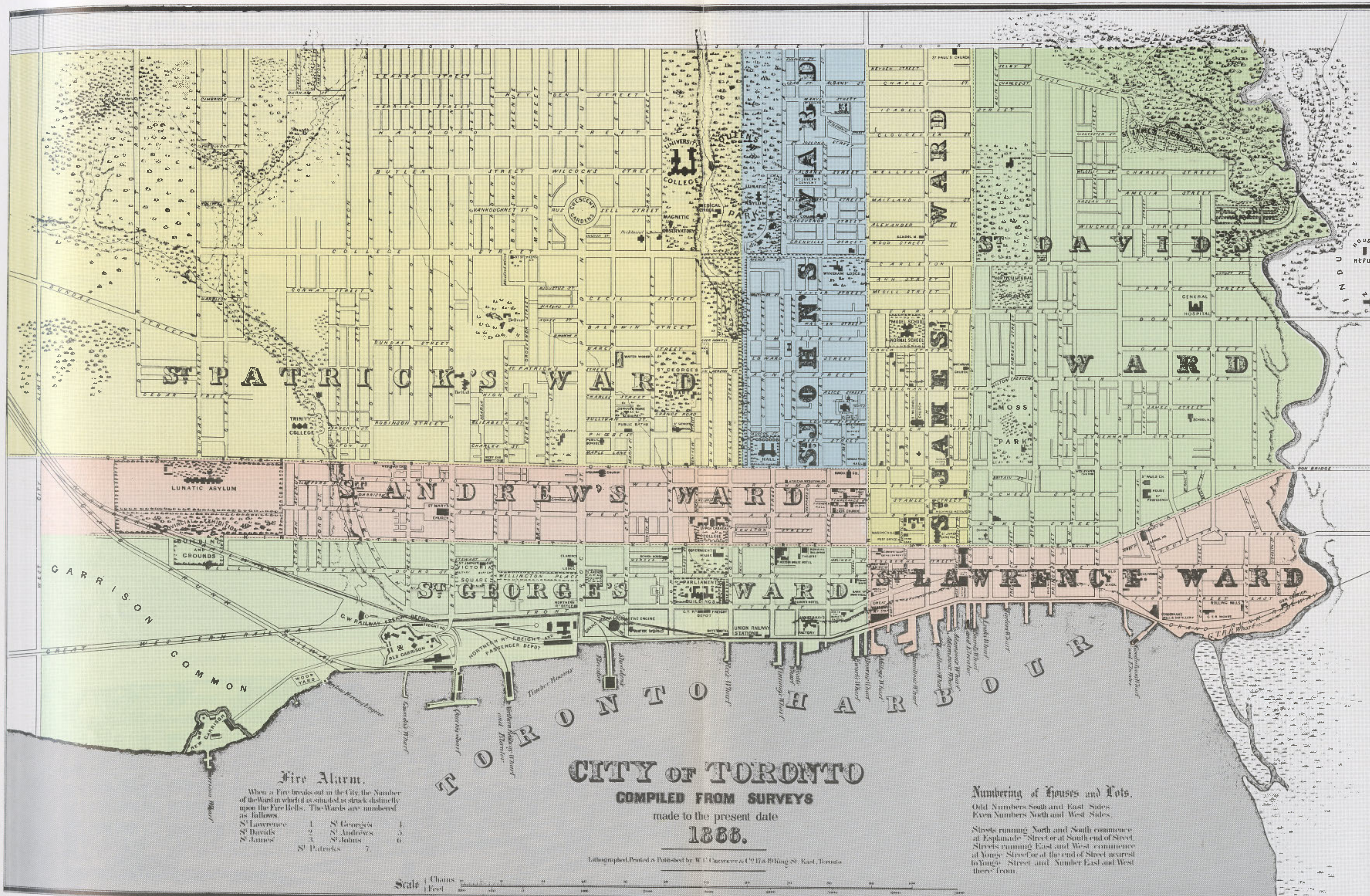
Cauchon observed also that as previous maps of the Province of Canada had become more or less obsolete and as parts of them were founded on imperfect information, he hoped the map that he had in the course of preparation would avoid such inadequacies "because nothing will be introduced into it that has not been determined by survey . . .". He promised as well the production of an edition of the map on a scale of 12 miles to the inch "for the more ordinary purposes for which a general map of the Province is required". Considerable doubt has continued to exist over whether these maps ever reached the publication stage. There is, however, in the Ontario Archives a map of the North West Part of Canada, Indian Territories and Hudson's Bay, compiled and drawn by Thomas Devine, Provincial Land Surveyor and Draughtsman, published in 1857 under the authority of Commissioner Cauchon. No scale is given and few settled parts of territory now included in Ontario are shown.

One of the earliest examples of systematic mapping and map making in Ontario was the Huron and Ottawa Territory Series. Editions of this map appeared almost every year from 1861 to 1867 inclusive and from time to time during the remaining years of the 19th century. The 1888 version was hand-colored. In the beginning maps of this series were published by the Crown Lands Department at Quebec, with the drafting work directed by Thomas Devine. On the 1868 edition the name of Rae Smith appears as engraver. The demand for this series likely arose from increasing settlement activity and from the relatively lucrative lumbering industry in that part of Canada. The 1861 and 1862 issues showed routes of colonization roads and were printed in New York City. Waterways were depicted by blue tints and roads by red lines. The 1863 edition, on a scale of 5 miles to the inch, portrayed land and soil categories by the use of solid blocks of red, grey and brown. All these maps were published by the Crown Lands Department of Upper Canada. The name of H. F. Hayward appears as draughtsman on many of these productions. Plans and maps were also being produced in this period under the same auspices and depicting the north shores of Lake Superior and Huron, published by W. C. Chewett and Company, Toronto. By 1866 yellow map tints were being employed to denote mining locations, red to identify Indian Reserves and blue to indicate the trend of shorelines.

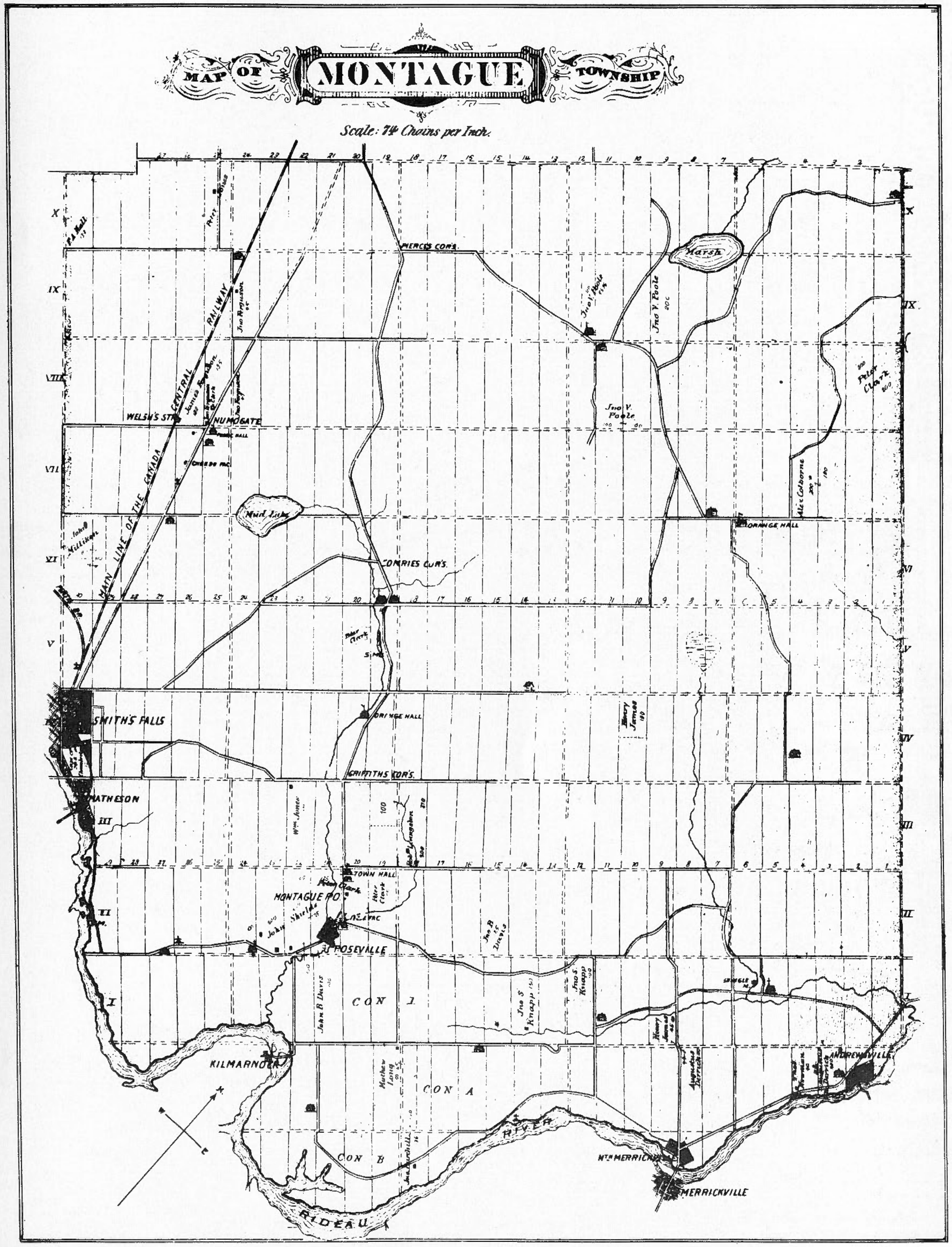
In 1872 Commissioner R. W. Scott reported that he had ordered the preparation of maps showing townships "recently surveyed", also colonization roads. Maps of mineral claims "patented at Thunder and Black Bays" as well as maps of Lakes Superior and Huron were issued on the scale of a mile to the inch. These were published by Copp, Clark and Company of Toronto, a firm that was destined to become prominent in Canadian map lithographing work. This 1872 mention may well represent the first time this firm's name appeared on any government-authorized map concerning lands within the new province.

In 1893, with the creation of Algonquin Park as a provincial preserve a new series of Ontario government maps came into being, the Algonquin Park Series. The 1893 map of the park was printed directly from lithographic stones by a Toronto firm and was included in the report of the Ontario Park Commission. This map was revised and reissued in 1908, 1911, 1914 and 1921 and subsequently, in an effort to keep pace with park expansion and developments.

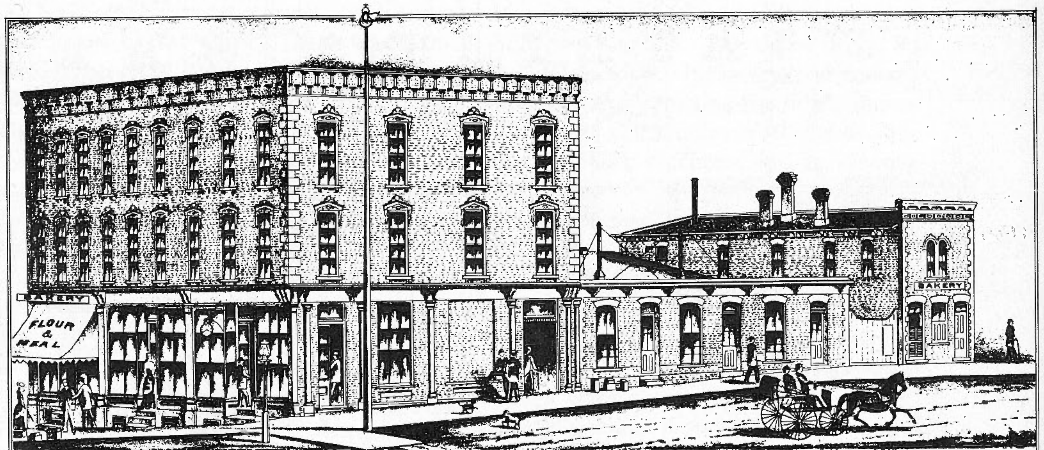
Despite these energetic attempts there remained a shortage of reliable official maps in relation to rapidly expanding requirements. In 1894 the President of the Royal Society of Canada declared that ". . . the actual state of the geographical delineation of the older provinces leaves much to be desired. Many parts of these were surveyed during the early history of the country by methods which would now be regarded as extremely primitive, while no such thing as a topographic map exists for any considerable tract in any of these provinces; although some approximations to such maps have been attempted in certain districts by the Geological Survey, for its own purposes. . . ".[17]



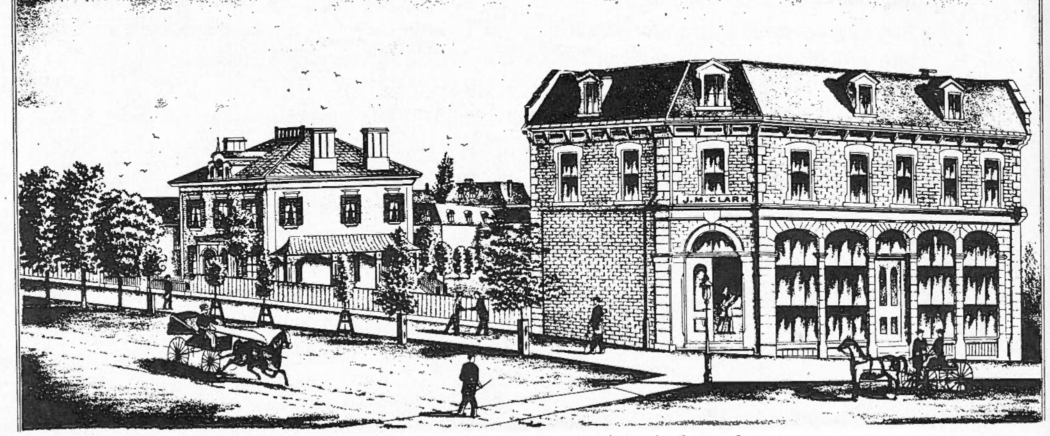
MAP 9. Plan of the City of Toronto, compiled from surveys made to 1866, published by W.C. Chewett and Company.



MAP 10. Map of Montague township, Lanark county, Ontario, illustrated with local sketches from *The Atlas of Canada* published by H. Belden and Company, Toronto, 1880.



GARRETT'S BLOCK, BECKWITH ST, SMITH'S FALLS, ONT.



STORE & RES. OF J. M. CLARK SMITH'S FALLS, ONT.

The Lake of the Woods Series of Ontario government maps began in 1897. In 1903 and subsequent years revisions were made and reissues published. A Rainy Lake Series followed. In 1899 a map of the province, ostensibly the work of Copp, Clark and Company was published and, curiously, bore the official Ontario crest. Undoubtedly the map was the work of draughtsmen in the employ of the provincial government.

In 1900 Commissioner of Crown Lands E. J. Davis reported in connection with Ontario territory lying between the Canadian Pacific Railway and James Bay that "the reports of the various exploration parties, together with a map of the country explored, will be printed and presented to the Legislature concurrently with this report." In 1903 the Crown Lands Department issued a revised map of part of Kenora District on the scale of a mile to the inch. This map underwent subsequent revisions. In 1910 as a result of survey work by Louis Valentine Rorke (who became Ontario Director of Surveys in 1918 and later, Surveyor General of the province) a "Plan of the Townsite of Winnipeg River Crossing on the National Transcontinental Railway, District of Kenora", was published by E. H. Harcourt, Toronto, on the scale of 200 feet to the inch.

FIGURE 54. 'Lining' survey barges upstream in swift water, 1900.

From 1901 to 1904, when the final report of the Commissioner of Crown Lands for Ontario was issued, no mention was made of maps constructed or published. Nor were any references of this nature contained in succeeding reports of the Minister of Lands and Mines or of his successor, the Minister of Lands, Forests and Mines to the end of the period under review.

In April, 1912, a significant and timely report was made to the Ontario government by W. R. Rogers, who had spent several days in Ottawa in the previous month, apparently on the instructions of provincial authorities, investigating equipment and methods being employed in the several map-making bureaus of the federal government. Rogers advised that the topographic contoured maps being produced by the Geological Survey of Canada were of a high order of excellence, equal to those of the United States Geological Survey but that the cost of this work was high. He pointed out that Chief Geographer J. E. Chalifour of the Department of the Interior, Ottawa, had offered to supply Ontario with transfers from copper plates whenever provincial authorities might need them for map compilation. Rogers also commented that compared to the standard topographic sheets then being issued by the Interior Department on scales of 4 and 8 miles to the inch, maps published by the Ontario Surveys Branch were inferior. He suggested that if a new map of Ontario was to be undertaken by the province, federal maps should be used as a basis for the project. He called attention to the fact that the province of Quebec was making rapid strides in improving methods of map preparation and reproduction and that "unless we spend more money on map work we'll soon be outstripped by that province."[18]

In a memorandum to the Deputy Minister of Lands and Forests, dated May 21, 1921, Director of Surveys Rorke listed 24 maps depicting various areas of the province and published under the direction of the department. He cited the costs of production in each case. "While the costs of printing some ten to twenty years ago did not amount to a large sum in the year", the Director observed, "it will be noted that [these] have so increased . . . that the Department would be justified in making a charge for maps supplied . . . ".

During most of the 50-year period under review a highly useful contribution to Canadian mapping was also made by the Ontario Bureau of Mines. Geologists in the employ of the province began mapping in 1881. Ten years later the Bureau of Mines was created to form part of the Crown Lands Department. In 1920 this organization became the Ontario Department of Mines, after its separation from the Department of Lands, Forests and Mines. Up until 1917 the Bureau had issued 88 maps, many of which are now out of print. Although the primary purpose of the sheets was to convey geological information, these were also detailed planimetric maps. The earliest maps of this nature were area compilations at various scales from 2 miles and 8 miles to the inch.

The Cobalt silver camp, the first major ore discovery in the province in the 20th century, was mapped in detail by Mines Bureau personnel using cadastral survey control supplemented by plane-table work, underground surveys and mining plans. For the more general areas, gaps between base or meridian lines were mostly filled in by surveys along mining claim lines. By 1917 most of the then known mineralized areas had been covered by at least some mapping. All such maps were accompanied by highly detailed and well-illustrated printed reports with references to means of access, topography, wild life and vegetation.

British Columbia

In British Columbia pressures for increased map production mounted with a marked growth in population in that province after 1871 and with the quickening pace of resources development. An expanding mining industry was mainly responsible for the steady demand for more detailed cartography although lumbering, fishing and farming contributed to the growing need.

Cadastral surveys on which any mapping had to be based were largely scattered and unrelated in earlier post-Confederation years but gradually some of the separated patterns were joined. The all-too-frequent failure of boundary lines to coincide on such contacts proved the need for a system of over-all control. Probably the first sustained effort to establish primary triangulation for this purpose was made by Tom Kains (1851-1901), who occupied the post of Surveyor General of British Columbia from 1891 to 1896. In his 1892

FIGURE 55
Surveyor-mappers in a cottonwood canoe of their own construction on the Naniko River, B.C.

annual report to the Chief Commissioner of Lands and Works, Kains stressed the importance of topographic mapping in the province and drew attention to the technique of photo-topographic surveying in mountainous regions, as introduced six years previously by Deville. Kains suggested that panoramic photographs be taken from each camera station occupied in connection with a system of triangulation surveys proposed for British Columbia and from which contoured maps could be compiled.

In subsequent years up to 1900 a fair beginning was made on the Kains' program. Ontario-born W. S. Drewry (1859-1939), who proved to be an apt pupil of the Ottawa triumvirate of Deville, Klotz and King, came to the coast province in the early 1890s and in 1892 commenced a map of the Nelson area, which published in 1896 was the first contoured map of any part of British Columbia on which colors were used to portray various types of topographic information.

In that period there was lively activity in the staking of mineral claims in the Kootenays and in order to tie in these scattered holdings, local triangulation nets were established called Mineral Monuments or, more briefly, "M.M.s". Prominent in the performance of these surveys, commenced in 1896 were Ernest Albert Cleveland (1874-1952), and James Herrick McGregor (1869-1915).[19] Cleveland's work resulted in 1898 in a map of part of the East Kootenay. Based on the field work of this competent Dominion and provincial land surveyor this sheet appears to have been the first printed map of a British Columbia area serving to emphasize the importance of triangulation control.

The remarkable exploratory and mapping accomplishments of a pioneer missionary, Rev. Adrian Morice, deserve mention also. Equipped with only a compass, barometer and sounding line and making use of the topographic ability of Indians of the region Father Morice mapped an area some 200 miles wide centred on his Fort St. James base on Stuart Lake between the years 1883 and 1904. His sketches and field notes were compiled into the first detailed map of the region including numerous lakes, soundings and drainage features as well as mountain peaks with elevations, trails and settlements. The two-color map was published by the Chief Commissioner of Lands and Works, Victoria, in 1907, on a scale of 10 miles to the inch under the title: *Map of the Northern Interior of British Columbia, by A. G. Morice, O.M.I.*

In the last decade of the 19th century many regional maps were issued in succession to district maps made by the Royal Engineers thirty years previously. This impetus in map production can also be laid to Kains' policies of 1891-92. Prior to this date cadastral surveys were the main activity and lithographed maps were few and of a general nature. One highlight of this period, however, was the production in 1886, under joint federal-provincial auspices, of a map of the Cariboo district by Amos Bowman, assisted by James McEvoy. This product may be regarded as the first large-scale accurate map to be published of any part of the land mass of British Columbia.

Some 50 maps were published under Kains' direction, mostly in the southern explored areas of the province; however, the Klondike Gold Rush in 1897, focused attention on northern British Columbia, which resulted in a succession of maps of the Atlin Gold Fields.

The great activity in land settlement and timber lands occurring in 1906-07 resulted in 1908 in the formation of a Department of Lands, separated from the Lands and Works Department which had been responsible for surveys until then. A re-organized Surveys Branch, recognizing the need for a framework of base maps, developed a reference map system of quadrangle sheets on one or two miles to one inch, on which to plot the daily land transactions. From their inception, these also provided the compilation bases for most of the lithographed series until a compiling section was formed following the First World War. Mr. Joshua E. Umbach (1879-1930) (later Surveyor General 1917-30) contributed to this program as Chief Draughtsman from 1911 to 1917, followed by F. O. Morris in 1917.

Early in 1912, George G. Aitken, a draughtsman with the Geological Survey of Canada was approached to organize, as Chief Geographer of British Columbia, a geographical division of the Surveys Branch empowered to prepare and publish maps of the province for the government at Victoria. On the mapping side, as distinct from map making, the Topographic Section (later Division) was born in the same year as part of the same Branch.

Impressed by the opportunity offered him in the coast province Aitken resigned from the Geological Survey of Canada in May, 1912, and proceeded to Victoria where he met, in turn, the British Columbia Surveyor General from 1911-17 George Herbert Dawson (1866-1940) and the premier of the province, Sir Richard McBride. Sir Richard explained that his efforts to obtain a suitable map of the southerly part of British Columbia had been disappointing. In his view there was an imperative need for a large wall map to form the first unit of a provincial series. Aitken, with some trepidation, respectfully inquired if the premier had in mind a definite span of time during which the work of compiling, drafting and printing such a map should be completed. "Yes," replied Sir Richard, "six months."[20] This limitation, in view of the scope of the project, presented a formidable challenge to the new Chief Geographer. The embryo Geographic Section or Sub-Branch was formed with commendable celerity. Two experienced map draughtsmen, W. H. Firth and Hugh C. Smith, left the federal civil service to join Aitken's staff. H. M. Wright was recruited from the provincial Surveys Branch and several other minor aides were obtained locally. First printed copies of what had developed into a 4-sheet wall map were in circulation within eight months of the premier's request for action. This map, drawn on a scale of 1:1,000,000 (15.78 miles to the inch) proved sufficiently satisfactory to continue in use for 21 years.

The first mapping from ground photographs for the provincial government occurred in 1913 when R. D. McCaw (1884-1941) made a topographic survey for the Public Works Department along part of the Banff-Windermere highway, then under construction. In 1914, McCaw began work for the Surveys Branch of the Department of Lands, mapping an area in the Okanagan region. For several seasons following 1914 McCaw was the sole provincial practitioner of the photo-topographical method.[21]

The re-organization of 1908, also saw the establishment of a survey control policy of cutting out internal base lines on meridians and parallels. The First World War drew this program to a close and also placed a temporary halt to the reconnaissance topographical mapping in northern British Columbia that was started by F. C. Swannell in 1908 and extended to the northern boundary of the province by E. B. Hart and G. B. Milligan in 1913-14.

FIGURE 56
A. J. Campbell

Gradually a comprehensive control system was developed in the territory between the 49th parallel and the Alaska Panhandle as well as in the Rocky Mountains along the British Columbia-Alberta border where surveys employing photo-topographic methods were carried out under the direction of A. O. Wheeler, aided by A. J. Campbell. Outside the Railway Belt and the Peace River district provincial authorities were responsible for cadastral surveys. Land lots and mineral claims were surveyed by transit and chain, timber limits by the use of compass and chain.[22]

In the period immediately preceding the First World War the increasingly heavy demand for maps of various parts of the province was met on an improvised basis. Outdated maps were republished by the province from time to time, corrected whenever possible. The land boom had reached such proportions by 1913, that a catalogue in that year listed 38 provincially produced maps published or in course of production in the period from 1911, including 8 sheets of the Pre-emptor's Series. One of these, depicting Bulkley Valley, is a fair example of the cartographic work being done under provincial government direction at that time. The map showed land lots available for settlement and included the Telegraph Trail.

As a continuing program, British Columbia's provincial topographic mapping activities may be said to have commenced with the McCaw field party of the 1914 season. The crew operated as a single unit until 1920 when it was expanded into two field parties. By 1914, a multiple-point plan of systematic map production was laid down and proved reasonably durable. The Pre-emptor's Map Series, on a scale of 3 miles to the inch, was designed to meet the needs of land-seekers. Cadastral surveys were depicted and the status of lands (whether or not alienated from the Crown) indicated by map colors. Some sheets bore explanatory notes on agriculture, mining and forestry. The 1897 map of part of the Osoyoos district, issued by the Office of Lands and Works, was a forerunner of this series. Another group of maps, the Degree Map Series, produced on a scale of 2 miles to the inch, covered the earlier settled areas of the province north of the 49th parallel and adjacent to it.

In retrospect it would be fair to concede that good progress had been made in the fifty years following Confederation in the mapping of Canada by Canadians. But it was becoming increasingly clear to cartographers and surveyors that the task of mapping a nation so vast must be a continuing enterprise, a process that could never quite reach the elusive goal of perfection. The term 'finished map' could be used only in a relative sense, no matter how diligent or talented the efforts made to keep maps accurate and up to date. As long as economic expansion persisted and new sources of natural wealth were being brought to light, it would be necessary to add to information recorded in cartographic form for the enlightenment, use and reference of all.

During the period from Confederation to the First World War it was becoming more widely realized that in times of peace or of war, maps constituted much more than attractive sheets of colored paper. Portrayals designed to inform, guide and illuminate maps had, in fact, become indispensable to the full status and orderly growth of the nation. A good map could be accurate without being unctuous, graphic yet reliable and capable of speaking a universal language. Because, in essence, a map is more picture than text it had the power to attract immediate, curious attention and to encourage swift comprehension.

"A map in the hands of a pilot", declares an anonymous tribute to the cartographic art, "is a testimony of a man's faith in other men. It is a symbol of confidence and trust . . . Were all the maps in the world destroyed . . . each man would be blind again, each city would be a stranger to the next, each landmark becomes a meaningless sign-post pointing to nothing. . . . Here is your map, unfold it, follow it . . . it is only paper and ink. But if you think a little . . . you will see that these things have seldom joined to make a document so modest and yet so full of histories of hope or sagas of conquest."[23]

8

DEVILLE AND THE SURVEY CAMERA IN CANADA

Following completion of the Canadian Pacific Railway through the Rocky Mountains in 1885 it became imperative that surveying and mapping of British Columbia, particularly of the Railway Belt in that province, be completed as soon as possible. Maps were urgently needed for the establishment of points of departure for the opening up of mining claims, timber limits and farmlands to occupation and development.

During the decade and a half that followed the creation of Manitoba as a province in 1871 the survey of Canada's western interior had been relatively rapid and accurate. But suddenly a brand new situation faced topographers. From the Alberta foothills to Pacific tidewater they were confronted by a land consisting mainly of hills, craggy peaks and deep valleys. When Dominion land surveyors reached the high Rockies they realized that survey methods used so successfully on the prairies were only partly applicable to mountainous regions. In the generally level interior outstanding topographical features were few in number. In the Rocky Mountains conditions were reversed. Topographical features were both numerous and prominent. To lay out township and section lines would take considerable time and costs of operations in the field would be high unless some new method was adopted.

Other factors demanding rapidity in mountain surveying included vagaries of weather in such regions and the rugged nature of the terrain. In a climate where the open season for field surveys is limited, as a rule, to little more than three months, the ability of surveyors to cover any large tract of country in a short time became a matter of urgent importance. The very act of reaching a survey site, commonly located on a lofty summit, was in itself a time-consuming enterprise. In addition the frequency of sudden, severe squalls and of strong winds meant that at best only a few hours of stable weather could be counted upon for observation purposes. In the limited time available for field work it was physically impossible to record by notes or by memory the immense variety of topographic detail to be found in mountain country.

Dr. Edouard G. D. Deville, Surveyor General of Canada, in his wisdom, concluded that in order to survey such terrain speedily, effectively and at moderate cost, it would be necessary to employ photography in an auxiliary role. Not that the application of the camera to surveying was something new. In some respects the employment of photography in this field was as old as the art itself. But Canada, particularly during the closing years of the 19th century, used the survey camera over areas unexceeded in extent by any country in the world.[1] In the truest sense Deville may be said to be the father of photo-topographical surveying in Canada. He set about designing instruments that would be particularly suitable to Canadian requirements. These had to be adapted to transportation over long distances and difficult terrain and yet be capable of calibration in the field. With only a few minor improvements Deville's system continued to give good results in the first half of the 20th century.

FIGURE 57. E. G. D. Deville, Surveyor General of Canada, 1885-1924.

Towards the end of the 18th century a demand grew steadily in the civilized world for "pictures" of persons and of objects. Wood engraving revived and the art of lithography developed. Experiments were made in the use of the silhouette technique. L. J. M. Daguerre (1789-1851), a French painter who experimented with silver salts in order to discover their properties, by accident revealed the image or likeness produced by exposing an iodized silver plate in a camera, if the plate was first fumed with mercury vapor.

D. F. J. Arago (1786-1853), a French physicist interested in the investigation of basic laws of polarization of light, reported fully on Daguerre's invention to a meeting of the French Academy of Sciences on August 19, 1839. The process, named "daguerreotype" after its discoverer, proved highly successful, especially in the realm of portraiture.

W. H. Fox-Talbot, an Englishman, used other chemical agents in a process named "calotype". The image was developed on calotype paper and, in terms of light and shadow, presented an exact reverse of the object reproduced. Nevertheless this process was a genuine first stage in the progress of photography. But Daguerre's discovery provided a timely stimulant to the evolution of photography generally. All this took place before the midway mark in the 19th century had been reached.

The principles involved in the linking of picture-making to land surveying were first suggested by J. H. Lambert of Zurich in 1789. No substantial effort was made, however, to apply his theories in practice until 1791 when Beautemps Beaupré made an attempt to use a series of freehand sketches of sections of the Tasmanian coast and of Santa Cruz Island.

Beaupré, because these drawings lacked sufficient accuracy, failed to convince others of the feasibility of this method.

Although Arago, in publicizing Daguerre's experiments, indicated the relationship of his discovery to surveying, it was not until almost a quarter-century later that one Col. A. Laussedat (1819-1907) of the French Army, gave a full exposition of the method in his *Mémorial de l'Officier du Génie*. In this work he demonstrated the impressive amount of information that could be extracted from a photograph as well as the numerous processes available to a surveyor. Laussedat, in truth, may well be regarded as the author of photographic surveying. His studies extended over a period of many years and in 1859 he announced the successful culmination of his research to the Academy of Sciences in Paris. When that institution reported favorably on his method, surveying passed from the purely experimental stage to an accepted science.

Laussedat used a *camera lucida*, consisting of a four-sided prism mounted over a drawing board which, by a double reflection of rays through an angle of 90 degrees enabled the operator to see the image as though it was coming from the board and to make a freehand sketch of it. After many experiments and after a suitable lens became available, Laussedat substituted photographs for drawings in the process.

Deville, despite the fact that he had only just arrived in the office of Surveyor General of Canada, was quick to realize the special value of Laussedat's discoveries in the surveying and mapping of the extensive mountain regions of the Canadian West. He set about designing instruments that would be particularly suitable for Canadian requirements. These were so constructed as to be acceptable for transportation over long distances and across difficult terrain and yet be capable of calibration in the field. Deville's type of camera was adapted for photography in a horizontal direction only, and this continued to be satisfactory for practically all groundwork in the Rockies. With a few minor improvements Deville's system continued to give good results during the first half of the 20th century.

In the immediate aftermath of Laussedat's experiments the art of photography had taken important strides forward. In the early years of the American Civil War, Brady, the photographer, built up a world reputation for himself by his excellent camera work. The famous photograph of Lincoln and his generals at Antietam is a splendid example of his artistry. In Canada William Notman, as early as 1865, was producing such fine work as the excellent representation of the Parliament Buildings in Ottawa. More and more photography was becoming linked with the plane-table technique in surveying. Notable advances were made in the late 1870s in Italy under the leadership of Major-General A. Ferrero, Director of the Military Geographical Institute of that country. Photography was used in plotting sheets in mountain regions of a new map of Italy. Staff-Lieut. M. Michele, in 1876, plotted the Glacier du Bart following experiments with a plane-table and ordinary photographic apparatus. Also in Italy, Professor Porro, acquainted with Laussedat and his work, proposed for surveying purposes a camera built to receive spherical plates.

In 1889, in Ottawa, Deville published *Photographic Surveying*, a book in which he outlined problems of descriptive geometry involved in photo-topography. He dealt also with perspective and its application to the making of maps or plans from photographs. Also he described the instruments used in such work and the method of carrying on subsidiary triangulation necessary for delineation of geographical positions and the elevation of points from which photographs must be taken.

This 1889 edition was prepared for the sole use of Dominion land surveyors and was limited to 50 copies lithographed in the surveys office in Ottawa. Some copies found their way outside the service of the Department of the Interior, and the edition was quickly exhausted. A new edition of the work appeared in 1895, published by the Government Printing

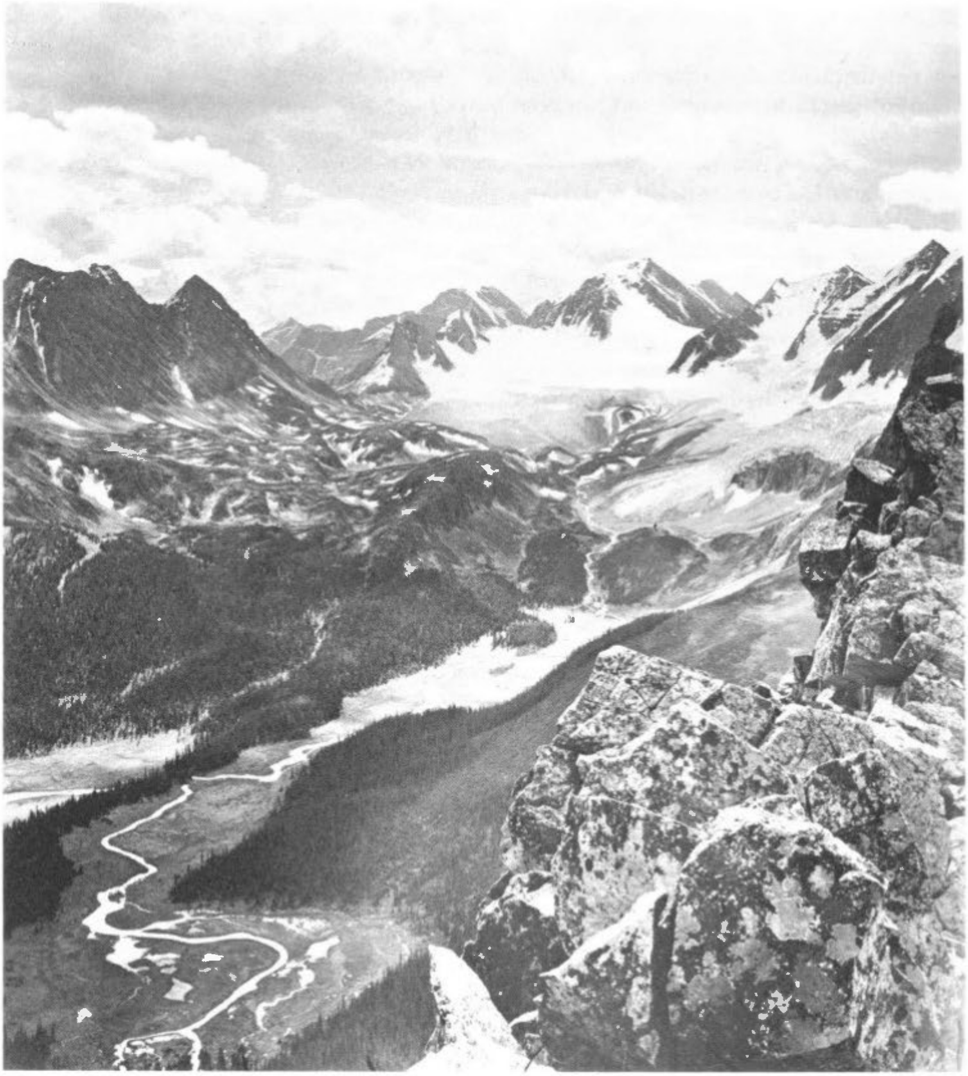


FIGURE 58. Jasper National Park view by M. P. Bridgland, showing type of mountain country requiring survey by camera method.

Bureau, Ottawa. In its *Preface* Deville pointed out that the photographic method of surveying was known at that time by several names, including photogrammetry and photo-topography. Such must be one of the very earliest official references in Canadian survey literature to photogrammetry, a science destined to play a highly significant part in 20th century surveying and mapping.

It was not, however, until George Eastman (1854-1932) invented what he called the "Kodak" camera in 1888 that interest in photography spread among members of the public. This was the first compact, portable camera and was the pioneer forerunner of the fixed-focus, fixed-exposure, roll film camera of the "box" type, appearing in 1900.

In 1886 J. J. McArthur, with a small party, set out to perform a topographical survey of the Rocky Mountains area along the Canadian Pacific Railway main line. He continued in this type of work for seven successive seasons. In that period he was able to map approximately 2,000 square miles using the scale of 1:20,000 and contour intervals of 100 feet. Along with a Troughton and Simms transit, with 3-inch circles reading to minutes and held on a tripod with extension legs (3 feet 4 inches when open: 20 inches when closed) McArthur was supplied with a camera which consisted of an oblong metal box open at one end and fitted into an inner case of mahogany. Inside the box were two sets of diaphragms to intercept any light not contributing directly to the image-forming operation. The whole interior of the box was blackened and a shade placed over the lens when the plate was exposed. The size of the plate was 4¾ inches by 6½ inches. A carrying case of leather held the camera and 12 single-plate holders and was fitted with shoulder straps. The total weight of the transit was 15 pounds and of the camera and plates, 20 pounds.

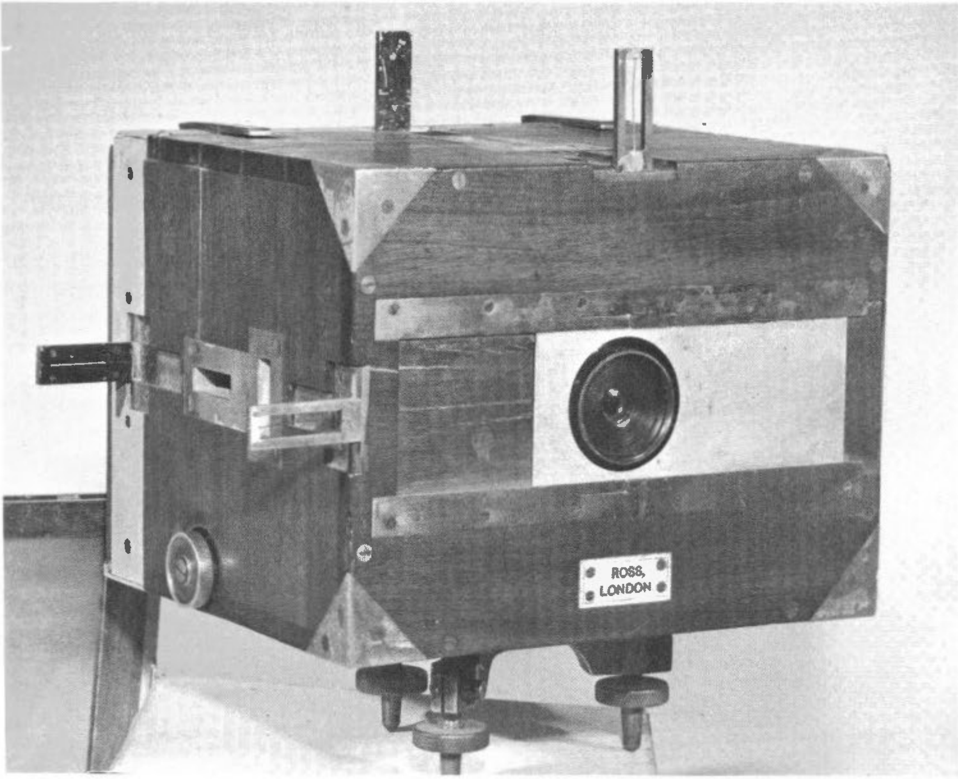


FIGURE 59. The shutterless Ross camera, made in England and equipped with hinged sighting bars, was one of the earliest makes used in Canada on surveys of mountain areas.

McArthur, in his official reports to the department, was most economical in references to photography as part of his survey activities. He never did contribute any substantial item to the literature of photo-topography. In 1886 he made no reference whatever to his possession of a camera in the field. In the following season he referred in his reports to Ottawa to a "convenient camera furnished us" and to "camera stations" as well as to "the taking of views" as part of his field work. But these are brief, almost casual remarks made in the course of a lengthy report.[2]

In the records, reports and articles written by various surveyors concerning the initial use of the survey camera in Canada there is an apparent conflict of opinion as to the exact year in which the practice was introduced to this country. J. S. Dennis Jr., in his short history of Dominion lands surveys from 1869 to 1889, stated under the heading "Season of 1886" that "an attempt was made during *this year* to introduce photography on the surveys, a number of surveyors being supplied with cameras. It was proposed to illustrate surveyors' reports by reproducing their photographic views, and it was desired to test the usefulness of photographs in providing topographical information."[3]

In an article published in 1897 Deville stated that the initial employment of the camera in Rocky Mountain surveys was in 1887.[4] In the preface of the (limited) edition of *Photographic Surveying* Deville again mentions 1887 in this regard. But in the preface to the later (1895) edition he omits reference to any specific year when dealing with the beginnings

FIGURE 60
Topographer and assistant with survey cameras, climbing to an observing station. 1887.

of Canadian topo-photography. Bridgland and other writers on this subject give the commencement year as 1886. In Deville's report to his supervisors covering that year's work he inserted a paragraph that affords a possible clue to this curious discrepancy in dates. "An attempt was made", the Surveyor General stated, "to introduce photography on the surveys, a limited number of surveyors being provided with cameras. Photography has for a long time been used in the survey departments of most countries, and the processes have been so much improved of late that they now involve very little extra labor. Photography permits the obtaining of topographical information more easily . . . and economically than any other method; it is particularly convenient in a mountainous country, and is now often employed for work of that description. It was proposed to illustrate surveyors' reports by reproducing their photographic views, thus adding interest to their descriptions. Unfortunately the results have not, so far, been very satisfactory. It is hoped that, with some modifications in the apparatus employed and the experience of the previous years better work will be done next summer."[5]

In these remarks the emphasis is placed on the production of photographs for illustrative purposes rather than on the practical application of the camera as a survey or mapping aid. It is possible, also, that Deville did not consider accomplishments in photo-topography in the 1886 field season significant enough to justify selection of that year as the genesis of the practice in Canada.

In his 1887 report Burgess, in his capacity as deputy minister, Department of the Interior, stated that the "topographical survey of the Rocky Mountains along the line of the Canadian Pacific Railway is making satisfactory progress and although the proportion of the survey staff engaged in this work is smaller than in the previous year, the Department has been able to profit by the experience of the past. . . . It is important to observe", he added, "as is stated by the Surveyor General, that with the assistance of a small camera, the surveyor is able to obtain and plot upon his maps details of the topography of the country which, if the methods hitherto pursued had been adopted, would require a long time to complete and would cost a large sum of money."[6]

Whatever may have been the principal purpose of placing cameras in the hands of surveyors in the 1886 season there is no doubt about the existence of considerable photographic activity that year in the Rocky Mountain region. Klotz recorded in his diary for September 14, 1886: "Deville arrives, looking after the surveys, especially in British Columbia and is taking numerous photographs along the Canadian Pacific Railway through the mountains. Since about a year photography has become a hobby of his, experimenting in all ways and manners, the ultimate object being to obtain some cheap method for illustrating our reports by views of the country of which the reports speak. . . . I have illustrated my own reports the past two years with photographs and at my own expense. Soon after breakfast Dr. Deville was off with his camera . . . He developed one of my negatives to see how the "paper" plates had kept during the summer, and was well satisfied with it."[7]

It is quite likely that some of the photographs, contributed by Deville to the special exhibit at the 1888 meeting in Ottawa of the Association of Dominion Land Surveyors, were taken on the Surveyor General's western trip two years previously. His contributions were described as "Views along the line of the C.P.R. in British Columbia and at Vancouver, New Westminister and Victoria by Captain E. Deville; views of Mount Field, Mount Stephen, Cathedral Mountain and The Golden Stairs." Other contributions to this display were made by Dr. G. M. Dawson and William Ogilvie ("Yukon rivers") and by Dr. Bell ("Hudson Straits and headwaters of the Ottawa River").

In 1889 McArthur reported that he had established 25 camera stations and had taken 250 views in the course of his field work in the Rockies. He also mentioned that the plate

FIGURE 61. View from survey camera station by A. O. Wheeler in 1902, showing Mount Wheeler on right and Grand Peak on left, Glacier National Park, B.C.

used that season was "orthochromatic" and that it had given "decidedly better results" than what had been obtained in the previous season. W. S. Drewry, engaged in surveys in the New Westminister district of British Columbia, was similarly equipped with a camera in the 1887 season, although dense smoke from forest fires hampered him until September. On high ground Drewry referred to the fact that he used the camera "between snow squalls and got only half a dozen views."

Drewry graphically described an incident that occurred at this time, hair-raising in its implications yet only one episode in the hazardous life of a surveyor in the Rockies:

"On our way down we left the route by which we ascended and followed a cascade emptying into Harrison Lake near our own camp; in doing this we committed a grave error, as we soon found ourselves in a canyon with almost perpendicular sides; night approaching we had not time to retrace our steps, so that there was nothing for it but to push on. We worked cautiously downward hanging on to projections of rock . . . and, at last, after narrow escapes from loosened rocks and treacherous bushes . . . we emerged from the canyon . . . and vowed to attempt no more explorations while descending mountains."

But Drewry proved to be an enthusiastic convert to photography as an aid to surveys in the Rockies: "The more I study the mountains the greater is my conviction that a triangulation and photo-topographical survey is at once the best and the cheapest . . .".

In mountain regions the accuracy of the photo-topographic map depended primarily on the precision of the triangulation system controlling the survey and, therefore, upon the number of camera stations and of points plotted. The relative rapidity with which camera work could be completed on mountain tops was a definite advantage, especially in cold, windy weather. Generally it was possible to finish the task in two hours of observation. Re-occupation of the station was seldom necessary. With a plane-table, however, the story was different. The apparatus was more cumbersome to carry and much more difficult to keep stable under windy conditions.

In Canada and the United States the design of photo-topographic instruments was based upon the separation of the camera and the transit. This allowed for a very simple type of construction. In addition to the fact that complicated adjustments in the field were thus avoided, little risk was run of causing damage to instruments in their transportation. Survey cameras were inspected at the Survey Laboratory in Ottawa each year prior to their use in the field.

FIGURE 62
A. O. Wheeler

Deville considered that the precision of a photo-topographic survey was the same as that of a plan plotted with a very good protractor or with a plane-table. He pointed out that the number of points plotted by photography was much greater than by other methods. It was necessary, however, to find summits suitable for the establishment of stations and in sufficient relief to permit ready identification of the same point as viewed from various stations. The camera method did not prove nearly as useful in a region of heavily timbered hills.

Arthur Oliver Wheeler, F.R.G.S. (1860-1945), whose two-volume work, *The Selkirk Range** constitutes a unique record of photo-topographic surveys of 1901 and 1902 in the

*Government Printing Bureau, Ottawa, 1905.

Selkirk Mountains area adjacent to the Canadian Pacific line, included in this publication detailed descriptions of camera survey operations in that rugged country. Born in Kilkenny county, Ireland, young Wheeler was educated at a Dublin private school. He came with his parents to Canada in 1876 and served as apprentice surveyor to Elihu Stewart of Collingwood, Ontario. Wheeler qualified as an Ontario land surveyor in 1881, as a Provincial land surveyor in Manitoba in 1882 and as a Dominion land surveyor in the same year. In 1891 he was commissioned a British Columbia land surveyor and in the same year, an Alberta land surveyor. In 1929 he was made an honorary member of the Dominion Land Surveyors' Association. His son, Sir Edward Oliver Wheeler (1890-1962), was a member of the graduating class at Royal Military College, Kingston, in 1910 (Sword of Honor Award). He became Surveyor General of India in 1941 and was knighted two years later. Early in 1921, when Wheeler, Jr. had joined the Mount Everest Reconnaissance Expedition as surveyor and photographer, he had used Canadian photo-topographic methods in detailed surveys of the Tibetan side of the world's loftiest mountain.

In a special paper delivered before an international gathering A. O. Wheeler described in detail preparations for his 1902 camera surveys.[8] His field party consisted of two assistants, two packers and a cook. When it became impracticable to employ pack ponies, the backs of the men were used to transport equipment and supplies. Instruments were carried to lofty summits, a task involving considerable danger. Crossings had to be made of treacherous, deeply crevassed snowfields and ice slopes. Avalanches were a constant menace. In order to peer into steep gorges and obtain working views the surveyors had to perch precariously on overhanging ledges and rock crags that provided only space enough to set up and operate instruments. In all 64 ascents of mountains were made in that field season, 17 of which were 9,000 feet or higher. The loftiest peak climbed was 11,113 feet above sea level. A total of 120 camera stations was occupied and 765 plates exposed.

In subsequent office work on these survey results Wheeler and his two assistants developed plates and made enlargements for plotting points, established correct elevations and produced a map, complete with contours. The time consumed on the entire project was 14½ months and the total cost amounted to $9,589.34.

The value of the camera as a survey aid in these experimental years was dependent upon weather and other conditions. Plates, while being exposed, had to be kept in a vertical plane. The position of the horizon and of principal lines had to be known as well as the focal length of the lens. Lighting was another important factor. Snowy peaks glistened in bright sunlight in marked contrast to surrounding deep, heavily timbered, shadow-filled valleys. The presence of a bluish haze or tinge often caused distant features to be indistinct, a condition known as "aerial perspective." From an artist's point of view aerial perspective, or indistinctness caused by distance, is desirable to convey the impression of remoteness. But to the surveyor such diffusion of light was most objectionable. In order to be of real value survey photographs had to be clear and full of details so that points to be plotted thereon appeared well-defined and easily identifiable.

The plate most frequently used in the pioneer years in Canadian topo-photography was a Wratten and Wainwright Panchromatic with a 'G' filter or yellow screen. This particular plate was sensitive to all light rays and, when used with a filter, gave satisfactory results. The screen reduced the effect of the most actinic part of the color spectrum—the ultra-violet to blue rays. In this way the obscuring blue haze was removed and distant points registered distinctly.

With his theodolite the surveyor located his camera stations and made any required secondary triangles as well as measuring the azimuth of at least one well-defined point for each photograph. From this azimuth the direction of the principal point was deduced.

FIGURE 63. View from survey station on Mount Clitheroe by M. P. Bridgland. Mount Geikie in centre, Tonquin Pass, and Amethyst Lake in foreground, Jasper National Park.

The lens in the survey camera was a Zeiss anastigmat. By means of a screw the photographic plate was brought into contact with edges of the camera box so that focal length was invariable. Horizon and principal lines were indicated by notches in the edges.

Having plotted his triangulation and camera stations the surveyor took a photograph and after finding the azimuth of his principal point, drew it on his plan. At a distance equal to the enlarged focal length he drew a perpendicular which formed the ground line. He repeated the construction for another photograph covering the same scene. Then he placed the two photographs before him and selected a number of points which could be identified on both views. He assigned a number to each point. The directions were next plotted on the plan, the altitudes being obtained by geometrical principles.

Climbing high mountains called for rugged endurance and alpine skills of a fairly high order. On lower slopes dense underbrush and windfall greatly impeded progress. At higher levels snow-covered slopes, glaciers and steep rock cliffs made travel hazardous and arduous. Many surveyors under these trying conditions suffered severely from the cold and high winds.

Sudden shifts in lighting conditions after the summit was reached were also frustrating. Rapidly moving clouds meant almost continuous variations. Storms came up quickly, often without any warning signs and camera-work had to be conducted with speed and precision. Smoke from forest fires as well as early snowstorms provided additional obstacles. Accordingly any successes achieved by the photographic surveyor in the Rocky Mountains depended largely upon his ability to obtain serviceable photographs under the most adverse conditions imaginable.

In this type of field work the country to be mapped had to be viewed from at least two points that subtended angles large enough to give satisfactory intersections yet not too great to permit easy recognition of the same points as these appeared on corresponding photographs, taken in pairs, from each camera station. For plotting purposes enlargements of 10 inches by 14 inches were made from negatives. Enlarging work was done at the surveys office in Ottawa. Dennis, in his short history of federal surveys, mentions that by April, 1887, the task of developing and enlarging surveyors' photographs had reached such proportions as to call for the appointment of a professional photographer at headquarters in the person of H. N. Topley.[9]

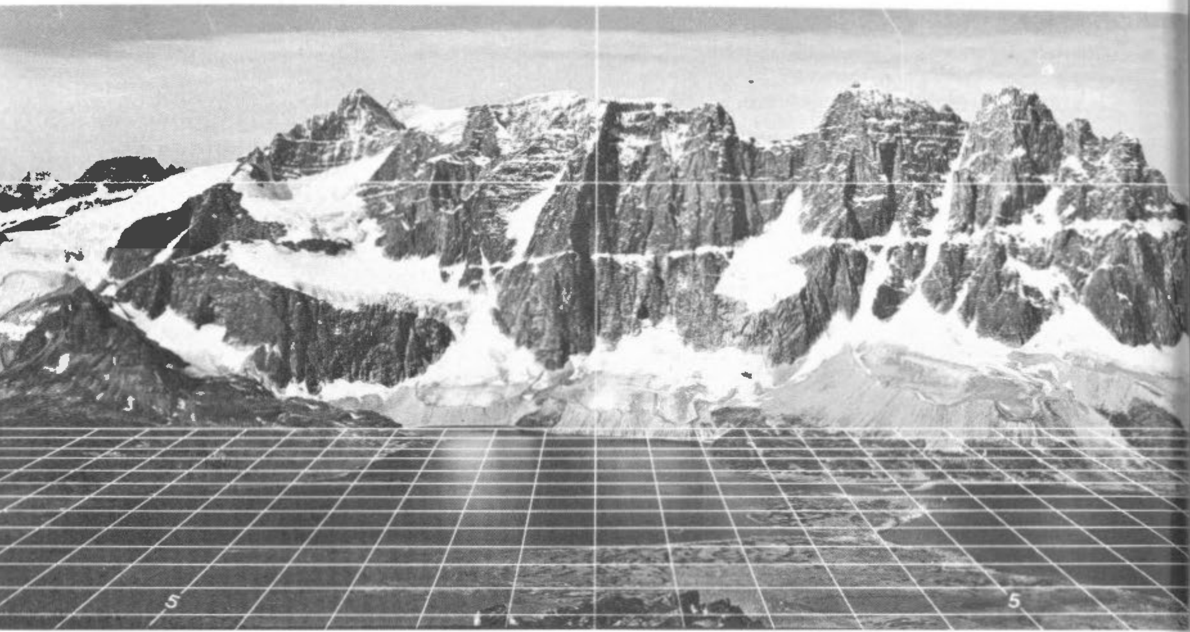


FIGURE 64. The Ramparts, Jasper area, photographed by M. P. Bridgland, with survey lines superimposed on the view to aid in mapping. Features are plotted by means of the squares.

The convenience of completing topographical work in an office environment, rather than in the field, turned the balance of choice in favor of the camera method. In addition the plane-table technique made considerable demands on the memories of surveyors, a factor not present in photo-topography. Photography possessed solid advantages as well in the varied processes which principles of perspective placed at the disposal of topographers. The success of the newly-adopted system rested to a large extent upon a thorough knowledge of descriptive geometry and perspective.

In the Ottawa office triangulation was plotted by orthodox methods, depending on the nature of the control. This might vary from precise triangulation to a reconnaissance survey while the triangulations and photography were carried on at the same time. Elevations of mountain peaks were completed from angles read in the field. Necessary corrections were made for curvature and refraction. A selection was made of views taken from a number of camera stations, relating to the same area. Points on corresponding views were identified to reveal the topography and were then plotted on the plan. Using these points as guides the topographer, with the photographs before him, was able to draw in the contours. The accuracy of his work was dependent chiefly upon the number of points plotted and the scale of the plan.

Relatively level features such as swamps, lakes and rivers were plotted by means of squares. The perspective of a series of squares was laid down and the projection, on the required scale, was drawn on the plan. The various features were then drawn on the projection, square by square. The squares were made sufficiently small to provide good definition. In practice the squares were not ruled on the photographs but produced with an instrument called a perspectometer.

The work of plotting points and drawing contours required, as a rule, twice as much time as the field work involved. There was no need for the photographer-surveyor to plot or make measurements. This was done by office staff. Though this was a tedious operation it was not subject to the sort of interruptions all too often experienced in the field. On occasions such interruptions took on the aspects of near-tragedy. For example, on Alaska-British Columbia boundary surveys in early October, 1907, a canoe used by the Canadian party foundered when it struck a submerged snag on the Iskut River. Five occupants of the craft reached shore with difficulty but contents of the canoe, including several valuable instruments and a priceless box of 96 exposed photographic plates were lost. Every effort was made to recover the plates but to no avail, even though a small party remained for a 10-day continuation of the search following the departure of the main party down river to Wrangell.[10]

Relative costs of the two operations were a consideration also in the decision to use photo-topography. In *Photographic Surveying* Deville estimated the total cost of 8 days in the field with plane-table equipment at $164 in comparison with 2 days in the field and 3 days in the office based on camera work at a total cost of $56. In another connection he cited the cost of a satisfactory topographical map of a mountain region, based on triangulation and photography as from 2¼ to 4 cents per acre. A survey party of seven men was regarded as the commonly accepted number for work in mountain regions. The party chief and his assistant, each equipped with a camera, were accompanied by five others including a cook and two expert packers where pack horses were used. In districts particularly difficult of access, extra men might be required.

Intangible rewards were enjoyed by adventure-loving surveyors in this type of work. A well-known British Columbia surveyor has eloquently described this sense of elation in achievement: "Having climbed to these high stations at considerable physical effort and sometimes at some risk, I know well the thrill of viewing the august panorama of other peaks circling the horizon . . . to see, here and there, peaks one has known before and, occasionally in the dim distance... big fellows one has... climbed years ago. It is like re-encountering old friends . . . and by this widening circle of alpine landmarks one's knowledge of the country is enhanced and takes form."[11]

Until 1892 Canadian photographic surveys were confined to the areas in the Rocky Mountains in the vicinity of the main line of the Canadian Pacific Railway. In 1892 the International Boundary Commission decided to examine the country along the Alaska-British Columbia boundary. The Canadian commissioner on this special assignment was W. F. King, who decided to perform his share of the international work by photo-topographical methods. In 1893 and 1894 seasons this project covered 5,000 square miles.

Irrigation surveys in southern Alberta on which the camera was employed, began in 1895 under the direction of A. O. Wheeler. In addition to stream gauging and the establishment of bench marks, it was necessary to ascertain locations of catchment areas and to define sites for reservoirs. Photography on the eastern slopes of the Rockies possessed a distinct advantage in relation to the planning of irrigation projects. By ordinary survey practices the suitability of any reservoir site could not be definitely ascertained until the area under investigation was at least partly plotted. This involved a preliminary survey. If, after plotting, the site was judged to be favorable for the purpose, the topographer had to go over the ground a second time in order to make a detailed survey. When the camera was employed, however, it was only necessary to plot the plan to a certain point. Photographs provided a general plan, furnishing all topographic details required. A second examination of the area was unnecessary. Whether or not, in the final analysis, a reservoir site was considered suitable, expenditures of extra time, money and work were avoided.

In several important aspects of early surveying in Canada Deville was far ahead of his time, but in his authoritative book he quite failed to envision the extensive possibilities of air photography in Canada. Admittedly at the time he wrote *Photographic Surveying* the

FIGURE 65. View of Niagara Falls during the photographic survey to determine rate of recession at brink, 1927.

fixed type of aircraft remained a profound secret in the womb of the future. But surveys had been made from balloons, using cameras. Deville expressed doubt, however, that the method would ever amount to anything more than a topic of theoretical interest. To his land-bound surveying mind the experiment appeared to be in the nature of a stunt. He was content to observe that the balloon procedure required an entirely new system of surveying by means of photographs taken on plates placed horizontally, or nearly so. "Of course," he conceded, "it is doubtful whether the method will ever be found practical."[12] Deville's early misgivings dissolved in the light of subsequent experience and he lived to see, as well as to take an active part in promoting, a formidable revolution in Canadian surveying and mapping, brought about by the development of heavier-than-air flying machines.

Perhaps the most impressive single application of the Deville photo-topographical system in Canada was the survey made of Niagara Falls by vertical air photography in order to determine the rate of recession at its brink. This survey was performed by W. H. Boyd, Chief Topographical Engineer, Geological Survey of Canada, in April, 1927. Prior to this understanding the customary method of surveying employed by those engaged in this feat of measurement was instrumental intersection for the determination of points along the edge of the falls. Instruments used in this regard were the surveyor's compass, transit and telescopic alidade. However, because of the huge masses of water flowing in swift motion and the constantly changing appearance of the torrents, it was exceedingly difficult to fix definite points along the brink with any assurance. It was decided, therefore, to use the photo-topographical method of survey. In photographs it proved to be much easier to judge the approximate position of a rock crest under such obscuring conditions, especially in relation to curved surfaces of water in rapid movement.[13]

Summing up achievements under the Deville system it should be pointed out that Dominion land surveyors McArthur, King, Wheeler and Bridgland, with the related work of A. J. Campbell and R. E. Harris, during field seasons extending from 1886 to 1906 and from 1911 to 1923, mapped a total of 20,950 square miles, using the camera as a surveying aid.

Reconnaissance and other land surveys in British Columbia and Alberta from 1904 to 1923, under the Geological Survey of Canada, employing photo-topographical methods, were performed by D. A. Nichols, F. S. Falconer, K. G. Chipman, W. H. Miller, R. Bartlett and A. C. T. Sheppard. These surveys covered more than 13,000 square miles.

Under the authority of the government of British Columbia similar surveys were conducted in that province covering 6,474 square miles and performed by R. D. McCaw and G. J. Jackson in field seasons from 1913 to 1922. In accordance with programs organized by the International Boundary Commission and the Geodetic Survey, Department of the Interior, King, McArthur, J. D. Craig and D. A. Nelles topo-photographically surveyed a total of 7,400 square miles along the Alaska-British Columbia boundary.[14] Other Dominion land surveyors who were engaged on this boundary work during the same period included W. F. Ratz, George White-Fraser, D.T.S., A. J. Brabazon, C. A. Bigger, Fred Lambart, E. J. Rainboth and A. G. Stewart.

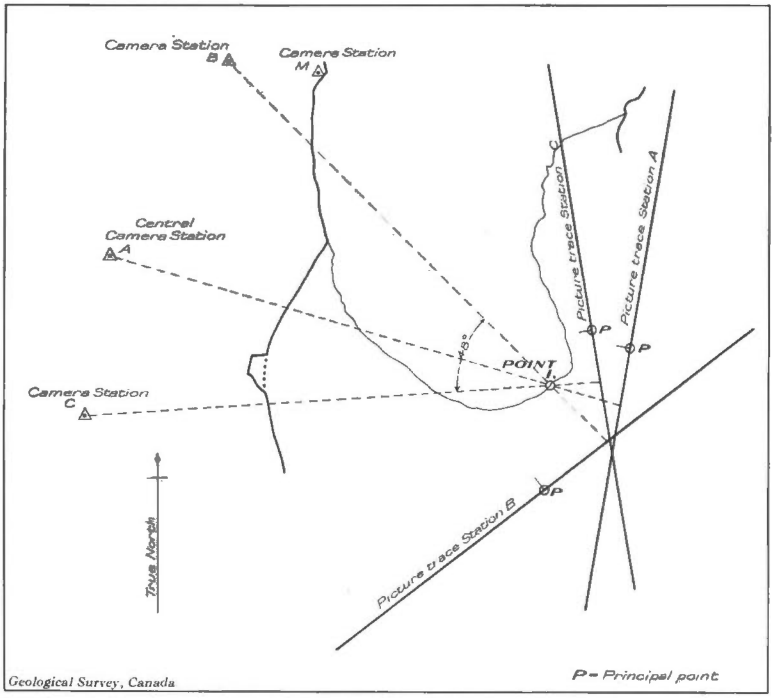


FIGURE 66. Diagram showing set of camera stations at Horseshoe Falls, established for purposes of the 1927 camera survey.

Deville's exceptional appreciation of the value of camera work in surveying and mapping was not limited to photography in the field. He was also keenly interested and involved in the improvement of map reproduction techniques and in the special function of the camera in producing copies of maps and plans required by surveyors for field use and for other purposes. This function is not to be confused with the printing of maps by various processes of photo-lithography, photo-zincography and photo-engraving. During the early years of the 20th century the copying camera became basic equipment in all survey establishments in Canada. Deville designed a Canadian version of this equipment and worked out a system of ratios in terms of percentages for guidance in reducing and enlarging processes. His mastery of the geometry of the copying camera remains unique in this country.[15]

In the words of this inventive and resourceful Surveyor General "nowhere has photography proved more useful than in survey departments." It should be added that no Canadian made a more valuable or more inspired contribution to the development of practical applications of the camera to the tasks of surveying and mapping than did Edouard Gaston Daniel Deville. Deville, in effect, introduced in this country a special type of terrestrial photogrammetry, a venturesome innovation marking the first application to Canadian conditions of the photogrammetric art. In the half-century following Deville's pioneer work, photogrammetry, in a variety of aspects and by gradual stages, became widely accepted as an efficient, economical method of making survey measurements through the use of photographs.

MAP 11. Portion of Deville's map, a milestone in the cartography of Canada's western interior, dated 1883.

9

THE YUKON GOLD RUSH AND WILLIAM OGILVIE, D.L.S.

"But mark how he bears his course . . ."
King Henry IV (1), Act 3, Sc. 1

William Ogilvie (1846-1912) had a very active surveying career in Eastern Canada, the Mid-West and the Far West. But his principal claim to lasting fame rests upon his notable achievements as an explorer, boundary-line surveyor and administrator in the Yukon Territory.

Article III of the British-Russian treaty of 1825, that determined the boundary between the territories of the contracting parties in Northwestern North America, provided in part that the line " . . . shall ascend to the North along the Channel called Portland Canal as far as the 56th degree of North Latitude; from this last-mentioned point the line of demarcation shall follow the summit of the mountains situated parallel to the Coast, as far as the point of intersection of the 141st degree of West longitude [of the same meridian] and, finally, from the said point of intersection, the said meridian line of the 141st degree, in its prolongation as far as the Frozen Ocean, shall form the limit between the Russian and British Possessions on the Continent of America to the North-West."

The first Canadian effort to define officially part of the boundary line thus described, following the purchase of Alaska from Russia by the United States in 1867, was made by Joseph Hunter, a civil engineer, of Victoria. In 1877, just one year after Custer's tragic last stand against Indians on the Little Big Horn River, Hunter was appointed by the Canadian government to make a partial survey of the Stikine River and to mark the boundary line along it. His work was confirmed in 1903.

In 1887 Ogilvie was authorized by Ottawa to head an expedition to locate as definitely as possible the 141st meridian on the Yukon River. This action heralded the first direct attempt to fix with precision the Canada-United States boundary line in that part of North America.

William Ogilvie, the man entrusted with this highly important mission, was born at Glen Ogilvie, now Cyrville, on the eastern outskirts of present-day Ottawa. His grandfather William, who had come to Canada from Scotland, established this tiny settlement in the 1840s. In 1869, at the age of 23, the grandson of the same name began practice as an Ontario land surveyor. There are records of some of his earliest surveys, made for the federal Public Works Department in 1870 and 1871. In those seasons Ogilvie headed a field party of six men, commencing work on the line between the 7th and 8th concessions of Gloucester township, not far from Ottawa. Ogilvie was one of a considerable number of provincial surveyors who were blanketted in as Dominion land surveyors, without taking any formal examinations. Their commissions dated from April 14, 1872, in accordance with the terms of the Dominion Lands Act of that year.

For a period of 12 years, from 1875 to 1887, Ogilvie performed surveys on behalf of the Department of the Interior in Canada's North West as far as the Peace River and Mackenzie River areas, as well as pioneer surveys in the Railway Belt of British Columbia. In his reminiscences Ogilvie wrote that he left Ottawa in May, 1875, for Fort Garry "recently rechristened Winnipeg but still more generally known by the former name." Three years later he was sent to Battleford, then the newly-named capital of the North-West Territories, for the purpose of fixing its latitude and longitude. It was on this mission that Ogilvie claimed he saw a herd of more than 10,000 bison.

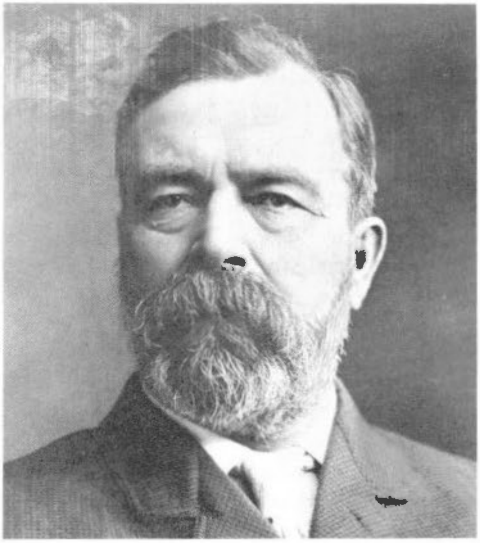


FIGURE 67
William Ogilvie.

Ogilvie described in memorable terms a contest he observed involving two Indian buffalo hunters. "One of them", he wrote, "was armed with a modern Winchester of that period, a very light . . . weapon: the other, with a single barrel shotgun sawed off short. Each was mounted on a perfectly trained hunting horse. The Winchester carried 17 cartridges in the magazine and one in the barrel, making a total of 18 which could be shot by an expert in as many seconds.

"The other Indian with his old-fashioned muzzle-loader might consider himself fortunate if he fired a shot a minute . . . To reload the Winchester was the work of an instant—with the old shotgun it was a feat worth seeing. The powder was carried in a horn slung by a string over the shoulder, the charge poured from it into the palm of the left hand, the gun brought up with the right [hand] and the charge transferred to the muzzle. A bullet carried along with others in the mouth, spat into the gun, and sent home by rapping the butt sharply on a part of the saddle, a cap placed on the nipple completing the loading.

"The result—all 18 shots fired from the Winchester into the side of a buffalo, it continued its way apparently little the worse for the fusilade, while the man who fired the sawed-

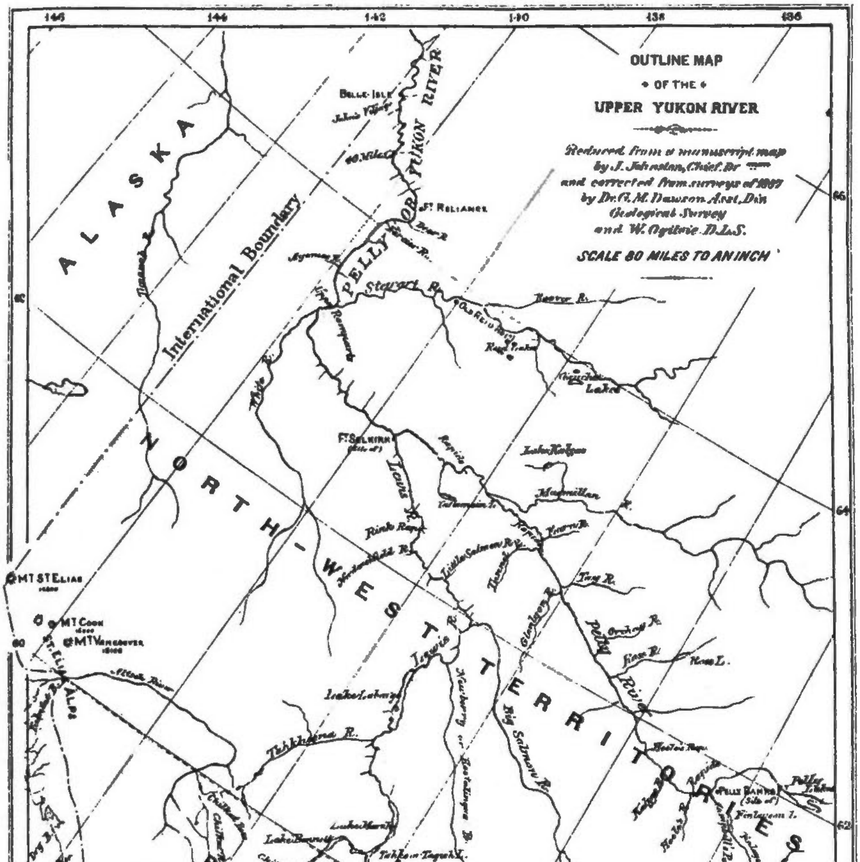


FIGURE 68. Map of the Upper Yukon River incorporating results of 1887 surveys by G. M. Dawson and W. Ogilvie.

off shotgun was fortunate enough to send his animal tumbling head over heels at the third shot—and won the contest."[1]

On September 10, 1878, Ogilvie reached Blackfoot Crossing on the Bow River. At this place some 700 Blackfoot Indians had assembled with their venerable leader, Chief Crowfoot. Some mischief-maker had notified the Indians that surveyors were coming to lay out the boundaries of their reserve and in the process would "erect a high wall that would last forever as a barrier" between the Indians and the outside. No matter what Ogilvie and his party members tried to do, the Indians prevented him from starting his survey. Ogilvie, unaware of the reason for their animosity, was at a loss over how to proceed with his official task. The natives would not even permit the white men to build a fire. Caught in this strange impasse Ogilvie was encouraged greatly to hear one of the Indians say something in French. "I could make myself fairly understood in that language", Ogilvie recounts, "and I inquired for Chief Crowfoot, letting it be known that I wanted to satisfy him what was to be done in regard to the survey." Fortunately the French-speaking Indian could speak English and the Blackfoot dialect as well. As a result Ogilvie soon came to an understanding with the old chieftain. Crowfoot instructed his people that Ogilvie was to be allowed to carry on his official work without any hindrance.[2]

Ogilvie, in commenting on travel conditions in the western interior in 1882, stated that the journey from Calgary to Edmonton then occupied ten days! In 1891, returning to Ottawa from a trip down the Mackenzie River to the Liard and from the headwaters of the Nelson River across the watershed to the Peace River at Fort St. John, Ogilvie remarked that he had railway transportation all the way to Ottawa from Edmonton, a real novelty.

It was in 1887, on his boundary locating mission, that Ogilvie first saw the Yukon Territory, the land that was to win his deep affection. Within a few years it won the attention of the world. He was under instructions from Surveyor General Deville to survey the Yukon and Pelly Rivers and to define the point where the 141st meridian (Alaska-Yukon boundary) intersected the Yukon River. Up to this time such an expedition represented the most important and extensive exploratory survey ever undertaken by the Department of the Interior. Its results were eagerly awaited by Ottawa. Ogilvie left Victoria on May 13, under the direction of Dr. G. M. Dawson, then Assistant Director of the Geological Survey of Canada. The journey to his observatory point on this survey occupied the greater part of the 1887 field season.

It was while he was at Juneau on his way north that Ogilvie heard reports of a low mountain pass from the head of Chilkoot Inlet to the headwaters of the Lewes, later known as the Yukon River. Local Indians seemed secretive about the pass but ultimately an Indian from the interior, one who had travelled the area previously, was induced to act as guide for Capt. William Moore, who accompanied Ogilvie on this journey. Ogilvie has recorded that he incorporated the information gained by Moore's sortie "in my plan of survey from Dyia Inlet . . . I have named this pass 'White Pass' in honour of the late Hon. Thomas White, Minister of the Interior."[3] It was during White's term of office that the Ogilvie expedition was authorized.

Two years after the purchase of Alaska by the United States, Professor George Davidson, of the United States Coast and Geodetic Survey, made a reconnaissance survey and determined the latitude and longitude of a point on an island in the Chilcat River. Using this established point as an anchor for his own subsequent surveys Ogilvie carried his survey line over the summit of the mountain chain to Lake Bennett, reaching the locality of the 141st meridian on the Yukon River in mid-September, having covered 640 miles since his disembarkation. This point was near Fortymile River, a tributary of the Yukon, some 60 miles northwest of present-day Dawson, a settlement named by Ogilvie in tribute to Dr. G. M. Dawson.[4]

Ogilvie employed two canoes, the crew of one craft working ahead of the other and picking out sites favorable for observation stations. At each station they would land, set up a base rod and wait until the bearing of it in degrees, minutes, and seconds of arc from the preceding station was read by Ogilvie or his assistant. This operation was repeated throughout the working day. Distance was calculated by trigonometry. The topography along the Yukon River was given as well as its length from point to point. On reaching the vicinity of the boundary, winter quarters were established. Ogilvie settled into his winter-long, extremely arduous task of obtaining all the astronomical observations he could on the position of the 141st meridian west of Greenwich in that neighborhood. Lacking a telegraph line for determining longitude with precision, his only resort was to make observations on the moon. Two methods were open to Ogilvie in this regard, one, that of ascertaining the exact local time when the moon occults (eclipses) a star, the other, that of obtaining the exact local time when the moon crossed the meridian of the observation place.

Before he left Ottawa Ogilvie and Chief Inspector of Surveys W. F. King had arranged that he would observe a series of star eclipses (by the moon) in the vicinity of the International Boundary line where it intersected the Yukon River. Because of cloudy, stormy weather this method proved ineffective. So Ogilvie was compelled to use moon culminations or crossings over the meridian. From November, 1887, to February, 1888, Ogilvie obtained 22 such transits of the moon. The hardships he endured in the observing process were trying in the extreme. All of the observations were taken in an unheated cabin through a slot in the roof. This precaution was essential since any artificial warmth would have caused waviness of the star or lunar images. Some of Ogilvie's observations were taken when the temperature was 50 below zero, often when the temperature was 40 below zero. Very seldom, in fact, was the cabin warmer than 30 degrees below!

Ogilvie's principal instrument on this expedition was rather primitive by comparison with 20th-century standards. The telescope was that of a small portable astronomical transit mounted on an improvised base. The original mounting weighed at least 400 pounds, which rendered its conveyance to the field inadvisable, if not quite impossible. By designing his own "set of brasses" to be placed on a suitably wide tree stump, his travel weight was reduced on this item to 80 pounds. A three-day hunt was required to find a tree in the locality possessing the required diameter. Actually the position of the tree determined the site of the winter quarters on Fortymile River. The stump, in the event, proved to be on a steep hill-side and it swayed noticeably with temperature changes. Thus it was seldom stationary and had to be levelled every evening before observations could be taken. At the conclusion of these precarious operations, aided by references to compiled mathematical tables, the resulting position of the meridian was marked by cutting a line through timber stands north and south of the river for a considerable distance. Then a survey was made upstream on Fortymile River and the boundary line marked accordingly.

In 1907 Canadian and American survey parties, employing the star-transit and electric-telegraph method, fixed the meridian line on a true location only several seconds removed from the position established 20 years before by Ogilvie. At the time Ogilvie had only one chronometer which, although a good product, was unequal to the strains placed upon it by extremely low temperatures. He had reason to deplore his lack of a second watch. He could have kept this in the cabin at a relatively uniform temperature so that the timing of the watch used in actual observing could be compared in the interests of greater accuracy.

Ogilvie once told a friend how, on one disturbing occasion, he had lost a gold watch presented to him by the National Geographic Society of Washington, D.C., in recognition of his explorations in the North West. He was crossing a small northern lake with two Indians. They paddled the canoe in the centre of which Ogilvie sat trolling. In some curious way he dropped his priceless but chainless watch overboard in the deepest part of the lake. He was greatly distressed by this loss and as the day was nearing sundown, he established camp on the lakeshore with the intention of searching for the watch next day. Accordingly he took bearings to locate the exact place of his accident. Next morning when he went to the beach to wash, while the Indians cleaned fish that had been caught the previous day, Ogilvie noticed a small pike that had been tossed back into the lake and that was behaving in a strange manner, swimming in circles close to the shore with its tail extended upwards. Investigating at closer range he discovered wedged in the fish's throat his gold watch, still keeping good time.[5]

Three fur traders of outstanding importance were active in the Yukon at a time when gold miners began prospecting the territory. They were N. L. "Jack" McQuesten, Arthur Harper and A. H. Mayo. In one way or another these men were associated in trading ventures. Fortymile River and Sixtymile Creek were named to indicate the estimated distance of the mouths of these streams from Fort Reliance, established by McQuesten in the 1870s on the Yukon River about 6 miles below present-day Dawson. Harper, in the early 1890s, built a trading post opposite the mouth of Sixtymile Creek, naming it "Ogilvie" after the surveyor.

The Klondike River, flowing from the east into the Yukon River opposite Dawson was, according to Ogilvie, known to natives of the region as 'Tron-diuck' or 'hammer-water' in their Indian dialect. This had reference to the fact that in order to place nets across its mouth to capture salmon, stakes had to be hammered into the gravel bed of the stream. Later Ogilvie referred to another version of the Indian name, e.g., 'Troan-dike' from which, it is surmised, the English name is derived. On September 1, 1887, Ogilvie, on his initial glimpse of this area, reported that the principal industry of the district was salmon-trapping. Nine years later this unspectacular fish-stream was suddenly transformed into a throbbing hive of mining activity quite unmatched in the long story of man's search for gold.

During the winter of 1887-88 many miners visited Ogilvie's cabin. Aware of his status as a government employee and, to some extent, as a representative of the federal government in the district, the men sought information on the attitude of Ottawa concerning the application of mining laws and regulations to the Territory.* The special rigors of the climate and the special problems presented, in particular, by permafrost demanded a larger size of discovery claim than that commonly provided elsewhere within Canada. Views expressed by these miners to Ogilvie, on this and related matters, were incorporated in a memorandum and conveyed by him to Ottawa. He advised his superiors that the size of creek claims ought to be at least 300 feet in length and extend completely across a valley bottom.

When Ogilvie reached Ottawa in January, 1888, he was relieved to find Interior Minister White and his deputy, Burgess, were eager for information about the Yukon. It was on Ogilvie's advice in September, 1893, that the exercise of Canada's jurisdiction at the boundary mining camp at Fortymile was formally undertaken by Capt. Constantine of the Royal North West Mounted Police. This officer was the forerunner of a total force of 20 "mounties" sent the following year to maintain law and order in the region. In 1895 the Yukon was made a provisional district of the North-West Territories and in 1898 it became a separate Territory, with Dawson as its capital. A Commissioner was appointed as a governor of the Yukon and he was advised by a Legislative Council of six members.

In the beginning Yukon gold miners were content to use a simple "rocker" and their

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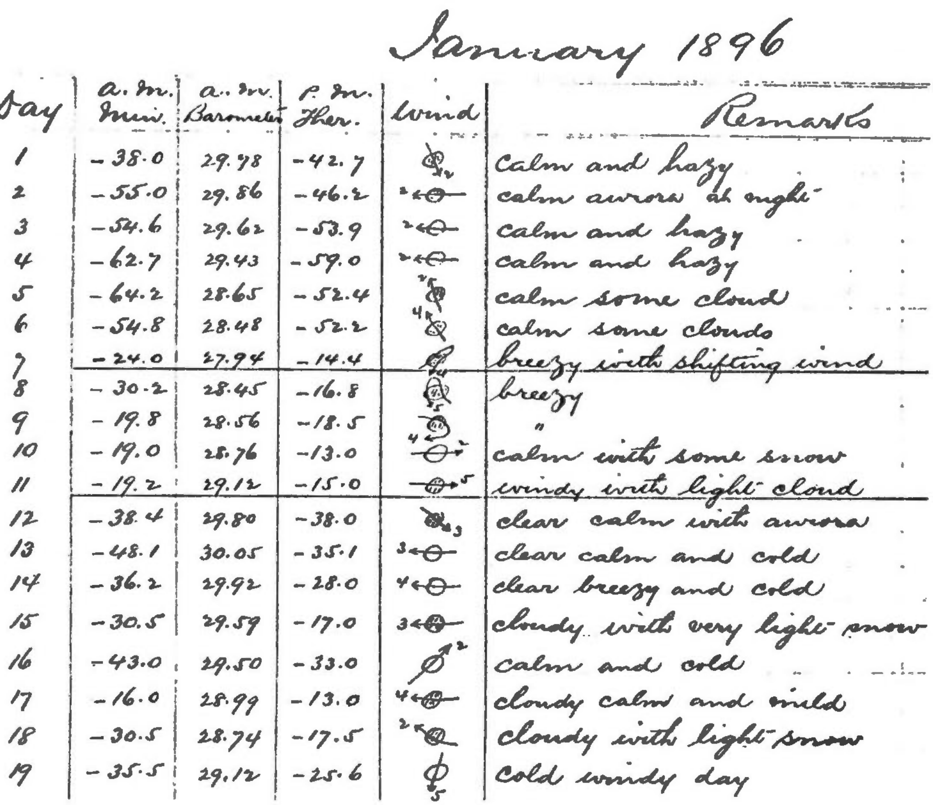
*On April 14, 1887, Ogilvie was appointed Commissioner of Police within British Columbia and the North-West Territories. His powers in this role were never clearly defined and for the most part he was content to let these remain largely dormant.



January 1896

Day	a.m. Min.	a.m. Barometer	p.m. Ther.	Wind	Remarks
1	-38.0	29.78	-42.7		Calm and hazy
2	-55.0	29.86	-46.2		calm aurora at night
3	-54.6	29.62	-53.9		Calm and hazy
4	-62.7	29.43	-59.0		calm and hazy
5	-64.2	28.65	-52.4		calm some cloud
6	-54.8	28.48	-52.2		calm some clouds
7	-24.0	27.94	-14.4		breezy with shifting wind
8	-30.2	28.45	-16.8		breezy
9	-19.8	28.56	-18.5		"
10	-19.0	28.76	-13.0		calm with some snow
11	-19.2	29.12	-15.0		windy with light cloud
12	-38.4	29.80	-38.0		clear calm with aurora
13	-48.1	30.05	-35.1		clear calm and cold
14	-36.2	29.92	-28.0		clear breezy and cold
15	-30.5	29.59	-17.0		cloudy with very light snow
16	-43.0	29.50	-33.0		calm and cold
17	-16.0	28.99	-13.0		cloudy calm and mild
18	-30.5	28.74	-17.5		cloudy with light snow
19	-35.5	29.12	-25.6		Cold windy day

FIGURE 69. Page from Ogilvie's 1895-96 Yukon field book showing the typical systematic neatness of his weather records.

operations were confined to river banks and gravel bars. But frequently the best pay dirt extended into deep water and out of easy reach. The practice grew, therefore, of removing parts of river ice in spring months and of building fires on the river-bottom gravel, thawing it, and piling it in dumps preparatory to sluicing operations in the warmer months.

Ogilvie advocated a new principle in this process and by its adoption a stronger impulse was imparted to gold mining generally in the Yukon. The proposal was to thaw a hole down to bedrock where coarse gold, the type of deposit most prized by miners, could be obtained. This single improvement substantially widened the production capacity of territorial streams. Another significant improvement urged by Ogilvie was the use of steam, with the aid of a boiler and hose and a pressure at the nozzle of forty pounds, for rapid softening of frozen clay or gravel. The steam method, in fact, came to be commonly used on all placer claims in the Yukon Territory.

In the winter of 1895-96 Ogilvie, after building a new observatory cabin to replace the original which had been damaged by fire, set about the task of extending the 141st meridian (boundary) line north from Fortymile River. His only precision instrument was an astronomical transit. His ordinary line transit was a 3-inch instrument designed for mountain work. It was necessary for Ogilvie to produce a series of traverse lines with this latter instrument extending from the observatory to the boundary line, a distance of some 3 miles, and in this manner to originate his boundary extension survey. For the two months that he worked on this project he failed to sight a star on his transit. Accordingly the line was run for 50 miles without there being any opportunity to check for accuracy. With his tiny instrument the line was extended from peak to peak, sometimes separated by many miles. At almost every station the horizon was photographed completely in accordance with the new Deville system. This procedure resulted in a fairly accurate map of the 20-mile strip along the boundary line, 10 miles on each side. In addition the position and elevation of some remote peaks were ascertained and given names, mostly of pioneers in the region.

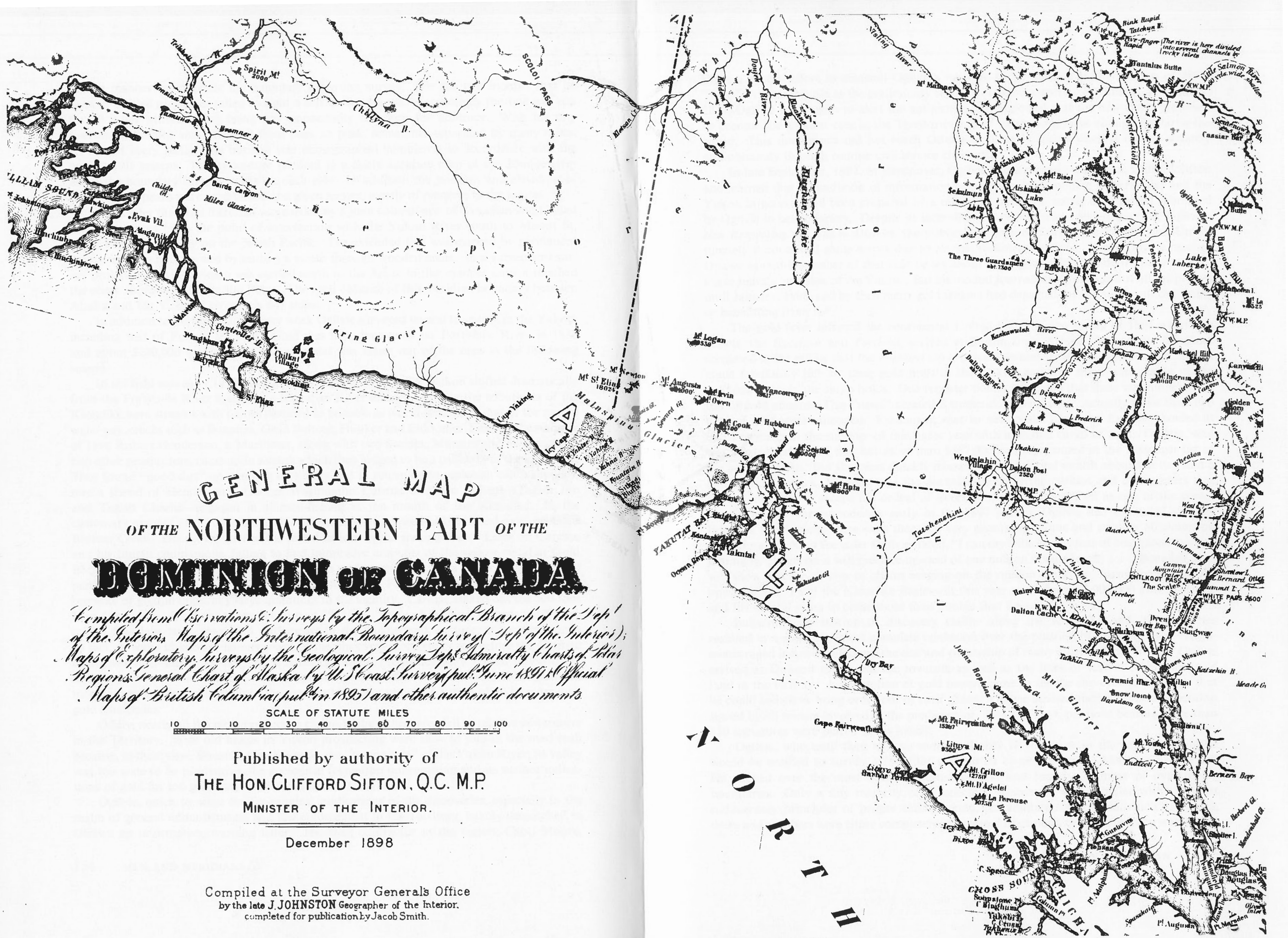
Years later the 141st meridian was carried by a joint commission of Canadian and United States surveyors from the point of intersection with the Yukon River south to Mount St. Elias, north of Icy Bay on the North Pacific. The extended line was marked by permanent monuments on hilltops and by cutting a swath through wooded areas. In a subsequent survey project the same meridian was carried north to the Arctic in like manner until it touched the ocean shore at Demarcation Point. The total distance of this meridian boundary between Alaska and the Yukon Territory is 647 miles.

In addition to his boundary survey work Ogilvie surveyed several townsites in the Yukon, including that of Fortymile camp. Gold was first discovered on Fortymile River in 1886 and about $200,000 worth of the yellow metal was taken out of the area in the following season.

In the field season of 1896 mining interest and activity in the Yukon shifted dramatically from the Fortymile River area to the Klondike River district. Among the tributaries of the Klondike were streams with names destined to become as world-famous as that of the parent waterway, creeks such as Bonanza, Gold Bottom, Hunker and Eldorado. Early in the summer of 1896 Robert Henderson, a Maritimer, along with two Swedes, Munson and Swanson and two other prospectors, came upon a creek which they judged to be a tributary of the Klondike. They found "good dirt" on panning its waters and in returning to replenish camp supplies, met a friend of Henderson's, George Washington Carmac and two Indians—Tagish Jim and Tagish Charlie—engaged in salmon-fishing at the mouth of the Klondike. In the customary manner of the Northland the fishermen were advised of the "good pay" on Gold Bottom Creek. Henderson invited his friend to join in the staking there. Later on Carmac and his Indian companions, failing to find impressive amounts of the yellow metal at Gold Bottom, crossed high ground in a trying march and reached Bonanza Creek. Here Carmac panned out $12 worth of gold within a few minutes. Further examination disclosed the presence of gold in unusually large quantities in the vicinity. Carmac staked out the 500-foot long discovery claim number one on August 17, 1896. News of the find, recorded at Fortymile a few days later, electrified settlements in the Yukon and, in time, the entire world. In fact, in some unknown manner word of the discovery circulated even before the Carmac claim was duly filed. As early as August 19 several properties were staked immediately above and below claim number one. From that moment the Klondike Gold Rush gathered momentum until it developed into the most publicized and most frenzied of all international gold stampedes.

Oddly, nearly all the most productive claims in the richest area fell to relative newcomers in the Territory. Wise old hands in Yukon prospecting were slow to join in the mad rush because, in their view, Bonanza Creek was on the "wrong side" of the Yukon River, its valley was too wide to be productive, the geological formation unpromising and its surface indications of gold far too glittering to be more than a trace!

Ogilvie, quick to sense the far-ranging implications of the discoveries, especially in the realm of general administration and law enforcement in the Territory, hastily despatched to Ottawa an informative, warning letter. The mail contractor in the region, Capt. Moore,



MAP 12. Portion of the Interior Department's map of northwestern Canada, 1898.

made a special effort to transmit Ogilvie's message to the outside in the autumn of 1896. The effort proved futile as the preliminary report won scant attention in Ottawa. In January, 1897, Ogilvie tried again to alert the authorities. He reported that the new camp promised to become the greatest ever in the Territories and of dimensions large enough to startle the world. This intelligence did not reach Ottawa until early spring when it moved sedately and obscurely through routine civil service channels.

In late September, 1897, in Vancouver, Ogilvie had a meeting with Hon. Clifford Sifton and learned that a handbook of information concerning the Klondike in particular and the Yukon in general had been prepared by a departmental clerk, partly on material submitted by Ogilvie to headquarters. Despite its secondhand authorship and pedestrian title, *Information Respecting the Yukon District*, the publication enjoyed fairly wide circulation. Unfortunately it contained some errors due to clerical misinterpretations. When Ogilvie reached Ottawa in mid-December of that year he set about writing an official guide for those intending to join the invasion of the Yukon. But his modest journalistic effort was not off the presses until January, 1898, and by then many gold seekers had departed for the north without seeing or benefitting from it.[6]

The gold fever infected the continental United States in the spring of 1897 when two vessels, the *Excelsior* and *Portland*, arrived at Seattle from Alaska. Newspaper headlines screamed to the public that the *Portland* alone carried several score passengers who had been made fabulously rich by their gold finds in the Yukon and that there were stacks of the precious metal in the cargo holds. One reporter boldly estimated that there was more than a ton of gold aboard. This "news" created a tremendous sensation. Actually more than two tons of gold were unloaded. Excitement rose to new peaks when the *Excelsior* landed at San Francisco in the summer of that same year with a second cargo of gold. Ogilvie, who was aboard, estimated that not more than $587,000 was represented in the passenger list of the *nouveau riche*. But the press quickly miscalculated the total wealth aboard at two and a half million dollars. So great was the dockside crush of the curious and of reporters that Ogilvie, in order to escape the ordeal of interviews, passed himself off as one of the crew.[7]

In private correspondence, early in the 1897 season, Ogilvie had estimated that on Bonanza Creek alone there were then 200 very promising claims and another 80 claims on the Eldorado. As to the latter Ogilvie stated, "I can say without any fear of being found wrong that many claims on it will produce upward of one million dollars [each] . . . Bonanza, too, will show a score or two of claims verging on the million mark and many from $100,000 upwards . . . I say the Klondike Basin will this year send down $2,000,000 and next year and for several years to come more than double that figure."[8]

Indiscriminate staking of discovery claims along the Klondike and its tributaries resulted in a state of almost complete confusion over the position of property lines. Arguments raged interminably as to the size and ownership of many claims. Early in 1897 Ogilvie arrived at Dawson to lay out the townsite as well as the lines of several other blocks of land in the vicinity. A deputation of gold miners came to see the surveyor in the hope that he could somehow bring order out of their chaos. Ogilvie advised them to submit a petition signed by all miners involved in the predicament. In a few days, petitions bearing more than 130 signatures were placed in his hands.

Ogilvie, who until then had no more authority to intervene in the situation than he would be entitled to survey a town lot without its owner's consent, was now free to act. He walked over the most hotly contested ground and found a number of overlapping boundaries. Only a tiny minority of prospectors, it seemed, were familiar with the most rudimentary principles of proper claim-staking. In addition, information such as names, dates and numbers were either completely obliterated from posts or tree trunks by weathering or otherwise rendered illegible. In one area, for example, where 61 claims were staked, actual measurement revealed that the land available could, at most, contain only 52 full claims.

The first survey along Bonanza Creek was decidedly primitive in nature. A rope was obtained by the prospectors, who were led to believe that it was 50 feet long, in order to measure out properties beginning with the initial discovery claim. Ogilvie, when finally called in to sort out the resulting problems, examined under oath 13 out of the 25 prospectors who participated in that first unofficial and unbelievably crude survey. Even so he could not learn with certainty who had actually measured the rope, nor to whom it belonged and apparently nobody had seen the rope measured. Nor could he ascertain just how the rope was held in conducting the measuring process. Yet more than 50 fantastically valuable claims had been bounded in this manner in one afternoon! As a result, under Ogilvie's scientific re-survey, some exceedingly rich properties were reduced from 500 feet to 450 feet or less.[9]

One hard-bitten hold-out from the petitioning deed was a miner reputed to have threatened to shoot Ogilvie if he came near his holding to re-survey it. Ogilvie's base line ran across the belligerent fellow's cabin and Ogilvie had to set his transit on the cabin roof in order to carry the line over. This he did without hearing any remonstrance, though he knew that the miner was inside at the time. When Ogilvie descended from his precarious perch the occupant of the cabin emerged and laughingly asked him what he was doing! Then he invited Ogilvie in for a meal, an invitation gladly accepted. Ogilvie was further astonished that his host, on being advised that the survey meant that he had to move entirely off this potentially rich claim, quite willingly agreed to do so.[10]

During early 1897, up to the stage when spring thaws and resulting floods prevented active prospecting, Ogilvie surveyed 120 claims on Bonanza and 50 on Eldorado. Respected by everyone for his integrity and reliability, Ogilvie was made a sort of supreme arbiter in all property disputes in these goldfields. None of his decisions was ever seriously questioned nor was any animosity shown, no matter what the decision. The nearest policeman was 65 miles distant. It was a particularly trying experience for Ogilvie to enforce the reduction of claims when his surveys disclosed some of these to be over-size. Both firmness and diplomacy were required when every foot of the ground involved could easily contain a considerable financial return to the owner. One ten-foot-wide property on Eldorado Creek was considered to be worth between $10,000 and $20,000. A miner named Jim White managed to stake a fractional claim which, after Ogilvie's survey, turned out to be only three inches in width. Thereafter he was popularly known as "Three-Inch-White."[11]

Ogilvie remained immune from the "gold-rush" fever. He was determined not to allow any shadow of suspicion or of self-interest to diminish his good name and reputation. He did not wish to enjoy any advantage of a material nature arising from his special position or knowledge as a trusted civil servant. One pie-shaped property on Bonanza, 86 feet wide at its base, was found to be surplus to a claim according to Ogilvie's survey and thus open to anyone for staking. Later this segment proved to be one of the richest pieces of ground in the Klondike region, producing eventually half a million dollars for its owner. Although Ogilvie did stake this plot of land for himself, he relinquished it on being appointed in 1898 as Commissioner (Governor) of the Yukon Territory. This action enabled one of his survey party chainmen, Dick Lowe, to claim the slice and thus become wealthy.

Fractional claims soon acquired exceptional importance. These accidental surpluses, arising out of over-size discovery claims, were invariably marked by Ogilvie on posts at the end but not at the beginning of the fragmentary property. But the experienced, discerning prospector could detect the fractions despite this partial concealment in the interests of public peace and order. In only one historic instance did Ogilvie depart from this general pattern, a procedure by which he avoided charges of discrimination on behalf of his friends.

Clarence Berry was the half-owner of claims numbered 3, 4, 5 and 6 on Eldorado Creek. He and his partner decided to do all their preparatory, cruelly hard, winter-long work on claim number 5.

"... I reached claim 5 in the evening", Ogilvie stated, "just as men were quitting work in the shafts below, and as it was a cold, windy day—ten below zero—I ... directed my men to take my instruments to a nearby cabin. I then turned to my notes to figure out the length of the claim, the men, meanwhile standing around me guessing what I was doing and anxious to learn how the claim turned out in size. I never suspected a fraction here: such diligent search having been made for them in all the rich ground that it seemed impossible for one to escape [detection].

"My calculations showed that claim number 5 was 540 feet 6 inches long, thus opening a fractional claim of 41 feet 6 inches to location." This meant that all the winter's work accomplished on claim number 5 could well have been wasted. In order to prevent what could easily have developed into a wild scramble, with the possibilities of serious injuries, for the possession of the fraction by staking on the spot, Ogilvie resorted to play-acting. He was successful in diverting the attention of the onlookers by casually inviting himself to supper in Berry's cabin. In the wake of Berry's distress on hearing of the overage and the resulting probability that he would lose completely the fruits of labor, Ogilvie suggested that Berry look without delay for a friend who would agree to stake the surplus land in his own name, then transfer it to Berry in exchange for a part of the lower end of claim number 3. Berry, in record time, found a reliable friend who consented to join in this arrangement and who, in the dark of that very night, staked the fraction in strict conformity to the mining regulations as explained to him by Ogilvie. Later it was discovered that the value of the winter's dump of pay dirt, excavated by Berry and piled up on the fraction, exceeded $136,000.

Within a year of Carmac's epic discovery on Bonanza the population of Dawson had increased to 1,500 and the rush from outside the Territory had not yet made its full impact felt.* But an influx of unforeseen proportions was in the making as a result of the excitement originating in Seattle and San Francisco in the summer of 1897. By October of that year administrative problems in the burgeoning community of Dawson had become acute. Enforcement of law and order, collection of customs duties and taxes (mining royalties) and the handling of mail were suddenly transformed from leisurely, routine activities into harassing riddles. The small staff in tiny post-office premises tried valiantly to transact the postal business of a city of many thousands. One vessel's cargo included 5,700 letters. Demands for expanded public services and surveys became loud and urgent.

A growing stream of complaints reaching Ottawa drove the government to definite action. Thomas Fawcett, D.T.S., one of the men who had served under Dennis in the Surveyors' Corps in 1885, was appointed Gold Commissioner in the Yukon as well as land agent and surveyor representing the Department of the Interior in the Territory.[12] Fawcett left Ottawa for the north on May 1, 1897, accompanied by two Dominion land surveyors, James Gibbon and E. D. Bolton, along with four other men. In August it was found necessary to send reinforcements consisting of two additional Dominion land surveyors, R. W. Cautley and J. A. Cadenhead, as well as four more civil servants. In that hectic field season eight surveyors, out of a total of 29 available on the staff of the Surveyor General, were engaged in measurements in the Yukon or in related activity.

That summer Major James M. Walsh was appointed Commissioner (Governor) of the Yukon Territory. An ex-Mountie of impressive military bearing Walsh lacked the particular

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*Approximately 30,000 persons were in Dawson in 1898 but the population fell swiftly after that season.

qualities required by the varied responsibilities of his position. Before many months had passed he tendered his resignation. Casting about for the type of man most likely to succeed in the post, the government at Ottawa approached William Ogilvie in the summer of 1898, pressing him to accept the Commissionership in succession to Walsh. He agreed and his appointment was formally confirmed on October 7, 1898. In the meantime Fawcett had been replaced as Gold Commissioner in order to assume direct supervision of general survey work in the Territory.

Some extracts from Fawcett's official correspondence emphasize the explosive nature of many of the problems he faced as Gold Commissioner. In a letter to Walsh early in January, 1898, Fawcett outlined some of his worries:

"I am very short-handed at the office. When the two surveyors and other assistants arrived in early October I tried my best to secure supplies to keep them here [Dawson] but failing, I got an order for supplies at Fort Yukon . . .

"The cost of surveying in this country will be so much in excess of anything in connection with which the government has had any experience in the past that I doubt that they would authorize the necessary cost of anything like an accurate survey . . . There were women rushing about and staking . . . so I set the limit [of claims] at three. It became so evident that the women were staking for speculation and not with any intention of mining, that I thought I would be justified in limiting them to a less number than the men were allowed to stake [four]."[13]

A month later Fawcett wrote to the Department of the Interior, Ottawa, in a desperate frame of mind:

"Men seem to lose all sense of honour and truth in the restless search after gold or whatever will bring it and seem to think nothing of swearing falsely . . . We have on an average two disputes per day arising mostly from jumping claims, recording claims by men who have not staked them, staking for other persons and acquiring an interest for doing so . . . ".

There was an echo, too, in his letters, of Ogilvie's experiences in the same locality in 1896:

"I want to send a survey party as early as I can have them equipped to make a survey of Dominion Creek which is in a very bad condition [of overlapping claims] through the mixing of numbers and other crooked work by those who originally staked the claims and subsequent staking of fractions. As soon as I ascertained that things were so badly entangled I closed that part of the creek and have refused to accept any more applications there until after the survey. There are a good many cases of frozen feet and faces . . . A . . . Mr. Hamlin, D.L.S., [probably L. B. Hamlin] . . . who had been on Sulphur Creek . . . had been very badly frozen . . . It seems he was sent out by the Provincial Government [B.C.] to examine and report on the Hootalinquia route and he came on here instead of going back to Victoria."[14]

In mid-April Fawcett advised Surveyor General Deville of survey activities then under way:

"My entire survey staff is employed at present laying out all the available ground to enlarge the townsite of Dawson. I expect the land which is now being laid out into lots will, when sold, realize not less than $30,000 . . .

"I will have to send my party over to Dominion [Creek] in a few days to survey the portion which I closed last November because of the overlapping of claims . . . I will have a member of the Mounted Police accompany the survey party to eject those who have taken possession after the ground was closed and not open for further location."[15]

Grievances were still rampant among the miners at Dawson at the time of Commissioner Walsh's departure from office. Discontent reached its peak at a meeting of prospectors there in the summer of 1898. A petition was drawn up as a result and mailed to Prime Minister

Sir Wilfrid Laurier on August 15. In this document it was alleged that "many government officials have forfeited claim to people's confidence and respect". The administration of the Gold Commissioner's office also came under fire and it was hinted that information about unrecorded ground had been improperly conveyed to individuals outside that office. The words "incompetence", "breaches of trust" and "malfeasance of office" were employed as well as complaints about "the want of experience of mining inspectors."

In this charged and uninviting atmosphere Commissioner Ogilvie assumed his new duties. His appointment, however, met with undisguised satisfaction not only among responsible elements in the Territory but also in the ranks of American adventurers who, by then, formed the vast majority of the Yukon's population. Many of these newcomers were highly individualistic personalities who were not by nature readily amenable to civil authority. But they had heard from Yukon old-timers of Ogilvie's characteristic indifference to personal advantage, of his deep understanding of the prospector's mentality as well as of his firmness and fairness in dispensing justice "without favor or affection". So it came about that the man who had done his utmost in 1896 to alert Ottawa to impending troubles in the goldfields of the north was drafted to repair the damage resulting in the interval from official ignorance and neglect.

Ogilvie's initiation to the duties of his high post was made easier by a timely announcement from Ottawa that a Royal Commission would be set up to hear grievances and to inquire into the charges of graft by various officials. Through the mid-winter months (1898-99) at Dawson the new Commissioner presided at sessions of the public investigation. The results were inconclusive but the hearings served the useful purpose of providing a safety valve for the releasing of pent-up resentments and feelings of hostility toward officialdom. Ogilvie, in his report to Ottawa, reduced the charges to their original trivial proportions. Confidence in administrative integrity was speedily restored. Although the departmental foundations of Territorial government had been established under Commissioner Walsh, much remained to be done, following his brief tenure of office, to enable public services to function efficiently. In this respect Ogilvie accomplished miracles under most difficult circumstances. Able men were drafted into the civil service. Voluminous correspondence was handled punctually and effectively. New mining regulations were devised to meet special situations. Courts and schools were established and strengthened. Above all, law and order were fully restored.[16]

Ogilvie remained in office until 1901 when he decided that his work as Commissioner was completed. His term had been distinguished by a visit to the Territory in the summer of 1900 by the Governor General of Canada, Lord Minto, accompanied by Lady Minto. The Governor General, in a letter to Ogilvie, complimented him on the "excellent arrangements made for our reception" and His Excellency forwarded to the Commissioner a gift of viceregal photographs. He invited Ogilvie to come to Rideau Hall when next he visited Ottawa.[17]

The Legislative Council of the Yukon Territory lamented over the departure of Ogilvie from the Commissionership and presented him with the text of a unanimous resolution in which they sadly took "this last opportunity of expressing . . . the high appreciation of his conduct in all his dealings with the Council and . . . his continuous efforts to help in the development and welfare of this Territory under the most trying difficulties due to the peculiar circumstances under which the Territory was opened."[18]

Ogilvie's accomplishments as Commissioner were made possible in great measure because of his exemplary conduct, judicial temperament and highly practical contributions to the advancement of the Yukon over a period of years immediately preceding his elevation to the governorship. His ability to adjust bitter disputes peacefully and thus avoid possible serious complications was everywhere realized. Deputy Minister of the Interior James A.

FIGURE 70. Sunset on the Klondike, the river that gave its name to the famous Yukon goldfield. Between 1897 and 1904 more than $100,000,000 worth of gold was produced in this area.

Smart paid Ogilvie a well-merited tribute in a public statement applauding his services to Canada:

"I consider it my duty to place on record . . . the Department's high appreciation of the very able and satisfactory manner in which Mr. Ogilvie has discharged the important and delicate duties entrusted to him by the Government of Canada in connection with the development of this district. The marked ability and tact which he has displayed at all times throughout his arduous operations, and his constant endeavour, under most trying circumstances, to properly safeguard the interests of the Government of his country, justly entitle him to the esteem and gratitude of the Canadian people."[19]

Interior Minister Sifton, too, had occasion to refer to Ogilvie as "a man of highest character and attainments".[20] On June 30, 1898, Sifton wrote to Ogilvie, enclosing a cheque for $5,000, the amount voted by Parliament "in recognition of your services in the various explorations you have made in the Western and North Western portions of Canada". This, however, was not the first time that these same achievements had won noteworthy attention and appreciation. In 1891 Ogilvie had been awarded the much-coveted Murchison Grant, an award fathered by Sir R. I. Murchison, a former president of the Royal Geographical Society.

With the advent of modern methods of mining gold much of the romance associated with prospecting on the northern creeks disappeared from the Yukon scene. Large corporations, extensively financed and equipped with giant dredges, entered the field and engaged in intensive re-working of Klondike hills, valleys and streams from which so much wealth had already been extracted, with so much hardship and drudgery, by individual miners. The use of panning and primitive sluices was replaced by electrically-driven heavy machinery, operating night and day during the open season.

Ogilvie resumed his private surveying practice in eastern Canada following his departure from the Yukon. In 1911 he returned to the western interior under the authority of the Railway Branch of the Department of the Interior. He had been asked to report on the suitability of land for reclamation in The Pas district. This assignment proved to be one of his last important survey undertakings. While in the vicinity of James Bay he contracted pneumonia and, at the age of 66, died in the Winnipeg General Hospital in November, 1912. The funeral service was held in his Ottawa home and his remains were interred in Beechwood cemetery in the capital city of his beloved country.

The Ogilvie Range of mountains in the Yukon, Mount Ogilvie on the boundary of British Columbia and Alaska as well as a wide Yukon valley and a Manitoba hamlet today bear the name of this distinguished surveyor and attest to the high character and attainments of an eminent Canadian.

10

RENEWED INTERNATIONAL BOUNDARY-LINE SURVEYS

"I am near to the place where they should meet, if Pisanio . . . mapped it truly."

Cymbeline, Act 4, Sc. 1

The heroic deeds of explorer-surveyors, men of the calibre of Champlain, Mackenzie, Thompson and Fraser, are the stuff of legend and rightfully enjoy prominence in the story of Canada's development. But the work of pioneer land, railway and boundary surveyors, which helped to transform a vast wilderness into ordered growth, has seldom stirred public imagination. Yet these men, too, subdued the unknown and replaced ignorance with knowledge. The lives of frontier scouts, of cowboys, soldiers and mounties have become invested with a glamor not bestowed upon surveyors working by celestial and terrestrial rules applied through the expert use of their modest, unspectacular instruments. The bold advances of the Wolseley expedition of 1870 and of Canadian mounted police in their famous trek from Dufferin to Fort Macleod in 1874 have become part of Canadian folklore. Yet, whether in treacherous muskeg west of the Lake of the Woods or on the seemingly limitless plains in the vicinity of Red River or hundreds of miles to the west of that waterway, men in uniform found that dauntless surveyors had been there before them. It was, in fact, at the Wood Mountain survey depot, 430 miles west of Red River and 22 miles north of the 49th parallel of latitude, a provisioning point of the international boundary-marking project, that Commissioner Macleod and his weary mounties obtained essential supplies that enabled them to continue their journey to the foothills of the Rockies. By that time the boundary surveyors had nearly completed their allotted task. Perhaps if their relatively mundane mission had been less well-performed or less practical in its uses, their accomplishments might have been gloriously enshrined in the national story as an exciting, epic chapter of achievement.

The success of Canadian and United States boundary survey commissions from 1857 to 1862 in cooperatively establishing the land line separating the two countries in the Pacific Northwest had amply demonstrated the effectiveness of this type of joint action. Cordial and efficient teamwork in this somewhat sensitive area helped greatly to dispel feelings of ill-will generated in both countries by angry differences over the location of the boundary separating islands in the Strait of Georgia.

Archibald Campbell (1813-1887), Chief Clerk in the War Department, Washington, was the United States Commissioner of these surveys. Lieut.-Col. John S. Hawkins, R.E., was chief British representative for the establishment of this land boundary. "It is possible", Hawkins read in his general instructions from London, "that you will hereafter be required to continue the survey from that point [crest of the Rockies] to the Lake of the Woods. Her Majesty's Government have made a proposal to that effect to the Government of the United States, but whether the proposal is accepted or not, you will have in all probability sufficient work to occupy you for two seasons in surveying the Boundary under the Treaty of 1846."[1]

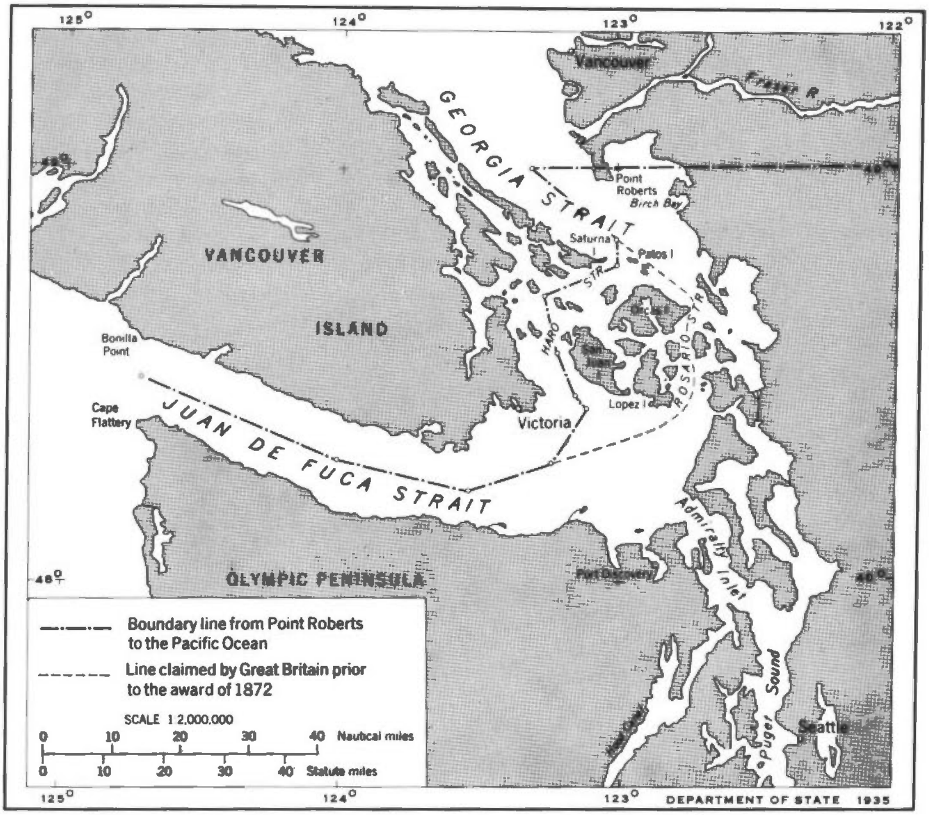

FIGURE 71. Boundary claims and settlement line in Gulf of Georgia.

In addition to his chief astronomer, Capt. R. W. Haig, R.A., Hawkins had assisting him three officers of the Royal Engineers, namely, Capt. C. J. Darrah and Lieuts. Charles W. Wilson and Samuel Anderson. Just prior to the submission of the final report of the British Commission, Anderson replaced Wilson as secretary to the British side. As a result of the work of both commissions, twenty-eight astronomic stations were established along the border across a distance of 409 miles. Intervening points were established by straight lines (tangents) drawn between the basic stations, and monumented. Vistas or swaths were cut through timber stands between marked points except in high, rugged, mountainous sections. Timber-cutting was completed across a total distance of 90 miles. In all, 161 monuments were erected.

The Americans completed their field work west of the Rockies in the 1861 season. The British side finished their assignment in the spring of 1862. The compiling of maps and completion of reports occupied several years. The preoccupation of Washington officialdom with crises of the American Civil War resulted in a postponement of the final settlement and it was not until 1869 that Col. Hawkins, in company with Lieut. Samuel Anderson, went to Washington to sign the final maps and documents relating to the land boundary in the Pacific Northwest, stretching from Point Roberts to the crest of the Rocky Mountains, along the 49th parallel. Both sides reserved for future decision the "middle channel" dispute over the water boundary, an argument that was to be decided against Canada by the arbitrator. The survey on the mainland cost the United States $600,000 and the British nearly £110,000.

The experience gained by Lieut. Anderson turned out to be an invaluable asset for the British and Canadian side in future boundary surveys involving the United States. The close relationship between Anderson and Wilson, whom he had replaced in this type of survey work, was to prove useful also in this highly specialized field. In time Wilson, after a period of service as Capt. Wilson in charge of the topographical department of the War Office in London, became Major General Sir Charles W. Wilson following the Nile Expedition formed to relieve General "Chinese" Gordon at Khartoum. Toward the end of that historic episode, Wilson commanded the advance column of the expedition. This 1884-85 venture was the first major overseas military operation conducted by the British in which Canadians, serving in a contingent of voyageurs, participated as citizens of a self-governing part of the British Empire.[2] From 1886 to 1893 Wilson was Director General of the Ordnance Survey of the United Kingdom.

Barely a year had elapsed following the final formal agreement on the boundary in the Pacific Northwest when President U. S. Grant sent a message to Congress proposing a joint United States-British project to mark the boundary between the Lake of the Woods and the summit of the Rocky Mountains. Indicative of the general vagueness of American knowledge concerning Canadian geography, the President confused the Strait of Georgia with Georgian Bay in his message of December 5, 1870.

"The land boundary", President Grant stated, "has already been fixed and marked from the summit of the Rocky Mountains to the Georgian Bay. It should now be in like manner marked from the Lake of the Woods to the summit of the Rocky Mountains." Moreover, the same error is repeated in a formal statement to the President from his Secretary of State, Hon. Hamilton Fish, seven years later.[3]

With arbitration of the San Juan Island dispute under way, official attention had turned from the Pacific Northwest to a comprehensive survey of the Canada-United States land boundary between the Lake of the Woods and the Rockies. Fenian raids into Manitoba from the south in 1871, as well as continuing uncertainty over the precise location of the border at the western extremity of the Lake of the Woods and at Pembina, south of Winnipeg, served to expedite survey preparations. In March, 1872, Congress voted $50,000 so that operations could commence. The British and Canadian governments each agreed to pay half the costs of the British Commission.[4] Prime Minister Macdonald submitted to London a nomination for the post of British Commissioner of the boundary survey. He recommended, not a Canadian, but a Scottish-born officer of the Royal Artillery, Capt. Donald Roderick Cameron (1834-1921). In the course of his service career Cameron was posted to Halifax where, in 1869, he married the daughter of a Nova Scotian destined to become Prime Minister of Canada, namely, Dr. Charles Tupper. In the following year Tupper entered the Dominion cabinet as President of the Council. The newly-married Cameron was assigned as an aide, by Sir John A. Macdonald, to the staff of Hon. William

McDougall, then Lieutenant-Governor designate of the North-West Territory. His relations with McDougall had not been particularly congenial during the ill-starred, futile expedition of the autumn and winter of 1869. Cameron became friendly, however, with Bishop Taché of St. Boniface and the Scot made use of his training in French military schools by translating into English the bishop's *Sketch of the North-West of America.*

Three years after the fiasco at Pembina, Cameron was once more in the public limelight. The War Office in London, though unenthused over the Macdonald nomination, appointed Cameron to the post of British Commissioner (Hawkins being unavailable) but assigned Lieut. Samuel Anderson to the expedition as chief astronomer, with Lieut. Albany Featherstonhaugh as his first-ranking assistant. Both Anderson and Featherstonhaugh were promoted to captaincies in August, 1872. Cameron's choice for secretary of the British Commission was Lieut. Arthur C. Ward, R.E. Ward had known Cameron in Nova Scotia previous to the latter's marriage there. Another officer of the Royal Engineers, Lieut. William J. Galwey, was named as assistant astronomer. Forty-five non-commissioned officers and men of the Royal Engineers were selected by Anderson to form part of the expedition. In his ability to assume leadership of field parties, Sergeant Kay proved to be the most notable of these well-trained, disciplined and resourceful men.

FIGURE 72. Her Majesty's Boundary Commission (49th Parallel) 1872-76.

In addition to British members of the expedition, Cameron placed Canadian civilian personnel on the Commission staff, namely, W. F. King, W. A. Ashe, G. F. Burpee, G. C. Coster, L. W. Herchmer, Dr. T. J. W. Burgess, Dr. Thomas Millman, Dr. W. G. Boswell and Dr. G. M. Dawson. The principal survey positions on the Canadian side of the affair were filled by Lieut.-Col. A. G. Forrest of the Canadian Militia, Ottawa, and Alexander Lord Russell (1842-1922). Both Forrest and Russell were Provincial Land Surveyors, Ontario.* Major Macdonald, an experienced Canadian militia officer, helped organize the expedition in its early stages.

On the American Commission the influence of West Point was predominant, just as traditions of the Royal Engineers weighed heavily on the British side of the boundary-marking project. The United States Commissioner, Archibald Campbell, was a veteran of railway, canal and boundary surveys, and a West Point graduate, as were two of his three assistant astronomers, Capt. J. F. Gregory and Lieut. F. W. Greene. The third assistant named at the time of the formation of the commission was Brevet** Major William J. Twining, a lecturer at West Point. Brevet Lieut.-Col. Francis U. Farquhar was named chief astronomer. Dr. Elliott Coues joined the United States Commission as its medical officer and naturalist. James E. Bangs functioned as its secretary.

In rates of field remuneration the military personnel of the British Commission fared considerably better than their American counterparts because of the provision of "boundary pay" additional to their regular army pay. They received advances of £100 each for equipment, in addition to travel expenses and rations. The Americans admitted that the quality of the British survey instruments was superior to that of their own. Canadians on the staff of the British Commission ranked as officers and received the same allowances for outfitting as the Royal Engineers. The surveyors among them received $1,800 a year and assistant astronomers King, Ashe, Burpee and Coster received $1,500 a year.

Payment of laborers on the survey proved to be a problem during early stages of the project. "The rates of wages in Manitoba", reported Cameron, "were so very much higher than those which prevailed in farming districts of Eastern Canada and the States, that it became necessary to bring in competition from these quarters. By this means the lowest rate was reduced from 1 dollar, 50 cents to 1 dollar, the former being that which was prevalent in Manitoba and at which men were hired by the Dominion Government at Ottawa on the parties being first organized."[5]

Considerable foresight was shown by the Royal Engineers, based upon their experience in British Columbia a decade earlier, in assembling for this venture into the western interior of North America a library of varied reading for the information and entertainment of members of the field party during off-duty periods. Fiction, history, plays, poetry and essays by British and American authors were included in this portable library. During prolonged spring thaws especially, when active surveying was impossible, this collection of books proved most beneficial. At the conclusion of the boundary-marking project the library was sold.

Cameron was meticulous in his paper work and in the organization of his men. He was strong on discipline but his relative ignorance of theoretical and practical aspects of surveying was the despair of his British colleagues. His relations with Campbell, following a brief initial period of harmonious cooperation, were less than cordial. But his failure to agree promptly with the American viewpoint on all questions may have been due as much to the limitation of his instructions from the Foreign Office in London as to any temperamental deficiency on his part. Cameron divided functions of the British Commission into seven categories and named the following as chiefs:

Topography	:	Lieut. Anderson
Commissariat	:	Mr. Herchmer
Medical	:	Dr. Burgess, assisted by Dr. Millman

*In regard to this appointment A. L. Russell is sometimes confused with L. A. Russell, then the Assistant Surveyor General of Canada. The latter's connection with this boundary survey was confined to his telegraphic signals from Chicago in 1872.

**Brevet denotes a commission that gives an officer a title above his rate of pay.

Veterinary	:	Dr. Boswell
Natural History	:	Dr. Dawson

Cameron, it is assumed, headed the other two categories, Intelligence and Headquarters. The fact that Canadians were allotted important duties on this project was, in itself, an eloquent indication of Ottawa's growing insistence that Canadians must exercise more than an indirect influence on decisions and findings of international bodies vitally affecting the national interests of the Dominion.

The scientific reputation of 25-year old George Mercer Dawson (1849-1901), son of Sir William Dawson, principal of McGill University, was firmly established by his noteworthy 387-page *Report on the Geology and Resources of the Region in the Vicinity of the 49th Parallel from the Lake of the Woods to the Rocky Mountains.* Shortly after its publication Dawson was appointed Chief Geologist of the Geological Survey of Canada. He became Assistant Director of the organization in 1883 and its Director 12 years later. In 1888 he was asked to go to Washington, D.C. to confer on the Canada-Alaska boundary question. For his work on the Bering Sea Commission in the early 1890s Dawson was made a Companion of St. Michael and St. George. "Doctor George", as he was familiarly known, became one of the most outstanding scientists Canada has ever produced. He helped to build reliable foundations for much of the geological and botanical knowledge that Canadians possess concerning the western and northwestern regions of their country. It was mainly his pioneer work along the 49th parallel that established his reputation as a profound scholar and skilled observer.

W. F. King, fresh out of the University of Toronto and filled with the eager enthusiasm of an 18-year old on the brink of a fascinating adventure, wrote to his father from Pembina late in September, 1872:

"Today is Thursday, just two weeks since I started—meeting on the train Dr. Burgess, Captain Anderson, Captain Featherstonhaugh, Lieut. Galway [sic] and Major Macdonald . . . " Young King then related how he had journeyed to Thunder Bay by way of Collingwood, across Lake Huron to Little Current, St. Mary's Village to Thunder Bay. Crossing to Duluth he travelled by the Northern Pacific to Moorhead, Minnesota. "We went aboard the *Selkirk*, a flat-bottomed steamboat with a stern wheel. On Wednesday we arrived here at the Hudson Bay Post at Pembina, Manitoba . . . I shall describe the voyage on the Red River some other time. We are encamped a little way from the Hudson Bay Post and about half a mile from the Yankee camp and 2½ miles from the American Village at Pembina. You had better address your reply to W. F. King, care of Captain Cameron, N.A.B.C., Pembina, until I send you further notice [6 cent stamp] . . . ".[6]

In approaching their survey task the boundary commissioners faced an assortment of treaties dealing with the legal and political aspects of the boundary from the Lake of the Woods to the summit of the Rockies. Article 7 of the Treaty of Ghent had authorized commissioners to determine, in accordance with the 1783 treaty, that part of the boundary extending from the water communications between Lake Huron and Lake Superior "to the most North Western point of the Lake of the Woods" and to cause such parts of the said boundary to be surveyed and marked. Particular attention was to be given to the location by latitude and longitude readings of "the most North Western point".*

As late as 1818, when the Boundary Convention was concluded between Great Britain and the United States, it was obvious that the location of the most northwestern point in the

*Allusions to the North Western Point began to replace references to North West Angle in treaty terminology in the early 19th century. The Angle is now generally regarded as the arm of the Lake in which the most northwestern point was originally located.

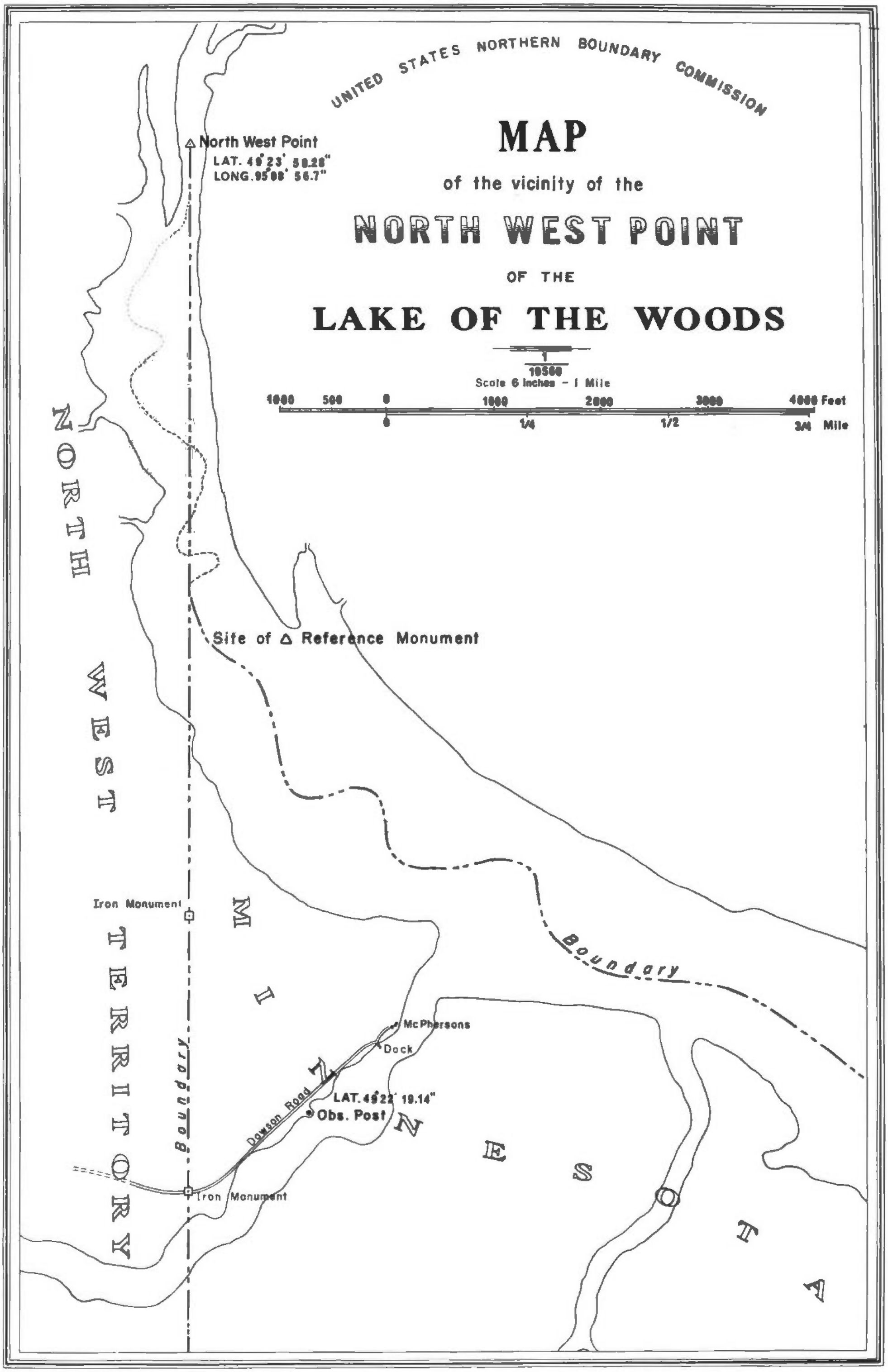

FIGURE 73. International Boundary, Lake of the Woods.

Lake of the Woods was not definitely known to those who framed and signed its provisions. By Article 2 of that convention it was agreed by the two contracting powers that a line from that point along the 49th parallel, "or a line drawn due north or south as the Case may be" until that line intersected the 49th parallel and from the intersection due west along that parallel "shall be the Southern Boundary" of the territories of Great Britain *from the Lake of the Woods to Stony Mountains.* (author's italics)

Between the conclusion of the 1818 Convention and the signing of the Webster-Ashburton Treaty of 1842 the name "Stony Mountains" was replaced, in popular and official parlance, by the term "Rocky Mountains". By the 1842 treaty the boundary was redefined as between these two geographical features. The latitude and longitude of the most northwestern point had been determined by special surveys made by David Thompson and Dr. Tiarks in 1824-25. The coordinates as ascertained by Tiarks were mentioned in the text of the Webster-Ashburton Treaty as 49° 23′ 55″ north latitude and 95° 14′ 38″ west longitude. Because the point was not located on firm ground it could not be marked in the customary manner. But a reference monument had been erected by Thompson in the form of a pyramid of logs of oak and aspen.

In July, 1872, in Washington, D.C., the two boundary commissioners met each other for the first time. They agreed quickly upon a three-pronged initial assault on the task assigned to them. First, they would ascertain with accuracy a point on the 49th parallel close to the western bank of the Red River. Once that point was determined the second step would be taken, that of surveying the boundary line to the east during what remained of the 1872 field season. Thirdly, portions of the eastward-trending line that were wooded were to be cleared to a width of 30 feet by the British party at the joint expense of the two nations.

It was September before the two commissioners arrived at the point of beginning of the boundary survey. The Americans encamped at Pembina and the British-Canadian party occupied specially-constructed barracks at Dufferin, as North Pembina (Canada) had come to be called. Early in October the British and American chief astronomers arrived at the Lake of the Woods. The North West Angle of the lake was located without difficulty but several days of careful search was required, along with assistance of local Indians, to discover the remains of the David Thompson reference monument of 1824. This consisted of a partial crib of hand-hewn logs, submerged in several feet of water. When measurements were made by Farquhar and Anderson from the site of the crib remains, it was found that the most northwestern point lay close to the limit of the North West Arm and within 500 feet of the latitude fixed by Tiarks almost half a century earlier.

Cameron and Campbell arrived on the scene a fortnight later and the easy cordiality that had featured their relationship up until that time, ended abruptly. Campbell was fully prepared to accept the recovered monument as conclusive evidence of the location of the key boundary point. Cameron, however, mindful of his instructions from London to avoid premature discussions in the matter, could not be induced to make the finding unanimous. Campbell and his American associates, as well as Anderson, were much aggravated by the stubborn attitude of the British Commissioner, although they must have realized that his decision to leave the issue unsettled had been taken in the hope that the two major governments could somehow reach a mutually satisfactory arrangement. Twining, who succeeded Farquhar as chief United States astronomer early in 1873, dealt understandingly with Cameron's viewpoint when he made his final report:

"...considering that the northwest point, so determined", Twining wrote, "lies within what must be acknowledged to be English territory, I am of the opinion that the English commissioner may, without being considered as acting in an obstructive manner, take the ground that the evidence is not conclusive but in making such objection, it is incumbent on him to suggest some other point as the "most northwestern" which the shape of the bay would render possible".[7]

Cameron, of course, did not act upon what seemed to be a reasonable American suggestion. But before long he found that two could play at his waiting game. When Cameron, following the return of the commissioners to Red River early in November, hastily tried to obtain official confirmation of the exact location of the 49th parallel on that river, he was met with the explanation that American astronomical calculations had not been completed. Autumn coolness was in the prairie air in more ways than one. But Cameron had not been completely uncooperative. He willingly agreed to the cutting of a sight line due south from the point in the North West Arm recommended by the two chief astronomers and Campbell. This agreement involved the clearing of a 16-mile swath through the wooded peninsula to its south shore.

By November the Americans had nearly exhausted the funds at their disposal and were compelled to withdraw from field work and to confine their activities to paper work in a headquarters office in Detroit for the winter season. This financial plight was relieved when Congress in its winter session voted $125,000 for a continuation of the boundary survey.

Travel conditions in the early winter of 1872 on this section of boundary survey work are graphically outlined by Capt. J. F. Gregory in his final report to the Chief (U.S.) Astronomer:

"I reached Fort Pembina with the animals [from Point de Chêne] in a much exhausted condition, owing to scanty forage and the very bad condition of the roads. On one day, the 5th [of November], because of the almost bottomless mud, we made but 11 miles, although the wagons were light and we were on the road from daylight until three hours after dark". Departing from Pembina on November 12, Gregory reports: "On the second day out we were overtaken by a very severe snowstorm of two days' duration, which was succeeded by bitter cold winds, with the thermometer much of the time below zero—and as the men were not provided with suitable winter clothing, they experienced much discomfort, though none were seriously frozen."[8]

In the last week of November, 1872, Anderson returned to Fort Garry on completing his observations at the Lake of the Woods. Over the newly-installed telegraph facilities he received a message urging him to go without delay to Dufferin and from the Red River station there to enter into an exchange of telegraphic signals with Lindsay Russell, Assistant Surveyor General of Canada. Russell, with the generous assistance of Professor Stafford, Director of the Chicago Observatory, had been successful in arranging for the use of lines between the two stations for one hour on each of five nights during the winter season. Russell's story of this momentous enterprise is contained in cold, official terms:

"For the purposes of the International Boundary Commission and those of the Dominion Land Survey, in 1872 Captain Anderson, R.E., Chief Astronomer of the British Commission at Pembina, in cooperation with myself at Chicago, determined by electro-telegraphic method the difference in longitude between the Observatory at Chicago, and his astronomic station at the former place. This, with the known reliable position of Chicago and Greenwich, will give by reference to the Pembina station the necessary connection of all our future surveys with Greenwich."[9] This interchange of time signals indicated that the Red River station was at 97° 13′ 51″ west longitude. From this point longitudes east and west were determined by measurements along the boundary.

Twining and Featherstonhaugh conducted a series of observations in the boundary area at Red River in order to determine latitude with precision. Their conclusions, calculated separately, differed by only 32 feet. This difference was halved in order to reach a fix agreeable to both commissions. These findings confirmed the location of the Hudson's Bay Company store as north of the 49th parallel by about 100 yards. Canada's custom house, however, was found to be more than 500 feet inside the United States.

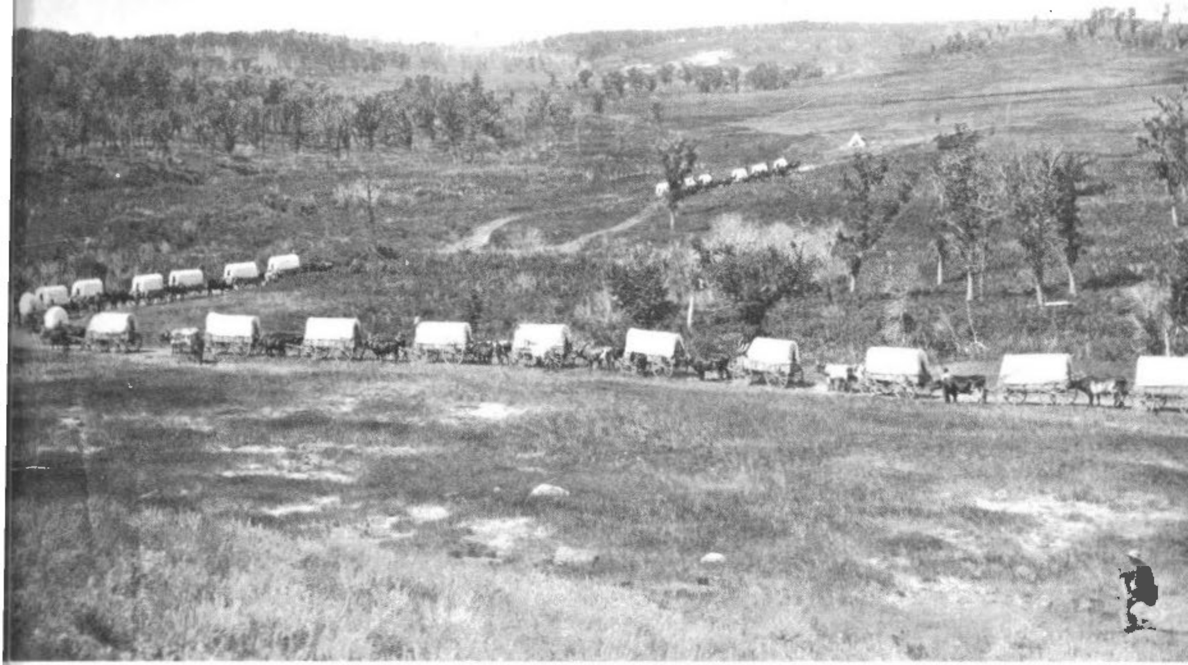

FIGURE 74. British survey party supply train, 49th Parallel.

The opening of the 1873 field season, marking the beginning of the long trek westward of both the British and American boundary parties, revealed an interesting contrast in national policies concerning the provision of military protection for surveyors and supporting elements. As a precaution against possible active Indian hostility the Americans were accompanied by two companies of regular cavalry and a company of infantry, the whole force totalling about 230 men. On the other hand the British did not consider an armed escort necessary to the safety of their survey party. A show of the flag, in Cameron's view, was sufficient immunity from Indian attacks. His attitude proved to be a trifle optimistic. Several incidents of harassment of his surveyors by the Sioux, raids unmentioned in British records, were reported by American observers. Generally, however, tribes of the western interior seemed well-disposed to the white intruders.

Nevertheless the British made one concession to caution when Cameron hired William Hallett, a veteran hunter of the plains, to recruit and command a troop of 30 armed, mounted métis, to function as guides, hunters and cattle herders. As a pleasant gesture to the boundary assignment on which they served, these riders were jocularly known as the "49th Rangers". Instructions from the Foreign Office that a special survey be made of the Lake of the Woods provided Anderson with an opening to request additional men. Reinforcements arrived in the spring in the persons of Lieut. Valentine F. Rowe, R.E., and George C. Crompton, a former officer of the Royal Navy. D'Arcy East, formerly an officer with the Royal Artillery, also arrived to take the place of Hallett, who had died in the winter of 1872-73.

On May 12 the first party of surveyors to enter the field in the 1873 season was a British group under the command of Sergeant Kay. They commenced mapping a 6-mile-wide belt north of the 49th parallel and westward to the Pembina River. There the party linked up with A. L. Russell's party operating in the territory adjoining to the west. On May 26 Lieut. Galwey took the first astronomical party of the season into the field. On June 7 Capt. Featherstonhaugh led his party to the east side of Pembina Mountain, about 35 miles west of Dufferin. These stations were observed by the experts of both commissions and in view of the negligible differences in their respective findings the two chief astronomers agreed that the British and Americans could observe at alternate stations to avoid duplication of effort and to save time.

Daytime temperatures often rose to very high levels; nights on the prairies were usually cool and would have been entirely refreshing but for the traditional affliction of North American land surveyors. At dusk mosquitoes attacked men and beasts in ravenous hordes. The tender skin rimming the eyes of transport animals attracted swarms of the tormenting insects. Bulldog flies, whose bites left bubbles of blood on humans and animals alike, proved to be an added ordeal. Horses, in particular, suffered greatly and had to be tied to prevent their escape into the night.

Surveyors and their wagon trains formed an imposing cavalcade as they travelled across the empty, dusty plains. For the most part oxen were used by the British for hauling heavy commissariat transport; the Americans favored the use of mules. Cameron, in his report, gives an interesting, detailed description of the utilitarian, two-wheeled Red River carts:

"They are made entirely of wood, unless friction plates of iron are specially ordered for the axle-tree arms and metal bouches for the naves. The shafts and transoms forming the frame are of oak; and the guard-rails of strips of oak, supported by ashen or oak rods inserted in the framework . . . Two spare axles were carried with every cart, and a few spare wheels were supplied, but these precautions were quite insufficient. The breakages were repaired, but in very numerous instances the wrecked vehicles had to be abandoned on treeless wastes. The shafts and bodies of these carts, however, proved thoroughly substancial [sic]; and when mounted on spare . . . wheels and axles they answered every purpose that could be desired, and made most economical vehicles."[10]

While British astronomers observed the stars to fix the position on the ground of each astronomic station, assistants would survey a tangent (straight line) to the next station to connect up with it—a line laid down at right angles to the meridian of the previous stations and continued by chain and transit work to the meridian of the next following station. Then right-angle offsets from the tangent to the parallel were measured out on the ground at from one- to three-mile intervals. At these points permanent marks were erected along the boundary. One-mile intervals were adopted as far as the west boundary of Manitoba, then three-mile intervals were used.

Snowstorms and prairie fires hindered progress in September. Surveyors had narrow escapes from severe burning, or suffocation by smoke. On several occasions men worked desperately all night to keep flames away from tents and provisions. In the dry grass of the plains the backfire method was commonly used. But if the grass was long, a rapidly-spreading fire was particularly dangerous as it soon became impossible to gallop horses through the flames without seriously burning the animals. Through experiences such as these a number of the surveyors developed into expert plainsmen. Their lives, unlike those of the native inhabitants, took on a strange two-world aspect, related on the one hand to primitive frontier conditions, and on the other hand to a distant but well-remembered sophisticated civilization.

During this first summer of surveying in the western interior another source of friction developed between Cameron and Campbell. The Britisher, against the views of his own chief astronomer, urged that the boundary line take the form of a mean parallel, formed by averaging local variations at all astronomic stations and thus producing a more perfect curve, as befitting a parallel of latitude. There had been unanticipated complications in the measurings. On the parallel, distinct deflections of the direction of gravity were detected by the surveyors of both nations. These were not surveying "errors" in any ordinary sense of the term but rather were deflections from theoretical directions computed for homogeneous earth. Actual findings did not agree with the theoretical values used by the boundary surveyors. In the vicinity of Turtle and Pembina mountains and near the Sweet Grass Hills (in northern Montana almost directly south of Medicine Hat, Alberta) results indicated that the actual directions of gravity were deflected from the theoretical values toward these topographical features.

Greene, the American surveyor, remarked in his final report:

"Having given the actual deflections it now becomes interesting to see how far these can be accounted for by the attraction of masses above the surface, and how many of them must be referred to some attracting force under ground where, according to Pratt 'we seem to have an unlimited resource upon which to draw, to explain any anomalies of local attraction we may perceive on the surface'." Greene added this comment, "It may seem strange at first that the distant attraction should be so much larger than those nearer the station; but this must always be so in a country like the plains east of the Rocky Mountains, where there are few abrupt irregularities but where large tracts of country have a gradual tilt in the direction of the drainage."[11]

Cameron, in his final report and in reviewing this novel development, pointed out that the definition of the line was complicated by the fact that "from some influence, supposed to be due to irregularity of direction in the action of gravitation upon the levels of astronomical instruments" the points successively determined by the astronomers were not located where they were expected to be, namely, on the 49th parallel. This was a reason why Cameron had advocated the establishment of a regular mean parallel, averaging out the determinations to avoid "a possible excess of irregularity in the course of the boundary line". In other words, Cameron was insisting that a mean or average parallel of regular curvature, run after all determinations had been made, was preferable to a series of curved lines joining astronomically-determined points the location of which was subject to certain irregularities. When Campbell, the American commissioner, at first proposed that the boundary be run as a series of straight lines representing arcs of great circles, Cameron rightly objected that such arcs, drawn on the proposed pattern of inscribed polygons, would range north of the 49th parallel, conceding to the United States about 100 acres every 20 miles. He saw no reason why a circumscribed polygon pattern could not be chosen, with arcs tangented to or south of the 49th parallel so that Canada would benefit from the acquisition of areas of a similar size. Whereupon the commissioners agreed that the line should everywhere have the curvature of the parallel 49 degrees north, between marked points.

Anderson, concerned over Cameron's interpretation of the treaty provisions and the support given by the Canadian cabinet to his view, quietly communicated during the winter months with his friend Wilson in Whitehall. Wilson advised cabinet circles in London that the question of a mean parallel had arisen during the boundary surveys of 1857-62 and that both Hawkins and Haig had been opposed to the procedure on the grounds that resulting territorial adjustments could not justify the heavy costs of running such a parallel. The Astronomer Royal, when consulted by the Foreign Office, ruled in favor of the United States' view that a series of points could be determined with sufficient accuracy by astronomic means to satisfy and implement the terms of the treaty. As to the dispute over the precise location of the most northwestern point of the Lake of the Woods, Wilson advised that Tiarks' determination of 1825 was the only alternative to accepting the site of the remains of Thompson's reference monument and the adoption of such a point would give the Americans even more territory.

Near the end of the 1873 field season some misgivings arose in Ottawa over financial aspects of the boundary survey. The attention of the Canadian cabinet, at the instigation of Minister of the Interior A. C. Campbell, was drawn to the fact that Cameron's expenditures up to June 30, 1873, representing costs of surveying activities, totalled $111,283.37. The cabinet complained that Cameron, in making payments for services rendered the expedition, was acting entirely on instructions from Whitehall. Despite the fact that the Canadian government was responsible for one-half of all project expenditures, no supervision of these operations by Dominion authorities had been arranged. It was accordingly recommended by the cabinet in Ottawa that "steps be taken to bring the subject under the attention of the Right Honorable the Secretary of State for Foreign Affairs with a view to obtaining such right of supervision of Captain Cameron's expenditure and accounts as may be called for in the interests of the Dominion." This was a salutary step and heralded much firmer demands in the future from Ottawa for a more influential and effective voice and control in matters directly affecting the important interests of the Dominion.

All in all, however, the 1873 boundary survey season had been a pronounced success. Anderson, at the beginning of October, in his final reconnaissance of the season, selected a site for the first British astronomic station to be established on the 49th parallel for the following season's work. This was located at a point 432 miles west of Red River. The Americans, who had pushed their topographic survey to a point 385 miles west of Pembina, concluded their summer surveys at about the same time as the British.

The 1874 field program for the British involved an advance to the westward of some 450 miles before actual surveys could commence, and an 850-mile return trip to base camp in the autumn. Logistics of this project demanded close study and careful preparation. Plans were even made for wintering some fifty men near the Rockies if the 1874 surveys failed to complete the boundary-marking assignment.

During the winter of 1873-74 Greene, the American, marked the 49th parallel for 56 miles east of Red River, cutting a swath, where necessary, to a width of 10 feet. In the main he accepted as accurate the British lines of survey in the region. At the end of January, 1874 he returned to Pembina. Except for a second trip by D'Arcy east to the Lake of the Woods, no other boundary surveying or exploring was undertaken until after the spring break-up.

On May 20, 1874, the main British expedition of 11 officers and 128 men left Dufferin for the west country. Before the initial survey stations were reached Rowe, in a fall with his horse, suffered a skull fracture and was incapacitated for most of the field season. Dominion land surveyor Ashe took Rowe's place and the topographic party under his charge began work beyond West Poplar Creek. Because Congress had delayed voting the survey appropriation until early June, the Americans were late in commencing their boundary line operations. They were escorted in this final season by five companies of infantry and two of cavalry. It was June 29 before Greene, for instance, reached the place where his topographical survey had ended in 1873.

Past countless clusters of bison bones, bleached and melancholy reminders of man's careless destruction of the species, almost to the point of extinction, the cairn-marked boundary line advanced steadily to the west across the three principal prairie steppes. Neither insect pests, hailstorms, violent winds nor grass fires impeded for long the onward march of the determined surveyors although smoke, haze and shimmering heat waves made the tasks of these dedicated measurers doubly hard.

There was an imposing concentration of men, animals, transport and stores early in August in the Sweet Grass Hills area. These three prominent buttes rose some 3,500 feet above the level of the surrounding plains. More than 500 men formed the highly mobile population of this mushroom community, an impressive white-man oasis in a vast Indian-occupied empire. It was at this place that Cameron and Campbell met again. Cameron was not in the best of spirits, having received instructions from the Foreign Office to accept the site of the remains of the monument, discovered by the two chief astronomers in the Lake of the Woods, as a proper reference to the most northwestern point there. He had been instructed also to agree to an astronomical, rather than a mean parallel along 49 degrees north latitude.

The somewhat less than enlightened treatment by Americans of the plains Indian of the United States brought its inevitable bloody climax at Little Big Horn, in what is now Montana, in June, 1876, when Sitting Bull and Crazy Horse, supported by a thousand enraged Sioux warriors, massacred the Custer force. Among those slaughtered were some of the army units that had safely escorted boundary surveyors through Indian territory in 1873 and 1874. Ironically, the first beneficiaries of the establishment of the border line were Sitting Bull and his braves, fleeing to Canada from American military wrath.

Dominion land surveyors connected with the boundary-marking project received high praise from their British colleagues. Anderson, in his final report, remarked that "To Mr. Ashe especially great praise is due for taking Lieut. Rowe's place in charge of the surveying party at the shortest notice, and he filled this position with credit to himself and with advantage to the Commission. The whole of the surveying operations of the season [1874] devolved upon Mr. Ashe and the Royal Engineers of his party". Anderson also reported that Capt. Featherstonhaugh "speaks very highly of the ability exhibited by Mr. King, sub-assistant astronomer, in the work entrusted to him . . . ".[13]

Cameron reflected something of the awe-struck attitude of the laity in his tribute to the astronomical observers who, independent of one another, "seeking on the earth's surface, points which are defined by their position relative to the equator, taking the stars for guidance" differed only in their calculations by distances less than the width of a narrow country lane.[14] In 71 days of surveying in the 1874 season Ashe and his party completed 362 miles of boundary line and surveyed all prominent streams, valleys and ridges in a belt of country varying in width from three to six miles, north of the 49th parallel. King, aided by Ashe and his party, cut through more than 24 miles of wood in the vicinity of Turtle Mountain. In the two seasons of surveying in the western interior 857 miles of traverse had been chained. Much of the surveying was carried out on the basis of a gruelling 12-hour work day. Men would leave camp at about 6 a.m., carrying their lunch with them and eating it on pony-back, returning to base about 6 p.m. Survey parties, in the nature of things, could not make extended stops such as astronomic parties were required to do, but were ever on the move.

The services of Crompton, as well as of Rowe and East, proved highly useful. Crompton, a topographer, performed duties of a reconnaissance officer and made observations and sketches. Cameron had special praise for Capt. Abney, R.E., Professor of Photography, School of Military Engineering at Chatham, England, for his carefulness and ability in the selection and use of photographic equipment of the British expedition. A total of 234 photographs illustrated the nature of the country traversed.

Capt. Featherstonhaugh located his final astronomic station at the Belly River crossing, 748 miles west of Red River. The most westerly monument of the earlier Hawkins-Campbell survey, erected in 1861, was reached by Anderson on August 18, 1874. By the end of August all parties of the expedition had commenced the long trek back. The main British party arrived at Dufferin on October 11.

Cameron, with his family, remained in the winter quarters while he brought the affairs of the British expedition to a conclusion. The four officers, Anderson, Featherstonhaugh, Galwey and Ward, gathered in Ottawa to complete their maps and to write reports. Six men from the ranks of the Royal Engineers accompanied them as clerks. Capt. Anderson dined at Rideau Hall, a guest of the Governor General and Lady Dufferin. The astronomer, who was favorably impressed by the appearance of Canada's capital, was also a guest of Prime Minister Alexander Mackenzie.

Some time later Anderson dined in Washington with the British ambassador to the

United States, Sir Edward Thornton. This function served also as a farewell to Mr. Charlton of the British Embassy staff, who was about to leave for England with his bride, daughter of the United States boundary commissioner. Campbell, having had his way in the matter of retaining the Lake of the Woods peninsula from the British during the survey project had, on the other hand and by the irony of circumstances, lost his daughter to one of them.

In summary, 388 monuments and marks had been established by the commissions along the parallel, as well as 40 astronomic stations. The former included iron pillars, stone cairns, earth mounds, timber marks as well as mounds of mixed earth and stone. The cost of the American survey project was slightly in excess of $300,000. The total of British expenditures is not mentioned in Cameron's report but undoubtedly it exceeded £100,000 and may well have reached £150,000. Included in this outlay was the cost of publishing in Montreal 1,000 copies of Dawson's 1875 report. A set of 24 topographic maps, in duplicate, on the scale of 2 miles to the inch, was prepared along with a descriptive list of the monuments and marks. These were submitted to the final meeting of the commissioners in London on May 29, 1876. For their services on the boundary survey Major Cameron and Capt. Anderson received the award of Commander of St. Michael and St. George (C.M.G.) from Queen Victoria.

Cameron, who became a Major General, was Commandant at Royal Military College in Kingston from 1888 to 1896. Cameron Lake and nearby Cameron Falls, scenic attractions in southern Alberta, commemorate his services to the boundary survey project. Anderson Peak in the Rockies in that vicinity is named after Cameron's chief astronomer. Mount Galwey and Mount Boswell are other impressive memorials in the Canadian Rockies to members of the British Commission of 1872-76. In Glacier National Park, Montana, Mount Campbell stands as a natural monument to the work of the United States Commissioner.

It was a great constructive task, as remarkable as it proved lasting. In total length and durability the 49th parallel across the western interior of North America stands unique as an international boundary following, not natural features, but a strictly geographical concept —a line astronomically, legally and geodetically surveyed.

The establishment of the boundary provided Canada and the United States with the first legally enforceable basis for governmental control of offences arising out of lawless international activities in the Midwest. Bootlegging and gun-running, horse-stealing and illegal actions of that nature were at once made subject to more effective policing. The North West Mounted Police found that the completion of the first surveyed line, demarcating the border-line between the two countries and extending fully across the great plains, made possible and practical the administration of law-enforcement in its international aspects.

Boundary Resurveys in the Early 1900s

Point Roberts to the Most Northwestern Point, Lake of the Woods

In the closing years of the 19th century there was a marked increase in discoveries of mineral deposits in the vicinity of the border between Point Roberts and the summit of the Rocky Mountains. The resulting need to locate mineral claims accurately in relation to the boundary line inspired the despatch of urgent pleas to Ottawa and Washington, D.C. to arrange for a more complete and more readily discernible demarcation of the International Boundary from coast to coast. As a more intensive definition of the boundary between the Strait of Georgia and the summit of the Rocky Mountains was particularly pressing, a joint Canadian-United States examination of the line was made in 1901 and 1902. In the latter year, and again in 1903, through an exchange of notes, the two countries jointly made provision for a ground retracement of that section of the boundary. The commissioners responsible for the efficient discharge of the task were W. F. King, Chief Astronomer, Department of the Interior, acting for Canada; O. H. Tittmann and C. D. Walcott for the United States. In sharp contrast to arrangements made for Canada-United States boundary surveys of the previous century we find, on this occasion, a Canadian citizen, recommended for the post by a Canadian cabinet, placed in the position of highest responsibility opposite American counterparts.

In each field season from 1901 until completion of the project, the boundary survey parties, Canadian and American, worked concurrently on the task assigned to them and always on terms of cordial comradeship. In that first season two Canadian field parties were active, headed by Dominion land surveyors J. J. McArthur and W. F. O'Hara. The former's party concentrated on the Point Roberts area while the latter's operated inland toward the Similkameen River. Reginald A. Daly, a geologist, and J. M. Macoun, the naturalist, were attached to McArthur's party. J. M. Bates, E. T. de Coeli and J. W. McArthur performed duties as survey assistants. With O'Hara were Bruce Strachan and J. M. Sheppard along with 12 helpers. Sheppard worked in each season of this boundary-marking project, specializing in monumentation. In the 1902 season T. A. Davies, who obtained his Dominion land surveyor's commission a few years later, served with O'Hara also.

In 1903 one Canadian party and two United States parties were in the field west of the summit of the Rockies. O'Hara had 23 men with him that season, including de Coeli and Wilmot M. Tobey, a Dominion land surveyor who later became a Dominion topographical surveyor. In 1905, as in the previous year, McArthur's party of 60 men included Samuel H. Bigger, S. S. McDiarmid and Noel J. Ogilvie, all Dominion land surveyors. T. A. Davies specialized in photo-topography that season. Trail cutting, topographic work, monumenting and triangulation were carried out. In the 1906 season Bigger was stricken with acute appendicitis soon after surveying began. He was rushed to hospital but died on July 6. The triangulation work, which was to have been accomplished under his direction that season, had to be postponed.

By the end of the 1907 field season about three-quarters of the boundary work between Pacific tidewater and the summit of the Rockies had been completed and readied for joint Canadian-American inspection. This inspection was carried out by Noel J. Ogilvie for Canada and C. H. Sinclair for the United States. Despite trying conditions including heavy windfall, violent hail and snowstorms as well as extremes of temperature, steady progress was made. Once a pack horse, carrying the party's cook stove, lost its footing on a rocky trail and rolled 200 feet down the mountainside through tangled brush. Surprisingly, neither horse nor packload was damaged. But it required a day's hard toil to cut a path to recover the animal and its load. Afoot and on horseback the two inspectors travelled a total of 1,400 miles.

Early in the field season of 1908 boundary retracement work had been completed and found satisfactory. The surveyors and their helpers had overcome many hazards. Forest fires and streams in full flood had caused serious delays; transportation of supplies along hazardous trails presented formidable challenges to man and beast and the moving of heavy monuments and bags of cement in rough country had been exceedingly difficult.

In April of 1908 a treaty was concluded at Washington, D.C. It declared, in part: "It is agreed that each of the High Contracting Parties shall appoint, without delay, an expert geographer or surveyor as a Commissioner . . . to render more effective the demarcation of the existent boundary . . . and . . . shall observe the . . . protocol of the final meeting, dated May 29, 1876, of the Joint Commission . . . as follows:

. . . 2. In the intervals between the monuments along the parallel of latitude, it is

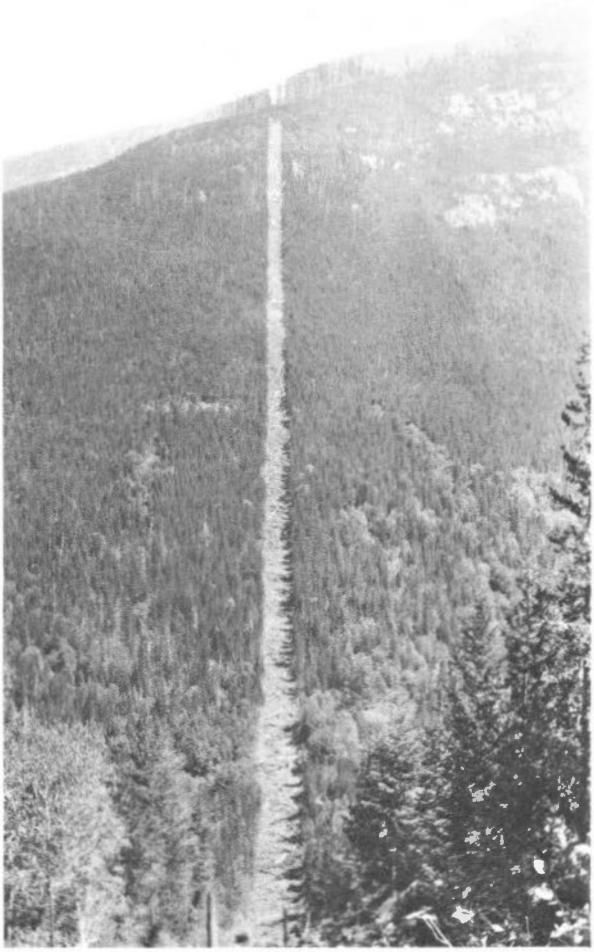

FIGURE 75
B.C.-Montana boundary vista cut through forested area.

agreed that the line has the curvature of a parallel of 49 degrees north latitude; and that such characteristic shall determine all questions that may hereafter arise with reference to the position of the boundary at any point between neighboring monuments".

Preliminary investigations by Canadian and United States engineers proved the general reliability of the line as originally surveyed and also that the locations of original marks were all recoverable. Thus the way was opened to a complete retracement and re-monumenting of the line, cutting of vistas, execution of triangulation network for topographic control as well as the production of maps of the entire boundary. The agreement also authorized surveyors to adjust all monument positions so that these fitted into the general North American triangulation net or, expressed in more technical terms, "to the North American geodetic datum."

East of the Rockies the forces of nature were in an uncooperative mood and problems arose to plague the survey parties. Severe flooding conditions in streams and rivers of the high plains were followed by swarms of torturing mosquitoes. A Canadian party was the only one active in the field of boundary surveys during the 1908 season. It was accompanied by F. D. Granger, a United States representative. Mr. Granger, in fact, continued to carry out his observing functions for a number of seasons. Various Dominion land surveyors performed similar duties from time to time with American field parties during these years: J. L. Rannie, D.T.S., George W. R. M. White-Fraser, D.T.S., also T. H. G. Clunn and M. F. Cochrane. In the 1908 season the Canadians worked from Coutts, Alberta, along 100 miles of boundary as far as Lodge Creek near the Alberta-Saskatchewan border. Americans, in the following season, surveyed from the summit of the Rockies to Coutts, a distance of about 90 miles.

J. J. McArthur headed the Canadian field party in 1909 and again in 1910. Francis P. Steers, a Dominion land surveyor also, was with McArthur during this period. By early November, 1911, the Red River had been reached. This represented the goal of Canada's effort on the boundary retracement project. Vistas had been cut and cleared on the east slope of Turtle Mountain and through the wooded area of the Pembina Mountains. About one-quarter of the original cast-iron monuments, having been broken or in disrepair, had to be replaced. A number of the field party fell victims to a typhoid outbreak and were hospitalized in Morden, Manitoba. J. W. Menzies, a Dominion land surveyor, was with McArthur in the final field season on this work. In 1912 the Americans carried the boundary survey from Red River to the Lake of the Woods.

In all, 653 new intermediate points had been established where previously there had been only 3-mile intervals between markings. All new points, as well as old cairns and mounds had been newly identified by means of iron monuments. From the North Branch of Milk River to Akamina summit, aluminum-bronze monuments, similar to those used west of the Rockies, had been installed. These monuments were made in three sections in the interest of portability in mountain areas.

Certain recommendations concerning boundary marking, made by the 1908 commissioners, were embodied in the treaty concluded by Canada and the United States in Washington, D.C. in 1925. Their recommendations included a revision of the most northwestern point in the Lake of the Woods, namely, a transfer of that location, by nearly one mile, to the south of the point formally agreed upon as valid in 1876. This alteration resulted in the surrender to Canada of two tiny areas of United States waters in the North West Arm of the lake. These areas totalled two and a half acres in extent and were entirely surrounded by Canadian waters. By Article One the parties to the treaty agreed "that this most southerly point of intersection, being in latitude 49° 23′ 04.″49 north and longitude 95° 09′ 11.″61 west shall be the terminus of the boundary line . . . in lieu . . . of . . . the Northwestermost point." The geographic coordinates of this key point of the boundary surveys, as cited in the 1925 treaty, differ somewhat from the coordinates accepted by the 1876 commissioners, then stated to be latitude 49° 23′ 50.″3 north and 95° 08′ 57.″7 west.[15]

The 1925 treaty also implemented a recommendation that a system of straight lines between boundary monuments be adopted. Article Two stated in part:

" . . . whereas the average distance between adjacent monuments . . . is one and one-third miles and therefore the deviation of the curve of the 49th parallel from a straight or right line joining adjacent monuments is, for this average distance between monuments, only one-third of a foot, and in no case does the deviation exceed one and eight-tenths feet; and whereas it is impracticable to determine the course of a line having the curvature of a parallel of 49° north latitude on the ground between the adjacent monuments . . . and whereas it is desirable that the boundary at any point between adjacent monuments may be conveniently ascertainable on the ground, the Contracting Parties, in order to complete and render thoroughly effective the demarcation of the boundary between the United States and the Dominion of Canada for the Northwestermost Point of the Lake of the Woods to the summit of the Rocky Mountains . . . the boundary shall be defined as consisting of a series of . . . straight lines joining adjacent monuments . . . ."[16]

Although, strictly speaking, the curving parallel was intended to be the international boundary in the western interior, once boundary monuments had been installed at one-mile intervals the amount of land involved in the separation between straight lines connecting such monuments and the curved line of the 49th parallel connecting those same monuments, was without any practical territorial significance. But the result would have been quite different if any boundary monuments had remained 20 miles apart. As has been pointed out, if the original American proposition concerning straight-line courses had been accepted Canada could have lost to its southern neighbor as much as 100 acres every 20 miles.

Lake of the Woods to Lake Superior

The re-establishment of the Canada-United States boundary from the Lake of the Woods to Lake Superior was based on the location of the line in that region and shown on maps prepared in 1826 by David Thompson and William Bird, surveyors to Commissioners Barclay and Porter under Article 7 of the Treaty of Ghent. The section from Lake of the Woods through Rainy Lake had been agreed upon by Barclay and Porter and the line was shown by a black line drawn through the watercourses, traced in red on the Canadian side and in blue on the American side.

The section from Rainy Lake to Lake Superior was agreed to in the Webster-Ashburton treaty of 1842 and shown by them on the same maps by a red line. The maps of the surveyors were severely simple, drawn on a scale of one mile to the inch. They depicted little more than the boundary line and adjacent shore lines of boundary lakes and rivers. No records, other than these maps, could be found of the original boundary surveys in this section, except the journal of the commissioners in which parts of the boundary were described in relation to certain islands.[17]

The task of this new survey, commenced shortly before the outbreak of the First World War, was to prepare improved topographic maps showing the true positions of islands and of other natural features. The tentative boundary line was then to be drawn on the maps in a series of straight-line courses in order to conform as nearly as possible to the curved boundary line shown on maps of 1822-24. After careful checking the line was accepted by the 1908 treaty commissioners. Geographic positions of boundary turning points were then accurately determined by triangulation.

So far as Canadian participation in this area was concerned the boundary survey work extended mainly over the seasons 1912 to 1916 inclusive. Even before that period, in 1896, a preliminary examination and report of this section had been made by an engineer acting under the instructions of Chief Astronomer King of Canada. American survey parties worked from Lake Superior westward in the field seasons 1908 to 1912 as well as in 1917 and 1918. By the latter year the principal task in the region had been accomplished. But minor surveys and miscellaneous monumenting continued to be performed by American parties in the seasons 1921, 1922, 1925 and 1926.

Canadian boundary surveyors made their first appearance on this project in May, 1912, in the Angle Inlet of the Lake of the Woods. The Canadians that year and during several succeeding field seasons were in charge of J. J. McArthur. He was assisted by Dominion land surveyors F. P. Steers, H. M. Barton and H. P. Moulton as well as by J. M. Perrier, A. Albrecht and 12 helpers. The United States representative on Canadian survey parties during this period was F. D. Granger.

The Canadians moved about on the job in two motor boats and several small craft. Throughout the first season their work was often delayed by heavy rains and high winds. The waters of the lake were frequently rough, and constant care had to be taken to prevent the motor boats from being driven ashore. Monuments at boundary reference points were established along the shores of the Angle Inlet and on islands as far east as Oak Island. All monuments were tied into the triangulation net initiated at the meridian boundary. In addition, topographic and hydrographic surveys were made of the shoreline and deep-water channel.

In the 1913 season the Canadian party made a junction at Bear Island of their triangulation work with that of the United States party moving up from Warroad, Minnesota. From there the Canadians moved to the mouth of Rainy River. Then more mapping, monumenting and triangulation work was done as far as Baudette, Minnesota. In 1914 two Canadian field parties were in operation and surveys were carried on at Lakes Namakan and Sand Point and at Lac LaCroix. By October 25 the main party of Canadians had completed mapping and triangulation to the west of Namakan Lake. At Kettle Falls a junction had been made with the work of the United States party advancing from the west. At the end of the 1914 season a large United States survey party was transferred to work on the Quebec-Maine highlands section. This development left one Canadian and one United States party to carry on with the task.

In 1915 Dominion land surveyor G. T. Prinsep served as chief of the Canadian party. Assistants who had joined the survey during the two previous seasons included G. B. Herridge, J. M. Sheppard, L. C. Nesham, Albert Wilkins, A. A. Brown and G. E. Wait. The parties of the two nations worked from opposite directions in order to meet near Curtain Falls. During the 1915 season a topographic survey, on which plane table and stadia were employed, was made of Little Vermilion and Loon Lakes, part of Lac LaCroix and of Loon River. Spirit levels were run across portages from one lake to the next. On July 23, 1915, commissioners King and Barnard inspected the summer's work and found it good. In cooperation the United States Coast and Geodetic Survey and the Geodetic Survey of Canada ran a triangulation and traverse from Lake Superior to the Lake of the Woods and from there westward to the 98th meridian arc of triangulation at Red River; this work was completed in 1924.

In 1916 a topographical survey was made of the east end of Lac LaCroix, of Bottle River and Iron Lake. With the close of that season's operations in late September the main task assigned to the Canadian commission in the region had been finished. Several small Canadian crews were active on miscellaneous boundary surveys in the area from 1921 to 1926. Prinsep and T. P. Reilly with two helpers constituted the personnel of these parties.

The work accomplished by the surveyors of both nations on the 426 miles of this section of the boundary was prodigious. Approximately 5,100 geodetic positions were determined, 1,382 monuments installed and 1,740 square miles topographically surveyed for the production of 36 boundary maps.[18]

Source of the St. Croix River to the St. Lawrence River

The entire boundary line from the St. Croix source to the St. Lawrence, including waterway courses, had been charted under the 1842 treaty. Land positions had been monumented but, generally, the water line had never been permanently marked before the 1908 treaty. Vistas that had been cut many years previously, had virtually disappeared in new growth. As a result of negotiations between Ottawa and Washington, restorative Canadian and United States survey work had commenced in this section as early as 1906.

These boundary surveys continued during 14 field seasons, including that of 1919.

After the surveyors had closed the last stretch of line in the highlands, final computations revealed that minor amounts of additional field work would be required to make the job a complete one. Some inaccuracies had to be remedied and certain modifications resulting from a decision of the commissioners had to be implemented. These modifications related to the change in method of laying down the boundary line through very narrow streams. This additional field work was carried out by small parties from sections of the two commissions during the seasons 1920 to 1923 inclusive.

Transportation of men and supplies often presented formidable problems. Many swampy sections had to be corduroyed* before horses and sleds could cross them. The entire region was densely forested and weather conditions were not always favorable. In one season, 1917, rainfall averaged one day in three. During the years of the First World War it became very difficult to recruit helpers. Men were scarce and wages were high. In addition it was not easy to persuade available men to accept the uncomfortable conditions inevitable in boundary survey camps of those times. In 1918 the influenza epidemic, that raged on the North American continent, seriously affected the Canadian party. Only three of its members escaped the contagion.

When flat, wooded country was encountered it was necessary to adopt special methods of mapping the topography. In woods and underbrush the elevations were determined by hand levels and aneroid barometers. Contours were located by compass and tape traverse, tied to the triangulation net or to plane table and stadia traverses run along roads, streams and railways.

In five field seasons commencing in 1906, the head of the Canadian party was G. C. Rainboth. With him was his son, George Louis, as well as his brother A. J. Rainboth. George Louis served with his father until the latter's death in November, 1910. Thomas Fawcett, D.T.S., then succeeded to the leadership of the survey party. George Louis Rainboth remained associated with Fawcett in this work until the end of the season of 1918. All of these men, save A. J. Rainboth, were Dominion land surveyors. Edward Joseph Rainboth, president of the Dominion Land Surveyors' Association in 1888, was a brother of G. C. and A. J. Rainboth. In addition to J. L. Rannie, D.T.S., other Dominion land surveyors active at one stage or another on this section of boundary work were G. T. Prinsep, J. D. Craig, H. F. J. Lambart, W. M. Dennis, T. C. Dennis, C. R. Westland, F. H. Mackie and John Allan Pounder (1892-1952). The latter's brother, Irvine R. Pounder was an assistant as were B. Foley, D. F. Chisholm, O. Sills, F. P. Reilly, A. M. Phillips, L. La Ferme, R. Tuite, J. Bowie, W. J. Sharpe, R. M. Sheppard, L. C. Nesham, W. Smith, J. N. Ingersoll and V. R. Davies. The latter became a Dominion land surveyor in 1922.

The entire 670 miles of boundary line from the source of the St. Croix River to the St. Lawrence River, including waterway courses, had thus been resurveyed and re-monumented and newly mapped. New Brunswick's share of the distance covered was 164.1 miles; that of Quebec, 506.2 miles. Also involved in the project were the northern boundaries of Maine, New Hampshire, Vermont and New York. A total of 4,204 monuments and 548 reference marks along boundary streams had been installed. On all straight-line courses monuments had been set frequently enough to permit easy sighting from one to another. A total of 61 map sheets was produced from these surveys, the belt of topography shown averaging one-and-a-quarter miles.[19]

Source of the St. Croix to the Atlantic Ocean

It is surprising that not until 1908 and the immediately succeeding field seasons was any

*Corduroying: surfacing an unstable roadbed by logs laid laterally in close formation.

precise delineation made of the water boundary between Canada and the United States from the source of the St. Croix to the Atlantic Ocean through Passamaquoddy Bay. The boundary commissioners in 1798, authorized to act as such under the terms of Jay's Treaty concluded four years previously, prepared a general map of the St. Croix River but were not instructed to lay down or mark on the map a definite line of demarcation. Nor were King and Mendenhall, boundary commissioners under the 1892 convention, authorized to do so. They were instructed to designate the course of the boundary in Passamaquoddy Bay but were unable to reach an agreement. They reported separately to their respective governments. By virtue of the first two articles of the 1908 boundary treaty, the original establishment of the International Boundary line in the St. Croix and through the Bay to the Atlantic was entrusted to the commissioners named under that treaty.

Field operations during the seasons 1908 to 1913 inclusive, also from 1917 to 1919 inclusive as well as in 1921 and 1922, were conducted in cooperation by Canadian and United States parties. Their work consisted principally of establishing control stations near the boundary line by triangulation and traverse surveys tied to stations of the United States Coast and Geodetic Survey. All monuments and range marks were to be fitted into the North American geodetic datum. This work involved compilation of 1,900 geodetic positions, data of real, continuing value to agencies of the two national governments as well as to engineers and surveyors as a foundation for other, more extensive surveys of the region adjacent to the boundary.

Provision was made in the 1908 treaty whereby the course of the boundary in the St. Croix River was to be "a water line throughout" and "to follow the centre of the main channel or thalweg* as naturally existing, except where such course would change or disturb, or conflict with the national character of an island as already established by mutual recognition and acquiescence".

Considerable data, useful in determining the thalweg, had been accumulated from 1889 to 1893 by means of hydrographic and topographic surveys by the United States Coast and Geodetic Survey. The river and Chiputneticook Lakes as far north as the mouth of Monument Brook had been thoroughly sounded. The commissioners decided to accept the data for this purpose. Determination of the main channel in Monument Brook was undertaken in 1921 as well as of the water connection between North Lake and Grand Lake.

The line of the main channel was then drawn on hydrographic maps and boundary turning points so located that straight-line courses joining those turning points formed a close approximation to the course of the channel. Boundary reference monuments were then set in appropriate locations along the river's banks. Boundary turning points, as such, were not actually marked. Location of the boundary from Milltown to the head of tidewater as far as Calais, Maine, and St. Stephen, New Brunswick, was made on the basis of 1918 surveys.

Field work was commenced in the late summer of 1908, consisting of general reconnaissance work and the establishment of a number of triangulation stations. Operations resumed in June, 1909, by a United States party of 3 men and a Canadian party of 10 working in conjunction, each on their own side of the St. Croix River. A. J. Brabazon of Portage du Fort, with assistants C. R. Westland, C. H. Brabazon and A. J. Rainboth formed the nucleus of the Canadian party that season. Brabazon, the party chief, and Westland were Dominion land surveyors.

In 1910 the Canadian party of 14 men camped initially at Upper Mills, New Brunswick,

*Thalweg: the line of deepest soundings in a watercourse. In international law, the main navigable channel of a waterway that constitutes a boundary line.

continuing the work of the previous season. The principals of this field party remained the same as in the 1909 season except Rainboth, whose name does not reappear in the records of this series of boundary surveys. His place was taken by the Dominion land surveyor, J. W. Menzies.

Where the river was relatively narrow and where dense timber stands occurred, the control points were determined by transit and tape traverses run from the nearest major stations rather than by triangulation.

In 1911 the Canadian party worked northward along Spednik Lake, establishing boundary reference monuments. Triangulation work on Spednik and Mud lakes was completed by the Canadians in 1912. A transit and steel tape type of traverse was run southward along Monument Brook.

The major operations of both Canadian and American parties in 1913 were on Passamaquoddy Bay. The Canadians also made a plane-table survey of the St. Croix River at Milltown and took soundings to determine the main channel of that part of the river.

No further boundary survey work took place in this area until 1917. As more comprehensive surveys were completed on other parts of the long boundary, along the 49th parallel, on waterways between Minnesota and Ontario, and along the highlands between Quebec and the United States, it was realized that the work previously done in the St. Croix-Passamaquoddy Bay section should be brought up to the survey and monumentation standards attained elsewhere. The commissioners decided that a complete topographic map should be made of that boundary area, additional boundary reference monuments installed and range marks in the Bay rebuilt. With the exception of mapping islands in the Bay, all this improvement work was allotted to the American commission. The Canadian representative accompanying the United States parties, during the seasons 1917 to 1919 inclusive, was the Dominion land surveyor, T. C. Dennis. The Canadian commissioner at this time was represented by A. J. Brabazon. In 1921 and 1922 the Canadian representative was J. A. Pounder, also a Dominion land surveyor. Over all these years American field work was inspected on separate occasions by Dominion land surveyors T. C. Dennis, J. D. Craig, J. A. Pounder and J. J. McArthur. In the 1922 season, when Canadian field parties conducted topographic mapping of Bay islands, Pounder was in charge of one of them, and G. T. Prinsep was head of the other. D. F. Chisholm acted as assistant.

The final boundary maps consisted of a series of 18 sheets, the maps being constructed on the polyconic projection on scales of 1:6,000; 1:12,000 and 1:24,000, depending on the amount of detail required to clearly show the boundary line. A limited edition of the maps was printed for each national government for distribution to government agencies, libraries and other organizations interested in boundary information.

The water line established from the source of the St. Croix to the Atlantic consisted of 1,103 straight-line courses joining numbered boundary turning points. A total of 256 reference monuments was established as well as 48 range marks on the shores of the Bay. The total length of the boundary line thus marked is 154.63 miles, 25.24 miles of which are through Passamaquoddy Bay. The work was completed under boundary commissioners Noel J. Ogilvie for Canada and J. W. Van Wagener for the United States. The entire task had the valuable aid of the Geodetic Survey of Canada and of the United States Coast and Geodetic Survey. The competent and painstaking work of the Canadians involved in this important project was worthy of the highest commendation.

Canada-Alaska Boundary

(1) *Tongass Passage to Mount St. Elias*: In the 19th century, after 1867, no part of the

far-flung Canada-United States border was so fluid and indefinite as the sector along the northwest coast of America, now known as the Alaska Panhandle. The defining of the 647-mile Alaska-Yukon line along the 141st meridian to the Arctic Ocean had been relatively simple. But southward from Mount St. Elias, the hinge point of the entire boundary and farthest south point of undisputed Russian territory (up to 1867), the problem was immensely complicated. This was a region of incredibly long and deep fiords, flanked by majestic, snow-topped peaks, of glacier-bearing mountains and forests climbing steep hillsides from the water's edge. In addition to the formidable terrain the task of locating the boundary was made abnormally difficult by the vagueness of treaty provisions applicable to the problem. For three decades, as concepts of boundary line location fluctuated, Canadian customs buildings and Hudson's Bay Company posts moved back and forth in an effort to keep continuously within Canadian territory.

In 1867 the United States purchased from Russia, for $7,200,000 in gold, the region now known as the State of Alaska. Following the conclusion of that treaty of purchase, questions arose as between Great Britain and Canada on one side and the United States on the other, as to just exactly what territory had been ceded by Russia in this international transaction. Experts on both sides began to consult historical maps, records of early explorations, statements by public men in the countries affected and the terms of relative treaties in an effort to locate, rationally and precisely, the boundaries of the transferred territory.

The voyages in separate vessels in 1741 of Bering the Dane and of Chirikoff, under Russian auspices, provided St. Petersburg officialdom with at least a vague concept of the outline and extent of Alaska. Later visits to that part of North America by Russian fishermen and fur traders added relatively little to the sum total of their countrymen's knowledge of that territory at the time. Nevertheless Russians were the first to make practical use of Capt. Cook's charts of that part of the world. In 1793 and 1794 Capt. Vancouver explored, with care, the northwest coast of North America. During early years of the 19th century Russians, Englishmen and Americans were exploring and trading along this same coast. Disputes arose constantly over ownership of the *lisière** and adjoining waters.

In 1821 Russia asserted national sovereignty over the coastal areas of the Pacific Northwest as far south as the 51st parallel. Great Britain and the United States were quick to vigorously challenge this declaration and each of these countries conducted its separate negotiations with Russia in efforts to bring about a peaceful settlement of conflicting claims. The Anglo-Russian Treaty on the subject was signed in 1825 and much of the later controversy between Canada and the United States over the location of the Alaska boundary stems from varying interpretations placed upon the highly imprecise terms of that 1825 pact.

Articles Three and Four of the 1825 pact, containing the geographic description of the boundaries of Russian territories in North America as then defined, were inserted in the 1867 treaty by which Russia ceded Alaska to the United States. Not even reputable map makers of that period were well-informed on this area of the world. An 1822 Arrowsmith map, for example, placed the head of Lynn Channel or Canal directly on the 135th meridian. On an Arrowsmith map dated 1833 the same meridian was drawn considerably to one side of the canal. At the time of the Anglo-Russian treaty negotiators were obviously uncertain of the location of the 135th meridian in relation to the head of Lynn Canal. If that meridian, which actually runs through the town of Bennett, had been selected as the permanent boundary then the large part of the canal would still have fallen within Alaska.

In February, 1873, Sir Edward Thornton, British Ambassador to the United States, reported from Washington to the British government that the United States Secretary of State

*Territory along the edge (of a seacoast).

Hamilton Fish had estimated that the proposed survey of the Canada-Alaska boundary would require 10 seasons to complete and would cost the United States an estimated $1,500,000. United States government engineers, however, reported that in the existing circumstances it would be quite sufficient for the governments concerned to decide upon some particular fixed points, such as the head of Portland Channel (Canal) as well as boundary line crossings of the larger rivers, also at Mount St. Elias and where the 141st meridian crosses the Yukon and Porcupine rivers, leaving the detailed joining up process until some agreeable future occasion.[20]

In November, 1873, following gold discoveries on the Stikine River, Capt. D. R. Cameron (then engaged on international boundary survey work in the western interior of North America) reported, on request, to the Secretary of State for Canada for transmission to London, England, his estimate of costs and of total time required for a "temporarily efficient marking of the line from the southermost point of Prince of Wales Island to the Arctic Ocean". Cameron reported that, in his view, the project would require two to seven years to complete and that the cost would not be less than $425,000 and not more than $2,230,000. Congress, however, failed to make an appropriation to provide for American participation at the time and the matter was dropped.

In November, 1876, an incident occurred in the North West that profoundly influenced the direction and pace of boundary-marking developments in that region. One Peter Martin, a citizen of the United States, was arrested at Cassiar in Canadian territory for a criminal offence and was being taken down the Stikine River on the way to Victoria, B.C., the place of trial. In the course of that journey Martin assaulted a guard and escaped. He was recaptured on what Martin claimed to be United States territory. His appeal on these grounds to American authorities resulted in official representations on his behalf to the effect that his captors were without jurisdiction to act as they had in that area. Many questions were thereupon raised concerning territorial rights along the Stikine under the 1825 and 1867 treaties. Eventually Martin was released. But the affair spurred British-Canadian governments into a renewal of requests to Washington for a proper delineation of the boundary line.

The jurisdictional wrangle had also led to action by Surveyor General Dennis at Ottawa. On March 3, 1877 he instructed Joseph Hunter, a civil engineer in British Columbia, to locate on behalf of Canada the boundary-line crossing of the Stikine River. "Generally to take such observations", his authorization read, "as will enable you to lay down with approximate accuracy the crossing of the river [should the same occur within 10 marine leagues* of the coast] by a line in the words of the treaty 'following the summit of the mountains parallel to the coast . . . [la crête des montagnes situées parallèlement à la côte]' ". Hunter's findings were communicated by Ottawa to the United States government and the result accepted as a provisional boundary line, without prejudice to the rights of either government as to the ultimate location of the true boundary.

The first definite official action to arrange for a large-scale international survey of the Canada-Alaska boundary south of Mount St. Elias was authorized under the Convention of 1892. Article One of that agreement provided for a joint survey of the area adjacent to the boundary between 54° 40′ and the west shoulder of Mount St. Elias. Mendenall, later succeeded by W. W. Duffield, for the United States, and W. F. King for Canada, were appointed boundary commissioners and their first meeting was held in Ottawa in February, 1894. A preliminary topographical survey of the principal deep-water passages, including the continental shoreline from the mouth of the Portland Channel to Lynn Channel had been

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*1 marine league equals 3 nautical or geographical miles, each of 6,080 feet. 10 marine leagues equal therefore 34.55 statute miles, each of 5,280 feet.

completed by the United States Coast and Geodetic Survey in 1892. This work formed the basis for the coordination of various detached surveys by parties sent out by the two commissioners in the three field seasons 1893 to 1895 inclusive. Canadian surveyors who were in charge of parties on this important assignment included O. J. Klotz, W. Ogilvie, A. J. Brabazon, A. C. Talbot, James Gibbons, A. St. Cyr and J. J. McArthur. Results of these surveys were embodied in 24 maps, produced in addition to 12 maps constructed as a result of American surveys.[22]

In accordance with the photo-topographic method of survey then in limited use, mostly in very rugged terrain, a number of photographic views of the area were produced as well. The summit of Mount St. Elias (Alaska) was found to be slightly over 18,000 feet high, that of Mount Logan nearby (Canada), to be 19,850 feet. The geographical coordinates of Mount St. Elias were fixed at latitude 60° 17′ 35″.10 north and longitude 140° 55′ 47″.32 west. The summit of Mount St. Elias, a boundary point, was found to be 2.41 miles east of the 141st meridian. The boundary then proceeded northwesterly to a shoulder of the mountain and thence north along the 141st meridian.

During the winter of 1894-95 a party headed by Ogilvie ascended Taku River, then negotiated the White and Taiya (Chilkoot) Passes leading from the head of Lynn Channel to the interior. Because of unusually stormy weather the party was compelled to return to its base, having accomplished only a traverse survey of part of the Taku River. During the 1895 field season Brabazon headed a survey in the region between the mouth of the Alsek River and Gokutal Bay, directly south of Mount St. Elias. It is significant to find in Alaska that Brabazon Range commemorates the constructive, daring work of this eminent Canadian in fulfilling his part in joint survey projects in the southwestern part of that State.

Final reports related to this boundary-marking work were signed in Albany, New York, on December 31, 1895, by Commissioners King and Duffield.

The discovery of gold in the Yukon Territory and the resulting rapid economic development in that part of the continent in the closing years of the 19th century made more imperative than ever the official demarcation of the Canada-Alaska boundary on the ground. Delays of a political nature impeded the pursuit of diplomatic efforts to arbitrate the question. Prime Minister Sir Wilfrid Laurier wrote to a friend early in 1899 on the topic of improving relations with the United States:

"... The stumbling block was the Alaska boundary. In this our American fellow Commissioners were at first and almost to the last disposed to come to a reasonable compromise. I may tell you confidentially that the compromise was that they gave us Pyramid Harbour on the Lynn Canal with everything but the official sovereignty in name ... This arrangement provoked such a storm in the Pacific states* that our fellow Commissioners withdrew their consent ... ".[23]

But pressures for an early solution to the dispute were mounting. In 1901 the assassination of President McKinley brought the aggressive, impetuous Theodore Roosevelt to the summit of authority in the United States. If there was to be arbitration of the boundary issue then, President Roosevelt made it clear, such arbitration must be on the basis of a six-man tribunal, three to be appointed from each side of the dispute. As a Brooklyn newspaper commented at the time "there was as much chance of convincing a tribunal so constituted of the soundness of the Canadian case as there was of a thaw in Hades."[24]

In January, 1903, a convention was signed at Washington by the British ambassador to the United States and by the United States Secretary of State under which an Alaskan Boundary Tribunal would be "immediately appointed" to consist of "six impartial jurists of

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*Ports of the Pacific states had flourished in the closing years of the 19th century on trade with the Yukon.

repute". Three of these were to be appointed by His Britannic Majesty and three by the President of the United States. Optimistically but, as matters turned out, perceptively, the authors of this convention required that decisions on specified questions to be submitted to the tribunal should be reached on the basis of a majority judgment. Judges appointed on the British-Canadian side were Lord Alverstone, Lord Chief Justice of England, Sir Louis A. Jetté, Lieutenant Governor of Quebec, and Allen B. Aylesworth, a Toronto barrister. On the United States side those named early in March were Hon. Elihu Root, Secretary of War, Hon. Henry Cabot Lodge, United States Senator, and Hon. George Turner of the State of Washington, former member of the supreme court of that state.

It was a unique body. These nominations marked the first time that an adjudication of an international boundary dispute had been attempted by what was ostensibly a court, composed of an equal number of jurists from each of the sides concerned. The outward forms of judicial procedure were observed and the objective was to arrive at a decision binding on the parties to the dispute. Sessions of the tribunal took place in the Foreign Office building in London, England, and extended from September 12 to October 8, 1903. Eighteen days were required for hearing of the arguments. The tribunal's decision was announced on October 20. As matters developed, Lord Alverstone's views proved to be the decisive factor in the outcome of the arbitration.

The tribunal was asked to render a decision on seven questions:

1. What is intended as the point of commencement of the line?

2. What channel is the Portland Channel?

3. What course should the line take from the point of commencement to the entrance to Portland Channel?

4. To what point on the 56th parallel is the line to be drawn from the head of the Portland Channel, and what course should it follow between these points?

5. In extending the line of demarcation northward from the said point on the parallel of the 56th degree of north latitude, following the crest of the mountains situated parallel to the coast until its intersection with the 141st degree of longitude west of Greenwich, subject to the conditions that if such line should anywhere exceed the distance of 10 marine leagues from the ocean, then the boundary between the British and Russian territory should be formed by a line parallel to the sinuosities of the coast and distant therefrom not more than 10 marine leagues, was it the intention and meaning of the said Convention of 1825 that there should remain in the exclusive possession of Russia a continuous fringe, or strip, of coast on the mainland, not exceeding 10 marine leagues in width, separating the British possessions from the bays, ports, inlets, havens, and waters of the ocean, and extending from the said point on the 56th degree of latitude north to a point where such line of demarcation should intersect the 141st degree of longitude west of the meridian of Greenwich?

6. If the foregoing question should be answered in the negative, and in the event of the summit of such mountains proving to be in places more than 10 marine leagues from the coast, should the width of the *lisière*, which was to belong to Russia, be measured (1) from the mainland coast of the ocean, strictly so-called, along a line perpendicular thereto, or (2) was it the intention and meaning of the said Convention that where the mainland coast is indented by deep inlets forming part of the territorial waters of Russia, the width of the *lisière* was to be measured (a) from the line of the general

direction of the mainland coast, or (b) from the line separating the waters of the ocean from the territorial waters of Russia, or (c) from the heads of the aforesaid inlets?

7. What, if any, are the mountains referred to as situated parallel to the coast, which mountains, when within 10 marine leagues from the coast, are declared to form the eastern boundary?

In the course of the legal arguments heard by the tribunal two main issues emerged. Firstly, what course should the boundary line follow at the mouth of the Portland Channel? Secondly, where did the line run from the head of that channel northward on the mainland to Mount St. Elias? At the time of the 1825 Anglo-Russian treaty the British view was apparently accepted by the Russians, namely, that the crest of the mountains situated parallel to the coast would be the boundary line unless a gap occurred in the range, in which case Russia could claim only up to a maximum of 35 miles inland. The treaty provided an alternative that if such a mountain range proved to be more than 35 miles distant from the ocean, the boundary should follow a line parallel to the sinuosities or windings of the coast and never, at any point, more than 35 miles distant therefrom.

Through the maze of learned arguments the primary question persisted: did any such chain of mountains exist? The Americans maintained that no chain of mountains parallel to the coast, as mentioned in the treaty, existed. The Canadian case was that such a range did actually run near the coast and that a boundary line drawn along their summits would leave many long inlets deep within Canadian territory. This claim to sovereignty was highly important in regard to the Lynn Channel through which an all-Canadian entry by sea to the Yukon Territory would thus become available.

It is hardly surprising that the terms "coast" and "chain of mountains parallel to the coast" as employed in the Anglo-Russian treaty became the objects of conflicting interpretations. This disagreement was reminiscent of the prolonged arguments over the location of the "St. Croix River", the "highlands" of Quebec south of the St. Lawrence River and the disposition of islands between sovereignties in Passamaquoddy Bay. These differences arose mainly from a lack of surveys and therefore of reliable geographic knowledge of boundary areas by those responsible for the ambiguous wording of treaty terms. In the Canada-Alaska boundary dispute it was argued on behalf of the United States that the word "coast" as used in the 1825 treaty meant indentations of every bay and inlet (however narrow) into which tidewater entered. The Americans maintained that the boundary should follow the sinuosities of the coast, that is, the long way around inlets, allowing 35 miles of land between the boundary and salt water. Canadian counsel contended that "coast" meant following the general direction of the shore, by-passing indentations and crossing from headland to headland. The adoption of this view would have meant a drastic narrowing of the coastal strip claimed by the United States.

In contrast to the Canadian position United States counsel insisted that the coastal strip or *lisière* was meant to be a solid, continuing land barrier between the country adjoining it and the Pacific Ocean and that the boundary, whether following a mountain chain or not, must run around the head of every inlet. This, in effect, would deprive Canada of any usable harbor along that coast. One pronounced advantage enjoyed by the Americans in this argument was the fact that the United States, to a considerable extent, had been in actual occupation of the contested strip. A weakness in the Canadian case also was that the Russian assertion and resulting American assumption of an unbroken *lisière* had not been vigorously challenged for a number of years. But the Canadian case appeared strong on the basis of the wording of the 1825 treaty.

In the final outcome of the adjudication Canada failed to win a clear-cut victory on any aspect of its representations. There was, it is true, unanimity among the six judges on the answers to Question One and Question Two. Actually there was little, if any, room for serious differences about the point of commencement of the boundary, namely, Cape Muzon on Dall Island, or over the location of the Portland Channel.

The initial divergence of opinion among members of the tribunal was on Question Three. Four islands of importance lay at the mouth of Portland Channel carrying the names, Wales, Pearse, Sitklan and Kannaghunut. The Canadian judges were incensed when Lord Alverstone joined the American judges to run the boundary line north of Wales and Pearse islands only, then by a sharp, right-angle turn in the line southward, carried it through Tongass Passage and to the *south* of Sitklan and Kannaghunut. By this strange decision these two latter islands were made territory of the United States. The Canadian judges, taken completely by surprise by this majority ruling, had never doubted that the only historic, logical entrance to Portland Channel lay *north* of all four islands. Nor had any contrary formal opinion or claim been made at sessions of the tribunal. One Canadian judge was moved to declare that the tribunal award in this respect was nothing less than "a grotesque travesty of justice".[25]

When Question Five was answered in the affirmative, adjudication of Question Six became unnecessary. Questions Five and Seven were decided on the basis of the same count, four judges to two, with Lord Alverstone joining the three American judges. The two Canadian members strongly dissented and, in fact, refused to sign the declaration of the award.

Although the decision on the existence of a coastal mountain range, conforming to treaty description, favored the Canadian argument, Canada was deprived of any advantage from the finding through the majority action in selecting specific border mountain peaks which, in many instances, were located well inland and considerably beyond the heads of inlets.

There had been rumors, before the tribunal's decision was made public, that Lord Alverstone would side on the important issues of the case with the Americans. Sir Wilfrid Laurier had commented "If we are thrown over by the Chief Justice he will give the last blow to British diplomacy in Canada".[26] The storm of discontent that was aroused in Canada by the decision of the Alaska Boundary Tribunal was fierce, widespread and sustained. Laurier had to face heavy criticism from the parliamentary opposition over his handling of the whole affair and for his failure to safeguard Canadian interests. At the time, however, and in view of the rigid, unyielding American attitude, it represented the only way in which an award could be made by that tribunal. The significant, long-term result of the arbitration was the strong, continuing impulse given to the growing movement in this country to bring about an independent control by Canada of the conduct of its foreign affairs. In the years that followed the award Canada's administration of its relations with other nations was quietly and steadily advanced.

Included in the maps used by tribunal members in making their award were the maps accompanying the joint Canadian-United States surveys of 1893-95 on which they had marked the general course the international boundary was to take. This winding line included Hunter's early line across the Stikine River and the *modus vivendi* lines across White and Chilkoot passes. On the Chilkat River, however, the line was moved about 20 miles upstream to cross Chilkat, Tahini and Kelsall rivers. From a point near Taku River to a point near Stikine River, a distance of about 125 miles was left undefined pending further surveys. By an exchange of notes between the British and United States governments in 1904-05 Commissioners King (Canada) and Tittmann (United States) were authorized to define boundary peaks and carry out delineation of the boundary along the 125-mile gap.

Field surveys for these purposes were started in 1904. The original triangulation and

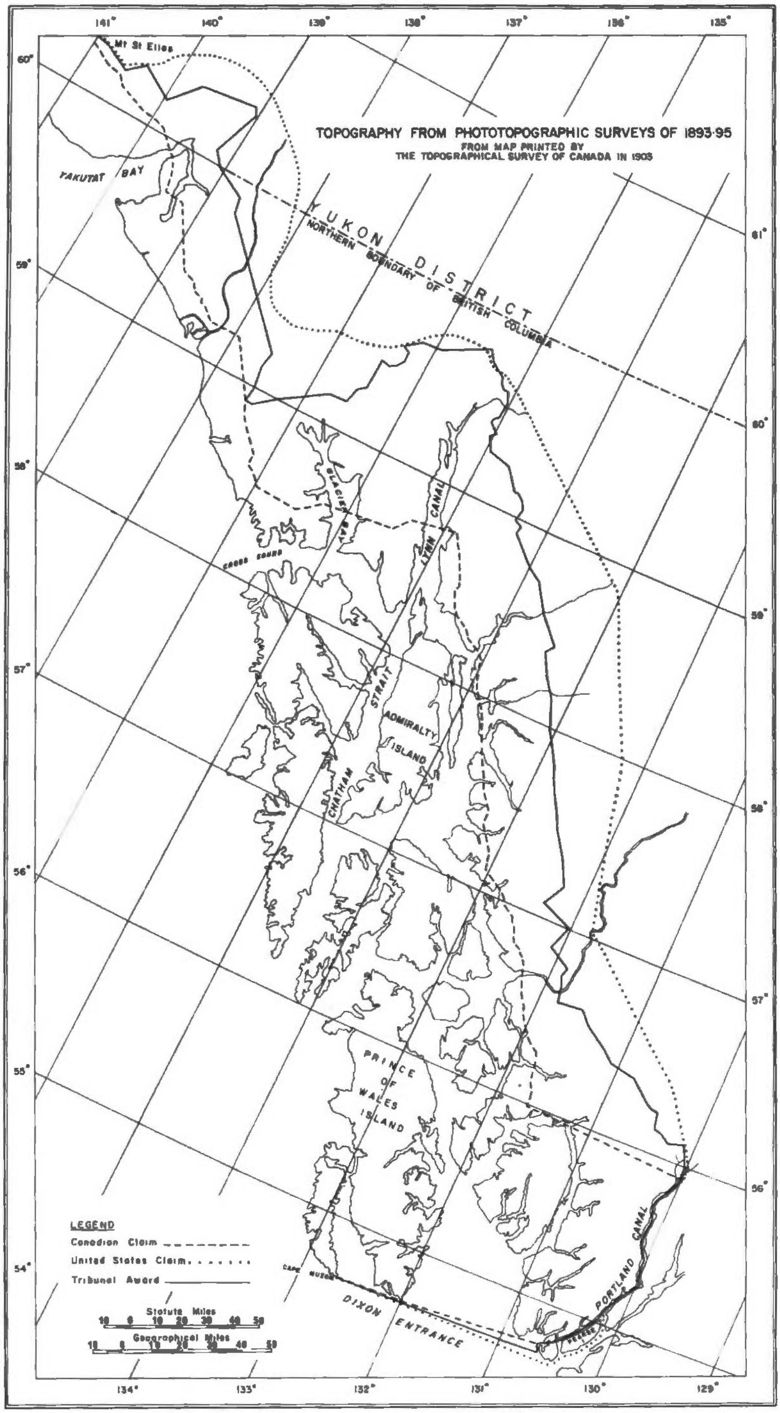


FIGURE 76. Canada-Alaska boundary claims and settlement line along Panhandle.

photo-topography were revised and extended, monuments set at suitable sites to mark the boundary on the ground, and a 20-foot skyline vista was cut through most of the timbered areas. Mountain climbing, navigation of swift glacial streams as well as cautious, tiresome back-packing progress over treacherous glaciers and snowfields were almost everyday experiences during these immensely difficult surveys. The movement of camp equipment, supplies, instruments and materials for constructing monuments was always arduous under

FIGURE 77. Surveyors heading upstream on Yukon River in poling boat, 1910.

such conditions but especially so when these impediments had to be carried to altitudes of several thousand feet. Nearly one-third of the entire boundary region is perpetually covered by snow and ice. As an example of transport difficulties it took packers on the Davies Glacier 8 hours to travel 4 miles. Field work was usually undertaken within a half-day's travel of the base camp. When distances became too great, or routes were so formidable that men could not reach objectives and return to base the same day, a fly camp equipped with barest necessities would be established in a convenient location. Rain, snow and fog were commonly encountered and many uncomfortable days and nights were endured in the makeshift camps.

Travel over snowfields was usually done early in the morning to take advantage of the surface crust. Although men were roped together and carried alpenstocks, a route that had been quite safe earlier in the day often became extremely hazardous later, especially when deep crevasses had to be crossed on melting snow bridges. Some serious accidents were unavoidable under such dangerous conditions. On two occasions there was loss of life. In 1909 a member of a field party broke through a snow cornice on a mountainside and fell 2,000 feet to his death. In 1913 a landslide buried two light-keepers in their camp at Cape Muzon.[27]

These Alaska boundary surveys between Cape Muzon and Mount St. Elias occupied 12

FIGURE 78
Canada-Alaska boundary survey party, 1909. A. G. Stewart at right.

field seasons, 1904 to 1914 inclusive and, later, in 1920. When field operations ended in 1914 it was not anticipated that further boundary demarcation work would be required under the authority of the tribunal award. However, a considerable amount of mining activity developed in 1910 in the region directly north of the head of Portland Channel. As a result additional field work was authorized over the distance between the head of that channel and Blue River.

Dominion land surveyors who were in charge of boundary survey parties in the 12 seasons included C. A. Bigger, George R. White-Fraser, D.T.S., W. F. Ratz, A. J. 'Jack' Brabazon, J. D. Craig, F. H. Mackie, Noel J. Ogilvie, T. C. Dennis and W. Mel Dennis. Other Dominion land surveyors engaged in these boundary-marking tasks who held their commissions at the time or soon afterward included H. F. J. Lambart, A. G. Stewart, D. J. Fraser, C. R. Westland, H. M. Barton and G. T. Prinsep. Dominion land surveyors who acted as Canadian representatives with United States field parties included C. A. Bigger, G. R. White-Fraser, D. H. Nelles, F. H. Mackie, T. H. G. Clunn and J. A. Pounder.

Ottawa-born Alexander George Stewart (1886-) has recorded some vivid impressions of the historic 1908-11 surveys along the Alaska Panhandle on which he worked as an assistant and during which period torrential rains and aggressive insects made life miserable at times for surveyors in that wild, mountainous country. There were other formidable afflictions in that region. Stewart has recalled that boundary surveyors "wore gumboots that came up to our hips and these were intended to keep out the icy-cold water. But we would fill them with water deliberately first thing in the morning in order that it would become warm from our bodies and thus serve as insulation . . . ".

"The survey line had to be 20 feet wide. Some of the trees we had to cut were six feet in diameter. We used double-bit axes and seven-foot crosscut saws. We worked ten hours daily, seven days a week . . . Markers had to be placed every three miles in solid rock. We couldn't find much solid rock in some river valleys so we had to pack in cement, gravel and water and then build three-foot-square aprons for obelisk-type monuments. Smaller monuments weighed 56 pounds and stood 2½ feet high and these had much smaller concrete bases. These monuments were made of heavy bronze with *Canada* marked on one side and *United States* on the other."

Mr. Stewart began practice in Edmonton as engineer and surveyor in 1912. Enlisting in 1916 he went overseas with Canadian Railway Troops and helped to build light railways in France, sometimes under heavy fire from enemy guns. Stewart served as chief surveyor, Edmonton land titles office, for many years following the First World War.

In 1912 William Melbern Dennis, in charge of the Canadian survey party during that field season, reported the presence of ice worms at the junction of Grand Pacific and Melbern glaciers. It was on the recommendation of J. D. Craig that the outstanding survey services of Mel Dennis were fittingly recognized through the official selection in August, 1922, of his middle name as the title of this well-known British Columbia feature. Scientific circles excepted, ice worms have long been regarded as purely mythical creatures, symbols of all that is amusingly imaginative in the folklore of the Far North. Dennis was astonished therefore to come upon these brownish, pin-size ice worms on July 4 while leading his survey party in the Glacier Bay region. In the early morning relatively few of the worms were visible and these vanished from sight during the later daylight hours. But in the evening the creatures completely covered the ice surface and were distributed on a pattern of one worm to approximately one square inch where the ice was hundreds of feet thick. On the following day the worms had completely disappeared. Some specimens were identified as belonging to the genus *Mesenchytraeus solifugus.* The Dennis findings have been corroborated by other discoveries. Snow and ice worms belonging to this genus have been classified by science in some 60 known species. Some 21 of these and several varieties have been recorded in North America, all confined to the Pacific slope. Only three or four species of the worm, however, are definitely known to inhabit continuously an environment of only snow and ice. During midwinter the worms are generally inactive and do not appear on the surface until some melting occurs.[28]

William Melbern Dennis (1885-   ), born in Prince Edward Island, was a school teacher in that province and a graduate of McGill University before he took up surveying. He was commissioned Dominion land surveyor in March, 1911, and was assigned by Dr. King to a field party under G. L. Rainboth in British Columbia. Then for several seasons Dennis served in a region very different from the gently rolling fields of his native province. Under Noel Ogilvie he was active on Canada-Alaska boundary surveys for several seasons, including triangulation work in 1914 at Dixon Entrance. His younger brother, Thomas Clinton Dennis (1887-1963) obtained his Dominion land surveyor commission in May, 1911, and was chief of party in 1912 on the Canada-Alaska boundary surveys and, in 1920, was a senior member of the Canadian field party in the same region under J. D. Craig. The Dennis brothers were not related by blood to the first Surveyor General of post-Confederation Canada.

Noel J. Ogilvie (1880-1967) served articles with Deville, McArthur and Edgar Bray. In the 1907 season Ogilvie was Canadian representative on the inspection of boundary survey work between Point Roberts and the Rockies along the 49th parallel. It was toward the end of that season that McArthur wrote to Ogilvie:

"See that you have an opportunity of checking a couple of their long chords. It is definitely mentioned in the Convention that it must be a skyline 20 feet wide throughout. Mr. Tittmann was astounded at the large timber through which our line runs . . . I expect we will have everything cleared up by October 1st. I think we may congratulate ourselves."[29]

On one occasion while mountain climbing on International Boundary survey work Ogilvie met Thomas Riggs, Jr., attached at that time to an American boundary survey field party. Riggs, some years later, became Governor of Alaska. In 1917 Ogilvie was named director of the Geodetic Survey of Canada and, subsequently, was given the title of Dominion Geodesist. In 1931 he was appointed International Boundary Commissioner in succession to J. D. Craig. He continued in the position until 1947. Noel Ogilvie was the last of the Canadian commissioners to be appointed basically through the British Foreign Office. Subsequent occupants of that office have been nominated by the federal department responsible for surveys and then the recommendation for appointment conveyed to the Canadian government by the Department of External Affairs, Ottawa.

The 808.2 miles of the International Boundary running from the entrance of Tongass Passage to the southern terminus of the 141st meridian boundary consisted of 28 boundary turning points on the water portion of the line and these were referenced by 52 monuments. A total of 194 boundary points marked the land section of the line. Thirteen boundary maps accompanied the final report. Latitudes and longitudes are given on the 1927 North American geodetic datum. The map sheets, covering an area of about 32,000 square miles, were submitted with the final report, signed at Ottawa in November, 1951, by the commissioners, J. Leslie Rannie for Canada and John A. Ulinski for the United States. The maps were engraved on copper plates and lithographed in atlas form. The boundary line, monuments and lettering appear in black, elevations and contour lines (other than on glaciers) in brown, drainage in blue including elevations and contours on glaciers, and timber is shown in green. Each map sheet covers one degree of latitude and two degrees of longitude. Sheets are on polyconic projections on a scale of 1:250,000 or about 4 miles to the inch, with contour intervals of 250 feet. In Canada these boundary maps and reports are on file in the Public Archives in Ottawa and in various reference libraries throughout the country.

The photo-topographic method, which had proved its special suitability for topographic surveys in rugged terrain, was used in boundary area surveys after the boundary award of 1903. Between 1904 and 1912 about 700 camera stations were occupied in the Panhandle and some 5,000 photographs taken by Canadian and United States parties combined. In some of the river valleys the plane-table method supplemented the camera.[30]

(2) *Arctic Ocean to Mount St. Elias (141st Meridian)*: Following William Ogilvie's first boundary surveys in the Yukon in 1887-88, and again in 1895, supplemented and checked by independent boundary surveys in 1889-91, the question of completing surveys along the 141st meridian boundary had remained fairly dormant. In January, 1896, the Canadian government proposed to the United States government that a provisional demarcation of that boundary line be made. Hon. Richard Olney, United States Secretary of State, in a counter-proposal stated that as the differences in measurements between Ogilvie's findings and those of the United States Coast and Geodetic Survey were so insignificant (in one place being only 6 feet, 7 inches) a new Convention ought to be entered into by the two governments under which certain points along the 141st meridian where it intersected principal streams, could be agreed upon, with provision for a junction of such points by joint surveys as occasion might require. This process could be continued until the entire line was finally established. The Canadian government, through Minister of the Interior Daly, substantially concurred in this proposal and notified Washington that it was prepared to commence such work in the 1896 season.[31]

In 1902, following reports of increased mining activity in the vicinity of this boundary, the Ogilvie line from 1888 was extended some 60 miles from Sixtymile River to the flats at the head of Scottie Creek. This 1902 work was accomplished by McArthur. Nothing more was done on the task of surveying the 141st meridian until after the 1906 Convention which, in the main, followed provisions of the unratified 1897 draft.

Tittmann, Superintendent of the United States Coast and Geodetic Survey, and King, Chief Astronomer for Canada, under the authority of the 1903 Convention had been named commissioners in respect to the "Boundary Line, Alaska and Canada".[32] Following the 1906 Convention these appointments were officially confirmed and, in King's case at least, the duties included a specific assignment to that part of the boundary represented by the 141st meridian.[33] These latter joint surveys extended over a total of seven field seasons from 1907 to 1913 inclusive.

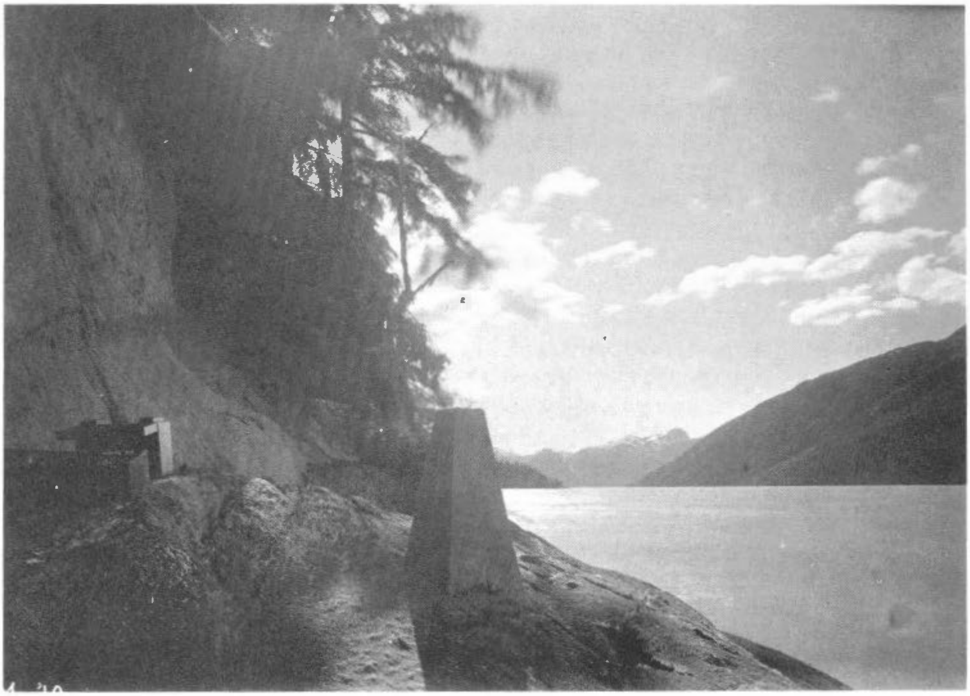


FIGURE 79. Boundary monument, head of Portland Canal.

The two commissioners decided that astronomical observations essential to any future Alaska-Canada boundary surveys should be completed during the 1906 season. The sole point on the 141st meridian boundary connected with outside surveys in any way at that time was at Yukon River crossing. The telegraphic connections with Vancouver were made by means of Canadian Government lines and Canadian Pacific Railway lines. Late in July, 1906, Dominion land surveyors McDiarmid and Klotz were sent to the crossing point and to Vancouver respectively. By September 3 of that year, over this 2,000-mile-long telegraphic connection, seven differential longitude determinations were obtained between that point on the 141st meridian and Vancouver. These observations revealed that the Ogilvie line, surveyed in 1878-88 and as marked on the ground, was only 218 feet in error. The relative insignificance of this discrepancy is, in itself, a tribute to Ogilvie's great skill in working out positions despite dependence upon instruments and weather conditions far from ideally suited to his purposes.

In 1887 the journey inland of the Ogilvie survey party, complete with instruments, provisions and two canoes, occupied seven weeks. Twenty years later, in marked contrast to the earlier experience, Canadian and American boundary surveyors loaded their horses and supplies at Skagway on the train of the White Pass and Yukon Route. Then they stepped happily into the relative luxury of first-class coach accommodation and enjoyed the 8-hour trip through majestic mountain scenery to Whitehorse. The surveyors arrived in Dawson by stage on April 13.

In 1907, owing to the lack of Canadian surveyors available for boundary-marking work, the greater part of field activity was undertaken by United States parties. Line-projection work was carried on jointly by a United States and Canadian observer and a Canadian representative was attached to the American triangulation party. On June 24, while working on the banks of the Yukon River, the surveyors detected the body of a man floating down-

FIGURE 80. Surveyors en route to boundary line, west of Whitehorse, Y.T., 1909.

stream. After the body was brought ashore near Boundary Creek the remains were identified as those of Frank McKay, drowned near Dawson three weeks previously. Although an officer of the Royal North West Mounted Police was summoned from Dawson he was unable to handle the case as the body had been recovered in United States territory. It fell to the surveyors to lay the remains to rest behind the old roadhouse near the mouth of Boundary Creek. The United States chief of party read the burial service.[34]

The country in which the boundary surveys took place was undulating to mountainous and featured by deeply eroded stream beds. Rivers were generally swift and heavy timber was often encountered in the river valleys. Travel was often good along the tops of ridges. Thick moss covering much of the lower country made progress there tiring for man and beast. The very long periods of daylight during summer seasons in these high latitudes aided survey work substantially. Mosquitoes and other insect pests were plentiful but by the use of netting at nights the men were able to secure some rest. Horses, however, suffered greatly from mosquito attacks and only the use of smudges made the lot of the animals tolerable. Wintering of horses in the Territory also presented serious problems during the survey period.

In mid-May, 1908, boundary surveyors were busy again. By that time two aluminum-bronze monuments had been placed, one on each bank of the stream, to mark the meridian crossing of the Yukon River. Meridian points had also been established along a distance of 130 miles. Topographic work was extended southward about 65 miles in the 1908 field season. A Canadian party set 24 monuments, completing their share of the work as far south as Sixtymile River. Projection of the boundary line was carried across the White River.

In the 1909 field season 51 men, of whom 17 were Canadians, and 83 horses made up the joint survey caravan. Topography was mapped by two plane-table parties. Strenuous efforts to occupy certain mountain peaks as camera stations failed. Weather conditions defeated such attempts in the high altitudes. A surveyor gives a graphic account of the results of a day's battling with the cruel climate: "It began to snow, but we had to go on . . . and reached camp at 8.30, worn-out and chilled to the bone and found the tent down and everything wet or frozen. We shovelled away the snow for a small space, with snowshoes, put up the tent as best we could and crawled into our scanty bedding. During the night it snowed 25 inches and continued snowing the greater part of the next day. Even with the coal-oil lamp burning full blast and three men in the little . . . tent, the thermometer registered only 32 degrees."[35] And this was on the 11th of August!

A. J. 'Jack' Brabazon, commissioned as a Dominion land surveyor in May, 1882, was chief of party on the Canadian boundary surveys along the 141st meridian for three field seasons, commencing in 1907. He was the son of Samuel L. Brabazon of Portage du Fort, Quebec, who had been blanketted in as a Dominion land surveyor under the 1872 legislation. His brother, Gerald Hugh Brabazon, although unlisted as a Dominion land surveyor, served in the Dennis Scouts in the Riel Rebellion in 1885. As Conservative candidate in Pontiac constituency he ran in 1900 for election to the House of Commons but was defeated. He was elected in 1904; defeated again in 1908 but re-elected in 1911. In all, G. H. Brabazon served 10 years in Parliament. He was mayor of Portage du Fort for 18 years. Claude H. Brabazon, son of Gerald, was active as an assistant on boundary survey parties in the Yukon and in the Maritimes. A glacier in the Yukon is named after A. J. Brabazon.

In addition to Canadian party chiefs Brabazon, Lambart and Craig, Dominion land surveyors who took part as assistants in this early 20th century work along the 141st meridian included D. H. Nelles, A. G. Stewart, T. C. Dennis, D. J. Fraser and E. W. Nesham. Other assistants were T. P. Reilly, H. S. Mussell and Claude Brabazon.

In 1909 triangulation work was carried from points near Mount Natazhat northward 83 miles to the range of hills in the bend of the Scottie River and connecting with stations established during the previous season. The boundary line along the 141st meridian was projected a total of 50 miles, and 100 miles of vista were cut.

In 1910 J. D. Craig, commissioned as a Dominion land surveyor in February, 1902, became chief of party in succession to A. J. Brabazon and remained in this capacity until the conclusion of boundary surveys by Canadian parties along the 141st meridian line. The main efforts of this fourth consecutive season in the field were confined to carrying work north of the Yukon River, advancing it sufficiently to enable an attack to be made from the north in 1911 with Rampart House as a base of operations. Topographic parties carried their work from the Yukon River across the Black River, a distance of 100 miles, and a vista was opened from its 1909 terminus 61 miles to Orange Creek.

A species of hoof-rot appeared among horses of the party early in the survey season and despite all precautions it spread, requiring the destruction of nearly one-third of the stock and weakening many of the remainder. This epidemic, combined with severe, wintry storms and damage inflicted on feed supplies by fall frosts, hindered progress from the time of the spring break-up to the fall freeze-up.

The following year 80 men and 150 horses were sent overland from Whitehorse to Carmacks, where they embarked on river steamer for Dawson. At Rampart House a miniature rodeo performance astonished local Indians who had never before seen horses. Broncho-busting by the packers, the breaking of horses to pack-saddles, caused intense wonder and admiration among the natives, the first one of whom to trust himself to the back of a plunging steed became a minor hero among his own people.[36]

A smallpox epidemic broke out at Rampart House that season but fortunately no member of the survey parties contracted the disease. The surveyors, however, had to keep away from the settlement that had been selected as a base for the season's operations. The ban resulted in a series of complications but makeshifts were made to meet the situation. Parties re-assembled in September at a point 65 miles below Rampart House. During the season topography had been carried north to Joe Creek, 40 miles from the Arctic coast. Triangulation parties finished their season's activities five miles south of the creek. During each of these annual boundary-marking expeditions Canadian and American surveyors worked so harmoniously that the impression was left on all sides that the work was being done by one large party dedicated to a common purpose.

In 1912 chiefs of the parties travelling by stage and river launch were able to reach Dawson ahead of their men and to make necessary preliminary arrangements for work in the field. This year no Indians welcomed the surveyors at Rampart House. Although the smallpox infection of the previous year had been carried, in all likelihood, from Dawson in clothing sent to the Indians as gifts, the natives held the surveyors responsible and gave them a wide berth.

Triangulation work reached the Arctic Ocean and was extended eastward along the coast about 25 miles but poor visibility prevented any connection with Herschel Island as planned. Atmospheric haziness persisted in the region and mirages were frequent. On one occasion a pack-train detoured several miles to avoid a non-existent lake. Projection of the boundary line was completed to the coast on July 18 to the accompaniment of ceremonies and the unfurling of flags. Demarcation Point, a long, narrow sandspit lacking any vegetation, proved to be between seven and eight miles west of the surveyed boundary. The boundary surveyors saw only a few Eskimos; the interest of these primitive people in the (to them) mysterious measuring activities of the white men took the form of a friendly, tolerant curiosity.

In the 1913 season the Canadian party made one of the highest climbs in the history of boundary surveys when they reached the 13,440-foot summit of Mount Natazhat, Alaska, on June 18. Howard Frederick John Lambart (1880-1946), who had obtained his Dominion land surveyor commission in November, 1907, reported that the Canadians remained "at the summit only 10 minutes, during which time they made 6 exposures with a hand camera and set a pole with a large flag. During the return journey, which took 5 hours, we were enveloped much of the time in clouds and it was intensely cold, with a heavy wind from the northeast."[37] Mount Lambart in the Yukon, in this general area, was named after this noted Canadian surveyor.

The official report of the 7th field season stated laconically that "an attempt was made to climb Mount St. Elias for the purpose of determining the intersection of the 141st Meridian with the line drawn parallel to the coast from the summit of the mountain. After ascending to an elevation of 16,500 feet, a furious storm forced the joint party to abandon the project." Actually it was a most heart-breaking experience for the daring climbers, five of whom were Americans and two Canadians. A. C. Baldwin, in charge of the party, recorded:

"By June 22 . . . our camp was now at an elevation of 7,500 feet, and to the east the western shoulder of St. Elias rose 9,000 feet in sheer height, too steep for snow to cling to. At intervals, from the dizzy heights an avalanche of snow would be seen creeping down the wrinkled sides. Seconds afterwards a dull roar would be heard, and, as the moving mass gained in proportions and speed, it swept everything before it, and reaching a precipice, would shoot out in a stream like foaming water and disappear in the depths below. Long afterwards, clouds of snow-dust hung in the air and the dull rumbling continued."

And again: "After nine hours of difficult climbing on June 29 we were within a few hundred feet of the top of the west shoulder . . . Four of the party only were feeling slightly the effects of the altitude and all were confident . . . when a storm, such as is known only at high altitudes overtook us. At first we were loath to admit that it was anything but a slight flurry and continued the ascent. It soon became evident, however, that it was to be of more than temporary duration and that even if the summit were reached, instrument work would be impossible and so . . . we reluctantly turned back."[38]

FIGURE 81. Thomas Riggs and J. D. Craig at Demarcation Point on shores of Arctic Ocean.

During that same field season a Canadian sub-party carried out a photo-topographic survey up the Logan glacier nearly 25 miles above the boundary while the topography between the glacier and Mount St. Elias was similarly obtained by a joint Canadian and United States party. The dominating presence of Mount Logan inspired hopes in these boundary surveyors, and particularly in Fred Lambart, that Canada's highest peak could soon be scaled. Twelve years later that dream was realized. Lambart of the Geodetic Survey of Canada was made deputy leader of a party of Americans and Canadians that made the first successful ascent of Mount Logan in June, 1925. Lambart had also been given the responsibility of selecting the equipment required by these mountaineers. Eight men, including three Canadians, formed the climbing group. Six of them, including Lambart, reached the summit in the early evening of June 23, 1925.[39]

Commissioners King and Tittmann declared the field work on the entire survey completed and signed their concluding report at Washington on December 17, 1913. They stated that 202 monuments "now marked the line from the Arctic Ocean to Mount St. Elias" over a distance of 645 miles, also that a vista 20 feet wide had been opened through all timber, triangulation carried north and south from the Yukon River and that a belt four miles wide had been mapped for practically the entire distance of the 141st meridian line.

The international nature of the survey made inevitable numerous crossings and re-crossings of the boundary line by members of both national parties. All immigration and customs formalities were waived by both Canada and the United States in respect to these survey activities. Everything within reason was done by officials of both governments, at headquarters and on the ground, to expedite the work of the boundary survey.

Throughout these boundary surveys, lasting more than half a century and extending over 5,500 miles of international borderline, there was at all times a most commendable spirit of cooperation between surveyors of Great Britain, Canada and the United States in technical aspects of their work. The names of many who were engaged on boundary location will be familiar. Besides those who won prominence in surveying and mapping, a considerable number rose to positions of high responsibility in the public affairs of their respective countries.

11

THE DEVELOPMENT OF CANADIAN HYDROGRAPHIC SURVEYS

"And sounded all the depths and shoals . . ."
King Henry VIII, Act 3, Sc. 2

The contribution made by Admiral H. W. Bayfield, in the course of a remarkable career of surveying in Canada's fresh-water and salt-water domains, laid the foundations for a steady, if modest, growth in Canadian hydrographic services during the 50-year period following Confederation. Although this distinguished British Admiralty surveyor had left the Great Lakes in 1825, he continued surveying work in the Atlantic approaches to Canada for another 30 years. When the union of Upper and Lower Canada took place in 1841, Bayfield moved his survey headquarters from Quebec to Charlottetown. It was under that Act of Union, resulting in the formation of the Province of Canada, that a Board of Works was brought into being by the Canadian government. The Board was empowered to construct St. Lawrence River canals above Montreal where required as well as to improve and enlarge canals already in existence. The earliest recorded accounts of Canadian, as distinct from British Admiralty, hydrographic surveys are to be found in the reports and charts of provincial engineers, prepared for public works purposes. The Board of Works may be regarded, therefore, as a significant link (during a period of gradual transition) between strictly Admiralty surveys and Canadian hydrographic measuring work, particularly in bettering navigation in the St. Lawrence River system.

The story of early marine surveys on Canada's Pacific Coast would not be complete without reference to such 'Men of Admiralty' as Capt. Henry Kellett, R.N., Commander James Wood, R.N., Capt. George H. Richards, R.N., and Commander Maurice H. Smyth, R.N., and their respective vessels, H.M.S. *Herald*, H.M.S. *Pandora*, the steam sloop *Plumper* and H.M.S. *Egeria*. In 1856 Capt. Richards and Midshipman D. Pender, R.N., undertook boundary and other marine survey work in the *Plumper*, later replaced by the *Hecate*.

In 1862 Col. Moody of the Royal Engineers requested that Governor Douglas use his good offices to have Richards investigate Bute Inlet and North Bentinck Arm but Richards parried by pointing out the necessity for immediate surveys along the west coast of Vancouver Island. The captain and the colonel agreed, however, on the need for early development of a system of lights, buoyage and pilotage in British Columbia waters. In 1862 Richards requested that the Royal Engineers at New Westminster lithograph 120 copies of his new chart of Nanaimo harbor for local sale.

By 1863 Richards had completed a resurvey of Vancouver Island waters and of many of the main channels between the island and the mainland. In that same year he was recalled to England to become Hydrographer to the Royal Navy and to finish his active career as Vice-Admiral Sir George H. Richards. In his capacity of Hydrographer to the Royal Navy he never overlooked the need for marine surveys on Canada's west coast. Richards realized more than most men of his time that neither Canadian maritime trade nor colonization could flourish unless accurate hydrographic surveys were made and charts distributed to mariners.

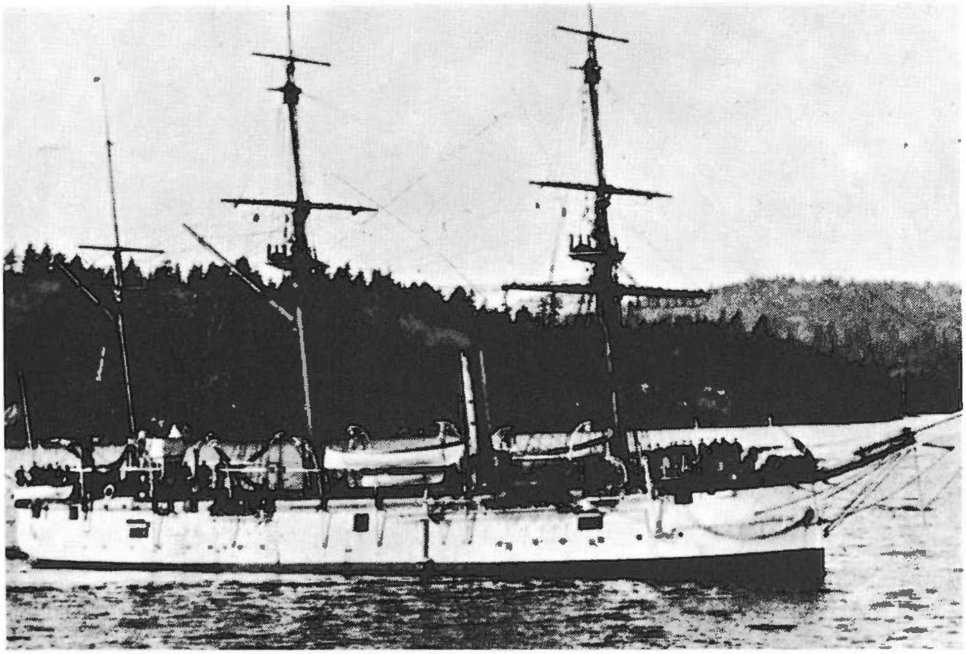


FIGURE 82. H.M.S. *Egeria*, the last ship to chart Canadian waters under Admiralty administration.

From the earliest days of exploration and settlement in Central Canada men were moved by dreams of establishing a ship canal from Georgian Bay to Montreal by way of the French and Ottawa rivers. David Taylor, David Thompson and William Hawkins were engaged on this survey, a project authorized by the Upper Canada legislature in 1837. Under the terms of an act "to provide for a Survey of the Ottawa River and Country bordering it, together with the Country and waters lying between that River and Lake Huron" the sum of £3,000 was voted to pay for the investigation.[1] David Thompson also performed hydrographic survey work for the Board of Works on Lake St. Peter (St. Lawrence River) in 1841. Some authorities regard Thompson, who had already won considerable renown as an exploratory surveyor and pioneer mapper of the North West, as one of the earliest marine surveyors in the newly-formed Province of Canada.

Twenty years after David Thompson's examination of Georgian Bay ship canal proposal, surveying activity of this nature was still in progress. In 1856 J. West made a preliminary investigation of the route then under official consideration. His work was followed by the appointment in that year by the Board of Works of the Shanly brothers, Walter and Robert, to make a survey, along with James Stewart, preliminary to the same project. These men were engaged in the field during the seasons of 1857 and 1858.[2] The whole concept, in those times, was a particularly grandiose one but its immense possibilities and formidable physical challenges attracted the interest and stirred the imaginations of men of outstanding engineering abilities. Walter Shanly and his successors, while supporting the feasibility of a navigable water link between Lake Huron and the St. Lawrence through Lake Nipissing, stressed the inadequacy of existing hydrographic information on the Georgian Bay section of the project.

In July, 1894, Parliament granted a charter to the Montreal, Ottawa and Georgian Bay Canal Company. But it was not until 1904 that the initial sum of $250,000 was voted to inaugurate, under the Minister of Public Works, a detailed official survey from the Bay to the St. Lawrence River at Montreal, a distance of 440 miles. At the outset nine survey parties were sent to the field and this force was later augmented by a hydrographic investigating party, three test-bore parties, a precise levelling party and a party assigned to Lake Nipissing and canal feeder surveys. All these varied tasks were divided among the districts of Montreal, Ottawa and Nipissing. F. H. Peters, destined to be Surveyor General of Canada and Chief, Hydrographic and Map Services, was in charge of surveying activities in the Nipissing district. E. J. Rainboth, in the early stages, had charge of similar survey work in the Ottawa district. Precise levelling on the project was supervised by C. F. X. Chaloner, who had performed geodetic levelling work for the Department of Public Works.[3]

The surveys occupied several field seasons and were conducted, at times, under conditions that were extremely trying, even hazardous. In summer the rough water and treacherous currents created some highly dangerous situations for surveyors. In winter, particularly in the season of 1904-05, high winds, drifting snow and clogged roads combined seriously to hinder progress and to cause considerable hardship for crews in the field. The fact that the surveys were completed at the cost of only two drowning accidents eloquently testified to the efficiency and care exercised by those actively involved.

Each survey party was issued with the following instruments: 2 transits with stadia, 1 Y level, 1 Dumpy level, 2 field glasses, 2 box sextants, 1 prismatic compass, 1 hand level, as well as rods, chains and sounding wires. The steel tapes used were pretested for temperature variation and tension. Meridians were established by observations of Polaris or some other circumpolar star. Shoreline stations served to unite topography with hydrography.[4]

As a result of these intensive investigations engineers in charge of the surveys reported that the ship canal could be built at an estimated cost of $100,000,000 combined with an estimated annual expenditure of nearly $1,000,000 for maintenance. When the First World War broke out this ship canal project was shelved and has not been revived beyond the stage of occasional discussion.

In 1909, on very short notice from Ottawa, A. R. Dufresne, district engineer at Winnipeg for the federal Department of Public Works, was asked to see that a reconnaissance survey was made of the Nelson River in order to determine the practicability of establishing navigation on that river between Lake Winnipeg and Hudson Bay. E. S. Miles was selected by Dufresne to conduct this survey. With one assistant and two Indian helpers the party set out by canoe from Norway House on August 28 and the survey was concluded in mid-October. Some of the mileages involved were obtained from the 1884 survey in that region made by Otto Klotz. A hand level fixed to a light tripod was used to obtain differences in water elevations at all rapids and falls; a small current meter was employed for gauging work and a box sextant for triangulation purposes. It was reported by Miles that the length of the Nelson River (430 miles) and the total lift on this route (700 feet) were close to corresponding figures for the proposed Georgian Bay Ship Canal. Miles was very guarded in his report to Dufresne, confining himself to the statement that "sufficient information has been obtained to show that any undertaking having in view the establishment of navigation on the Nelson River is one of considerable magnitude."[5]

Passage of the British North America Act in 1867 had marked, in theory if not in actual practice, the advent of hydrographic surveying in Canada under Canadian auspices. By virtue of clause 10 of Section 91 of that Act "the exclusive legislative authority of the Parliament of Canada" was extended to all matters of national import related to "Navigation and Shipping". In 1868 (31 Vic. ch. 57) the Department of Marine and Fisheries was organized to assume, at least in some degree, these new responsibilities. In 1884, for some now obscure reason, the department was provided with two deputy ministers presiding, respectively, over a Marine Department and a Fisheries Department but reporting to a single minister (47 Vic. ch. 18). This dual-deputy arrangement continued for only 8 years. In 1892, by 55-56 Vic. ch. 17, tidal observations and hydrographic surveys were assigned to a more unitary form of Marine and Fisheries. Despite this forward-looking legislative action departmental jurisdiction over hydrographic surveying and charting of Canadian waters remained unclear until early in the 20th century. Two other federal departments, namely, Public Works, and Railways and Canals, were performing similar functions. The foundering of the *Sicilian* in the St. Lawrence River below Quebec on November 24, 1902, focussed attention on the jurisdictional duplication and conflict. The mishap, without doubt, was a factor contributing to the amalgamation of hydrographic and charting work within one federal department, that of Marine and Fisheries. An Order in Council, P.C. 461, was passed on March 11, 1904, "with a view to systematizing and facilitating work in connection with Hydrographic Surveys". As a result the Department of Marine and Fisheries was accorded sole control and management of such surveys. Charts, equipment, vessels and personnel of the Public Works Department, concerned with similar functions, were transferred to Marine and Fisheries.

It should be observed at this stage that a manuscript map, produced in 1740 and now in the Public Archives of Canada, depicting the North Channel of Lake Huron, contains the results of soundings made in the entrance to Lake Superior and in St. Mary's River. The name of the draughtsman does not appear on the manuscript but it is thought to be the work of G.-J. Chaussegros de Léry. It would appear, therefore, that French military engineers can be credited with the first hydrographic surveying and mapping of these waters. It was not until nearly fifty years later, in 1788, that Captain Gother Mann, R.E., visited Lake Huron and parts of the North Channel as well as the southeastern region of Georgian Bay to map these areas with soundings.

After Bayfield's departure from the Great Lakes in 1825 and until the mid-1880s, little hydrographic surveying took place on the Canadian side of the lakes. In the early autumn of 1882, however, a tragedy of the first magnitude occurred and resulted in the inauguration of the first intensive, systematic survey of Georgian Bay under direction of Canadian authorities. On September 14 of that year the 347-ton steamer *Asia* foundered in a wild gale off Byng Inlet in Georgian Bay, about 35 miles northwest of Parry Sound. All but two of the passengers aboard were lost. Among those who died was the Ontario land surveyor Robert Sparks of Ottawa who, with a brother also lost, had intended to survey family property fronting on the Bay. They were kin of Nicholas Sparks, one of the founders of Canada's capital city. Robert's sister Mary became the wife of William Ogilvie, noted Dominion land surveyor and pioneer in the Yukon.

The ill-fated vessel, after leaving Collingwood and, later, Owen Sound the night before the storm struck, was heading for the mouth of the French River, destination of most of the passengers. No accurate port record was kept of the passenger count but it was reliably

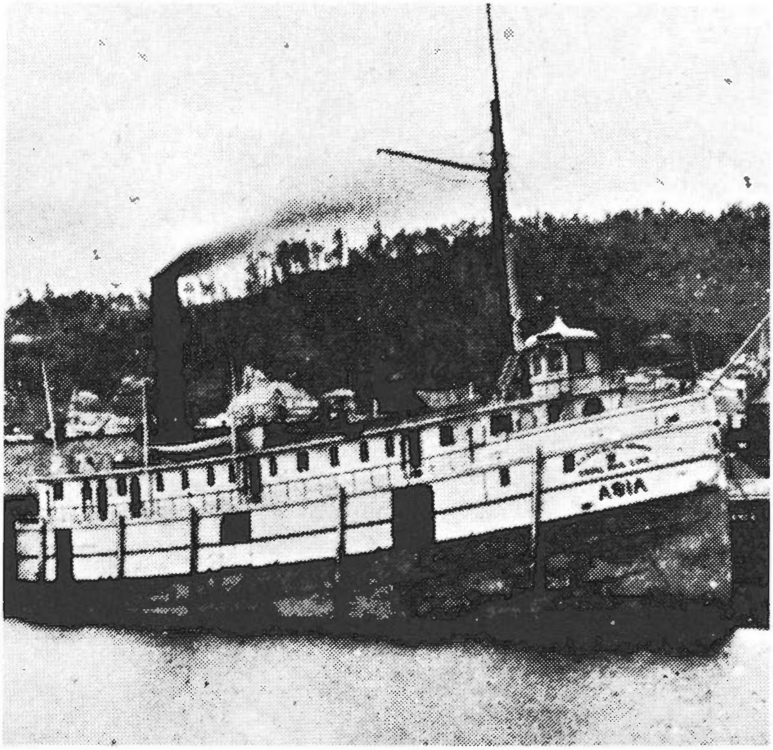


FIGURE 83. The ill-fated *Asia*.

estimated that the total number aboard the *Asia* exceeded 120. The fierce winds, accompanied by unusually high seas, hit the vessel just before noon on the 14th and within twenty minutes the *Asia* had capsized. Headlines on news stories in the Toronto *Globe* of September 26 cited "Dangers of Navigation" and "Unknown Sunken Reef Discovered". A lead editorial on the disaster in the same newspaper commented that "the foundering of the steamer *Asia* . . . is the last and worst of those terrible disasters with which we are becoming too familiar on the Northern Lakes . . . a frightful picture of the dangers which attend our inland navigation . . . ".

Collingwood, in the wake of the terrible event, was alive with grim speculation over the main cause or causes of the tragedy. There were rumors that the *Asia* was dangerously overloaded and unable, therefore, to respond properly to its helm under conditions of stress; the force of the gale, it was said, was unprecedented in that region; the 9-year vessel, it was claimed, had not been properly inspected beforehand and was actually unfit for sailing; moreover, poor judgment had been shown in taking the vessel out of port in the face of adverse barometer readings; life-saving equipment aboard had been inadequate, if not quite unusable and that an extensive, unmarked shoal or reef of rocks existed in the Bay in the vicinity of the sad occurrence.

Neither the coroner's jury verdict, as reported in the Toronto *Mail* of October 13, 1882, nor the report, now unavailable, of a special federal marine inquiry conducted by Capt. P. A. Scott, R.N., evidently placed much importance on the presence of a shoal so far as the actual foundering was concerned. What was emphasized, rather, was the calamitous effect of the other factors involved. Nevertheless the scope of the disaster and the fact that some mention had been made associating with it certain unmarked navigational hazards in the Bay, triggered prompt and decisive action at Ottawa. So much energy and celerity was shown in this regard that there is reason to wonder whether a departmental decision had been reached in the capital even before the sinking of the *Asia*, a decision to carry out at an early date a renewed marine survey of the Bay. About this time also the transcontinental (Canadian Pacific) railway was being constructed around the Bay, with the promise of a great upsurge of activity in the West and consequently heavier traffic on the Great Lakes. In addition there was a growing feeling in the country as a whole that the time had arrived for the creation and development of Canada's own hydrographic survey organization on the large inland lakes. The *Asia* incident was the dramatic, deeply shocking climax to a long series of mishaps on the Lakes. It served, as nothing else could, to fasten public and official attention on the pressing need for new charts and navigational aids, especially in Georgian Bay of Lake Huron.

One practical difficulty persisted. At the time it was quite impossible to find a Canadian sufficiently trained in hydrographic surveying to supervise the Georgian Bay project. Accordingly the Colonial Secretary in London was approached on January 3, 1883, by the Canadian High Commissioner there who pointed out that dangerous reefs in Lakes Huron and Superior required a careful survey of these waters "in view of the large and rapid increase in traffic which is now taking place." The Commissioner inquired if the British Admiralty would agree to appoint a competent hydrographer to make the survey "it being understood that the Government of the Dominion will provide at their expense the vessels and all necessary assistance which the supervising officer might request." The Admiralty agreed to this proposition.

FIGURE 84
Captain J. G. Boulton, R.N.

Bayfield's lake charts, having regard to the circumstances of his times, represented a notable accomplishment but, as Boulton later stated, "The principle I . . . adopted [was] to confine myself to present trade routes, not feeling justified in putting this country to the expense of surveying waters over which, at present, a vessel has not inducement to pass."[6]

Early in 1883 Staff Commander William Frederick Maxwell, R.N., met the Minister of Marine and Fisheries in Ottawa and discussed with him the subject of a Georgian Bay survey. He strongly recommended that Staff Commander John George Boulton (1842-1929) with whom he had been closely associated in earlier marine survey work, especially in Newfoundland and Labrador waters, be placed in charge of any such project. By mid-July Boulton had been released for this purpose by the British Admiralty and by mid-August, following a brief visit to Ottawa, he was at Georgian Bay.

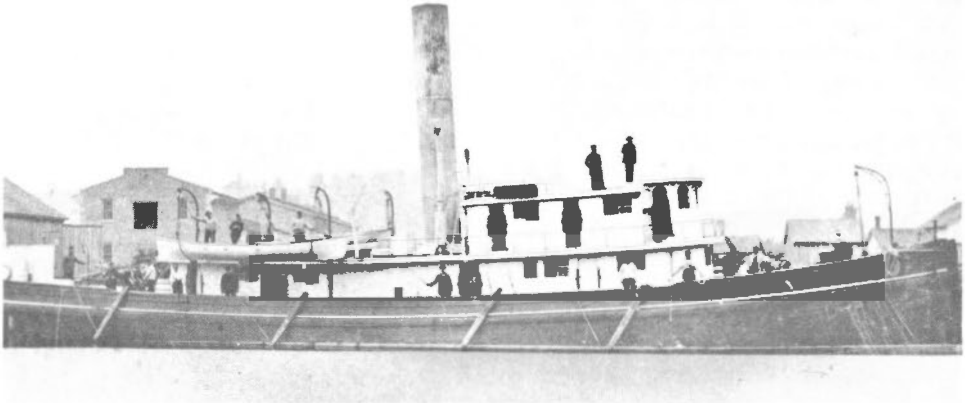


FIGURE 85. H.M.D. Survey Steamer *Bayfield.*

"The survey of Georgian Bay and the north channel of Lake Huron was taken in hand in the autumn of 1883 but having neither vessel nor assistants not much more than a reconnaissance was made at that advanced stage of the summer".[7] This comment by Boulton was much too abbreviated to convey the whole truth of the situation. While the department busily cast about for a vessel suitable for hydrographic surveying, Boulton hired tugs on a day-to-day basis in his eagerness to obtain first-hand knowledge of the dimensions of his task. Realizing that a properly-fitted ship would not be available to him prior to 1884, Boulton hired the small fishing tug *Ann Long* and began triangulation work along the northwestern shores of the Bay. Although the *Ann Long* was the first chartered vessel in the employ of what has since become the Canadian Hydrographic Service, the craft that came to be known, respectfully, as "the first *Bayfield*" must be regarded as the true pioneer among ships more or less adapted for survey work and operated under Canadian government auspices on the Great Lakes. Appropriately this trail-breaking vessel was named after Admiral H. W. Bayfield, R.N.

It was in the spring of 1884 that the department purchased the tug *Edsall* for $15,000 and then spent an additional $4,000 to equip her for marine survey functions. This refitted tug was rechristened *Bayfield* and it remained in surveying service for 19 field seasons. In 1900 it was reported to Ottawa that "for work upon the shores of the lakes now unsurveyed, principally Lake Superior, a larger, stronger and faster vessel is urgently required".[8] Accordingly, three years later, this first *Bayfield* was sold to private interests. During the period of her government commission most of the navigation routes in Canadian waters of the Great Lakes from Lake Erie to the entrance of Lake Superior were charted. A sturdy pathfinder, the *Bayfield* was more than just a response by the government of Canada to the problem of bringing about a reduction of ship losses. She was the first vessel, following Confederation, to be used for training Canadians in hydrography.

In the closing years of the 19th century sail was rapidly giving way to steam on the great waters. Fur trading was declining in importance as an economic activity in Canada's western interior. Wheat was beginning to emerge as a staple product of prairie agriculture suitable for large-scale exportation. Speedier, larger and deeper-draft vessels, plying routes never before used, began to carry cargoes from the head of the lakes to tidewater.

In March, 1884, Boulton made a decision of far-reaching importance to Canadian hydrography. He appointed as his First Assistant a youthful Ottawa-born graduate of Royal

Military College, Kingston, William James Stewart (1863-1925). Stewart was Gold Medallist and First Student of his graduating class. Destined to spend most of his career in hydrographic survey work Stewart became, in time, the first Canadian to occupy the high post of Chief Hydrographer. On May 26, 1884, the first *Bayfield* entered active survey work in Georgian Bay with Capt. Alexander M. McGregor (1828- ?) as sailing master and pilot. Charles Linter was chief engineer on the craft. This staff proved to be highly competent but even with the addition of other crew members it was a tiny force to undertake the immense task confronting them.

The area to be covered in the Bay was extensive and filled with operational hazards. Under such conditions a short survey season combined with a limited staff meant that surveys could not possibly keep pace with the demand for charts. The work was deliberate and time-consuming. Surveyors still employed lead lines dropped from the decks of the *Bayfield* or from the 6-oared open boats or dories. But Boulton somehow managed to remain hopeful. "... should minerals be discovered", he reported in 1885, "it will be an easy matter to extend the survey over that particular locality and with this contingency in view, the centres of the main triangulation stations have been marked by broad arrows cut into the rock, or iron bars driven into the soil."

On February 15, 1886, there was published at the Admiralty in London, England, an engraved chart, the first to be issued under orders of the Government of the Dominion of Canada. This historic chart, No. 906, was titled, "Cabot Head to Cape Smith and Entrance to Georgian Bay". In the same year the second chapter of *Georgian Bay and North Channel Pilot* was printed in Ottawa and issued by the Marine and Fisheries Department just prior to the opening of the navigation season.

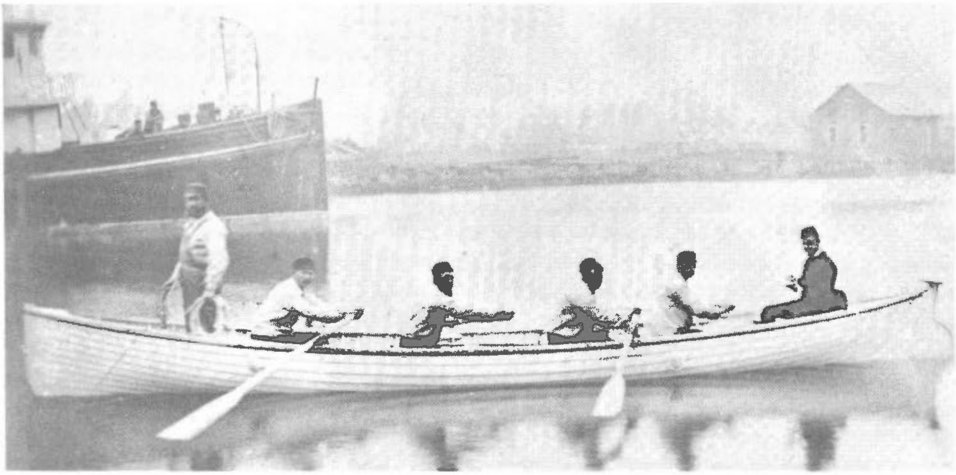


FIGURE 86. Sounding crew of the first *Bayfield*, 1884.

In June, 1890, the Canadian Pacific liner *Parthia*, outbound for the Orient, encountered a shoal in Burrard Inlet, the arm of the sea on which Vancouver is situated. This incident resulted in the dispatch of a unit from the Georgian Bay survey staff for the purpose of making a special survey of the Inlet under Stewart. Just as the first fresh-water survey under Canadian auspices had been started by Boulton, so the Burrard Inlet survey under Stewart represented not only the first hydrographic survey conducted entirely by Canadians in British Columbia waters but also the first salt-water survey to be performed under instructions of

FIGURE 87
W. J. Stewart.

Canadian government authorities. This task was undertaken and completed in the summer of 1891.

In April, 1893, Staff Commander Boulton returned to England and was succeeded by Stewart as officer in charge of the Georgian Bay survey. By early summer, 1894, work in the area had been completed. In all, 11 field seasons had been required to finish the slow, exacting and monotonous labor. The total cost of these Georgian Bay and North Channel surveys was $215,000. "With the possible exception of Lake Superior", Stewart pointed out, "none of the other lakes will take anything like that amount of time or money".[9] He contrived to make the expenditure even less imposing by pointing out to Ottawa that the United States government, in completing by 1881 surveys of American shores and waters of the Great Lakes, had required 40 years and a staff three times as large as their Canadian counterpart. Moreover they had spent $2,977,000 in the process.[10]

In the light of pressing demands for reliable charts of the Great Lakes generally, Stewart was instructed by Ottawa to carry out surveys on Lake Huron for the remainder of the 1894 season. In his report on that year's progress Stewart observed, "The south shore of Grand Manitoulin Island was found to be very low, much broken up and densely wooded almost to the water's edge, trending so nearly to a straight line that an ordinary triangulation was out of the question. I therefore constructed a number of 3-cornered platform buoys to support small and light pyramids. These were moored off-shore as far as could be conveniently seen from the low shores, and in this way a very satisfactory series of triangles were carried on, connecting Cove Island lighthouse to the Duck Islands . . . ". Stewart also reported that

FIGURE 88
Frederick Anderson.

the survey of Georgian Bay was practically finished and indicated there was only a relatively small area in the middle of the Bay that had not been systematically sounded.

Before the opening of the 1895 season it was decided that priority in surveying would be given the north shore of Lake Erie "both because the quantity of traffic in the lake is important and the coast dangerous, and because the completion of the survey is a preliminary necessity of the international boundary line." This was but the first of many subsequent occasions on which services of Canadian hydrographers would be required in connection with international boundary line location.

In 1901 Stewart turned over the Lake Huron survey to Frederick Anderson (1869-1957) and proceeded to Lake Winnipeg to carry out the initial hydrographic survey of that body of water. In order to save time and money the Geological Survey of Canada map of the lake was used as a base sheet for the new chart. Published in Ottawa in 1903 this was the first photo-lithographed chart made by Canadians and printed in this country.

In December, 1901, the 276-ton steam tug *Lord Stanley*, purchased by the department for $50,000, replaced the first *Bayfield*. On its way to the Upper Lakes the *Lord Stanley* met with a mishap at Toronto. The resulting need for repairs brought about a postponement of her departure for Lake Superior until the beginning of the 1903 field season. At this time, much against his well-articulated wishes, that grizzled veteran of the lakes, Capt. McGregor, was retired at the age of 75. The *Lord Stanley* was rechristened and became known as the second *Bayfield* with Capt. A. O. Zealand as her sailing master. She remained on the Great Lakes until the end of the 1920 season. With the completion of surveys in Lake Superior that autumn the second *Bayfield* was transferred to the Gulf of St. Lawrence Survey. During most of the 1920s this vessel was employed on rather spasmodic survey service in Northumberland Strait and in the vicinity of the Magdalen Islands. Not counting her years with the

National Revenue Department and with the Navy, nor the seasons during which she underwent repairs, the second *Bayfield* had been engaged on active surveying duties during 20 field seasons. In that period the waters from the Gulf of St. Lawrence to the head of the lakes were recharted. This splendid record of marine survey service was worthy of the name she carried so proudly.

Three years after the completion of the first of the Canadian hydrographic surveys of any of the Great Lakes, Stewart reported on the preparation and publication of a second edition of the *Georgian Bay and North Channel Pilot*. Two years later, in his 1899 report, he commented that "the demand for the last edition (300 copies) had been so great that it had been cleared out." The 1899 edition was reprinted in Ottawa in the following year. Four years later a new, complete edition of this *Pilot* appeared in print.

Sailing Directions, allied with charts, well deserve the appellation "road maps of the seas". *Sailing Directions* is an expression generally synonymous with the term *Pilot* when applied to an official publication designed to provide guidance for mariners supplementary to information borne on nautical charts. The British, traditionally, and Canadians, in more recent years, make use of the term *Pilot* but Americans tend to employ the description *Sailing Directions*. The British Admiralty began to publish such directions about 1825. In 1846 Bayfield's book was titled, *Sailing Directions for the Gulf and River St. Lawrence*.

Another term frequently heard in the language of marine charting was that of *fair sheet*. In recent times, however, this expression has given place to the description *compilation sheet*. In days when hand work played a prominent part in the production of charts a fair sheet represented the final draft or manuscript chart before submission to engravers and printers. This final draft was based upon a field or rough sheet and was, in fact, a drawing compiled from information contained on the field sheet.

The marine survey of Lake Erie between Point Pelee and Port Colborne, costing $38,608.95, requiring two seasons and a part of a third to complete, was finished in 1897. As an early example of international inter-dependence Stewart reported in 1896 that " . . . the balance of the Canadian shore [of Lake Erie] was surveyed by the United States government about 20 years ago and as no complaints have been made . . . there seems no necessity for a resurvey."

In 1896-97 two fair sheets of the Canadian coast of Lake Erie were prepared. One was sent to the Hydrographer to the Royal Navy "who had all our charts engraved free of charge" and one to the Hydrographer to the United States Navy. After 1898, when survey work was resumed on Lake Huron, the title of the Canadian organization was changed from Georgian Bay Survey to Great Lakes Survey. Even at that relatively advanced stage of development the Canadian hydrographic staff numbered six men in addition to Stewart, three of whom were hydrographers. Only one vessel, the second *Bayfield*, was available for such tasks.

Following Confederation responsibility for hydrographic surveys on its inland waters was assumed by Canada. The British Admiralty continued its surveys on the Atlantic and Pacific coasts of this country. Canada, in nearly every case, paid half of the costs involved in prosecuting these efforts. In the early years of the 20th century, however, Great Britain was confronted by a new situation in the realm of sea power, namely, an ominous growth in the naval strength and potential of a dynamic Germany. Mindful of this latent threat to her national security Britain decided to curtail her widespread marine survey operations. In May, 1904, the Admiralty formally requested that Canada assume full responsibility for hydrographic surveying of her own sea coasts. In January, 1905, the Governor General, Earl Grey, forwarded from Ottawa to the Colonial Secretary in London a minute of the Canadian Privy Council "expressing concurrence in the desirability of Canada's undertaking the marine surveys of her own sea coasts" but requesting "that until arrangements for giving assent to

FIGURE 89
P. C. Musgrave, R.N.

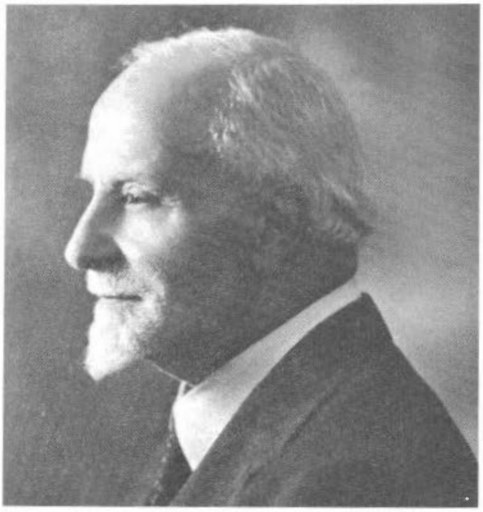


FIGURE 90. H. D. Parizeau.

this plan are completed . . . the Admiralty will allow their surveying vessels on those coasts to continue their work there." To this proposal the Admiralty replied affirmatively.

With the exception of some hydrographic work by the Public Works Department, no systematic Canadian marine surveys had been carried out in the lower St. Lawrence until Stewart arrived on the scene in 1905. For this project he was able to obtain the loan of the *Gulnare*. A succession of survey vessels bore that name, after the example of the *Bayfield* line. The ship loaned to Stewart was the last of the name *Gulnare* to operate under Admiralty auspices in Newfoundland waters, prior to the appearance there of a newer and more seaworthy vessel, the English steam yacht *Ellinor*. Following its replacement the *Gulnare* was employed in the Gulf of St. Lawrence by the Tidal Survey of Canada, embarking on this work in the season of 1902. It was from the Tidal Survey organization that Stewart, three years later, was able to borrow this gallant but aging craft.

It has been noted that the consolidation of 1904 brought nearly all Canadian government marine survey activities under the Marine and Fisheries Department. Under the terms of Order in Council P.C. 1200, dated August 2nd of that year Stewart was appointed Chief Hydrographic Surveyor. In practice, however, he preferred to use the shorter title, Chief Hydrographer. Stewart was not slow to realize that with the merging of survey services he had under his command not only more men and equipment with which to carry out projects, he had the nucleus of what could well become a survey organization of truly national significance and proportions.

Two years later the first continuing marine survey, under Canadian auspices, commenced on Canada's Pacific Coast. George Blanchard Dodge was released from the staff of Surveyor General Deville to supervise the early stages of this ambitious project. Prior to his arrival in Ottawa, Dodge had seen service with Admiralty surveys in Newfoundland waters. In the spring of 1907 Mr. P. C. Musgrave, late Lieutenant Royal Navy, who had joined the Hydrographic Survey of Canada, was appointed to succeed Dodge. Under Musgrave's energetic direction the approaches to the port of Prince Rupert were examined and a preliminary photo-lithographed chart of the work was issued prior to the opening of the following navigation season. In those days of highly ambitious railway construction the Grand Trunk Pacific's transcontinental line was being pushed westward with considerable speed. Sites for the most suitable Pacific terminus of the railway in the general area of the Portland Canal entrance were being investigated. Port Simpson, in fact, was intended originally to serve the railway in this role and initial surveys under the British Admiralty took place in that vicinity. But, in the end, the port of Prince Rupert was finally selected.

In hydrographic surveys near Prince Rupert, Dodge, and subsequently Musgrave, had as assistant Montreal-born Henri D. Parizeau (1877-1954). Parizeau had joined the federal Department of Public Works in May, 1901. Later that season he was, in effect, assistant to the resident engineer in the Lower St. Lawrence River and joined a party engaged in precise levelling work in that area. He first encountered hydrographic field work in the Thousand Islands area in 1903. When the departmental amalgamation took place in the following year Parizeau was absorbed into the Marine and Fisheries organization and was promoted to senior assistant, Upper St. Lawrence River. In 1906 he volunteered to assist in urgently required marine surveys on the Pacific Coast. He remained on this work during four seasons, returning to Central Canada after that spell of duty. Parizeau, however, was destined to serve for many more years on the Pacific Coast in hydrographic survey activity. In 1912 he began a survey of James Bay and in 1913 he was placed in charge of Great Lakes surveys but in 1920, on the death of Musgrave, Parizeau was again on Canada's West Coast as Musgrave's successor in charge of marine surveys there. From 1920 to 1937 Parizeau never missed a season's work in the arduous performance of his command.

Musgrave invariably showed great respect for the formalities and ritual of naval life. When he was in charge of a survey vessel, formal dress was required of those attending dinner aboard. Parizeau, in contrast, was rather free and easy in these matters. Musgrave, Parizeau and L. R. Davies, in retrospect, appear as the true founders and early developers of Canadian hydrographic surveys on the coasts of British Columbia.

Parizeau could tell a story with great flair and he delighted listeners on many occasions with his yarn about early soundings in the South Atlantic. In 1845, Capt. Kellett, in command of H.M.S. *Herald* left England bound for the North Pacific Coast of Canada. His sailing vessel, en route, was becalmed in the South Atlantic and, according to Parizeau, Kellett decided to put the delay to good purpose by taking deep sea soundings. Splicing together several thousand feet of spun yarn his men wound this on a reel. The line, weighted with a 200-pound piece of cast iron, was paid out until the reel stopped turning at 2,940 fathoms (17,640 feet). To check on the accuracy of the operation a second sounding was made. Each of these two soundings consumed four hours. As Parizeau would point out to his hearers the depth of water, using echo sounding devices of 100 years later, could have been determined with even greater accuracy in the space of a few minutes.[11]

In regard to pioneer marine surveys in Canada's Pacific waters special mention ought to be made of H.M.S. *Egeria.* From 1898 to 1910, under instructions from the British Admiralty, this vessel was employed on various surveys under a succession of commanders. In 1898, for instance, Commander M. H. Smyth, R.N., began triangulation work in the Juan de Fuca Strait and in the Strait of Georgia as a preliminary operation in connection with a resurvey of ship channels between Vancouver Island and the mainland. Smyth was succeeded, in the command of the *Egeria*, first by Commander C. H. Simpson, then Commander J. F. Parry, followed by Capt. F. C. Learmouth, Capt. J. E. Parry and Lieut.-Commander J. D. Nares, all of the Royal Navy. On December 8, 1910, the *Egeria*, according to Admiralty records, was paid off and recommissioned the following day with a reduced complement, to prepare the ship for sale after April 1, 1911. Thus ended Admiralty charting in British Columbia waters, activity that had commenced a century and a quarter earlier under Captains Cook and Vancouver.

Take note of their departure
and salute their fame.
By dedication to demands
of duty and precision
these Men of Admiralty,
made safer and more usable
the mighty waters, green and indigo,
that wash the shores and serve the needs
of Canada.

Charts produced as a result of surveys performed by H.M.S. *Egeria* greatly assisted vessels active in the lumbering and fishing industries of British Columbia and contributed in a marked degree to the safe and expeditious transportation of passengers and freight to ports serving the Yukon Territory during the Klondike Gold Rush.

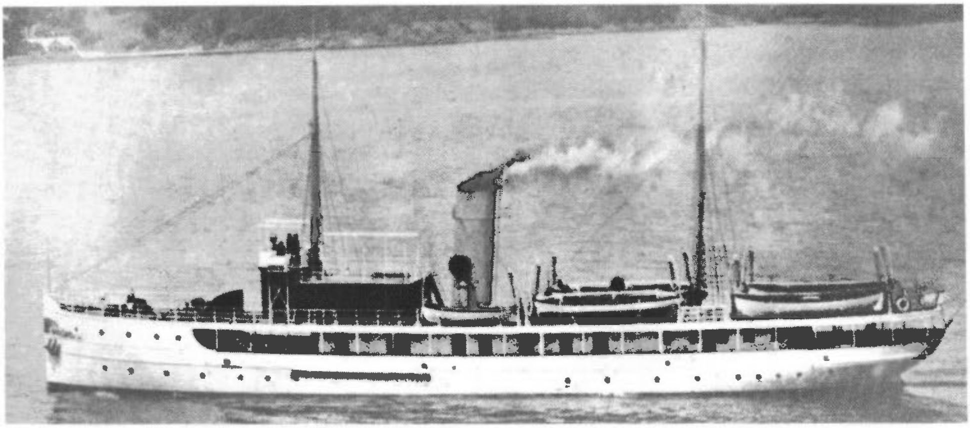


FIGURE 91. C.G.S. *Lillooet*, first survey vessel designed and built in Canada (at Esquimalt) for Canadian hydrographic survey work.

In addition to the *Bayfield* and *Gulnare*, other survey ships employed in Canadian hydrographic work prior to the First World War included *La Canadienne*, a vessel made available by the Department of Marine and Fisheries to Lieut. I. B. Miles, R.N., in 1906 for work in the Lower St. Lawrence. Four years later the *Cartier*, built in Scotland, replaced *La Canadienne*, and remained in service until 1947. The *Acadia*, which began survey tasks in Atlantic waters in 1913 was the first Canadian survey ship to have its structure reinforced for work in ice. The *Lillooet* was the first survey ship designed and built for Canadian hydrographic surveys. It was constructed at Esquimalt and commissioned in 1908 for surveys on the Pacific Coast. The *Lillooet* commenced her career near Prince Rupert in June of that year, continuing operations in that vicinity during the two following field seasons. In 1911 she was in the Ocean Falls area, working in conjunction with a shore party under Davies in the Queen Charlotte Islands. For a quarter-century CGS *Lillooet* was closely identified with marine surveys on the Pacific Coast of Canada, and in 1916 ended her days. In 1917 the vessels *Acadia*, *Cartier* and *Bayfield* were taken over by the Royal Canadian Navy.

Early in the 20th century public interest in Canada's western interior became increasingly focussed on prospects for the establishment of an ocean port in Manitoba on Hudson Bay,

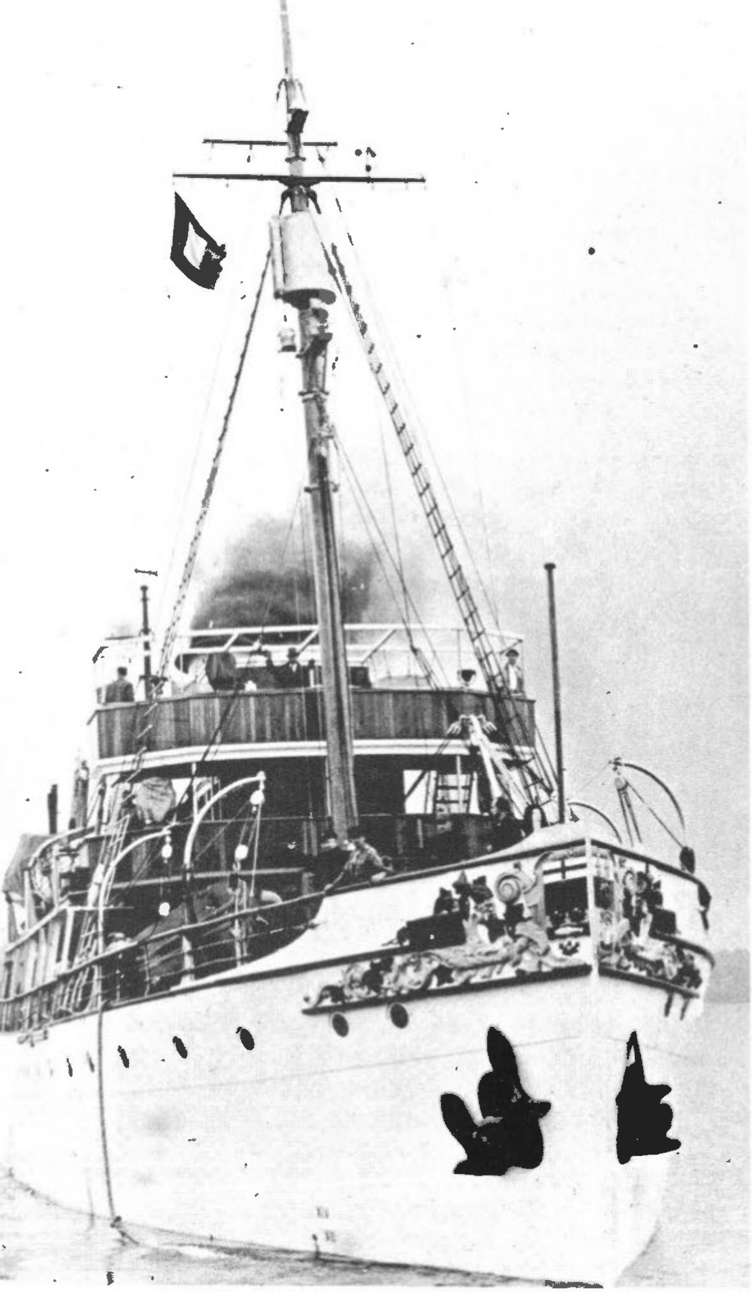
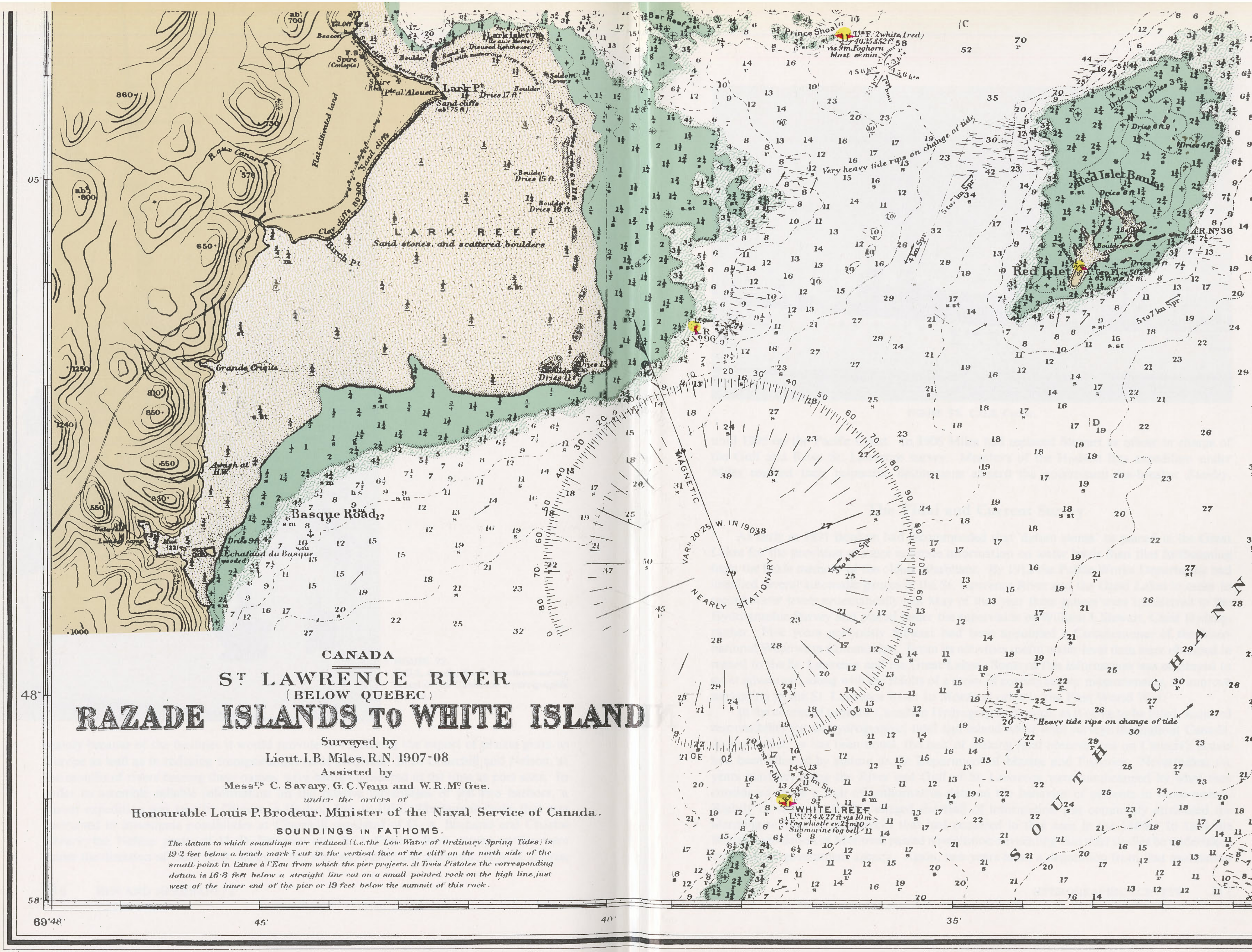


FIGURE 92.
C.G.S. *Acadia,* the first northern survey vessel of the Canadian Hydrographic Service.

mainly because of the facilities it would provide in expediting the export of prairie grain to Europe as well as in reducing transportation costs involved. Both Churchill and Nelson, at the mouths of rivers bearing these names, were being considered at the time as port sites. In order to assemble reliable information on the relative advantages of the two harbors, a survey expedition was sent by Ottawa to Hudson Bay in 1910. The launch party that was instructed to investigate possibilities at Churchill consisted of G. A. Bachand and Charles Savary; the Nelson party, of H. D. Parizeau and R. J. Fraser. Both survey parties were under the direction of Lieut. I. B. Miles, R.N., who was Admiralty Surveyor, H.M.S. *Egeria,*



MAP 13. Portion of the 1907-08 hydrographic chart of the St. Lawrence River below Quebec City. One of the first engraved East Coast charts produced by the Canadian Hydrographic Survey (Service). Published, 1911.

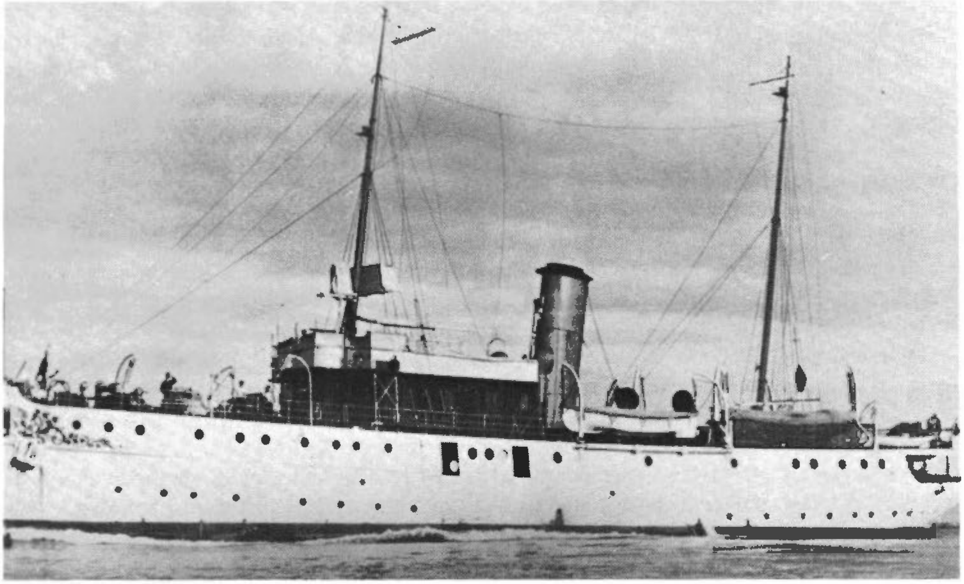


FIGURE 93. C.G.S. *Cartier*.

until 1905 on the Pacific Coast. In 1906 Miles had replaced Stewart as officer in charge of the Gulf and River St. Lawrence survey. Members of the Hudson Bay expedition under Miles reached their respective destinations aboard the government ice-breaker *Stanley*.

The Tidal and Current Survey

As early as 1891 Boulton had recommended that 'datum stones' be placed in the Great Lakes for the provision of more accurate information on water levels than that forthcoming from the fickle memory of the oldest inhabitant. By 1912 the Public Works Department had installed several automatic gauges in the St. Lawrence River and the Great Lakes in order to record water levels systematically. In May of that year these gauges were transferred to the Hydrographic Survey and placed under the supervision of William J. Stewart, Chief Hydrographer. Five years previously Stewart had been appointed a Commissioner of the International Waterways Commission. From its activities useful water-level data were obtained in regard to the St. Lawrence and the Great Lakes. Some of this information was employed to great advantage, along with the results of a series of current survey measurements, to improve navigation in the St. Lawrence River to Montreal prior to the First World War.

In the course of time the Canadian Hydrographic Service, as it came to be titled, acquired responsibility for all hydrographic, tidal and inland water level surveys throughout Canada. At the outset, as has been noted, the task of making tidal observations on Canada's coasts had been allotted by statute to the Department of Marine and Fisheries. Nevertheless for years mariners using the River and Gulf of St. Lawrence were handicapped by what they considered to be a lack of authoritative data on the behavior of currents in those waters. Rightly or wrongly, to this alleged shortfall of information was commonly attributed the alarming number of shipwrecks that had occurred in that area in the 1880s. In 1884 the British Association of Montreal passed a resolution advocating that tidal studies be undertaken by a federal government agency. Again, two years later, a deputation from that association and from the Royal Society of Canada made a forceful presentation on this issue to the Prime Minister and to the Minister of Marine and Fisheries. Little official action was taken at this stage, however, likely because of the relatively expensive commitments already made by Ottawa in regard to surveys of Georgian Bay and of Hudson Strait. In 1888 the two organizations again combined to petition Ottawa, supported on this occasion by the signatures of nearly 400 captains and ships' officers. In the petition it was pointed out that by means of the improvements recommended "serious loss of life and property due to shipwrecks attributable to unknown currents during fogs and hazy weather may thus be greatly diminished."

After periods of patience-testing inactivity, things began to happen. By the end of 1893 the government had moved to install a few automatic tide gauges on the Atlantic Coast. Temporarily the system was placed under the supervision of Charles Carpmael, Director of Meteorological Service at Toronto, with Andrew R. Gordon as Assistant Supervisor. In that same year William Bell Dawson (1854-1944) was appointed head of the newly-formed service authorized to make tidal and current surveys. He was a younger brother of George Mercer Dawson of the Geological Survey of Canada and had studied engineering in Paris following graduation from McGill. From 1878 to 1893 W. Bell Dawson had been active in Canada as a land surveyor and engineer. In his new role he signed as 'Engineer in charge of the Tidal Survey' and as such he proceeded to draft a master plan designed to provide this country with information on tides and currents equal in scope and reliability to that possessed

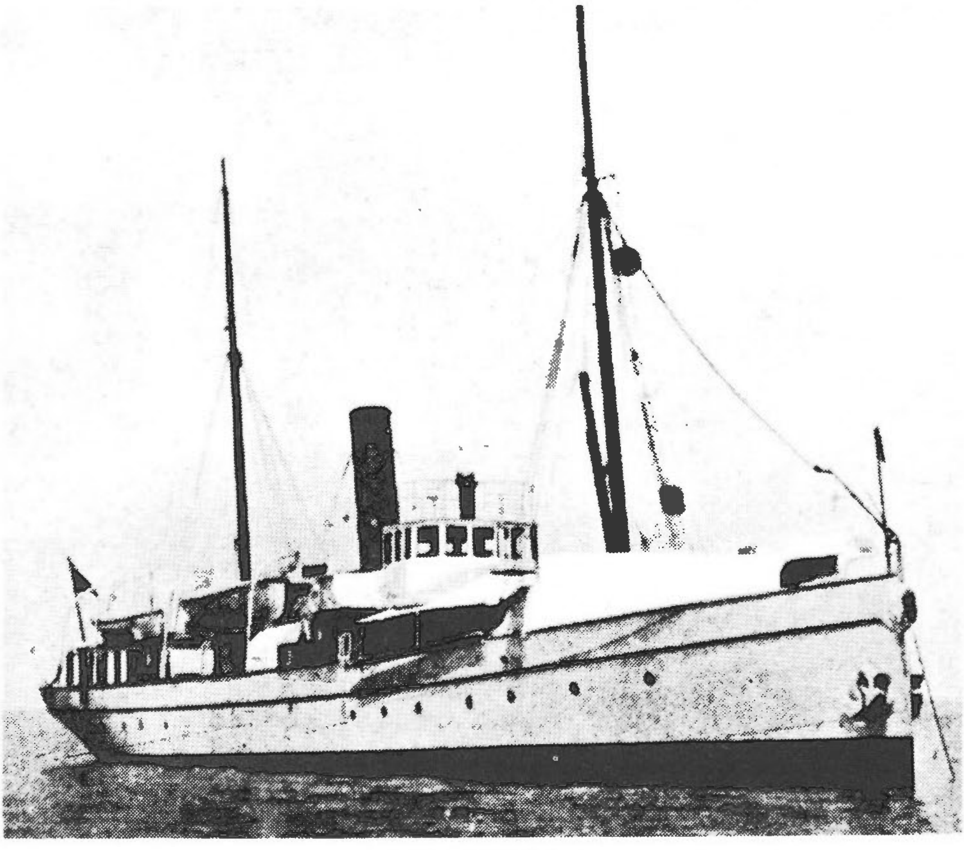
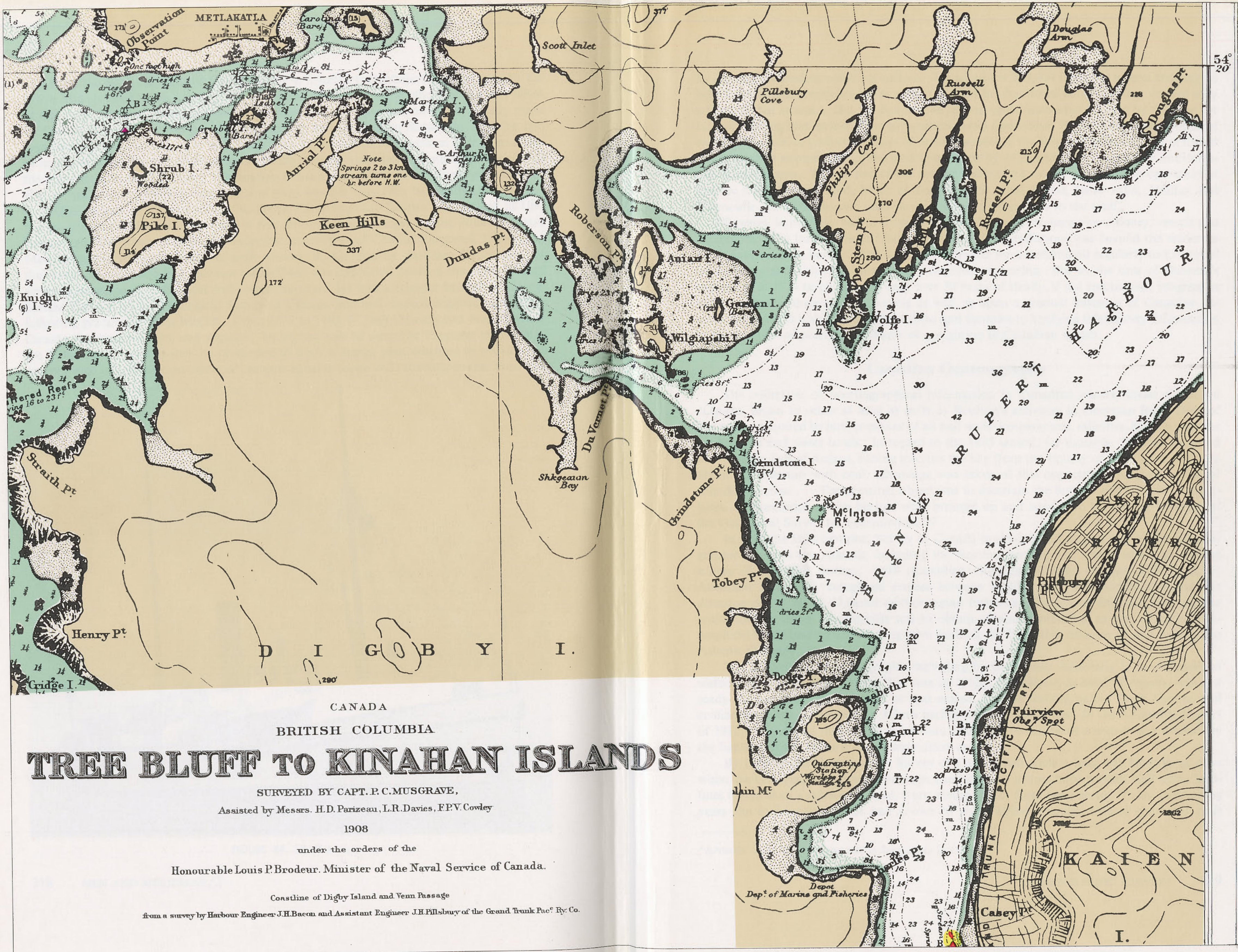


FIGURE 94. S.S. *Gulnare.*



MAP 14. Portion of the 1908 hydrographic chart of Prince Rupert Harbour and approaches. One of the first engraved West Coast charts produced by the Canadian Hydrographic Survey (Service). Published, 1911.

by the world's leading seafaring nations. He asked for $29,000 from the federal treasury to help finance field operations in the season of 1894 but had to be content with a vote of only a third of that amount. But the financial strain was eased somewhat for him by the loan for his work during that season of the government vessel *Lansdowne*. This gratifying development enabled Dawson to perform surveys of ocean currents in the Strait of Belle Isle and in Cabot Strait, the first examination of the kind to be made by a Canadian working under authorization from Ottawa. By the end of the century permanent tide gauges were in operation at Quebec City, Father Point, Strait of Belle Isle, St. Paul Island, Saint John, Halifax and Yarmouth. In 1902 *Gulnare*, tidal survey, replaced *Lansdowne* in the Gulf.

Dawson, in his time, had to contend against shortages in manpower, money, vessels and equipment. The translation of tidal records into tidal predictions was beyond the resources of his small staff to handle. The data they collected were transmitted regularly to Liverpool Observatory and Tidal Institute for any required processing. But by the time of Dawson's retirement in 1924 he could look back over 30 years of steady, if not spectacular, progress in this aspect of hydrographic surveying as well as upon a gradual lessening of Canadian dependence upon British scientific know-how and facilities in applying tidal survey information to the solution of practical problems of navigation in Canadian waters.

Canadian Oceanography

The collection of oceanographical information in Canadian waters, under Canadian auspices, began to occur at least as early as Boulton's activities in Georgian Bay. Data of this nature acquired by him, consisted of air and water temperatures, salinities, bottom samples for analysis and water levels. In regard to the 1885 season, for example, Boulton reported that "on the 2nd of August, having to cross the bay from the vicinity of Byng Inlet to Owen Sound to replenish with coal, advantage was taken of this opportunity to carry a line of soundings across . . . The principal object was to ascertain the bottom and surface temperatures . . . Specimens of the bottom were brought up and handed to the Acting Director of the Geological Survey for examination."[12]

In 1915 the Hydrographic Survey of Canada organized and carried out its first oceanographic cruise in the Atlantic, including the Northumberland and Cabot straits as well as waters of the Gulf Stream. CGS (Canadian Government Ship) *Acadia*, with Capt. F. Anderson in charge, completed cruises between Halifax and Newfoundland under the direction of Dr. Hjort, Director of Norwegian Fisheries. These were followed by a similar cruise for Dr. Hjort. Its purpose was to obtain off-shore soundings as part of an oceanographical study bearing on the long-term outlook for Canadian fisheries in that part of the Atlantic Ocean.[13]

The last season of hydrographic surveying by the British Admiralty in Newfoundland waters prior to the First World War was in 1912. The *Ellinor*, in need of repairs, was not ready for surveying until August of that season. In the waiting period Capt. Combe and civilian assistants resurveyed St. John's harbor and its approaches. In the Admiralty Report of 1912 it was stated that "large areas were examined by means of a wire-sweep worked by the boats, and several new shoals were discovered."

By 1914-15 the Hydrographic Survey of Canada had come a long way from those days when, on Georgian Bay, operations were conducted by a tiny, hard-pressed staff using lead-lines tossed from a refitted tug boat, from sailing gigs or from open dories. In the intervening years the hydrographic fleet had grown to six* registered ships, several chartered craft

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*Actually seven, but one was lost in James Bay in 1913.

and a number of survey launches. The staff had increased to include not only hydrographers and water-level surveyors but as well mathematicians, cartographic draughtsmen and compilers. The whole program had become closely allied with the more energetic assertion by Canada of its sovereignty over remote and isolated parts of its far-flung domain, as well as with the economic development of the country as a whole. When it is borne in mind that Canada has a coastline of more than 100,000 nautical miles, probably the longest of any country in the world, and that it borders three oceans, results accomplished in terms of hydrographic surveys performed, nautical charts compiled and constructed, tide and current tables issued as well as *Pilots* and *Sailing Directions* published, form an impressive and exciting record. These achievements were made possible only by the pioneering zeal, skill and endurance of men such as Bayfield, Boulton, Musgrave and Miles of the British Admiralty, and by such Canadian-born hydrographers as Stewart, Anderson, Parizeau and Charles Savary, as well as Dawson of the Tidal and Current Survey.

12

THE GEODETIC SURVEY OF CANADA: THE FIRST DECADE

"Bless the mark . . ."
Two Gentlemen of Verona, Act 4, Sc. 4

In retrospect it is not easy to understand why so many difficulties and delays attended the creation of a federal government goedetic survey organization. Nearly a quarter of a century elapsed from the time the first approach was made to Ottawa authorities, advocating such an establishment, until it was brought formally into being in 1909. The intervening years were filled with extensive correspondence on this project, supplemented by reports, resolutions, petitions and other representations from scientific bodies and learned societies, all pressing vigorously for the inauguration of geodetic surveying on a national, systematic basis in Canada.

Undoubtedly the Laurier government and its immediate predecessors in office at Ottawa had been subjected to intensive pressures to institute or expand federal services in a variety of fields. During these years dynamic forces were at work influencing and shaping the future of Canada. The extent and direction of western settlement took shape as considerable numbers of people left their homes in the older-established parts of the nation for the plains and parklands west of Winnipeg. Mining and lumbering areas in northern Ontario and Quebec also experienced a marked influx of settlers.

This transference of population within Canada, along with a steady flow of immigrants from Europe and the United States, was followed by a period of acute economic strains, political unrest and of changing political alignments. In his tour of the West in the summer of 1910 the Prime Minister, Sir Wilfrid Laurier, found that tariff protectionism, as a national fiscal policy, was fast losing support in that part of the country. Sir Wilfrid had been present as a national godfather at the historic ceremonies at Regina and Edmonton marking the creation of the new provinces of Saskatchewan and Alberta in 1905. Now, within five years, he discovered that the newcomers he had saluted so eloquently at the twin birthday parties had become deeply discontented with their lot. Freer trade with the United States was demanded by strident and persistent voices. As Sir Wilfrid pondered over these portentous developments he came to regard reciprocity in trade between Canada and the United States as a logical remedy for the economic ills then afflicting both nations. But in its subsequent promotion of a reciprocity arrangement and in the general election that followed, the Liberal government and party failed to win the support of a majority of Canadians. In September, 1911, Sir Robert Borden swept triumphantly to power in Ottawa, the first Conservative prime minister in 15 years. The solemn, deep-voiced Nova Scotian had succeeded the distinguished-looking, gracious-mannered Sir Wilfrid to the leadership of a nation in flux.

In the closing years of the 19th century the terms 'trigonometrical', 'triangulation' and 'geodetic' were generally employed as interchangeable descriptions of a basic type of surveying. In essence each term, as then used, meant the establishment of accurate points scattered across a given area and, taken together, forming a geometrical framework within which hills, lakes, valleys, rivers and islands and other natural features could be depicted in their true relationship on a topographic map. Data for placing parallels of latitude and meridians of longitude in their true alignment with reference to existing cadastral and other surveys could be determined only through what has since become known as a geodetic survey.

Geodetic work, based on the science of geodesy, the study of the size and shape of the earth and of its gravitational field, is regarded as the backbone; the strong, reliable and supporting framework of the entire superstructure of all surveys and map making. Just as a durable private home requires a solid foundation, as well as a central heating plant to serve the differing temperature needs of its assortment of rooms, so primary geodetic controls, including precise levelling, form the firm basis on which depends the accuracy of topographic, hydrographic, military and other surveys as well as the reliability and usefulness of maps compiled therefrom. The inevitable tendency of adjoining but unrelated cadastral surveys, for example, to coincide only imperfectly, can be corrected by reference to established geodetic standards. Savings in time and money achieved by dispensing with resurveys, in preventing litigation and in better map making are some of the practical benefits flowing from the adoption of a primary pattern or network of triangles.

One of the earliest attempts in Canada to perform geodetic survey work occurred in 1883. Under R. Steckel a geodetic levelling party functioned as an activity of the federal Public Works Department. It operated mainly along the St. Lawrence and Richelieu rivers, establishing permanent bench marks* and working gradually towards the Atlantic coast, with the object of fixing the differences in elevation between mean tide level and inland bench marks. Information on these pioneering efforts is to be found in Steckel's reports to the department in 1885, 1891, 1898 and 1906.

But the need for a federal government organization, basically devoted to geodetic survey work, continued to grow. Thomas Fawcett, who had resumed private practice as a land surveyor following active service in the field during the 1885 campaign against Riel and his followers, took a momentous step. As President of the Dominion Land Surveyors' Association, and on its behalf, Fawcett addressed a memorial dated March 2, 1886, to the Minister of the Interior. He pointed out the pronounced advantages of a Coast and Geodetic Survey for Canada and advocated that its work "be conducted under the direction of the Department of the Interior . . . as it has in its employ a number of surveyors qualified . . . to undertake . . . extensive Governing Surveys, thus rendering it unnecessary to apply to the Imperial Government for scientific men to prosecute such work . . . ". Fawcett also urged that "a chain of primary triangulation along the St. Lawrence River and Gulf, also the Great Lakes, would provide a basis for the extension of the survey into the interior of the different provinces . . . and could readily be connected with the United States Lake Survey . . . it is in the

*Bench mark: a relatively permanent material object, natural or artificial, bearing a marked point whose elevation above or below an adopted datum (usually mean sea level) is known.

interests of the country at large that a Trigonometrical Survey *should at once be begun.*"[1] (author's italics)

To help keep the matter alive the Association appointed a committee of five of its members to study the question in detail and to prepare a further memorandum. Two years later the committee, consisting of W. F. King, O. J. Klotz, W. S. Drewry, E. J. Rainboth and J. S. Dennis, submitted a memorandum of their conclusions to the Minister of the Interior. In their presentation they urged that a geodetic survey of Canada be inaugurated at an estimated annual outlay by the government of $15,000.

In his 1894 presidential address to the Royal Society of Canada Dr. G. M. Dawson commented " . . . it is clear that something in the nature of an established geodetic survey must be ranked as among the requirements *of the immediate future* . . . such a survey is essential as a basis for the complete geographical delineation of any great area . . . ".[2] (author's italics) Actually the accomplishment of this goal remained 15 years away!

In 1899 a memorandum from the Chief Astronomer, addressed to Deville and dated February 5, Dr. King indicated that the work of his office consisted principally of "astronomic and geodetic computations".

In May, 1903, the Royal Society of Canada submitted a memorandum to the Canadian government asking for the appointment of a commission to collect information and report upon the possibility of establishing a Geodetic Survey of Canada. In this submission it was recalled that five years previously the Society had drawn the government's attention to a proposal by the Superintendent of the United States Coast and Geodetic Survey, Dr. Henry S. Pritchett, to measure an arc along the 98th meridian from Acapulco, Mexico, to the Arctic Coast of Canada. This meridian line runs about 100 miles west of Hudson Bay. The object of this exercise was to provide data for the determination of the shape and dimensions of the earth. The Society pointed out that the Canadian part of this work would be of great practical utility in forming the basis of a geographical survey of Canada. The government, however, indicated at the time that it was unable to authorize Canadian participation. This rejection may have arisen from the fact that the proposed project would be carried out in a region then of little economic value or significance to Canada as a whole. The Society, nevertheless, in its 1903 memorandum asked for reconsideration of the matter and urged that the moment was propitious for the formation of a Geodetic Survey of Canada.

In the same document it was emphasized that often the same areas were being surveyed again and again in this country by land surveyors, geologists, railway and hydrographic surveyors. For every new project a fresh survey was made. Such duplication of work and of expenditure, it was argued, could be considerably reduced, if not entirely eliminated, by the establishment of a systematic triangulation net. It was conceded by the Society that few countries, if any, spent as much money per capita for survey work as Canada was doing at the turn of the century. The Department of the Interior was subdividing prairie land as well as parts of British Columbia; the Geological Survey of Canada was exploring and surveying in many parts of the country; the Department of Marine and Fisheries was surveying Canadian navigable waters. It was proposed that if all such information could be connected in a methodical triangulation network it would be possible to take a broader and more comprehensive view of great issues affecting Canada as a whole, rather than attempting to deal with such questions within the limited aspects of purely local and unrelated surveys.[3]

In 1903 also, Major E. H. Hills, R.E., head of the Topographical Section of the British War Office, was sent by that organization to study and report on a topographic survey of Canada as well as to make a report on military surveys in this country. In his report Major Hills stressed the advantages of a trigonometrical type of survey and contended that the Royal Society of Canada had been correct in its assessment that the triangulation method was desirable as a basis for other Canadian surveying activities. Major Hills found that existing survey practices in this country were both costly and inefficient and recommended that a topographic survey along systematic lines was an urgent necessity for military, administrative and engineering purposes.[4]

Chief Geographer James White contributed to the growing demand for a geodetic survey by alluding in his report to the Interior Department in 1902 to the difficulties of compiling a new map of Canada. "The lack of an accurate topographic survey", he stated, "the numerous sources from which information must be obtained; the difficulty in many cases of obtaining access to the plans of old and almost forgotten surveys; the necessity of incorporating surveys that are being made concurrently with the compilation of the map which frequently alter the work almost as soon as completed; . . . all tend to make the compilation of such a map a long and tedious operation . . . The difficulties encountered in compiling the new map of Canada emphasize the need of a good topographical map of at least the well settled portion of the Dominion. A few years ago I made a survey between two well determined points on Georgian Bay and Lake Ontario, respectively, which showed that part of Central Ontario, as shown on the best existing maps, was over two miles out in longitude and over a mile in error in latitude. Although our maps show streams, lakes, etc., even in the extreme north, much of the information on which this is based is of the vaguest kind."[5]

Leading up to geodetic survey developments in 1905 were surveys of that description authorized by the federal government for geodetic levelling work in connection with the Georgian Bay Ship Canal project. These tasks were carried out by a staff under Charles F. X. Chaloner, an experienced assistant to Steckel. The canal levelling surveys were made in late 1904 to November, 1906. Instruments used included the Tacheometre Sanguet made in France, under Steckel's direction, for the Department of Public Works.[6]

Field operations of the Geodetic Survey, under the ultimate responsibility of Chief Astronomer King, commenced in the summer of 1905. These operations marked the real, rather than the official, beginnings of the Geodetic Survey of Canada. Dominion land surveyor Charles Albert Bigger (1853-1923) of the Dominion Observatory staff, was in direct charge of these activities. The project was designed as a triangulation survey in the more settled parts of Ontario and Quebec and was undertaken primarily to connect the old and new observatories in Ottawa.* In 1905-06 the tiny staff of the organization was given office accommodation in the Dominion Observatory, Ottawa, but in the autumn of 1907 it was found necessary to provide more space and this was secured in the Trafalgar Building downtown. In 1914, partly as a result of recommendations of the 1907 committee that a central record office be made available to the Geodetic Survey in a suitable fireproof structure, the staff moved into a new brick building on the grounds of the Central Experimental Farm near the Irving Avenue entrance. This move marked the commencement of a 45-year occupation of those premises.

As early as the summer of 1905 the Department of Militia and Defence had requested that triangulation for topographic purposes be undertaken in central Canada, pending specific provision by Parliament for such a survey. Early in February, 1906, a memorial was drawn up and later forwarded to Sir Wilfrid Laurier by the Canadian Society of Civil Engineers, urging upon the federal government the importance of proper coordination of the various surveys conducted by several federal departments and also the adoption of methods to provide for permanent recording by monuments and other field marks. A study by a commission of experts was suggested as well, with the aim of establishing a general topographic and geodetic survey for all Canada.[7]

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*Located on Cliff Street and on the Central Experimental Farm respectively.

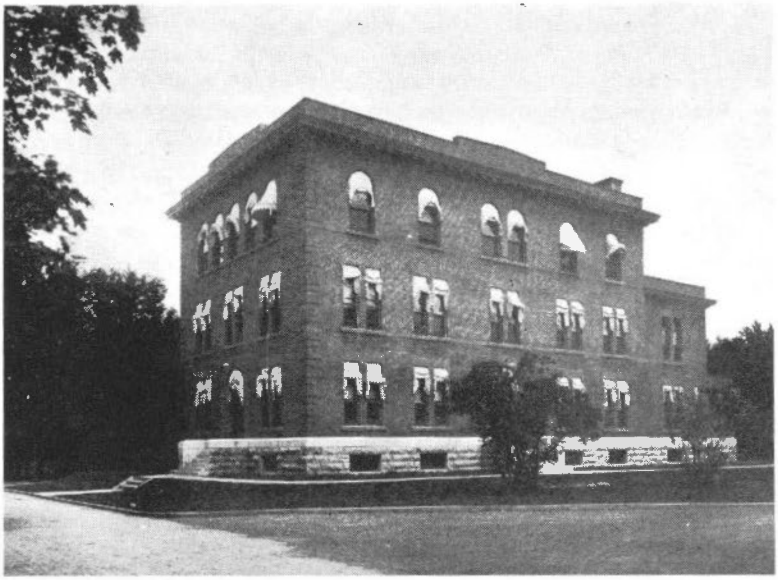


FIGURE 95. Geodetic Survey of Canada building, Ottawa, 1914.

The government of the day decided that, all in all, a committee of government and other officials, rather than the device of a more ponderous and more expensive commission, could serve just as effectively as an investigating and reporting body. Accordingly, in 1907, a committee was approved and instructed to consider and report on matters raised in the submission of the Civil Engineers. A fairly representative committee was convened under the chairmanship of Dr. King. It consisted of the deputy minister of Railways and Canals; the deputy head of the Geological Survey of Canada; the Chief of the General Staff, Department of Militia and Defence; Surveyor General Deville; Chief Clerk of the Engineering Branch, Department of Public Works; the Chief Hydrographic Surveyor, Marine and Fisheries Department, and three professors of surveying and geodesy from McGill, Toronto and Laval universities respectively.

The committee reported its findings to the Minister of Militia and Defence in mid-February, 1907. The committee expressed itself as strongly in favor of a comprehensive and reliable survey of Canada for the production of an accurate topographic map based on a network of triangulation and showing natural and artificial features of the country. Such a survey, in the view of the committee, was of urgent necessity to the people of Canada from the standpoint of public economy, extension of public projects and the development of the natural resources of this country. The benefits of such a survey, it was indicated, would be political, administrative, military, statistical and economic in nature. Better delineation of Canadian coastlines would be another dividend. The best interests of the nation would be served, the committee asserted, by the early production of accurate maps and the avoidance of duplication and overlapping in federal surveying activities. "For the proper coordination of existing surveys and the effectual control of future surveys it is recommended to establish in a permanent manner a network of triangulation . . . chains of required geodetic triangulations and nets of precise spirit levelling."[8]

In June, 1905, Canadian geodetic survey work began in earnest at Kingsmere, Quebec, not far from Ottawa. On July 23 the first station was erected on King Mountain, about 9 miles northwest of Parliament Hill. During the same season an 87-foot-high observation tower was built at Bowesville, south of Ottawa. Visible signs of geodetic work in the countryside were the wooden observation towers resembling primitive oil well derricks. The sudden appearance of novel structures aroused wonderment among residents in their vicinity. Strange explanations were provided by the uninformed for the presence of the towers. It was rumored, for example, that these structures had been erected in preparation for the next general election, thus permitting political orators, armed with megaphones, to glorify and even perpetuate the government of the day!

Bigger's description of this work is illuminating. "The survey", he stated, "is spread over the country trigonometrically, by triangles, starting from a measured base having the angles of the triangles measured, and their sides computed. The triangles selected are combined to form a multi-sided figure for more precise computation of distance. The angles of the triangles are measured . . . by theodolites."

Winter seasons proved best for geodetic reconnaissance work, including the selection

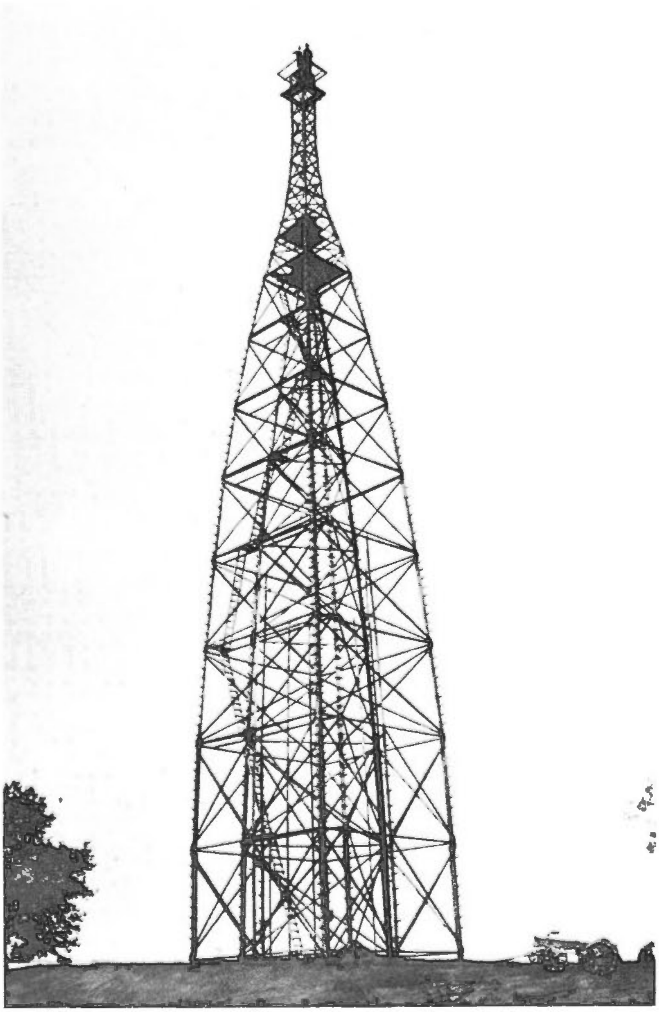


FIGURE 96
Observing tower near Chatham, Ontario, constructed in 1911.

of sites for observation towers. The absence of foliage and the presence of snow-cover on hilltops combined to reveal any irregularities of the horizon.

Each surveyor was equipped with a small theodolite, a compass, telescope, field glasses and a pair of heel spikes similar to those commonly used by telephone pole repairmen. At the day's end occupied stations were marked on maps and lines radiating therefrom to other possible stations were plotted.

In the 1906 field season a total of 9 towers, averaging 75 feet in height, were erected and reconnaissance was extended east and west from Ottawa. But government funds remained skimpy for these purposes and the work slackened. During the winter of 1906-07 Bigger and an assistant continued reconnaissance work from Ottawa across the southern part of

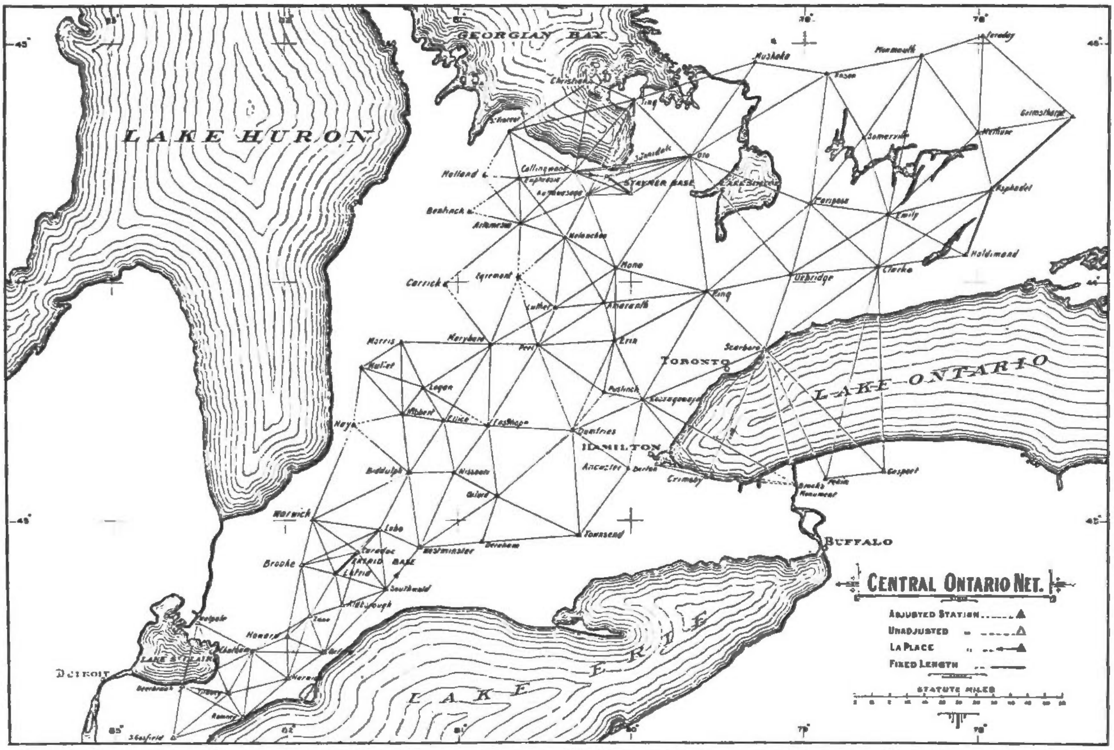


FIGURE 97. Central Ontario net, constructed 1907-17.

Quebec province. By 1907 the measurement of horizontal angles was under way and all observers on the staff were Canadian university graduates. The typical observing party consisted of a surveyor, a recorder, a cook and 5 or 6 light-keepers. The latter displayed lights from tower tops, by day using a mirror to reflect a beam of sunlight, at night directing a beam by acetylene gas lamp. The provision of apparatus for signalling, reported as highly satisfactory in other countries, proved somewhat less efficient in atmospheric conditions prevailing in central Canada. A pencil of light many miles in length near the earth's surface is subjected to local atmospheric influences that cause deflections in magnitude and direction. Variation in temperature and in wind force as well as the sharp contrasts between cultivated countryside and timbered areas also contributed to irregularities in the transmission of signals.[9]

During the 1908 season two levelling parties were active, one extending levels from Sherbrooke along the Canadian Pacific Railway line from Coteau to Polycarpe Junction, thence along the Canadian Pacific line by way of Kemptville Junction to Prescott, then westerly along the main line of the Grand Trunk Railway. Levelling parties, in subsequent years, usually consisted of an observer, a cook and four other men.

April 20, 1909, is regarded as the official birthday of the Geodetic Survey of Canada. On that day Order in Council P.C. 766 was approved and the title of the organization, already in fairly frequent use, was accorded legal status. The text of the Order in Council bears repeating here:

"On a Memorandum dated 5th April, 1909, from the Minister of the Interior, submitting that during the last four years a triangulation has been in progress in the better settled parts of the Provinces of Ontario and Quebec, under the Astronomical Branch of the Department of the Interior, the object of which is to determine with the highest attainable accuracy the positions of points throughout the country, and the lengths and directions of lines which may form the basis of surveys for all purposes, topographical, engineering or cadastral, and thereby assist in the survey work carried on by other Departments of the Dominion Government, by the Provincial Governments, and by municipalities, private persons or corporations. The operations have also included a considerable length of lines of precise levelling.

"The expense of the work has been paid out of the appropriation for Astronomical Surveys, which among other objects, provides for 'the astronomical and geodetic work of the Department of the Interior'.

"The Minister recommends that since the operations so far carried on have shown that this accurate basis for surveys of all kinds can be provided for at reasonable cost and since the value of such work is universally admitted, being vouched for by world-wide experience, that the work be continued under the designation of the Geodetic Survey of Canada and that Dr. W. F. King, the Chief Astronomer, be named Superintendent of the same."

From the time it came into being a policy of cooperation with the United States as well as with the various provinces and cities of Canada was followed by the Geodetic Survey of this country. An outstanding demonstration of this policy in action was the adoption by Canada of what came later to be known as the North American Datum. Early in 1913, after conferring with the United States Coast and Geodetic Survey, the Canadian organization agreed (as did Mexican authorities) to adopt United States Standard Datum as applicable in Canada and the name was subsequently altered to North American Datum. In this way Canada was able to make use of a system which otherwise could not have been established in this country except by costly operations extending over a period of many years. In addition, Canadian geodetic work in Canada and American geodetic work in the United States were joined together, and the respective national nets adjusted to fit together. One notable example of this type of cooperation was in the triangulation from the Lake of the Woods across 1,250 miles to the Pacific Ocean. Another was in the forming of a loop from Montreal down the St. Lawrence River and Gulf, to Anticosti Island, thence along the New Brunswick coast to the Bay of Fundy, joining the eastern end of the United States arc which provided a link through the New England states to the starting point at Montreal.[10]

Within Canada another aspect of this cooperative attitude consisted in occasional arrangements made with municipalities under which triangulation and precise levelling, required in the production of city maps and plans, were carried on by the Geodetic Survey. The Survey provided the engineer and his instruments, the city paying for materials and labor.

By 1916 the first Canadian transcontinental line of precise levels had been completed. Results of these operations, after 1913, were published from time to time. By the end of 1925 a total of 17,021 miles of precise levelling had been run, in addition to 10,000 miles of secondary levelling. Most of the 17,021 miles of survey had been performed since the beginning of 1912.[11] All of these lines of precise levels were connected to establish a single system extending from coast to coast. The system was based on five tidal stations, namely, Halifax, Yarmouth, and Father Point on the Atlantic seaboard; Vancouver and Prince Rupert on the Pacific. About 94 per cent of this levelling work had been carried along railway tracks. In many instances such lines formed the only routes available for running levels.

FIGURE 98
Noel J. Ogilvie.

The proliferation of railway lines in Canada during the first decade of the 20th century benefitted triangulation programs as travel to the field became much easier. In the same period the introduction of invar tapes proved to be a boon to geodetic work by making possible more accurate measurements of base lines from which triangles were expanded. These tapes, made of an alloy of steel and nickel, had a very small temperature coefficient. By 1925 the total area of triangulation work that had been completed by the Geodetic Survey of Canada had reached 170,000 square miles.

From 1904 to 1911 inclusive, descriptions of fiscal year activities of the Geodetic Survey of Canada were contained in annual reports of the Chief Astronomer. From 1912 on, with the exception of the period from 1919 to 1921, the Deputy Minister of the Interior summarized geodetic survey work in Canada in his yearly report. In addition, from 1918 to 1929 inclusive, annual reports of the Geodetic Survey of Canada were published in red-covered, attractively printed and well-illustrated volumes.

By the end of the first decade of its legal existence some of the more important groundwork for future expansion of the Geodetic Survey of Canada had been laid by its first Superintendent, Dr. W. F. King. In his administrative capacity he was ably helped by Assistant Superintendent Charles Albert Bigger. This highly competent Dominion and Ontario land surveyor, born in Oakville, contributed in a marked way to the general advancement of geodetic surveys in Canada. In 1905 he began his close association with Dr. King, following several seasons on resurveys of the boundary between Quebec and New York state, as well as the boundary between this country and Alaska. His direction of field parties engaged in carrying out geodetic assignments was outstanding, and until his death in 1923 Bigger's wisdom and diligence proved to be important factors in the development of an efficient organization.

Other Dominion land surveyors active in this type of survey work in pioneer times include Picton-born Wilmot Maxwell Tobey, D.T.S. (1877-1959). In 1901 Tobey was appointed mathematician to Chief Astronomer King. He wrote such works as *Geodesy, Geodetic Position Evaluation* and *The Differential Adjustment of Observations*, all federal government publications. The latter work came into extensive use in the readjustment of triangulation networks. In 1926 Tobey became Assistant Director.

Frederick Blair Reid, Supervisor of Levelling, issued a series of reports during the period 1910 to 1917 under the general title, *Precise Levelling.* All of these were publications of the Dominion Observatory, Ottawa. In 1912 Douglas H. Nelles, as a result of initial geodetic work in the Yukon Territory, made a report published as *Precise Levels Along Dawson and Glacier Roads from White Pass, B.C., to the 141st Meridian.* Later Nelles became Supervisor of Topography in the Geodetic Survey of Canada. Royal Harp Montgomery, D.T.S., foresaw, through his geodetic field work, that increased water-power development in this country would be accompanied inevitably by a brisk demand for vertical control in areas forming watersheds of our large river systems. William Melbern Dennis, in addition to other accomplishments, became an expert on instruments used on geodetic surveys. With Rannie he studied ways and means of improving their accuracy. Geodetic engineers such as W. H. MacTavish, A. J. Brabazon, A. J. Rainboth, Thomas Clinton Dennis and David MacMillan (1888-   ) performed valuable services during formative years of the Survey. F. A. McDiarmid's work as Geodetic Astronomer, including measurements of base lines, and as Supervisor of Standards, deserves special mention.

All of these well-trained, dedicated men helped to make possible subsequent accomplishments by such eminent Canadian geodetic and Dominion land surveyors as Noel John Ogilvie, John Leslie Rannie, D.T.S. (1886-1954), John Earl R. Ross, D.T.S. (1892-   ) and Cecil Herman 'Marsh' Ney. By 1917 Rannie was Supervisor of Triangulation. In time both Rannie and Ross, in that order, occupied the post of Dominion Geodesist as the directorship came to be called after 1936. Noel Ogilvie, as assistant to Dr. King, succeeded his distinguished chief after King's death in 1916.[12] His appointment as Superintendent in the following year marked the separation of the Geodetic Survey of Canada from the Dominion Observatory. By 1923 his title had been changed to that of Director. Noel's father, John Charles Ogilvie, was a first cousin of William Ogilvie of Klondike surveys fame. Noel was born in Hull, Quebec, in 1880. One of his private tutors was Dominion land surveyor Carl Engler who coached the young man in mathematics, surveying and astronomy. In 1901 Noel began his surveying career with the Department of the Interior under Deville, and in 1902 worked in the western interior with the Dominion land surveyor, Edgar Bray. Between then and 1905, when he was commissioned a Dominion land surveyor, Ogilvie was with J. J. McArthur in the Kootenay area. From 1909 to 1914 he worked on surveys of the Canada-Alaska boundary. Noel Ogilvie's span of leadership of the Geodetic Survey of Canada covered nearly 30 years until his retirement in 1946.

13

TYPICAL SURVEYS ON PIONEER CANADIAN RAILWAYS OTHER THAN THE C.P.R.

The clash of strong personalities, the plots and counterplots that accompanied the creation and growth of corporate entities, the intensive money-raising campaigns, the engineering accomplishments and political strife stimulated by the advent of the railway age in British North America invite attention. However, except for the vitally important part played by surveying and mapping in Canadian railway building, these aspects are too varied and far-ranging to find place in this account.

In a previous chapter the work of surveyors in the establishment of the transcontinental line of the Canadian Pacific and of its lands in the West has been traced. In order, however, to portray the function of surveys entering into the wider spectrum of railway construction in Canada this chapter offers some examples typical of the total achievement.

News of the startling success of the Liverpool and Manchester line of steam railways in the early 1830s triggered a veritable explosion of interest and action in the western world. In the 1840s a mania for purchasing rail shares swept the London money market, a boom in which nearly all classes of society participated. In one week in the summer of 1845 some 89 new railway projects were financed by funds raised in the British metropolis. Canadians were not immune to the construction virus but remained somewhat less susceptible to stock-gambling fever. The energetic initiation of railway-building in the United States contributed to the contagion in Canada. By 1840 a total of 2,800 miles of railway had been completed in that country.

Montrealers were in the forefront of early developments in this new field of endeavor in Canada. In their enthusiastic drive to compete with New York for traffic, rails began to supplement the services of canals. A natural freighting route lay between Montreal and St. John's, at the head of the Richelieu River-Lake Champlain water transport system. In order to carry on business between these two points early traders had to cross some 14 miles of countryside. This important travel-way was the first to attract pioneer railway builders in this country, men who were spurred by prospects of relatively substantial traffic, short haulages and heavy tolls. On February 25, 1832, a bill incorporating the Champlain and St. Lawrence Railroad Company was passed in Lower Canada. Soon after the organization of the corporation in 1834, initial surveys of the route were made. The broad-gauge line, consisting of wooden rails, ran from St. John's to Laprairie on the south shore opposite Montreal. On July 21, 1836, the road was formally opened but it was not until 1847 that heavy 'T-iron' rails replaced the wooden ones.

FIGURE 99. The *Dorchester* at the opening of the Champlain and St. Lawrence Railway between Laprairie and St. Johns, Quebec, July 21, 1837.

In the first ten years following the Act of Union the building of railways was one subject prominent in public affairs of the new Province of Canada in which regional or sectarian considerations played little or no part. Hardly anyone opposed railway construction. Most Canadians regarded railways as a magic talisman of prosperity, a tangible measure of progress and a badge of achievement. In 1845 the St. Lawrence and Atlantic Railway was chartered for the purpose of building a 125-mile-long line to the international border through Sherbrooke in order to link up with its American counterpart, the Atlantic and St. Lawrence Railway, and thus provide communication between Portland, Maine, and Montreal. This project would afford the Canadian city access to an open port in winter. In all probability this was the first railway of an international character in the world.

Lack of easy communication and of trading contacts impeded the growth of a common nationality among the various provinces of British North America. The establishment of satisfactory rail links with the Province of Canada was, in fact, the price set by the mainland maritime provinces and by British Columbia for entrance into political union with Canada East and Canada West. More than most parts of the western world at the time, the colonies of British North America required rail communications to help offset the depressing sense of isolation that afflicted pioneer settlers and communities scattered across immense expanses of forest, mountain and plain.

The first railway to be built in Canada West was constructed by the Erie and Ontario Company. It was chartered in 1835 and four years later its line was opened for traffic. Its first trains were horse-drawn. By 1857 a total of eleven railways were operating in the Province of Canada, representing a total of 1,402 miles of track. Two years later that mileage had risen to 1,871 of which 1,372 miles existed in Canada West and 499 in Canada East.

Two civil engineers named Keefer were prominent in railway and related surveys in Canada during this formative period. Their father, George Keefer, had left the United States as a United Loyalist and settled in the Niagara Peninsula. He founded the town of Thorold and served as first president of the Welland Canal Company. His son Samuel Keefer (1811-90) was for many years a government engineer and supervised the planning of the first Parliament Buildings in Ottawa and of a suspension bridge over the Niagara River. His half-brother, Thomas Coltrin Keefer (1821-1915) produced in 1851 the preliminary survey report of the Kingston-Toronto section of the Grand Trunk Railway.

Early achievements in railway building in Canada East were imposing but it soon became apparent that the St. Lawrence River at Montreal had to be crossed if full benefits of the new age in transportation were to be realized. Many experts of that day felt it was quite impossible to build a bridge nearly two miles long yet high enough to permit the passage of large vessels beneath it. In addition the structure had to be made strong enough to withstand the unusual pressures exerted by huge ice jams in winter and turbulent high water in spring. At this stage two able surveyors, T. C. Keefer and Alfred Brunel, appeared on the scene, men whose deeds shed lustre on the engineering profession in Canada. In 1851-52 Keefer, assisted by Brunel, completed surveys in contemplation of a railway bridge across the St. Lawrence at Montreal.[1]

As a result of this examination of the problem, Point St. Charles was selected as the best place of entry for the bridge on the north bank. In order to neutralize extreme ice pressures special bridge piers were designed and built so that their sharp edges faced into the strong currents of the river. In May, 1854, the first caisson was placed in position and by the end of November, 1859, Victoria Bridge, as it was named, was completed. On December 15 the first train crossed safely. Victoria Bridge remains a monument to bold concepts, wise surveys and dedicated, skilled workmanship.

Another engineer and surveyor who rose to prominence in the field of Canadian railway construction was Col. (Sir) Casimir Stanislaus Gzowski (1813-98). Son of a Polish nobleman, Gzowski arrived in Canada in 1842 by way of Russia and the United States. After serving as a government engineer for six years supervising road-building in Canada West, Gzowski was attracted to construction work with the St. Lawrence and Atlantic Railway. In 1853 he entered into partnership with (Sir) Alexander Tilloch Galt (1817-93), son of John Galt of Canada Company fame. This partnership built much of the Grand Trunk Railway from Toronto to Sarnia. Galt, a leader of English-speaking elements in Canada East was one of the principal architects of the Act of Confederation and was the first finance minister at Ottawa after July 1, 1867. He became the first to occupy the post of Canadian High Commissioner in London.

Gzowski had many noteworthy surveying and engineering feats to his credit including the undertaking and successful completion in 1872 of the Grand Trunk's International Railway Bridge across the Niagara River at Fort Erie. Even at the crest of his long and eventful career Gzowski vividly remembered his earliest employment in this country. In an address delivered in 1890 to the Canadian Society of Civil Engineers, now the Engineering Institute of Canada, he recalled that "during the administration of . . . Sir Charles Bagot, Governor General, I was appointed in 1842 in charge of construction of all kinds of roads [plank, macadam, etc.,] harbours, lighthouses and bridges, not including the Welland Canal; that work was under charge of . . . Samuel Keefer, at that time . . . chief engineer of Public Works in Upper and Lower Canada . . . the roads were made by cutting down trees for a certain width on each side of the centre line, but only blazing those standing on or near the boundaries of the 66-foot statutory road allowance. The setting of these allowances for roads was done with ordinary compasses by amateur surveyors . . . The Act respecting land surveyors requiring them to pass examinations before being allowed to practice had not yet been passed."[2]

The Ontario, Simcoe and Huron Union Railway, which became part of the Northern Railway Company, occupies a special place in the history of overland transportation in Canada. A bronze plaque, attached to a column at the portal of Toronto's Union Station, records for posterity a pioneer achievement of this line. The inscription proclaims that "at this place on May 16, 1853, the first train in Ontario [Canada West] hauled by a steam locomotive started and ran to Aurora". The cheers and happy shouts heard on that auspicious occasion have come echoing down the years but in the interests of accuracy it should be pointed out that the plaque ought to have been placed one block to the east of its present location.[3] Passengers, hauled by a wood-burning locomotive, paid one dollar each for the privilege of making this historic 30-mile journey to Aurora. Rails of this line, in the first years of its operations, reached to a point near Barrie. The inauguration of this passenger service heralded the advent of a period of vigorous railway building in this part of Canada, lasting through the 1850s. The event signified as well the emergence of Canada West from an economy based on water transport to a more industrial form of society based upon improved overland transportation.

Two exploratory surveys had been made by the company beyond Barrie toward Nottawasaga Bay, Lake Huron. Sandford Fleming and Alfred Brunel were engaged to carry out a more determinative survey. Their final choice for a terminal site on the bay, out of five possibilities, was a nameless swamp in the lee of offshore islands known as Hen and Chickens. In January, 1853, railway officials met at the place and christened it Collingwood. Within seven years after the railway's arrival there, Collingwood was a thriving town of several thousand inhabitants.

In 1888 the Northern Railway Company was absorbed by the Grand Trunk. By that time its lines had been extended to Meaford and to Penetanguishene on Lake Huron and to North Bay through Bracebridge and Huntsville. The Northern was the first rail line to break through into the Ontario northland where it became a principal factor in the revival of the timber industry in that region. It was also a nursery of Canadian railway management and engineering.

Meanwhile the prospect of railway construction had enlivened public and private affairs in the provinces by the Atlantic. Rail communications between the seaboard and the Upper St. Lawrence Valley had excited the interest and stirred the ambitions of maritimers as early as 1835. In that year an association of interested persons was formed in St. Andrews, New Brunswick, to promote the project. Two members of the group were authorized to conduct an exploratory survey of the hinterland between that community and the St. Lawrence escarpment, despite the fact that this region was already under preliminary examination by an international team composed of members of the United States Topographic Corps and of the Royal Engineers. In 1836 Capt. Yule, R.E., made a 200-mile preliminary survey from Point Levis to Mars Hill in order to determine the most feasible route for a railway. On vigorous representations from Washington, D.C., further surveying in the region was suspended until the international boundary dispute then raging in that general area was officially settled. Not until after the Webster-Ashburton Treaty of 1842 was another British survey undertaken with a view to linking Quebec by rail to Atlantic ports.

The Maritimes

After prolonged negotiations between Canadian and British statesmen, Westminster authorities were prevailed upon to instruct the Royal Engineers to make an accurate survey to ascertain the feasibility of a rail route from the Atlantic seaboard to the St. Lawrence River. Capt. Pipon and Lieut. Henderson were active on this task until October, 1846, when Pipon was drowned trying to save the life of another member of the survey party. Henderson carried on in charge until the summer of the following year when Major William Robinson succeeded him. On August 31, 1848, Robinson reported on five possible routes, including one from Halifax to the Baie de Chaleur via Truro, then up the Matapedia Valley to Mont Joli, a distance of 652 miles. The total cost of such a line was estimated at four and a half million pounds. The cost of the survey was slightly in excess of fourteen and a half thousand pounds.

In a letter dated August 6, 1847, one Wilkinson, a surveyor, wrote to Major Robinson giving instructions to the men in the field: "... I place no very strong reliance upon the Maps. But if a favorable opening . . . be found . . . [Corporal] M'Kenzie will continue levelling down the Restigouche slope until he strike[s] the exploratory north line levelled by Capt. Broughton and Mr. Featherstonaugh, at some point to be identified. Here he may cease levelling, and make thence a compass survey . . .".

Robinson, in a letter, referred to an example of the dangers and hardships encountered on this survey. Mr. Grant, one of the chief surveyors in his party "having left the line for a short time to make a sketch from some rising ground, could not again find the track, and after being lost for 5 days, without a morsel of food, was found on the morning of the sixth day, lying exhausted and at last extremity, by some lumberman passing almost providentially up the stream to which he had wandered, and where, unable to move farther, he had laid down on the top of the bank for two days. This solitary boat was, in all probability, the only one passing that way for a twelvemonth. Mr. Grant's hands and feet were frost-bitten and though this happened a month and a half ago [in early November, 1847], he had not yet fully regained the use of them".[4]

In one of the most significant state papers ever compiled in the English language Lord Durham had helped clear the way for the railway survey. It was in January, 1839, that he presented to Westminster his now-famous *Report on the Affairs of British North America.* In this perceptive analysis of Canadian conditions and in his statesmanlike remedies for Canadian problems of the time, Durham proposed the ideas of legislative union, actually consummated two years later, and of local autonomy for the several colonies. What is often overlooked is that Durham also observed that "the completion of any satisfactory communication between Halifax and Quebec, would, in fact, produce relations between these Provinces that would render union absolutely necessary". This proved to be a remarkably shrewd prophecy. Durham added, "Several surveys have proved that a railroad would be perfectly practicable the whole way".[5]

In the mainland Atlantic provinces the colonial governments undertook construction and management of rail lines within their respective boundaries during the period when negotiations with British authorities for financing the Intercolonial line, as the Halifax-Quebec rail link was called, had broken down. In 1848 Joseph Howe entrusted George Wightman, for example, with the task of conducting a railway survey from Halifax to Windsor, N.S. In the expansive manner of the times, Wightman's report dealt with nearly every aspect of railroading. His report is especially significant because it bore a distinctively Canadian, rather than a British or American, flavor. Wightman pondered over such typical Canadian construction problems as the effects of severe frost on roadbeds, the advantages and disadvantages of winter construction, and the behavior of subsoils. His findings, in all likelihood, contributed substantially to the technical improvements in Canadian railway-building practices later introduced by Fleming.

In the spring of 1850 the Nova Scotia legislature promised to subscribe half the cost of the Halifax-Windsor line and, in addition, ordered a survey to be made along the Annapolis Valley from Windsor to Digby Gut, about 90 miles. On December 15, 1858, a rail line was opened to traffic on the 61-mile stretch from Halifax to Truro. By 1860 a line between Saint John and Shediac, about 108 miles, was in operation. In this patchwork manner, and without any real unity of plan, the provinces of Canada, New Brunswick and Nova Scotia determined, within the scope of their own limited financial resources, to commence work at various points in the fond hope that the bits and pieces might one day become a connected system. In a sense these developments marked the real beginning of the Intercolonial Railway.

On March 14, 1851, after alternately hopeful and discouraging discussions, the British government offered to guarantee payments of interest on railway loans floated by provincial legislatures to promote the Intercolonial project but Westminster authorities insisted that the three million pounds sterling involved would not be forthcoming until preliminary surveys for the line had been completed and the final location approved by the British government. It was also stipulated that such surveys were to be carried out by three engineers, one to be appointed by the British, one by the Province of Canada, and one by New Brunswick and Nova Scotia, acting jointly. In the event, all three parties appointed the same man for the purpose, Sandford Fleming.[6] The Colonial Secretary, the Duke of Newcastle, praised Fleming's character as "unexceptionable" in his communication agreeing to the combined selection.[7]

Fleming began his reconnaissance survey on March 5, 1864. He divided the work between two regions; the Nova Scotia Division, and the New Brunswick and Canada Division. Each survey party consisted of the engineer in charge and men trained to carry on levelling, surveying and barometric observations, together with a full complement of axemen and packmen. Four civil engineers headed as many parties: Walter Lawson, T. S. Rubidge, David Stark and Sandford Fleming himself. The main object of these 1864 surveys was to gather information to enable the governments concerned to judge the comparative merits of some 15 projected routes for the proposed Intercolonial Railway. Rails had reached Rivière-du-Loup from the west and the Halifax-Truro line was in operation, so that the portion of the line to be provided for was that between Truro and Rivière-du-Loup, or 360 miles on a direct line. Once again, as in most reports in the long history of Canadian surveying reference is made to the very trying onslaughts of insects. "Various kinds of flies were more than usually troublesome during the first half of the season. The parties engaged in the northern section of country suffered very much", reported Fleming.[8]

In all, three main routes were accorded priority in Fleming's report made in February, 1865, namely, the Frontier, Central, and Baie de Chaleur routes. Fleming was not to decide at the time on the best route but to leave the choice to the governments. Several years later,

FIGURE 100. Fathers of the Canadian Confederation discussing terms of the British North America Act, London, England, on Christmas Eve, 1866.

at the request of government authorities, he did indicate his preference for the Baie de Chaleur route. While the survey was in progress in 1864 important and rapid moves were being made by men in public life in British North America looking towards a confederation of the provinces. In July, at Charlottetown, and in October, at Quebec, developments towards this union came in rapid succession. These culminated in an arrangement that provided, among other matters, for the construction of a railway system which other efforts, extending over a quarter-century, had failed to secure. Above all they resulted in the consolidation, under one central government, of provinces reaching across the northern half of the continent.

In a report to Hon. William McDougall, Provincial Secretary, in February, 1865, regarding his Intercolonial survey, Fleming expressed what may well be regarded as the credo of Canadian surveyors of the past, present and future. "I have endeavored", he wrote, "to carry on the Survey with a strict regard to economy, at the same time efficiency, and I have completed the whole service at as early a period as it was possible, within the means at my command".

Construction work on the Intercolonial system continued for more than nine years. In 1876 the whole length of line, over its rather circuitous route, was opened for traffic, touching six Atlantic ports and extending over a total length of 700 miles.[9] The Intercolonial continued to operate under that name until 1923 when, along with other lines, it was absorbed into the Canadian National system.

A map drawn on Mercator's Projection, showing the relative geographical positions of the British Islands and British America, with the shortest lines across the Atlantic also depicted, formed an appendage to Fleming's 1865 report of survey. In the matter of new geographical concepts Fleming gave an address in London in 1878 that contained passages of special interest to any involved in transportation problems peculiar to Canada.[10] "If on the surface of a large terrestrial globe [upon which all the land and water on the earth's surface were depicted on the same scale] we draw on one sheet of tracing paper the outlines of Canada and on another, the outlines of Europe, and then proceed to lay one over the other so as to cover as much of the land in each case as possible, and if we go on to measure and make allowance for portions left uncovered, we shall find that Europe somewhat exceeds the area of Canada but that the excess is not great . . . If we exclude from the comparison all land within the Arctic Circle, we still find that Canada covers fully more of the earth's surface than the comprised areas of European Russia, Lapland, Norway, Sweden, Denmark, Holland, Belgium, the British Isles, France, Switzerland, Germany, Austria, Turkey and all the principalities between the Adriatic and Black Seas. In fact if we leave out Spain and Italy, Canada appears to equal in area the remainder of Europe".

And again, " . . . To an Englishman or Frenchman the Severn or Thames, Seine or Rhone, would appear to be considerable streams but in the Ottawa which reaches its parent stream, the St. Lawrence, 600 miles from the latter's mouth, we have a river 550 miles long, three or four times as big as any of them". Also, "Compared with some of the [Canadian] lakes and rivers, the canals are unimportant but they will stand comparison with any works of their class. As engineering achievements I believe I am correct in saying they are unrivalled. They are certainly as much superior to the canals of the United States as the latter are in advance of anything I have seen in England".

The Central Provinces

In the Province of Canada three corporations, the Northern, Great Western, and Grand Trunk were the most prominent among early railway lines. In many cases early lines were but links in longer transportation systems or chains. For example, the Northern Railway line from Toronto to Collingwood was primarily a portage road between Lake Ontario and Lake Huron. The Grand Trunk Railway was the largest of the three corporations but all hoped to attract substantial east-west traffic in Canada. The Grand Trunk reached from Sarnia to Montreal and Portland, thus reinforcing the traditional flow of commerce in the St. Lawrence River valley.

In 1854 the Grand Trunk completed a survey of the Montreal-Toronto section and during that summer about 8,000 men worked on the right-of-way. But the mid-1850s were unsettled times. The Crimean War raged in Europe and on the Pacific side of British North America the San Juan crisis bedevilled Canadian-American relations. Canadians generally were given a timely lift in morale when, on October 27, 1856, the 333-mile-long Grand Trunk rail link between the two principal urban areas of the Province of Canada was formally opened for business. Stirring civic celebrations were held at Cornwall, Prescott, Brockville, Kingston, Belleville and Cobourg. For the first time in Canada's history morning newspapers published in Toronto could be read later the same day in Montreal, and vice versa. The same feelings of wonderment, even elation, over man's conquest of time and space, must have been experienced in 1856 as those that stirred Canadians about a century later when daily air flights made it possible for passengers to breakfast in Montreal and to dine in Vancouver before sunset on the same day.

Adequate provisioning was the magic key to the safety and well-being of nearly a thousand men performing arduous surveying duties along the National Transcontinental line, the eastern division of the Grand Trunk Pacific, a section for which the federal government was mainly responsible. These surveys began in the autumn of 1903 and continued through the following year. In the spring of 1905 some 34 location survey parties were at work for the

Grand Trunk Pacific. Some parties headed westward from the head of navigation on the St. Maurice River while others, starting from points several hundred miles to the west, headed eastward. These latter parties, following the banks of streams or working across country by dead reckoning, planned to meet parties proceeding from the opposite direction. The rigorous specifications for gradients and maximum curvatures of the line frequently called for explorations extending as far as 50 miles on both sides of the axis of advance. Often a half-dozen tentative locations would be made without achieving any satisfactory conclusion. After 18 months of intensive activity 9,156 miles of surveyed line had been run but only 358 miles of this total had been accepted as representing a final determination of route.

Though a final line through a survey district might total 300 miles, yet in that section alone it would sometimes be necessary for surveyors to explore and run preliminary lines exceeding five times that distance! Thus, between Moncton and Winnipeg, a line distance of 1,800 miles, parties had to cover more than 10,000 miles of exploratory, preliminary and location surveys in order to search out the most feasible route for the railway. All distances had to be carefully measured by chain. In order to ascertain precise levels both transit and levelling instruments were employed. Every surveyor of the Grand Trunk Pacific lines was instructed to keep grades of 1:250 against eastbound traffic and 1:500 against westbound traffic. The maximum curvature permitted was 4 degrees or a radius of 1,433 feet. If any surveyor found it impossible, under special circumstances, to keep within these limitations he reported his difficulty to his superior. Only the chief engineer had discretion to depart from the standards laid down.

When all survey reports had been filed it was found that, for the greater part, the rigid specifications could be observed. It was also revealed that, in all, nearly 250 streams would have to be bridged. The first construction contracts were awarded by the Grand Trunk Pacific in April, 1906. On June 1, 1915, 'regular' train service was inaugurated between Quebec City and Superior Junction, near Sioux Lookout and about 258 miles east of Winnipeg. In November a truly regular service was established between Moncton and Quebec City.

The Western Interior

In the opening years of the 20th century Canada rode the crest of a wave of prosperity. Settlers were attracted from Europe, the United States and from eastern and central parts of Canada, by the availability of cheap land in the west. They streamed into the region beyond Winnipeg in large numbers and with this marked upsurge in population came the conviction that the one existing transcontinental railway was insufficient to meet the needs of this rapidly developing territory. Charles Melville Hays (1856-1912), a successful American railroad executive, was brought to Canada by the Grand Trunk interests to help restore its failing financial fortunes. Hays, to a considerable extent, changed the map and history of Canada before losing his life in the *Titanic* disaster. He inspired the opening up of the more northerly stretches of the fertile western country as well as a veritable empire in northern Ontario and northern Quebec as well as in north-central British Columbia. Hays prevailed upon the British owners of the Grand Trunk to build a transcontinental line through virgin territory. His bold initiative gave the Liberal government at Ottawa an opportunity to foster the construction of a coast-to-coast rail system, an achievement that promised to match, if not surpass, the building of the Canadian Pacific transcontinental under Conservative administrations. Sir Wilfrid Laurier pledged federal government support to the Grand Trunk Pacific project, subject to a condition that over the years hardened into firm party policy, namely, that no grants of free land would be made to the railway company in aid of construction. Sir Wilfrid and the Liberals were adamant on this point. They reflected, in their attitude, Canadian resolve to abandon completely a policy that had tended, in the view of the majority, to alienate far too large a proportion of the best farmlands of the nation to private corporations.

The Grand Trunk Pacific Company, a wholly-owned subsidiary of the Grand Trunk Railway Company, undertook construction of the western division of the transcontinental line "to standards not inferior to those on the main line between Montreal and Toronto". In the early stages of its railway operations 86 townsites were purchased across the western interior by an agency of the Grand Trunk Pacific. Surveyors were asked to lay out towns on a pre-determined pattern. Railway stations were to be separated by not less than seven nor more than fifteen miles. Station names, according to their initial letter, followed in alphabetical order. Thus, in travelling west from Winnipeg on the main line of the Canadian

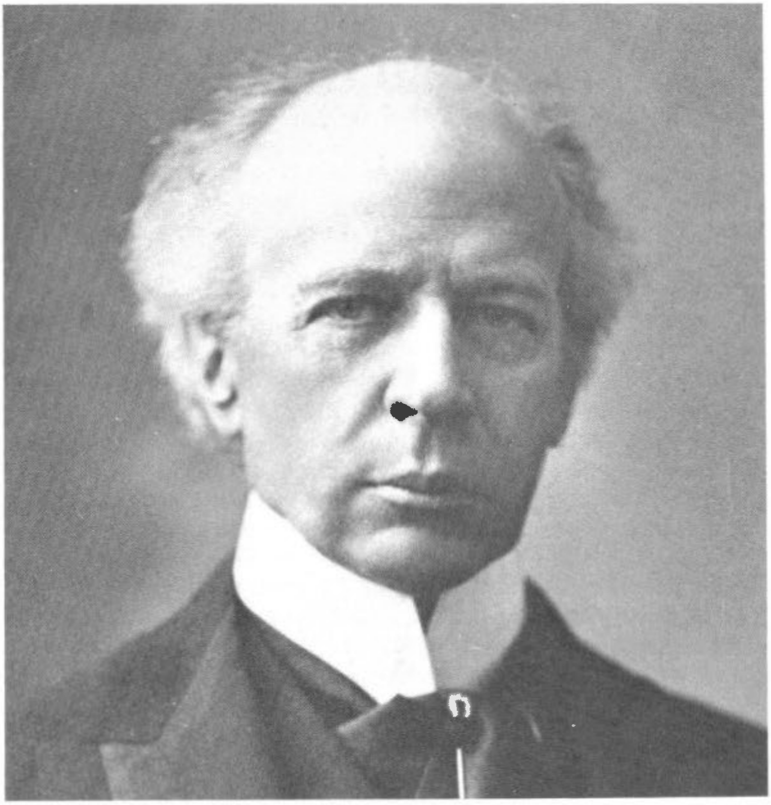


FIGURE 101
Sir Wilfrid Laurier.

National Railways (which adopted the Grand Trunk Pacific route across the prairies) one finds in Manitoba such towns, following on after Exira, as Firdale, Gregg, Harte and Ingelow. In Saskatchewan one comes upon the successive communities of Watrous, Young and Zelma. Even today, despite the introduction during intervening years of new names and the replacement of others, it is possible for a passenger to detect considerable remnants of at least four original and distinct alphabetical arrangements of station names between Winnipeg and Edmonton.

A writer of this period from 1907 to 1909 has described graphically the procedure usually followed by Grand Trunk Pacific Railway townsite surveyors and engineers:

"A party of engineers rolled along the proposed line from Winnipeg to Edmonton . . .

[When it] halted, surveying instruments were brought out to determine on the map the exact spot. 'We will put a town here', said the engineer in charge. The man who held the map put a spot on the sheet. Other men made marks on the ground and thus a town was born. There was no ceremony, no one was there to applaud, no residents came to shout. The party got into their wagons and drove on for perhaps another ten miles to assist at the birth of another town just like the first . . . The main street of the town runs down to the railway station; it is 80 feet wide and no building costing less than a thousand dollars can be erected on certain parts of it."[11]

The Rocky Mountains

At Wolf Creek near Edson, Alberta, the semi-parkland begins to yield to foothill country. More than 900 miles out of Winnipeg the western horizons suggested the nearness of the Rockies. The flat prairies lay far to the east. The carefully chosen rail route ran from Winnipeg to a crossing of the South Saskatchewan River at Saskatoon, across 416 miles of fairly open plains, and then headed for Edmonton, 331 miles to the northwest. After Wolf Creek the line passed through the Athabasca River valley and then entered Yellowhead Pass to cross the Continental Divide where Sandford Fleming's 1874 bench mark could still be seen.

When viewing Rocky Mountain scenery from comfortable, not to say luxurious, railway coaches it is not easy to visualize nor comprehend the ordeals of those whose survey work made such easygoing sightseeing possible. The cutting of trial lines to permit surveyors to use their instruments involved much scrambling over windfall, and deadfall, numerous fordings of swift mountain torrents and a great deal of sliding across massive, often very slippery rocks and boulders. Food supplies frequently became depleted and a state of semi-starvation was the common lot of railway surveyors operating in this rugged terrain. The finished task conveys the illusion that finding and preparing a way for the sleek, speeding trains of the future, was fairly obvious and relatively easy. Yet all too often for every mile of actual location, 50 or 60 miles of line had to be run. The production of 180 miles of rail route from New Hazelton to Prince Rupert meant, for example, running more than 12,000 miles of trial and preliminary surveys. Every obstacle of antagonistic nature, capable of thwarting surveyors, had to be overcome. The first 100 miles of track alongside the Skeena River represent a particularly impressive tribute to surveying and construction skills, as exercised in the heart of the Cascade Mountains. For the first 53 miles the grade is virtually level. This astonishing result was achieved in a region where hopes of introducing even one mile of level trackage were invariably crushed by the constant presence of forbidding, formidable terrain. Though costs of building this stretch of line proved high, economics produced in actual railway operations fully justified the initial engineering investment.

The presence of grizzly bears, on occasion, was an additional terrifying hazard encountered in field work in the mountains. Once during surveys along the Grand Trunk Pacific in the Rockies a surveyor and his assistant had to abandon their transit very hastily in order to escape the onslaught of an infuriated grizzly. When the animal finally retreated the two men made their cautious way back to the instrument, greatly fearing that their indispensable tool had been destroyed. To their profound relief they found the transit intact on its tripod but the waterproof cover had been torn to shreds.[12]

Three years of reconnaissance surveys through 40 passes reduced the number eligible for additional examination to four, namely, Wapiti, Pine, Peace River and Yellowhead. B. B. Kelliher, a railway-building Irishman brought to Canada by Hays, enlisted some of the finest surveyors available to scour the Rockies between the 50th and 55th parallels of latitude to discover the pass possessing the best grades. Upon the basis of their reports he boldly chose the Yellowhead. Two other Grand Trunk Pacific men whose names have become legendary in the railway-building world were C. C. "Four-tenths" Van Arsdoll* and that surveyor of outstanding competence in reconnaissance work for the Grand Trunk Pacific, R. W. Jones. Van Arsdoll acquired his unique nickname as a result of his famous ultimatum to surveyors that the grade of the final route through the Rocky Mountains was not to exceed four-tenths of one per cent.

The story of Kelliher's selection of a pass for the Grand Trunk Pacific through the Rockies is enlivened by what might be described as an exercise in military-like deception. The rival Canadian Northern Railway was thrusting westward rapidly at the same time and it was the unpublicized plan of its surveyors and builders to penetrate the mountain barrier through Yellowhead Pass. The Grand Trunk Pacific board of strategy, also loathe to make widely known its preference for the same pass, permitted press and public to speculate on whether it would choose Pine Pass or Peace River Pass. To encourage such doubts and to cheerfully mislead men of the Canadian Northern, ostentatiously large but bogus survey parties were concentrated in the more northerly passes by the Grand Trunk Pacific. All the while a small, highly competent crew of Grand Trunk Pacific surveyors unobtrusively scouted Yellowhead. As soon as their plans had reached completion, had been duly filed with the federal government, and officially approved, the company made public its decision to build by way of Yellowhead Pass.

Alaskan Boundary quarrels had hurt Port Simpson's prospects of becoming the terminal point on the Pacific of the Grand Trunk Pacific. At Sir Wilfrid Laurier's request a more defensible site, in military terms, was chosen. The townsite and harbor of Prince Rupert were so named by officers of the railway company. The name of the cousin of King Charles II of England, first governor of the Hudson's Bay Company, was selected following a prize contest open to the public and conducted through the press.[13]

Before the emergence of the Canadian National Railways as a legal entity in 1918, the Canadian Northern Railway constituted a major rail system in Canada, with lines extending both east and west. This far-flung system was the creation of two Canadians possessed of great talents, energy and vision: (Sir) William Mackenzie (1849-1923) and (Sir) Donald Mann (1853-1934). In their active careers they had for many years the able assistance of David Blythe Hanna (1858-1938). Hanna, after being president of the Canadian Northern, became first president of the Canadian National Railways.

The Canadian Northern Railway had its true beginnings in January, 1896, when Mackenzie and Mann embarked on their historic partnership by purchasing the Lake Manitoba Railway and Canal Company, with Hanna acting as superintendent of the line. Three years later that line and the Winnipeg Great Northern were absorbed into the Canadian Northern Railway. Within 16 years of this merger the Canadian Northern system controlled 10,000 miles of trackage in Canada, although the total *operated* mileage was somewhat less. Thus in the span of 20 years Mackenzie and Mann, by actual construction or by a variety of business transactions (many involving intricate financing arrangements) had developed an impressive network of local lines in the western interior and elsewhere. In 1901, for example, they entered the Ontario field and by 1909 had taken over the Central Ontario Railway. In all they came to own ten railway properties in that province and an equal number in Quebec province. British Columbia also attracted their attention and enterprise.

In those buoyant years of the first decade of the 20th century Mackenzie and Mann set greater goals for themselves. With high hopes and insufficient funds they ventured into transcontinental main line competition with the Grand Trunk Pacific. This proved to be a

*Some men named in this chapter were engineers rather than surveyors. In all probability they were civil engineers specializing in surveying activity. Laymen, witnessing their performance in the field, would naturally conclude that they were surveyors.

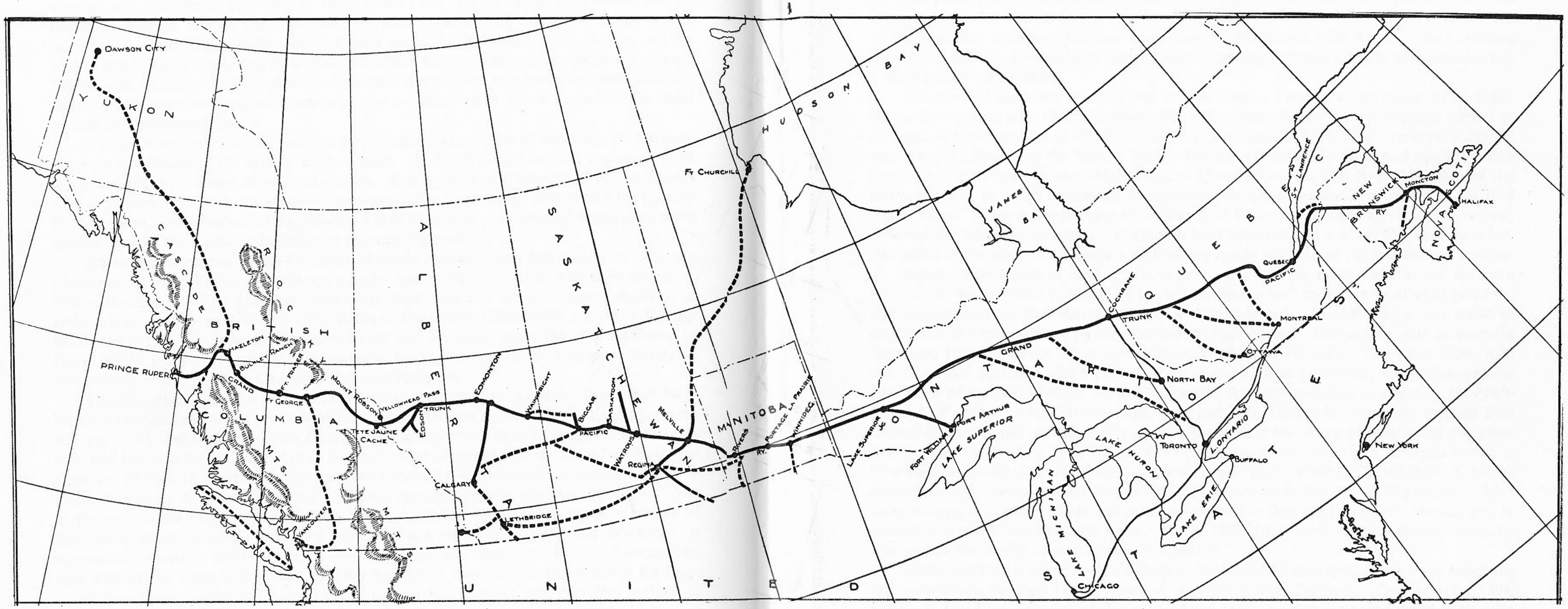


FIGURE 102. G.T.P. Railway routes.

monumental error of judgment. In earlier days the pair had promised that for every half million of new settlers entering the western interior of Canada they would build an additional 1,000 miles of railway. This pledge had been kept. But over-expansion of facilities and changing world conditions generated a sudden, swift decline in their fortunes. The outbreak of the First World War in August, 1914, dealt a crippling blow at the imposing transportation structure they had so valiantly erected. In terms of financial health the giant had all too quickly lapsed into a chronic invalid. On the conclusion of hostilities in Europe the inevitable occurred and the Canadian Northern, along with the National Transcontinental and some smaller lines, became part of the government-owned Canadian National Railways.[14]

Mackenzie and Mann, however, had made an immense contribution to the upbuilding of the western interior and in meeting the railway needs of the region in the first decade of the 20th century when population on the prairies tripled and a five-fold increase took place in occupied lands. The numerous surveys conducted under their auspices in the development of the Canadian Northern Railway must rank in significance with those of the Canadian Pacific, Grand Trunk Pacific and Intercolonial in helping to shape Canada's progress toward a more mature nationhood.

The story of surveying on local and branch lines in Canada would easily fill an entire book. For the purpose of this chapter only a few examples have been selected, almost at random, as representative of efforts in this field of endeavor. In 1878, for instance, a charter was granted authorizing the Nelson Valley Railway Company to build and operate a line from the international border (Manitoba) to Churchill on Hudson Bay. The plan of the promoters was to direct northward to tidewater the grain and cattle products of the Red River Valley. In the following year G. A. Bayne of Winnipeg, a man experienced in railway construction and who was both a Dominion land surveyor and a Manitoba land surveyor, was asked by the company to make a preliminary report advising on the feasibility of a route.

Bayne chose a plot of land at the western outlet of Playgreen Lake as the southern terminus of the proposed railway. He made a traverse as well to determine at what point the line should cross the Saskatchewan River at Grand Rapids. In 1880 Bayne was asked to make surveys northward and to start clearing the right-of-way. That season, with an assistant and some Indians, Bayne made a trial location of about 60 miles. Two years later, with 8 Indians, and equipped with a pocket compass and aneroid barometer, Bayne followed the west slope of the Nelson River watershed, looking for good crossings of streams. He established food caches about 100 miles apart. In mid-July, 1882, when the party reached Fort Churchill, they found all flags flying in their honor and the whole population of the place gathered on the landing as a salute of welcome was fired. During a fortnight's stay at Churchill, and with the aid of local Indians, Bayne made a survey of the harbor, taking soundings. His Norway House Indians declined to venture on the strange 'big waters'. After many stirring adventures Bayne and his crew returned to their starting point. He was able to present a report of considerable value. But in 1883 the Nelson Valley Railway Company was sold to the Hudson Bay Railway Company.[15]

In the Far North impressive gold finds in the Klondike area spurred action in supplying rail connections between Pacific tidewater and the Yukon Territory. Thus in May, 1898, surveyors faced the necessity of finding, without delay, a route for a line through 40 miles of forbidding mountain wilderness. Five survey parties were sent by the White Pass and Yukon Railway into the region. For weeks these surveyors were lost to sight. In the result, however, rail reconnaissance surveys were completed on both sides of the Skagway River and of the White Pass as far as Summit. The direct-line distance from seaboard to Summit was 14 miles. Making the most of the contours of the mountainsides in order to 'gain distance', that is, to obtain easier gradients at the cost of increased mileage, it was possible to build 20 miles of line. The railway was constructed from sections of each of the five routes surveyed. Acquisition of knowledge in subsequent years revealed that the route actually selected was the best that could have been chosen.

In these surveys John Hislop, with the title of Assistant Chief Engineer, was in direct charge of operations. He served under Chief Engineer Erastus Corning Hawkins. Both were Americans. Hislop seemed everywhere at once, encouraging and directing work in the field. In addition to keeping in touch with his five camps, Hislop had the responsibility of making certain that White Pass was, in fact, the logical gateway to the Yukon. The prevalence of rumors and the propaganda of native folklore suggesting that other and much better passes existed, added to his burden. In order to satisfy himself that other usable passes were purely mythical Hislop set forth on foot and covered about 50 miles of rugged terrain, including formidable swamps and snowfields before arriving at his destination utterly exhausted, his clothes in tatters and his feet, almost shoeless, torn and bleeding.

In Central Canada railways appeared in considerable numbers. Towards the end of the 19th century interest was mounting in government and private circles concerning the possibilities of opening up northern Ontario to settlement and development. Various proposals for providing transportation finally crystallized into a plan to build a line of railway directly into the north of the province from Lake Nipissing. Farming prospects in the clay belt of the region as well as possibilities for considerable lumbering activity, spurred action on this project.

In 1900 the legislature of Ontario provided funds for preliminary survey work on the proposed line. W. B. Russell was instructed to push ahead with the task. Operations were started in May of the following year. On May 10, 1902, after the Temiskaming and Northern Ontario Railway Act had passed, the first sod was turned at North Bay. Despite stretches of exceedingly difficult terrain, rail surveys and construction of the line continued at a rapid pace. In 1903, near Mile 103, silver and cobalt deposits were discovered. Within a short period the area became the immensely rich Cobalt mining field. By the end of 1904 Ontario Northern rails had reached a point just south of the present site of Englehart. Three years later the line was extended to the Cochrane area to effect a junction with the National Transcontinental Railway, thrusting westward from Quebec City. In 1911 the Porcupine gold mining area was linked by rail to the main line. In later years, up to the outbreak of the First World War, new branch lines were built or acquired to connect the main route with developing mining and pulp industries. The original route of the Ontario Northern Railway was selected by G. A. Mountain, Chief Engineer of the Canada Atlantic Railway, called in as a consultant. Initial surveys commenced under W. F. Russell of the Ontario Northern in 1901. In the following year Russell became Chief Engineer of the line.[16]

In the west the Alberta legislature of 1907 chartered the Edmonton, Dunvegan and British Columbia Railway Company to build from Edmonton to Dunvegan and thence to Fort George. After surveys had been completed, construction began in 1912 and four years later reached Spirit River, a distance from Edmonton of 357.8 miles but still some 25 miles from Dunvegan. In 1916 a branch line was extended 50 miles from Rycroft to Grande Prairie. The Alberta and Great Waterways Railway was chartered in 1909 to build from Edmonton to Fort McMurray by way of Lac la Biche. In 1913 J. D. McArthur, building the Edmonton, Dunvegan and British Columbia Railway, obtained control of the Alberta and Great Waterways property. Construction began at Carbondale, near Edmonton, in 1914 and by July, 1916, the Alberta and Great Waterways line had reached Lac la Biche. These two railways, together with two lesser lines, namely the Central Canada Railway and the Pembina Valley Railway, were all merged into the Northern Alberta Railways. Engineering records and location plans, to a large extent, were destroyed by fire. Information is therefore scanty about details of early surveying but it is known that W. R. Smith did nearly all location work and signed most of the plans of the Alberta and Great Waterways Railway and of the Central Canada Railway. He had some assistance from such Alberta land surveyors as Jean Léon Coté, A. J. Tremblay and C. C. Fairchild. Thomas Turnbull performed much of the location work for the Edmonton, Dunvegan and British Columbia Railway. Only one plan, signed by a surveyor, has been found in this regard and the sheet bears the name of the Alberta land surveyor, A. E. Farncomb.

In summary it may be said that records of reconnaissance and other surveys for the Grand Trunk Pacific Railway can be taken as typical of railway surveying generally in Canada between 1867 and the First World War. The reconnaissance type of survey was valuable in furnishing information on the topography of the country to be crossed by rail, as well as providing guidance on the main direction the line should take in order to minimize gradients, curvature, and earthwork. This initial scouting of the terrain was sometimes carried out by the chief engineer or surveyor, accompanied by several Indians who were familiar with the land. In those early times existing maps of the region to be investigated were too often unreliable or too general in character to be of much use. Accordingly the country traversed would be mapped by the surveyor to show feasible routes. In this work aneroid barometers as well as compasses were the principal instruments employed.

Preliminary surveys followed such pathfinding expeditions. These more detailed examinations served to narrow the range of route selection. A third stage, location surveys, were even more precise and these determined, with a considerable degree of finality, the course of the railway line. Surveyors and engineers would thus strive to determine the specific path that would best answer the demands of practicality and economy of construction. A location survey was never so final, however, that it could not be revised, often at the last moment in order to improve the economic balancing of grades, curvature, earthwork, bridges and culverts.

Railway surveyors had to be men of exceptional calibre, possessed of first-class physical and mental fitness, to function effectively through prolonged periods of exacting toil in the lonely primeval forestland, remote from civilization. The brooding silences of the apparently endless woods, the constant hazards attending their tasks, and the demoralizing sense of isolation tested human endurance to the utmost. Some of the ordeals encountered included the climbing of successive ridges, plunging into nameless valleys, wading through swamp and muskeg, crossing treacherous, swiftly flowing rivers, detouring around lakes and struggling over interminable deadfall. In the pitiless cold of winter and in the sweltering heat of summer, surveyors often had to hack their lines through dense undergrowth. Yet the strange elation that comes with the subjection of a formidable wilderness to the works of man, carried surveyors ever forward to ultimate triumph over all obstacles.

Survey parties, preparing the way for rail lines, usually consisted of the party chief, an assistant surveyor with transit, a leveller, a topographer and a draughtsman, accompanied by chainmen, picketmen and axemen. The topographer prepared a contour plan covering up to 500 feet on both sides of the preliminary line traced out and laid down by the remainder of the survey party. Otherwise splendid men were sometimes dropped from survey crews because they were found unsuited to running a line across wilderness country with sufficient speed. This gruelling work demanded men of good physique and possessing a congenial disposition. Acute hardships, even privations, combined with periods of highly strenuous exertions featured these surveys in the wilds, especially in the striking of camp in wintertime to move on to another place. Often the entire party had to take part in cutting a roadway of sorts through dense timber to reach their next base of operations. All baggage had to be back-packed or hauled in sleighs or toboggans built by the men themselves. On occasion there were drownings as men plunged through false or shell ice on lakes and rivers. Desertions of canoemen and of packers were not uncommon in summer. Clouds of black flies and mosquitoes made life miserable in warm weather.

The task of supplying survey parties scattered across more than 1,800 miles between Edmonton and Winnipeg required great resolution and remarkable organization. Hugh Lumsden is the man commonly credited with the planning and maintenance of these all-important supply services. By directing the cutting of roads into timbered areas where no previous paths existed, Lumsden was able to establish food reserve depots at strategic points. Each depot was placed in charge of a keeper and his assistant. Secondary depots were also provided, usually at eight- or ten-mile intervals along the lines of communication. From these auxiliary food caches, containing as a rule upwards of five tons of provisions, survey parties replenished their supplies in the field.

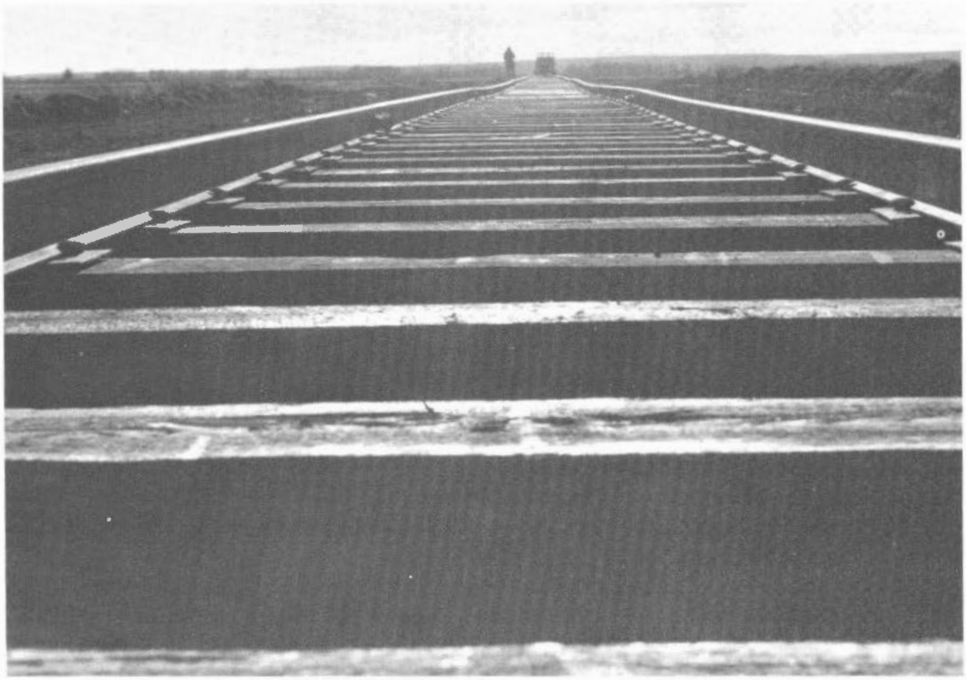
Food in the subsidiary depots consisted, for the most part, of staples such as pork and beans, oatmeal, flour and bacon. Supplementing this rather austere, if nourishing, diet were such delicacies as prunes, apricots, sugar, condensed milk, tea, coffee, butter, and lime juice. Variety, or the illusion of variety, in this stringent fare depended upon the skill and ingenuity of the cook of the party. These shipped-in foodstuffs were also increased and varied by such fresh meat as could be obtained by catching fish and hunting wild fowl and game.

Food caches were constantly in danger of raids by bears and by other wild animals. Nor were these supplies ever free from the much dreaded menace in timber country, the forest fire. On one occasion, near Lake Abitibi, flames threatened destruction of a main food depot. The keeper and his assistant fought valiantly for two days and nights in a grim effort to save their precious stores. Just as these appeared to be doomed a transport party arrived on the scene. Quickly summoning his men from the field the chief of district surveys directed his tiny force in a successful fight to save the provisions. More than once in their field operations railway surveyors found themselves directly in the path of a swiftly advancing, roaring inferno. There were numerous narrow escapes from fiery death.

There was no interruption of survey work because of winter. Often surveyors and their assistants waded hipdeep in uncrusted snow in extremely low temperatures, doing what they could to fend off frostbite and snow-blindness. Surveying between Lakes Abitibi, Nipigon and Winnipeg proved particularly trying under such circumstances. Medical doctors, allotted to the various survey districts, toured among the parties, helping to maintain their physical fitness. Scurvy, frostbite and appendicitis attacks were the most common emergencies requiring skilled attention.

As location surveys continued, the selection of a possible route for the rail line proceeded and a profile of the country being crossed was drawn in the field precisely to scale. Full information on the topography was noted on maps so that a reasonable estimate of construction costs could be made by experts. Surveyors also were required to report on the economic value of the country in which they were working, giving their judgment as to its future capacity to contribute revenue to railway operation. In later years and in more settled parts of the country, location surveys were followed by right-of-way surveys by means of which properties required by the railway for its operations were concisely defined. In turn these surveys were followed by construction surveys, marking out the particular strip of ground on which tracks were to be laid and setting stakes to control earthwork activities. The track centreline was pegged out by stakes placed 100 feet apart in a line along the centre of the cleared path. A fast-travelling revision party always worked a few miles ahead of construction in hopes that at the very last moment an improved location for the line could be found.

The appearance of railways in Canada brought about profound economic changes in this nation and made possible the rapid settlement and development of the western provinces in the period between Confederation and the First World War. Railways helped to open up mineral-rich areas in northern Quebec and northern Ontario. Railway-building accomplishments inspired a new approach in the realm of public finance and provided the foundation of a new industrial era. Steam power replaced water power in mills producing Canadian lumber and flour. Rail routes heralded the growth of manufacturing enterprise in British North America and signalled the beginnings of a tariff system designed to protect Canadian industries. By multiplying business and social contacts between peoples of the provinces the railways served to increase mutual understanding and joint action. In this way a spirit of constructive nationalism was encouraged and given new scope. But without the achievements of railway surveyors the pace of progress in all these important developments would have been much slower and much less significant. The value of the mass of information gathered and reported by them is beyond calculation. In the years following Confederation Canadians owed to these well-trained observers and measurers the greater part of the sound, reliable knowledge of natural resources that proved indispensable to the prosperity and general advancement of the new nation.



14

MILITARY SURVEYING AND MAPPING IN CANADA 1867-1918

"If you look in the maps . . ."
King Henry V, Act 4, Sc. 7

For nearly a generation following Confederation military surveying and mapping in Canada languished. The Royal Engineers, in earlier years of the 19th century, had produced a few useful but unrelated, large-scale topographic maps of localities in the vicinity of garrison towns in this country. Kingston, one of the fortified places, is described in the diary of a Canadian army officer, as the town appeared to him in 1813:

"Kingston is divided in two portions by a central square, used as a parade ground by the troops. There is also a market building and, opposite it, the Anglican Church, both are of wood. To the right of the square, the Court House and hotel, both of stone and two stories high. The latter is an excellent house in every respect, but the former is built in bad taste. The town of Kingston is the capital of the Midland District. The houses are built mostly of wood."[1]

When garrison forces were withdrawn to Great Britain activity in military surveys in this country dwindled. Between 1894 and 1902 the only noteworthy topographic mapping accomplished in Canada along military lines was carried out by cadets of Royal Military College, Kingston. On June 1, 1876, the college was formally opened by Prime Minister Alexander Mackenzie who, as stonemason in charge, had helped to build the Martello Tower at Fort Frederick in the 1840s. This was one of the units in a system of fortifications constructed to protect the lake entrance of the Rideau Canal.

Eighteen freshman cadets attended the opening ceremonies. Following graduation this historic Class of 1880 became affectionately and respectfully known as the "Old Eighteen". Textbooks of the cadets in those days included Robert's *Military Surveying*, Deville's *Examples of Astronomical and Geodetic Calculations* and Gillespie's *Land Surveying*. In 1882 a course entitled "Surveying: Military Topography and Reconnaissance" was listed as a major subject on the college curriculum. This course included a study of the principles and uses of the plane table and of levelling procedures.

A distinguished member of the college staff in the 1890s was Capt. Arthur Hamilton Lee

(1868-1947) who later became Lord Lee of Fareham and a First Lord of the Admiralty. From 1893 to 1898 he was Professor of Strategy and Tactics with the rank of captain. Robert Carr Harris was the first civilian professor to lecture at the college in civil engineering and architecture. After 18 years on the staff of Royal Military College he left to become the first Professor of Engineering at Queen's University. Capt. C. Russell Brown, R.E., was also a Professor of Surveying at Royal Military College before the turn of the century. His daughter 'Anna Russell' achieved international fame on the concert stage as a gifted comedienne.

The years from 1894 to 1902, in terms of Canadian military surveying and mapping, are generally known as the Reconnaissance Survey period. Much of this type of map making in those years was performed by Royal Military College senior cadets as part of their regular summer training. In this way military survey work in Canada was kept alive during that span of time. There is record of a map of part of the Eastern Townships "executed by Graduates of Royal Military College under the superintendence of Captain A. H. Lee, Instructor in Topography, 1894".[2]

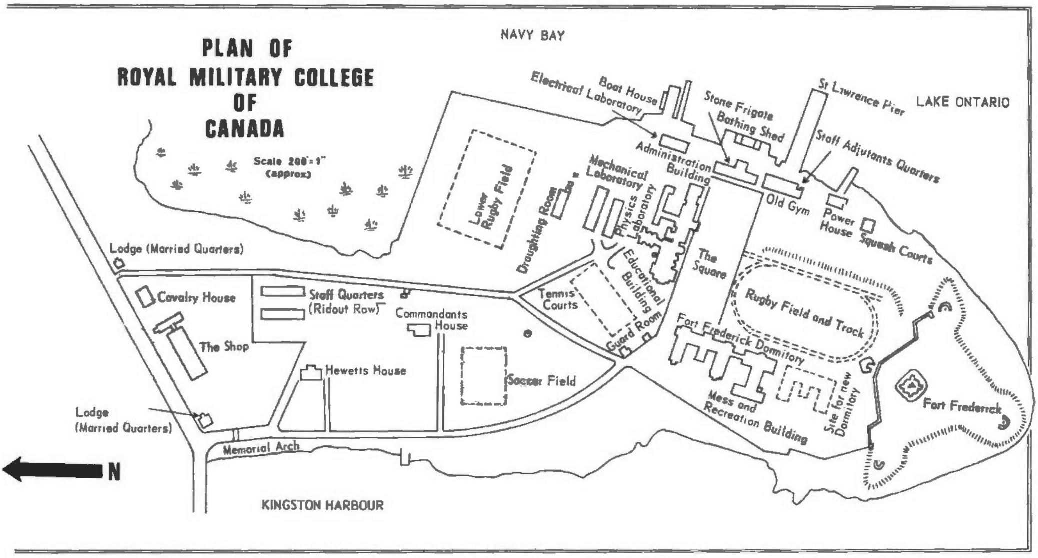


FIGURE 104. Plan of Royal Military College, Kingston, Ontario.

These none-too-accurate, uncontoured maps resulted from exercises in rapid sketching in the field rather than from any professional skill. In any event, in the absence of any system of primary control, the production of military maps in this country of a high standard of accuracy was quite impossible. The college Commandant reported, with reference to the year 1899, that a reconnaissance survey had been completed that summer near Toronto and London and that about "850 square miles were added to the work already done". In 1901 the cadet summer party surveyed and mapped in the vicinity of Magog, Quebec, and in the following season similar work was resumed in western Ontario. Two officers of the permanent militia of Canada accompanied the cadets on some of these projects.

In 1903 the General Officer Commanding Canadian Militia, Major General Lord Dundonald, recommended that an Intelligence Department be created within Militia and Defence, to consist of an Information Branch and a Mapping Branch. On July 1 the organization came into existence.[3] Under the command of Lieut.-Colonel W. A. C. Denny, as Director General, the original staff of the Department consisted of three captains, two non-commissioned officers from the Royal Engineers and a staff sergeant from the Canadian permanent force. Two of the three captains were graduates of Royal Military College, namely, A. Clyde Caldwell and William Beaumont Anderson (later Major General Anderson). It was Anderson's special responsibility to improve Canadian military maps. The duties of the new organization included surveying, draughting, map production, correction of published maps and the preparation of skeleton maps for use in field work.

In a well-organized, comprehensive report dated December 30, 1903, Major E. H. Hills, C.M.G. of the Royal Engineers and head of the Topographical Section of the British War Office, and published by the latter, emphasized the need and importance of geodetic surveys in Canada. Major Hills had been instructed to report to Sir Percy Lake, Chief of the General Staff of Canada, on the desirability of a military survey of Canada. The major, however, approached his task on a much broader basis, apparently on the assumption that resulting maps ought to be of value for all purposes. His report fell mainly into three sections. In the first, the value of good maps to a nation was described; second, existing survey work in Canada was summarized and judged inefficient and costly; third, the course which a systematic survey of Canada should follow was outlined. Generally, Major Hills recommended a topographical survey of Canada, stating that it was urgently required for military, administrative and engineering purposes. He advocated the establishment of a survey department to cost $75,000 annually and which would complete the mapping of 7,500 square miles of land on a scale of one-half inch to the mile. Such a map of all Canada would, the major pointed out, meet all reasonable military requirements. In war, he stated, accurate maps are a vital necessity to convey information on the nature of the country, means of communication, water supplies, natural resources generally, and for planning general strategy.

Militia headquarters, in the years prior to the establishment of the Intelligence Department, adopted, in the main, the policies followed by the British Army in Canada—certain relatively limited areas would be surveyed by competent engineer officers and other areas were made the subject of field sketching. At first mapping was done on sketch boards with the aid of prismatic compasses. Control, such as it was, came from township plans, railway surveys and the shorelines of marine charts. Before long, however, systematic horizontal and vertical control work commenced. Mapping began on a scale of one mile to the inch, with contour intervals of 25 feet. In the report of the Militia Council for 1905 it is noted that "transit and level parties have run 1,100 and 1,300 miles of line respectively" and that "the topographers have completed 1,775 square miles of accurate survey . . .". H. C. Cranston was taken on staff in July, 1905, and during the formative years of this survey organization was its only draughtsman. He had served with a topographic unit in the Boxer Rebellion in China and was familiar with field draughting and mule-pack printing-press techniques.

M. F. Phelan joined the Mapping Branch as a transitman in September, 1905. In the following year he assumed charge of horizontal control. Phelan has described conditions of his acceptance by Capt. Anderson, who assured him that "employment would last through the winter unless higher authority intervened. The party would consist in all of five men, running transit lines through parts of Quebec and Ontario. Accommodation at hotels, farmhouses, anywhere, would be the party's responsibility; each person paying his own expenses out of his salary . . . $110 a month for the chief, $75 for each of the other four. Costs of railway transportation and limited livery would be met by the government."[4] Under this arrangement Phelan began a term of service of nearly 38 years on army surveys.

In the 1904 season field parties were sent to the Niagara Peninsula on transit traverses for horizontal control, spirit levelling for vertical control. Results of this work were compiled on one general map from which sheets of Niagara, Welland, Grimsby and adjoining areas were produced. In September of the following year work commenced on a transit and chain

FIGURE 105. Capt. W. B. Anderson.

FIGURE 106. M. F. Phelan.

FIGURE 107. Capt. T. V. Anderson.

traverse line from Ottawa to Montreal. Near the end of December, 1905, the survey line was completed to the McGill University Observatory. For the remainder of the winter this survey party worked between Montreal and Kingston.

Phelan's comments at this stage of development in the unit's growth are interesting:

"Niagara was the first map sheet to appear . . . It was soon followed by the Ottawa sheet. The chief, W. B. [Anderson], was very pleased to see these first fruits of his labours, detailed contoured maps, the first of their kind in Canada, emanating from a systematic survey that had reasonable hope for continuance and growth. The maps were artistic and well printed. The roads, with features beside them, were quite accurately placed. Any considerable distances from the roads, especially in wooded, rough country, the contouring, etc., was frequently faulty. After the fixing of geodetic points by the Geodetic Survey of Canada at a later date, it was sometimes slightly embarrassing to find that a plotted point was on the side of a hill rather than at its top. The vagaries of water courses beyond open country could not be relied on, but on the whole there was little adverse criticism by those who had occasion to use the sheets."[5]

Sir Percy Lake, as first Chief of the General Staff of Canada, was quick to recognize the vital importance to national defence of accurate, properly contoured maps. In November, 1905, he urged upon the Militia Council adoption of an arrangement with the British War Office whereby up to six Royal Engineers, trained in topography, would be loaned to the Department of Militia and Defence during summer seasons in order to assist with Canadian military surveying and mapping. On November 30, 1905, the Militia Council approved the proposal and the loan program went into effect in the season of 1906. In the same year the Mapping Branch became the Survey Division and continued to function under the Chief of the General Staff. Capt. W. B. Anderson was appointed Assistant Director of the new division and this title persisted for the next quarter-century. Nearly half a century later the term 'Director' was adopted to denote the head of this survey organization.

In the field season of 1906 military survey parties worked in western Ontario and from there went to the Petawawa area where land had been acquired for army training. There they joined several topographers working under Lieut. S. H. Osler, engaged in gathering mapping information on the locality. Within the five-year period following his appointment Capt. Anderson organized and provided, on a methodical basis, a framework of traverses and instrumental levels on which was based detailed mapping of approximately 10,000 square miles. In these tasks he had the assistance of Lieuts. G. B. Wright, S. H. Osler, L. G. Van Tuyl and R. W. Stephenson, all graduates of Royal Military College.

During the 8-year period when non-commissioned officers and men of the Corps of Royal Engineers were on loan to Canada, more than 20,000 square miles in the more settled, central part of this country were completely surveyed. A total of 66 sheets of mapping, much of it on the scale of a mile to the inch, was compiled. Half of these sheets had been published by 1913. The Royal Engineers, along with Canadian soldiers and civil servants, worked mainly in the Eastern Townships and in western Ontario. Some work was performed as well in the vicinity of Montreal, Toronto, Ottawa and Kingston, also between Hamilton and Detroit, including the Niagara district.[6] The Royal Engineers at all times observed high standards of craftsmanship in mapping activities. Their work was meticulously done in the British military tradition and was of a type seldom seen in Canada up to that time. The deliberate pace at which they worked would have produced serious delays had they been employed on land settlement surveys in the western interior. Such surveys had to be performed with the greatest possible accuracy consistent with utmost speed. Too often, to be true, the former suffered for the sake of the latter. The accomplishments of the Royal Engineers personnel on loan to Canada from 1906 to 1914 helped to bring about a fundamental change in topographic mapping in this country by emphasizing quality of craftsmanship rather than quantity of output.

In 1908 Capt. G. B. Wright succeeded Capt. W. B. Anderson and two years later Wright was followed, in turn, by a brother of the first Assistant Director. Capt. T. V. Anderson (later Major General Anderson and Chief of General Staff) remained in that capacity until the outbreak of the First World War. Soon after his appointment to head the Survey Division, Capt. T. V. Anderson moved to add a lithographic section to its existing facilities. His goal was reached in 1913 with the establishment in Ottawa of a complete photo-mechanical and lithographic section. Accordingly there was no longer any need to forward manuscript maps to the Ordnance Survey in England for reproduction.[7] During a period when government funds for such a purpose were exceedingly scarce, this important expansion of services represented an administrative achievement of some magnitude. In addition to finding money for the purchase of necessary equipment it was also essential to get permission to obtain from England four well-qualified operators for the new plant, men who would become permanent officials in the civil service of Canada. The success of this undertaking was all the more remarkable in that there was, about this time, a gradual trend away from the practice of borrowing Royal Engineers to help in the prosecution of Canadian military surveys. In fact, by 1914, the arrangement had largely lapsed.

With the establishment of the Survey Division on a sound footing its duties became more clear-cut and may be summarized as follows:

1. The preparation of contoured maps on a scale of one mile to the inch.
2. The training of members of the Royal Canadian Engineers in topographic mapping and draughting work and lithography. It was intended that these trained men would act also as instructors in these subjects with other units of the permanent and reserve forces.
3. The preparation of large-scale maps for troop manoeuvres and for the guidance of artillery units and the defence of Canada generally.
4. The provision of special intelligence maps of specified areas.

On November 15, 1913, the Survey Division was rather arbitrarily transferred to the Master General of the Ordnance. After a nine-year period "in exile" the division was restored to its former place under the Chief of the General Staff. Capt. T. V. Anderson was succeeded by Capt. Philip de L. D. Passy, who served as Assistant Director from 1914 to 1916. His successor in office was Major J. B. Cochrane who assumed the duties, if not the title, of Assistant Director, continuing to function as head of the survey organization until March, 1929.

During the years from its inception to the outbreak of the First World War and, in fact, for a number of years following, the Survey Division remained financially undernourished. But it was becoming increasingly clear to civilian authorities that any country that failed to provide its armed services with good maps and charts deprived them of vitally important information.

After the declaration of war in 1914 the Survey Division was called upon to prepare large-scale plans for defence purposes on the Atlantic and Pacific coasts, the fixing of gun positions and related assignments.[8] Although survey units, as such, did not form part of any Canadian expeditionary force until the closing stages of the conflict, surveying naturally entered into activities of the Corps of Canadian Railway Troops serving overseas. This Corps, numbering nearly 16,000 by 1918, constructed and maintained railway lines of all gauges and was responsible for the bulk of light railway construction behind all five British armies in France.

Lieut. James H. McKnight, a Dominion land surveyor who enlisted in the Railway Troops, reported on survey work involved in the Somme offensive in 1916:

"It was found that for satisfactory work a survey had to be made and levels taken. Conditions under which this work was done were at times more trying than any previous survey I was ever on . . . The work was plotted and maps printed showing the location of all [railway] lines, with other information. The work naturally fell to the lot of the Dominion land surveyor together with supervising of grading."[9]

In the concluding months of the First World War a relatively minor occurrence within the Canadian army organization had a significant bearing on the future growth of Canadian military surveys. On May 14, 1918, formation of the Canadian Corps Survey Section was authorized. Capt. W. R. Flewin, C.E., was placed in command. The Section worked closely with the 1st and 5th Field Survey Battalions of the Royal Engineers and its duties consisted mainly of flash-spotting and accurate fixing of enemy battery positions. In addition a field triangulation party located Canadian guns and reference points in their vicinity as well as producing artillery maps, on stable bases and with azimuth arcs, for map firing purposes. A headquarters unit of the Section prepared special operation maps, barrage sheets and related cartography for reproduction prior to offensive operations. During the concluding phases of the war in France in 1918 the Survey Section also supplied large photographic mosaics, complete with map grids, for use in Canadian attacks at Amiens, Arras, Canal du Nord, Cambrai, Valenciennes, and in the advance on Mons. These activities laid the foundation for the development in subsequent years of Canadian artillery survey units.

By 1914 there were several agencies of the federal government producing topographic maps, including the Survey Division of the army. Each of these organizations selected a type of mapping considered the best for its particular purposes. Agreement did not exist on the mode of projection, the range and type of scales, or the patterns of grid or sheet lines to be used. There was a special lack of uniformity of practice concerning the mode of map projection. The problem of representing a sphere upon a plane surface does not lend itself to a complete or perfect solution. Man has attempted solutions by practising the art of projection in relation to map and chart construction. The classes of map projections thus developed are not mutually exclusive. Nevertheless certain class names, for convenience, are used in practice. Each principal attempt at a workable projection has some particular merit.[10] At least three types of projection were being employed in Canadian mapping, at the time, for large- and medium-scale cartography, namely Lambert's Conical Orthomorphic, the Transverse Mercator, and the Polyconic.

Soon after the First World War began it became obvious that maps at the disposal of Allied armies were defective from the military point of view. Lack of accuracy, difficulties in fitting separate sheets together properly, and a lack of precise grids for artillery purposes were some of the cartographic shortcomings. A general revision of maps commenced during progress of the fighting. Certain principles of map making were considered fundamental to the work of revision. These same principles were to prove of basic importance to the success of an organized system of national mapping in Canada, namely, applications of the most suitable map projection, scales and grid patterns. In addition to the need for proper selection and unification in these fields, greater attention would need to be given to the best possible use of colors and the representation of relief.

Experiences of Canadian soldiers in close contact with European mapping practices and products, proved salutary. On their return to this country they advocated a new approach to Canadian mapping problems. One of the army officers who gave leadership in this movement was Major Douglas H. Nelles, whose pre-war geodetic survey work in the Yukon Territory has been mentioned. Nelles strongly pressed for standardization of maps of Canada.[11] There was a steadily growing realization of the need for a National Topographic System of maps of Canada.

In 1922, following the formation of the Board of Topographical Surveys and Maps under terms of Order in Council P.C. 540, dated March 8, the board chairman, Deville, travelled to Europe to discuss Canadian map-making policies with British and French authorities. The British War Office, in the previous year, had been asked by Ottawa to advise upon a suitable mode of projection for Canadian military mapping. The War Office had recommended the same projection as that agreed upon by the Allies in the course of the First World War, namely, Lambert's Conical Orthomorphic. Deville, keeping in view the need for a projection usable in a National Topographic System, was not impressed by the British recommendation as it involved a departure of grid lines at the east and west limits of the country as a whole of about 27 degrees away from north. The magnitude of this departure, Deville felt, was unacceptable for general use in Canada. As a result of his discussions and in the wake of much thought on the subject Deville conceived the idea of dividing the map of Canada into lunes*, using the Transverse Mercator, also known as the Gauss Conformal projection. By restricting the lunes to 6 or 8 degrees in width, the grid lines did not, in any case, depart from the true north by more than a few degrees. Canada, after considerable experimentation and following a number of false starts on projection policy, finally settled on the 6-degree-lune Transverse Mercator projection for its topographical maps.

As early as 1899 the use of cameras in balloon surveying for military purposes had been the subject of serious consideration by Surveyor General Deville. His comments, contained in the concluding pages of his book, ***Photographic Surveying***, may have been inspired, in part, by pioneer experiments carried out sixteen years previously in Nova Scotia by a British army officer. In 1883 Capt. Henry Elsdale, R.E., delved into the realm of aerial photography by sending aloft small balloons carrying automatic cameras. In this manner he obtained photographs of barracks in the vicinity of Citadel Hill, Halifax, from an altitude of 4,500 feet. On top of his primitive camera six photographic plates had been placed, resting on one another with the prepared surfaces facing downward. A clockwork mechanism was tripped by the operator on the ground.[12]

"The great difficulty in balloon surveying", Deville pointed out, "will be to determine the trace of the vertical of the station on the picture plane, or the foot of the station on the ground plan . . . The oscillations of the balloon prevent the use of any kind of level inside

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*Parts of a plane or spherical surface bounded by two arcs intersecting at the poles.

of the camera and instrumental measurements of angles are open to the same objection . . . Balloon surveying would only be adapted to military purposes, although the advocates of the process are confident that it will eventually take the place of all other surveying methods."

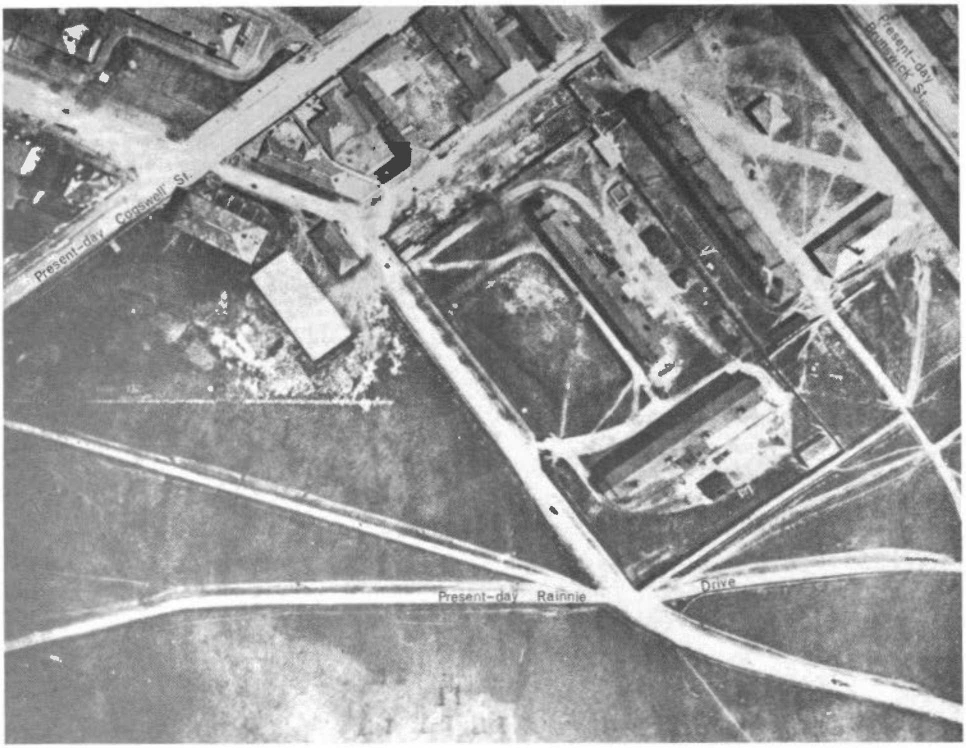

FIGURE 108. Earliest recorded air photograph in Canada, from balloon at Halifax, 1883.

A constructive development of revolutionary significance for civilian surveying and mapping in Canada resulted from the ingenious use of cameras mounted on scouting planes during the First World War. The first practical application of air photography to mapping in Canada began in 1918. Four important factors combined to make this possible: the availability of improved cameras, suitable planes, trained men and an organization capable of providing support for air-mapping projects. A number of planes were turned over by the Canadian government for these experimental peacetime uses. Experienced flying officers, fresh from triumphs overseas, formed the nucleus of the new service. Among these pilots were enthusiastic young surveyors, quite eager to face the personal risks involved in order to have an active share in a trail-breaking venture and to help advance knowledge of Canada's less accessible areas. An Air Board, first formed in June, 1919, was reconstituted a year later. Several of its members, including Surveyor General Deville, were keenly interested in the unfolding possibilities of mapping from the air and the Board gave its full backing to this promising enterprise.

The history of surveying and mapping, during the period reviewed in this chapter, would be incomplete without reference in some detail to notable work performed in these fields by graduates of Canada's Royal Military College. At least five members of the "Old Eighteen" became prominent in railway engineering in this country, including related survey work.

FIGURE 109. Royal Military College from the air.

Lieut.-Colonel Duncan MacPherson (1858- ?) and Richard C. Laurie were active for years on Canadian Pacific Railway surveys; Alexander Bell Ross was with the British Yukon Railway; George E. Perley served with the Intercolonial Railway. Lieut.-Colonel W. M. Davis (1857-1918), who began his professional career by participating in land surveys in northwestern Canada, was City Engineer at Prince Rupert from 1910 to 1913. Another member of the class was Major John Bray Cochrane who, after serving for many years as Professor of Surveying and Science at Royal Military College, became head of the Survey Division of the Canadian Army. During Cochrane's career on the college staff a number of cadets, who later became famous in the services or professions of Canada, learned military surveying and mapping from him.

From the ranks of subsequent classes of cadets, graduating prior to the turn of the century, came such eminent civil engineers as Col. (Sir) Percy Girouard (1867-1932), Col. H. J. Lamb, Brig.-General Francis D. Lafferty (1877-1919), Col. Reuben W. Leonard (1859-1930), and Major H. Grahame Starr (? -1925). All of these men, at one time or another, were active in surveying for the Canadian Pacific Railway.

The college also trained men who later achieved distinction in marine surveying. William James Stewart, the first Chief Hydrographic Surveyor of Canada, was succeeded in that position by a fellow-graduate, Frederick Anderson. Another graduate, Donald Colin Campbell, was associated for a time with the Georgian Bay Survey. Major Horace Heatherington Lawson was engaged on hydrographic surveys from the time of his graduation until 1914. From 1917 to 1942 he was Professor of Civil Engineering and Astronomy at Royal Military College.

James White, Chief Geographer, Department of the Interior, during the first decade of the 20th century, graduated from Royal Military College in 1883.

Lieut.-Colonel Ernest Wilson Hubbell (1862-1943), a graduate in 1887, became Chief Inspector of Surveys, Department of the Interior. Major-General W. B. Anderson of Class '97 early in his military career, as has been noted, was appointed first head of the Survey Division of the Canadian Army in 1906. Frederic Hatheway Peters, a graduate in 1904, was named Surveyor General of Canada (Dominion Lands) in 1924 and served in that office until 1948. Lieut.-Colonel LeRoy Fraser (Leary) Grant surveyed at Prince Rupert for the

Grand Trunk Pacific Railway from 1907 to 1909. From then until the outbreak of the First World War he performed land and irrigation surveys in the west coast province for the government of British Columbia.

The Royal Military College cadet who was awarded the Governor General's Gold Medal in 1910 when he graduated, became Sir Edward Oliver Wheeler (1890-1962). He was knighted in 1943 after he had been appointed Surveyor General of India. Lieut.-Colonel Frederick Fraser Hunter of Class '98 became Assistant Director of Surveys of Mesopotamia, following the First World War. In 1925 he was appointed Director of Surveys and Map Publication in the Survey of India and is reputed to have been the first such official to make use of aeroplanes for mapping the more rugged parts of that country.[13] Lieut.-Colonel Eedson Louis Millard Burns (1897-   ), Class of 1915, was appointed head of the then newly-formed Geographical Section, General Staff, in 1925. This placed him in charge of all military survey work in Canada.[14] This Section replaced the Survey Division, also officially known as the Topographical Survey Section. Burns developed air-photo survey methods widely used in the Second World War. He became an authority in photogrammetry and, as Lieut.-General Burns, served as Canada's delegate to international disarmament talks at Geneva. He was succeeded as head of the Geographical Section, General Staff, by Major J. E. Lyon who had also attended Royal Military College.

Canadian achievements in surveying and mapping generally are the more impressive because so many of them bear the indelible stamp of men who gained their early training at Royal Military College in Kingston.

15

EARLY ASTRONOMY IN CANADA: SURVEYING AND MAPPING THE HEAVENS

"A sun and moon, which kept their course, and lighted . . . the earth"
Anthony and Cleopatra, Act 5, Sc. 2

The first astronomical instruments to reach Canada, suitable for systematic use in observatories, arrived in Toronto in 1839. This equipment came from a dismantled British observatory on the island of St. Helena in the South Atlantic and was intended for Canadian use in what was, in its first years, essentially a magnetic observatory. Apparently up to the mid-1830s there were no observatories in the Western Hemisphere. This lack was a cause of deep concern to the British Admiralty which relied on such facilities for accurate determination of time and for the fixing of geographical positions. The Toronto observatory did not, however, acquire a telescope until 1881.

A former Dominion Astronomer, Dr. C. S. Beals, on examining an early photograph of the Toronto institution, found that the building did not include a dome in which substantial astronomical instruments could have been mounted. The structure did contain a small extension where a surveyor's theodolite was installed, presumably to help provide azimuths in connection with measurements of magnetic declination.

In 1850 Lieut. Ashe was appointed Astronomer at Quebec and construction of a tiny observatory was completed there in 1854. Citizens of Kingston were inspired by the occurrence of a solar eclipse, in that same year, to purchase a telescope and astronomical observations began in that Ontario community in 1857. But what is more or less officially described as the first astronomical observatory to be built in Canada was completed at a cost of £170 9s. 7d. in Fredericton, New Brunswick, in 1851. This wooden structure was surmounted by an eight-sided dome and pyramidal roof which together helped to make its appearance unique. The building had two wings, each 12 feet square. The telescope it housed cost several times more than the building.

The establishment of these pioneer facilities on the campus of King's College, later the University of New Brunswick, is mainly credited to the initiative and vision of two men, Sir Edmund Walker Head (1805-68) and the Scottish-born Dr. William Brydone Jack (1819-86), professor of mathematics, philosophy and astronomy at this New Brunswick college.

Dr. Jack, it should be noted, was as much at home in practical surveying work as in the observatory or in a lecture hall. Sir Edmund, who served as Lieutenant-Governor of New Brunswick from 1848 to 1854, was Governor-in-Chief of Canada, 1854 to 1861. He was instrumental in bringing about the introduction at the college of a course in engineering, reputed to be the first university course of its kind in Canada. Sir Edmund Head inaugurated as well the practice of responsible government in New Brunswick and was one of the first to advocate a practical plan for union of the provinces, thus foreshadowing the achievement of Confederation. It was his keen interest in the struggling institution and its possibilities that saved the college from extinction in the 1850s. Sir Edmund strongly recommended to the college council that lectures be provided not only in classical learning but in courses of a more practical nature as well. In December, 1853, King's College advertised a course in Civil Engineering to embrace " . . . methods of Surveying with the Theodolite, Circumferenter, etc . . . Method for determining best route for Railway . . . Railway curves and side widths; Calculation of gradients . . . ".*

Dr. Jack, a tall, strong, vigorous man, took a special interest in the observatory project from the start and equipped it with the best astronomical instruments available in that period. Undoubtedly general interest quickened in this undertaking following installation of a telescope in May, 1849. In collaboration with an observatory at Harvard University, Boston, operated by Professor Bond, accurate determinations of the longitude of Fredericton, Saint

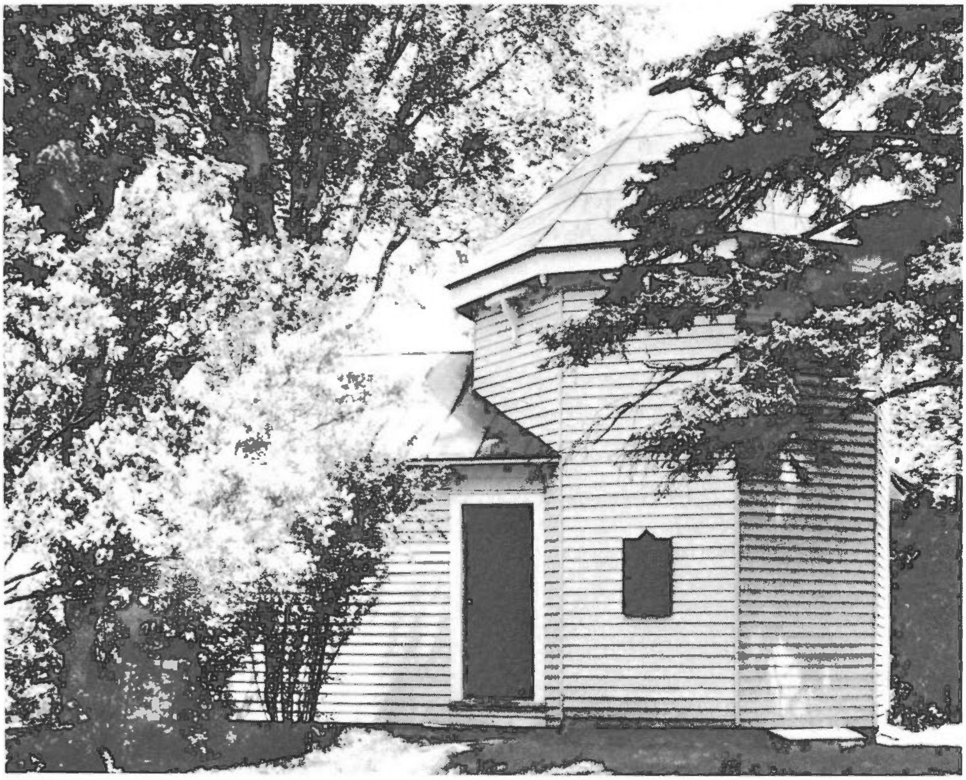

FIGURE 110. Brydone Jack Observatory on the campus of the University of New Brunswick.

*J. E. Kennedy, R.A.S.C. Journal, V. 49, nos. 4 and 5, 1955.

John, Grand Falls and Edmunston were made. For these purposes use was made of the newly-invented electric telegraph. All this surveying activity occurred in the 1850s.

In 1859 King's College became the University of New Brunswick and in the university calendar for 1864-65 is found a description of this pioneer observatory and of its contents:

"In the Observatory there is a large Achromatic Telescope of 6 inches clear aperture and 7½ feet focal length, by the celebrated makers Merz & Son of Munich. It is equatorially mounted, and provided with clock-work motion, and a delicate and beautifully constructed Wire Micrometer for measuring the relative positions of double and multiple stars . . . It is sufficiently powerful to exhibit all the principal objects of interest in the heavens and for size and efficiency is unequalled by any Telescope in British North America. In the Transit-room of the Observatory there are two very superior sidereal Chronometers and a thirty-inch Transit Instrument by Troughton and Simm, of London. The other Astronomical and Geodetical Instruments by the same makers are, a fine Altitude and Azimuth Instrument, with four Micrometer Microscopes, a large Theodolite with two Telescopes; a Gravatt's Level with Levelling Staves, and an eight-inch Sextant with artificial horizons and Stand. The University is probably far better provided with Optical Instruments than any Institution of the kind in the British Provinces."

The transit of Venus in 1882 undoubtedly stimulated a considerable amount of interest in this country but the solid growth of astronomy in Canada owes its origin chiefly to problems associated with the surveying of large areas within our far-flung borders. A substantial debt of gratitude is owed also in this field of effort to trailblazers such as Sir Edmund Head and Dr. Jack. Their foresight and bold action, despite formidable obstructive and discouraging forces, made it possible for Canadians in later years to meet in praiseworthy fashion a great challenge.

Canada was fortunate, at the beginning of the 20th century, in having the services of four exceptionally gifted men who were deeply interested in the field of astronomy. William Frederick King, Otto Julius Klotz, Robert Meldrum Stewart and John Stanley Plaskett, were especially gifted and well-trained in physics and mathematics, and became scientists of outstanding character and merit. Their persistent efforts, combined with the drive and foresight of Hon. Clifford Sifton, Minister of the Interior, had, by the end of the First World War, brought about in this country remarkable progress in the tasks of surveying and mapping the heavens.

At the time of Confederation astronomers generally had only limited concepts of the dimensions and form of the universe. Less than thirty years previously man had made his first accurate measurement of the distance of a star, other than the sun, from the solar system. Nor at that time had any reliable method of determining the radial motions of stars been devised. Nevertheless significant forces were at work in the scientific world, developments promising to change the entire approach to astronomy. In the closing years of the 19th century the attention of astronomers was being diverted from the solar system to studies of the sidereal system, a trend spurred by the prospect of achieving measurements of the positions and apparent motions of the stars. As a result of advances made in the period between 1867 and 1916 concepts of the dimensions of the universe had been extended impressively into space.

One method of measuring distances to stars involved applications of stellar spectroscopy. This branch of science was only a few years old at the time of Confederation; its introduction marked the birth of astrophysics, including revelations of the physical and chemical composition of celestial bodies. Information on the brightness and magnitude of stars could be obtained by comparing intensities of lines in their spectra, colored bands or lines resulting from the dispersion of beams of light from these luminous bodies on passage through a prism.

The formation and early development of the Dominion Observatory and of the Geodetic Survey of Canada can be attributed, in the main, to the quiet-mannered, unassuming Dr. King. He was brought to Canada from England by his parents at the age of eight. After early schooling in Port Hope, Ontario, King graduated in arts from the University of Toronto in 1869 with high honors, including the gold medal in mathematics. In November, 1876, at the age of 22 he was commissioned a Dominion land surveyor and Dominion topographical surveyor. After serving as Inspector, then Chief Inspector of Surveys in the Department of the Interior, King was appointed Chief Astronomer of Canada in June, 1890. His wife, Augusta Florence Snow, was the daughter of the Dominion land surveyor, John A. Snow.

FIGURE 111
Dr. W. F. King.

Previous to 1885 very little astronomical work had been performed in Canada. But with the creation of the Railway Belt in British Columbia detailed azimuth surveys of that region were urgently required. It was necessary to tie in this work occasionally with points whose latitudes and longitudes had been determined already by astronomical methods. O. J. Klotz and Thomas Drummond were entrusted with this undertaking in 1885, an assignment described in a previous chapter of this volume. Three stations were occupied in that season, with Seattle serving as a preliminary base point. It was during these surveys that Klotz became the first Canadian scientist and civil servant to whom the term 'astronomer' was applied by a government department.[1]

Entries in the unique diary kept by Klotz, with particular reference to the closing years of the 19th century, shed light on working conditions of those times:[2]

"*July 15, 1896*—King finishes observations with Montreal in regard to the longitude of Ottawa on which work he has been engaged for the past two months."

"*September 3, 1896*—Message from W. F. King concluding with the words 'estimates O.K.'. This means my name is included in the estimates for being put into the Inside Service as 'Astronomer'. [This development indicated that Klotz, in effect, had been promoted from temporary to permanent status in the federal civil service.] ... The usefulness and pleasure of the bicycle has taken such a firm root in the public that it is quite common now among the farmers, young women and young men."

Over the years the social and working relationships between King and Klotz were cordial and cool by turns. The diary significantly reflects these frequent variations in human temperature:

"*September 23, 1896*—King . . . is my best companion in Ottawa, for with no other can I speak so interestingly on subjects congenial to both of us."

"*August 7, 1897*—This morning King told me it had been settled that Brabazon was to go to B.C. to examine the boundary line (49th parallel). I asked him why I wasn't being sent, the work being principally astronomical . . . I saw Deville and told him the state of affairs. He told me of some trouble he had with King . . . Saw Sifton who remarked, "What has King to do with this appointment, if Brabazon is not an astronomer . . . ?"

The rivalry between the two men was always keen. Klotz was particularly sensitive to slights, real or imagined, in regard to their relative abilities as scientists. He was puzzled over what he considered to be the unfriendly attitude toward himself of Deputy Minister Burgess. "The only plausible reason seems to be to lower me in order to give King more prominence. He knows, as King does too, that I am King's superior in many things although King is my superior as a pure mathematician."[3]

The diary record contains an entry of significance in the story of Canadian mapping:

"*August 31, 1897*—Busy getting out a map of Southeastern Alaska, a map prepared under my direction and partly my own work. It's a compilation of 1893-4-5. The map was finished a year and a half ago but with . . . procrastination and inactivity [of others] . . . it was not photographically reduced to fit our largest lithographic stone . . . ".

Early in 1897 Deville recommended to the Deputy Minister of the Interior that an astronomical observatory be established in Ottawa "in connection with the longitude work in the West". This proposal was approved by the government for construction on Cliff Street, just north of the present site of the Supreme Court of Canada building. In the following year a 3-inch astronomical transit and a sidereal clock were purchased. By means of the latter instrument accurate time was obtained from observations of meridian passages of the stars, rather than from the sun. In addition an 8½-inch reflecting telescope with equatorial mounting was installed. By this type of mounting the axis about which the telescope operated was fixed approximately parallel to the axis of the earth. King's appointment as Chief Astronomer came two years after this development and constituted the first official recognition in this country of astronomy as a separate division of federal government activity. Klotz, shortly afterward, was named Assistant Chief Astronomer.[4] For the next several years some further longitude work was performed and additional instruments secured but prospects for a permanent observatory building remained dim.

In 1892 the federal government, partly as a result of representations from the Royal Society of Canada, cooperated with the British government in the determination of the longitude of Montreal in relation to Greenwich. This task was supervised by the Astronomer Royal, with Klotz participating as Canadian observer. Shipping interests, particularly, were vitally concerned in the results of this work. Four years later the longitude of Vancouver, in relation to Montreal and Ottawa, was also established.

In the summer of 1902, when the laying of the trans-Pacific cable approached completion, King advised Minister of the Interior Sifton that the installation presented a timely opportunity for the extension of Canada's chain of longitudes from Vancouver to Australia and New Zealand. The Chief Astronomer pointed out that the value to shipping interests of accurate positions in the Pacific Ocean would be even greater than in the Atlantic and that the completion of the first longitude circuit of the globe would constitute a notable accomplishment for Canada. Sifton, in October of 1902, was successful in inducing the government at Ottawa to authorize the project. Klotz was placed in charge, with F. A. McDiarmid and Frederick William Orion Werry as his assistants. In these longitude determinations full use was made of the time-checking facilities available through the cable. By January, 1904, the task had been completed.

Despite numerous set-backs at Ottawa the three musketeers, King, Klotz and Deville, continued to press for the construction of an adequate building for observatory purposes and they found comfort and encouragement in Sifton's understanding and helpful attitude. Finally, in 1900, the government placed the sum of $16,000 in the estimates of that year, specifically to provide for the erection of a suitable structure and for the purchase and installation of new instruments. A tentative site near the West Block on Parliament Hill failed to receive approval and the ultimate choice was the present location in the Central Experimental Farm. One of the principal factors entering into the decision to build the observatory was the ability of authorities in Ottawa at the time to foresee the need of numerous astronomical stations across Canada for the correlation of surveys generally and for mapping purposes, including advantages derived from regular programs of observations to determine star positions. In 1901 a 15-inch equatorial telescope and a sidereal clock were ordered for the new Dominion Observatory.

FIGURE 112. Dominion Observatory, Ottawa.

In the following year King sought the services of a man competent to advise on types of other instruments required and methods of installation.[5] Professor W. J. Loudon of the University of Toronto, a close personal friend of King, recommended the employment in that capacity of John Stanley Plaskett (1856-1941). The latter joined the Observatory staff in the summer of 1903. This action marked the beginning of a distinguished career in the public service that spanned the first four decades of the 20th century, a period during which Plaskett took a leading part in astrophysical research, as well as writing prolifically in this field. A son, H. H. Plaskett, later entered the same organization in Victoria, emulating his

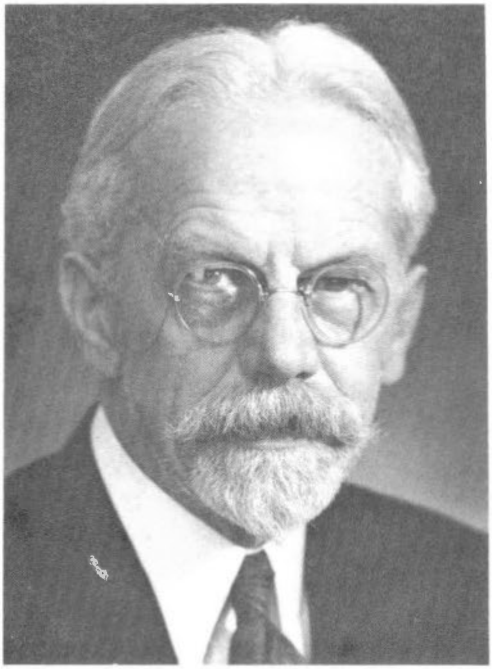

FIGURE 113
R. Meldrum Stewart.

father in persistence of research and in writing on various technical aspects of astronomy. In recognition of his outstanding contributions to knowledge in this realm of science H. H. Plaskett was appointed Director of the University Observatory in Oxford, England, serving in that post for the remainder of his active career.

Also in 1903 another brilliant graduate of the University of Toronto in physics and mathematics joined King's tiny staff. Robert Meldrum Stewart (1878-1954) was born in Gladstone, Manitoba, the son of a Presbyterian minister. When he graduated in 1902 young Stewart was awarded the University Gold Medal. Longitude determinations formed the major part of Observatory activities at the time Stewart arrived in Ottawa. He took a continuous, close and active interest in the expansion of this phase of the work until, years later, it became the responsibility of the Geodetic Survey of Canada. The first longitude determination involving the use of wireless time signals was performed under his direction in 1914. Another major development in Canadian astronomy, almost entirely due to Stewart's efforts, was the installation of a meridian circle telescope and the inauguration of accurate determination of fundamental star positions. He showed remarkable ingenuity and resourcefulness in detecting and eliminating numerous sources of instrumental errors peculiar to operations of this nature. Dominion Observatory catalogues of some 10,000 accurate stellar positions remain today as a monument to Stewart's ability and unflagging industry.

In April, 1905, the Dominion Observatory building was occupied by the astronomical and boundary-survey staffs. Chief Astronomer King at this time received the additional title of Director of the Dominion Observatory. The total number of civil servants housed in the new structure was 31. Because of the close interrelationship of astronomical and boundary surveys it never was possible to draw a clear-cut line of division between their respective responsibilities, although 14 men of the total were definitely engaged in field work on the international boundary. Among pioneer personnel of the Observatory Division, R. Meldrum Stewart was listed as observer and superintendent of time service. F. A. McDiarmid was classified as an observer, as were the Dominion land surveyors, W. M. Tobey, D.T.S. and F. W. O. Werry.

Functions of the new division were allotted among four units—Surveys; Meridian Work and Time Service; Geophysics; and Astrophysics and Solar Research. Within the space of a few years the last named was subdivided into three sections—Solar Physics; the Fifteen-inch Equatorial; and Photographic Photometry. Klotz, placed in charge of the Geophysics unit, organized his domain into three sections dealing with Seismology, Terrestrial Magnetism, and Gravity. He was intensely interested in seismology and for the next 12 years gave a great deal of attention to this aspect of his responsibilities. During that period he built up a high international reputation for the seismological station in Ottawa.

As a lecturer Klotz was in lively demand. He quickly enlisted and easily held the interest of audiences whether these were composed of fellow scientists or of members of the general public. This opening passage from an illustrated address he delivered on February 22, 1912, is typical of his style of speaking in popular vein:

"We have learned of the physical constitution of the moon, of her volume and mass, of her phases and rotation, of her borrowed light, of her gravitational or tidal effect on the earth—and now what about her connection with our weather, what about change of the moon, change of weather? Let us calmly do a little bit of reasoning about this; let us use just a little bit of common sense, and see what conclusion we inevitably arrive at."[6]

An expedition to Labrador in 1905 was organized to observe the eclipse of the sun on August 30th of that year. This was the first important field project undertaken by the Dominion Observatory in solar physics. J. S. Plaskett was entrusted with the leadership of this enterprise. Although cloudy conditions on site prevented useful observations of the phenomenon, Plaskett's report on the planning involved and of the trip itself, stamped him as an astronomical scientist of special ability and promise.

In 1907 Plaskett arranged for the provision of a new spectrograph incorporating the most advanced mechanical and optical ideas of that time and which utilized to the full the relatively small light-gathering power of the Ottawa telescope. He specialized in spectroscopic studies of binary-star systems. As a result of his intensive and fruitful work in this field the Dominion Observatory came to occupy a place in the front rank of institutions throughout the world engaged in this branch of astrophysical research.

Studies of the two natural earth-forces of terrestrial magnetism and gravitation, interrelated through their common source in the electrical nature of all matter, were not neglected. In 1907 Klotz inaugurated a systematic magnetic survey of Canada. At every magnetic station occupied observations were made for declination, dip and total force. By 1930 there were more than a thousand occupied stations, representing more than 650 localities. Although a few gravity stations were occupied in early years of the Observatory's existence, the work in this field was relatively spasmodic, owing to a lack of trained observers. The main object of these operations was to study the figure of the earth and the nature of subterranean strata.[7]

In his annual report to King, dated 1911, Plaskett strongly recommended the erection of a large reflecting telescope in order to extend the work of the Observatory to fainter stars. His representations were based, in all likelihood, on a resolution passed at a meeting in Ottawa that year of the Astronomical and Astrophysical Society of America, in which approval of the work accomplished with the 15-inch refractor telescope was expressed and the hope ventured that the Canadian government would provide a larger instrument. Plaskett's plea received additional support from both the Royal Astronomical Society of Canada and the Royal Society of Canada in the form of similar resolutions passed during the following year. In the brief of the latter organization it was suggested that the telescope be located at

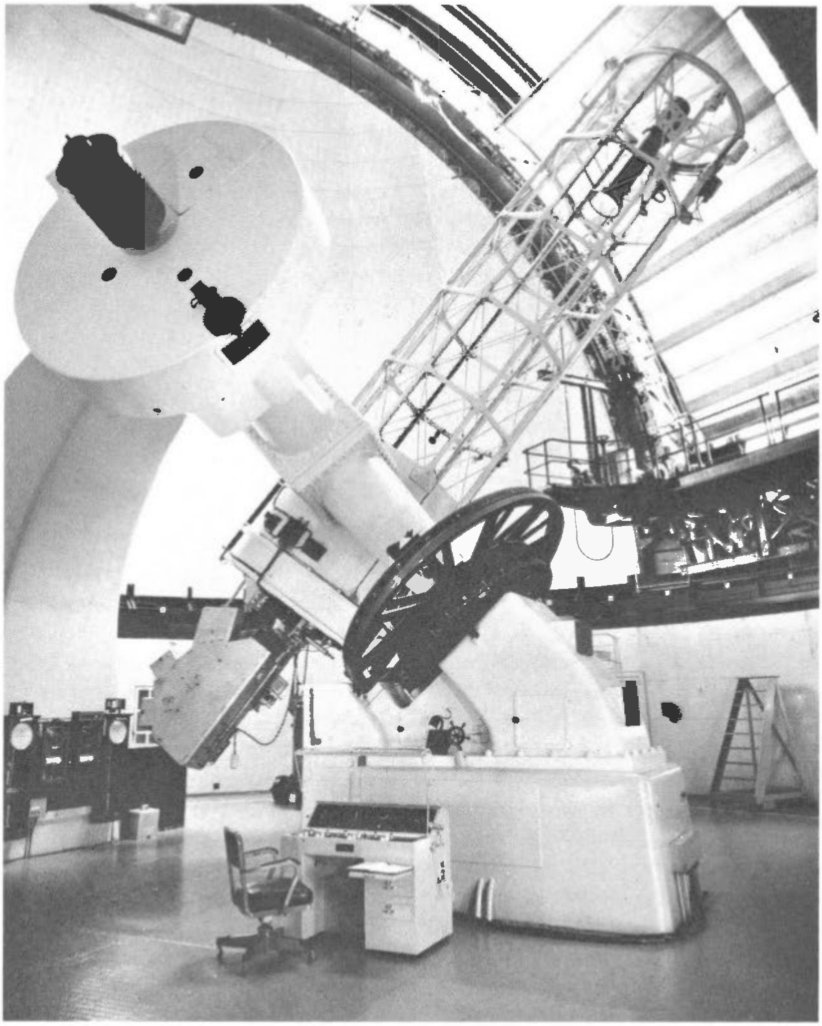

FIGURE 114. Dominion Astrophysical Observatory, Victoria.

a place in Canada most suitable for astronomical purposes. All this lobbying proved effective and in 1913 contracts were awarded for the construction of a 72-inch reflecting telescope, destined to be for a brief time the largest instrument of its kind in the world. After careful examination of possible sites for the telescope in various parts of Canada, Little Saanich Mountain, 8 miles north of Victoria and with a summit some 700 feet above sea level, was selected as the most advantageous location from the standpoint of stability, uniformity of night-time temperatures, and general viewing conditions. The construction of the Dominion Astrophysical Observatory, as it was to be known, began in 1915 and was fully completed three years later. J. S. Plaskett was named its first Director in April, 1917, and R. K. Young was appointed his assistant.[8] Later these two men were joined by W. E. Harper, H. H. Plaskett and, in 1924, by J. A. Pearce.

In theory the Director of the Dominion Observatory was in general charge of both the

Ottawa and Victoria establishments but in practice the Director of the latter institution was granted considerable freedom in the preparation and execution of research programs. By reason of the large size of the Victoria telescope it became possible to carry out investigations indispensable to the advancement of astronomical knowledge and this installation helped, during the years ahead, to bring prestige to Canada.

When the Geodetic Survey of Canada and the boundary surveys separated from the Observatory organization in 1917 a reorganization of the Observatory's functions took place. Scientific work of the Observatory was divided into seven main categories: Astronomy of Position (Meridian Work and Time Service); Solar Physics; the Fifteen-inch Equatorial; Photographic Photometry; Seismology; Terrestrial Magnetism; and Gravity.

FIGURE 115
J. S. Plaskett.

In their efforts to promote the work and objectives of the Dominion Observatory, King and his colleagues were frequently called upon to justify to policy-makers on Parliament Hill their researches in the realm of pure science. Governments, in the political nature of things, want to see practical results for the expenditure of public funds. It was incumbent upon the civil servants, time and again, to explain patiently that all practical applications of science are built upon findings derived from the testing of various theories. Stewart, for example, in defending requests in 1930 for increased government support of Observatory activities, dipped perceptively into the future:

" . . . astronomers are working hand in hand with physicists in investigations on the ultimate constitution of matter, each supplementing the work of the other. What will come out of such investigations we do not yet know, but if they should result in the harnessing of atomic and molecular forces for practical use, all the expenditures made on astronomy and physics during the course of history will be many times repaid".[9]

Following the death of Klotz late in 1923, after nearly 45 years in the public service of Canada, a touching tribute was paid to him and his work by the Board of Examiners for Dominion Land Surveyors of which he had been an "active and valuable member since

1883 and whose consummate scientific attainments reflected the greatest credit not only on this Board but on the country he so brilliantly and faithfully served and through whose efforts the profession of . . . surveyors has attained such a high degree of efficiency".[10] On this occasion the close friend, fellow-worker and admirer of Klotz, namely, Surveyor General Deville, by nature a most reserved and undemonstrative person, was visibly moved. King's life had come to a close seven years previously. Now Klotz had gone. Deville alone remained, the bereft survivor of this remarkable trio of scientific intellects. Deville appeared to be overwhelmed by a sense of loneliness and, possibly, by an awareness that for him, shadows were fast closing in.[11] Actually it was but a matter of months before Deville joined his eminent colleagues beyond that veil thus far unpierced by scientific insight or instrument.

During the half-century following Confederation, thanks to its resourceful, energetic and dedicated scientists, Canada had made commendable advances in the several fields of research represented in the organization of the observatories in Ottawa and Victoria. In 1927 Director Plaskett summed up that progress in memorable terms:

" . . . Canada's contribution to modern astromonical research is one of which every Canadian has good reason to be proud, as to the best of my knowledge it is unequalled relatively, so far as Government support is concerned, by any other country. Canada, with its small population and its relatively short span of national life, has established and supported two national observatories of the first rank, one of these having the second largest telescope in existence and both making important contributions to science."*[12]

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*For a period of several months in 1918 the 72-inch reflector telescope of the Dominion Observatory in Victoria, B.C. was the largest in the world but was superseded by the 100-inch instrument at Mount Wilson, California.

16

THE ONTARIO-MANITOBA BOUNDARY: STAGE ONE

"And from that full meridian of my glory . . ."
King Henry VIII, Act 3, Sc. 2

It is not widely realized in this country, nor in the neighboring republic that a geographical point close to the centre of the continental United States has had a significant bearing upon the determination of a key location on an interprovincial boundary in Canada. During the closing decades of the 19th century legal and other arguments resounded in the new Confederation over the exact course of the northern and western boundaries of Ontario and, in particular, of the Ontario-Manitoba boundary line. In debates over the interpretation of treaties, proclamations, orders in council and other documents related to these issues, the point of junction of the Mississippi and Ohio rivers drew frequent and prominent mention. It is altogether likely that the location of the existing Ontario-Manitoba boundary terminal point on Hudson Bay resulted from the extension northward, from the confluence of these two major American rivers, of the 89th meridian of west longitude.

The vague terminology of several 18th century documents served to sharpen rather than allay disputes over the nature and extent of Ontario's territory. Under the Treaty of Paris, 1793, "in order to re-establish peace on solid and durable foundations, and to remove forever all subject of dispute with regard to the limits of British and French territories on the continent of America" the southwestern limits of Canada were "fixed irrevocably by a line drawn along the middle of the River Mississippi from its source to the River Iberville [Ohio], and from thence by a line along the middle of this river . . . to the sea".

In the Quebec Act (Imp. 14 Geo. III, ch. 83), passed eleven years later, it was provided that the Province of Quebec included "all the territories, islands and countries in North America belonging to the crown of Great Britain, bounded on the south by a line from the Bay of Chaleurs along the high lands which divide the rivers that empty themselves into the River St. Lawrence from those which fall into the sea, to a point in 45 degrees north latitude . . . until the said western boundary strike the Ohio; . . . and along the bank of the said river westwards to the banks of the Mississippi, and *northward* to the southern boundary of the territory granted to the Merchant Adventurers of England trading to Hudson's Bay".

Under authority of the Constitutional Act, 1791, providing for the establishment of

FIGURE 116. The major political boundaries of Canada. The eastern part of the Arctic sector is only approximate.

Upper and Lower Canada, an order in council dated August 24, 1791* provided that the dividing line between the two provinces should "commence at a stone boundary on the north bank of the Lake St. Francis . . . to ascend the [Ottawa] River into the Lake Tomiscanning [Temiscaming] and from the head of the said Lake by a line drawn due north until it strikes the boundary line of Hudson's Bay; including all the territory to the westward and southward of the said line and the utmost extent of the country commonly known by the name of Canada". This rather expansive language led some zealous advocates of Ontario's territorial claims to place that province's western limits along the crest of the Rocky Mountains!

The more moderate position taken by proponents of Ontario's case as set forth in formal communications and proceedings was that by terms of the Treaty of Paris, 1763, under the Quebec and Constitutional Acts, and by subsequent official declarations, the western limits

*Public Records Office, London, England.

of the province extended to a meridian line passing through the source of the Mississippi River or, in the alternative, such limits should be fixed even farther west. On the other hand "northward" was interpreted by Ottawa authorities as meaning "due north" thus placing the boundary along the 89th meridian as projected due north from the confluence of the Mississippi and Ohio rivers.

In effect the disparity resulting from these differing interpretations was represented by the territory lying between a meridian passing close to Port Arthur (89° 09′) and a meridian passing just west of the Lake of the Woods (95° 14′). This area, some 275 miles in width, became known as "The Disputed Territory".

By the British North America Act (section 6) the former Province of Upper Canada was constituted the Province of Ontario and the western and northern boundaries of Upper Canada, as fixed by the Constitutional Act, 1791, became the boundaries of the new province. In 1870 the Parliament of Canada created Manitoba (33 Vic. ch. 3) and defined its boundaries as the international border on the south, parallel 50° 30′ north latitude on the north, the 96th and 99th meridians on the east and west respectively. A year later the power invested in Parliament at Ottawa to establish new provinces within Canadian territory and to increase, diminish or otherwise alter the limits of any province, with the latter's consent, was confirmed by statute (Imp. 34-35 Vic. ch. 28).

In the beginning Manitoba, lacking an ample provincial treasury and with its natural resources under Ottawa's control, was inclined to let federal authorities carry the battle to Ontario on its behalf in boundary disputes. The conflict came into the open, as a matter for inter-governmental negotiations, in July, 1871, when the Secretary of State for the Provinces, Hon. Joseph Howe, received in Ottawa a despatch from the Lieutenant Governor of Ontario. The message in part declared that "necessity exists for the settlement of the true boundary or division line separating the Province of Ontario from what is known as the North-West Territory. The importance of accomplishing this object has been recognized both by the House of Commons and the Legislature of the Province and appropriations [have been] made by them for defraying the expense of a Commission for that purpose, one member of which to be appointed by His Excellency the Governor-General and the other by myself. As the season is fast advancing it is desirable that these appointments be made at as early a date as possible . . . ".

Howe replied later in the same month, reporting that Parliament had voted $15,000 "to pay one-half the cost of surveying the said boundary line" and that Eugène Taché of Quebec City had been appointed Commissioner on the federal side. On September 19, 1871, Hon. William McDougall, a man seemingly attracted to controversy as by a magnet, was appointed Commissioner for Ontario. Nothing of substance, however, seems to have developed out of these initial moves and it was not until seven years later that fresh steps were taken by authorities to settle this boundary issue. Both the federal and Ontario governments agreed to the nomination of three arbitrators, namely, Chief Justice Harrison of Ontario, Sir Francis Hincks and Sir Edward Thornton. Their recommendations, known as "The Award" were announced in August, 1878. As matters turned out a House of Commons committee rejected "The Award" and consequently federal legislation to make it binding was not forthcoming.

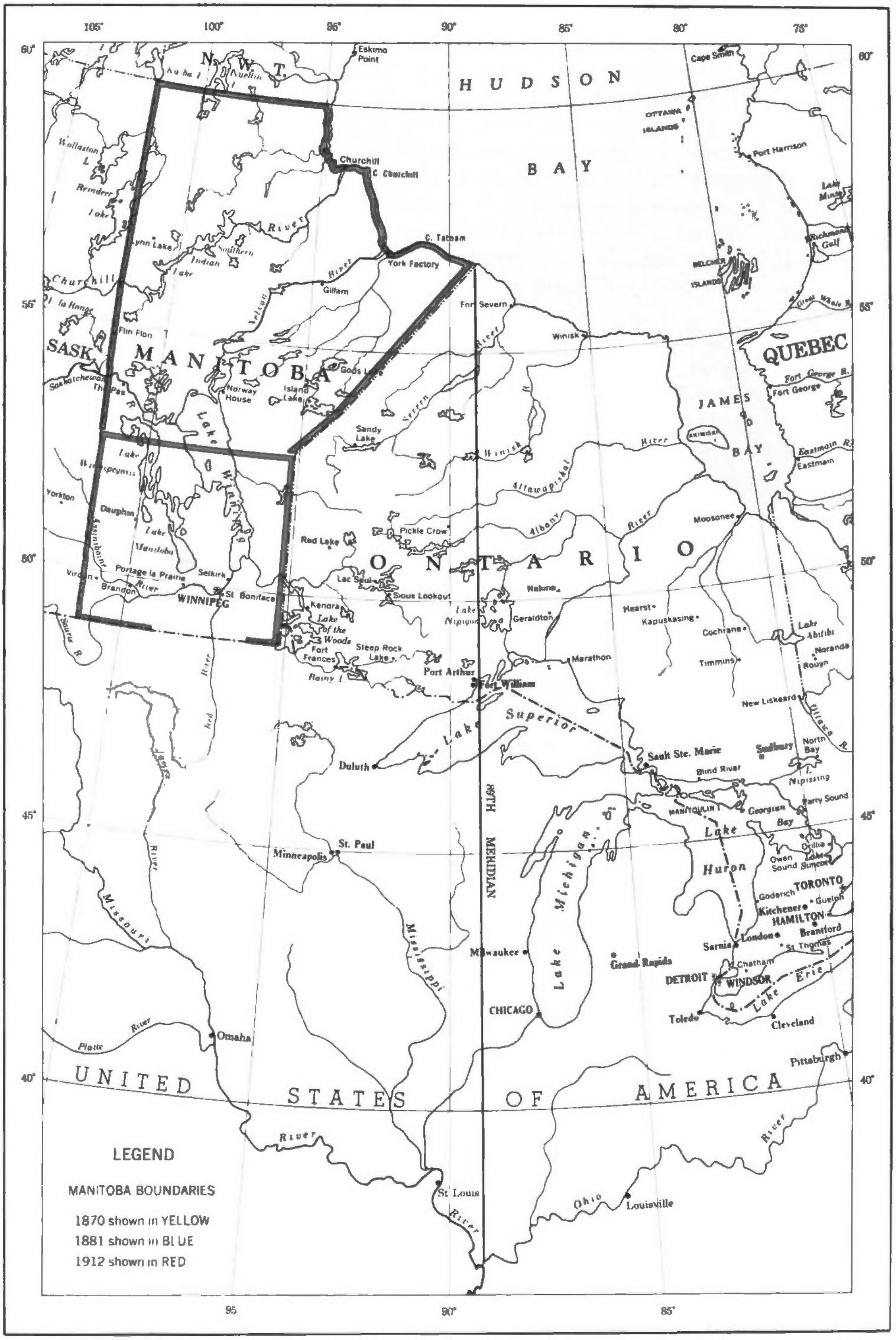
The decision of the three arbitrators nevertheless proved highly significant as their conclusions, in large measure, were approved and adopted in the judgment rendered in 1884 by the Judicial Committee of the Privy Council in London, England. For the purposes of this chapter the relevant part of "The Award" of 1878 decided that the boundary line should go " . . . westerly through the middle of Lac Seul, being the headwaters of the English River; thence westerly through the middle of Lac Seul and the said English River to a point where the same will be intersected by a true meridional line drawn northerly from the international monument placed to mark the most northwesterly angle of the Lake of the Woods . . . and thence south following the said meridional line to the . . . international monument".

It is likely that the House of Commons committee, in urging rejection of "The Award", was guided by testimony offered before it by Deputy Minister of the Interior, John S. Dennis, and by Surveyor General Lindsay Russell. Both men supported the view predominant in Ottawa's administrative circles, namely, that Ontario's western boundary lay along the prolongation of a meridian line drawn due north from the confluence of the Mississippi and Ohio rivers. The evidence given by Dennis consisted of his reading to the committee of a letter he had written to the Minister of Justice, Ottawa, on October 1, 1871, on the subject of the boundary between Ontario and the North-West Territories of that day. In his letter Dennis gave cogent reasons for his viewpoint and made some perceptive references to mapping in relation to the delineation of boundaries between nations:

"The map used in the House of Commons [Westminster] to illustrate the question of the boundaries of Quebec in the debate on the [Constitutional] Act is said to have been Mitchell's Map . . . The only copy of Mitchell's Map available is in the Library here [Ottawa] and on inspecting the Mississippi on it we find that the course of that river is taken up abruptly at a point in 47° 12′ north latitude and 101° 30′ west longitude at which point we further find in the map the following note by the author: 'The head of the Mississippi is not known. It is supposed to arise about the 50th degree of latitude and the west bounds of this map etc. . . . !" Dennis commented that it was "not at all probable that with the uncertainty asserted to exist in the map itself used by the House of Commons at the time the boundaries were debated and settled . . . that the House intended to use its [the Mississippi] banks as the [western] boundary of Quebec. Such a theory . . . would be entirely inconsistent with the minuteness and precision of language insisted on in settling the Ohio and the southern boundary . . . ". Dennis further pointed out that the meridian line north of the junction of the Mississippi and Ohio rivers would intersect the height of land in Ontario just slightly northwest of Lake Nipigon. He concluded his report by advocating that Ottawa and Ontario authorities agree to fix a conventional or mutually convenient boundary, thus reducing by half the estimated cost of such boundary surveys.

In 1881 Parliament in Ottawa decided to extend Manitoba's boundaries (44 Vic. ch. 14) and thus enlarge its territory. The new northern boundary of the province was defined as the centre of the road allowance along the 12th Base Line of the Dominion Lands Survey System. Manitoba's eastern boundary was declared to be the western boundary of Ontario. Apparently Ottawa authorities held the view that there had not been, up to this time, a boundary line common to the two provinces but that there had been a strip of unallotted territory separating them. This legislative step drew angry protests from the Ontario government. In 1882 Attorney-General Oliver Mowat of Ontario asserted that it was a 'grievous wrong' that 39,000 square miles of territory rightfully belonging to Ontario should have been transferred to Manitoba.[1]

The conflict between these rival claims reached its climax during the summer of 1883 when three separate police forces and three distinct sets of magistrates, appointed by each of the three governments involved in the boundary controversy, took turns harassing, and even arresting, each other. The settlement of about 1,000 persons, now known as Kenora, was the vortex of the jurisdictional storm. When lumbermen invaded the area, competition for the monopoly in providing liquor and timber-cutting licences in the area stirred animosities to fever pitch. Both Ontario and Manitoba authorities exercised licence-granting functions and into this legal maelstrom bootleggers poured gleefully.[2] Ontario's magistrates refused to recognize liquor licences issued to saloons other than those granted by Ontario officials. A



MAP 15. Evolution of Manitoba's boundaries and the projection of the 89th meridian from the confluence of the Mississippi and Ohio rivers to Hudson Bay.

Manitoba-operated jail in Kenora was raided by an unruly mob and burned to the ground. Mowat in Toronto continued to complain that illicit liquor-selling, drunkenness, immorality and crime had increased because of the policing paralysis resulting from the federal government's attitude and policy in the boundary matter.

Disorder in the area under dispute reached such proportions that finally the attorneys general of both provinces met and worked out a compromise agreement. Local police commissioners, one for each province, were appointed. Both provinces agreed to submit a joint case on the boundary question to the Judicial Committee of the Privy Council for decision. In 1884 this case was argued in London and a decision rendered in favor of Ontario. In the main the lord justices confirmed the validity of "The Award" of 1878. In 1889 the northern and western boundaries of Ontario, as described in that award, were defined by statute (52-53 Vic. ch. 28).

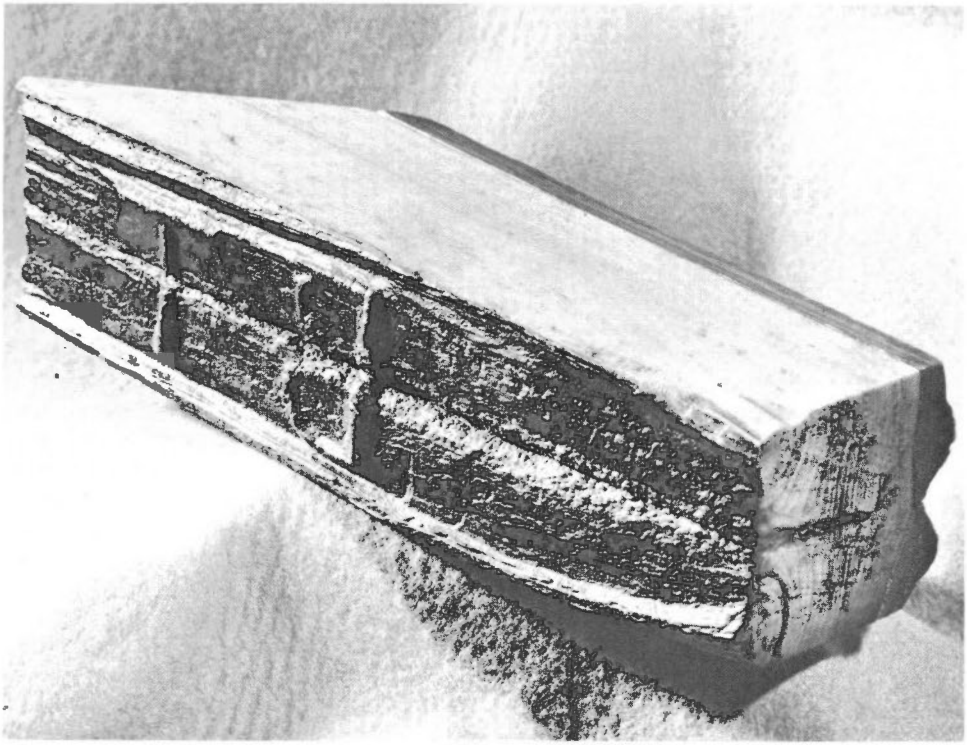


FIGURE 117. Section removed in 1932 from a poplar tree on the Ontario-Manitoba boundary to verify marks placed on it in 1897. Shown are the reverse of the original marks "BT".

Four years after legal confirmation by Parliament of the Privy Council decision the federal government invited Ontario and Manitoba to cooperate with the Dominion on a joint survey of the Ontario-Manitoba boundary line from the northwest point of the Lake of the Woods to the Winnipeg River.[3] A few months later the two provinces were advised by Ottawa that the cost of the proposed survey would not exceed $9,000 and the suggestion was made that it be shared equally by the three governments.[4] Manitoba, however, declined to participate in the proposed arrangement. Ottawa was advised that as Manitoba was "not the owner of the timber, the minerals or the public lands in that portion of the province lying along the eastern boundary thereof, it does not appear that the Provincial Government is sufficiently interested in the immediate limitation of the boundary to warrant the incurring of any expenditure at the present time".[5]

Not until 1897 were surveyors formally appointed and authorized as commissioners to run the boundary line, even to a limited extent. Hon. Clifford Sifton had been in office as Minister of the Interior for only a few months when, despite Manitoba's attitude of indifference, he instructed that correspondence on the boundary survey project be re-opened. As a result the Dominion and Ontario land surveyors Elihu Stewart and Bryce J. Saunders were selected by Canada and Ontario respectively for the discharge of this important task. The season was already well advanced but both surveyors were in the field by September 1, 1897.

Survey work began at the reference monuments established at the northwest corner of the Lake of the Woods by the International Boundary Commissioners in 1872. In the course of the next three and a half months the task of surveying the line was carried due north to its intersection with the Winnipeg River, about seven miles below the junction of the English and Winnipeg rivers and 58 miles, 27 chains and 20 links from the point of commencement of the survey. The waters of the two rivers at the confluence united in a wide, lake-like expanse containing about a dozen islands. A sky line was opened along the entire course of this line. An opportunity was thus afforded to take long sights from the most elevated points and so maintain direction. Astronomical observations revealed that pickets deviated but slightly from the true course. The line was carefully posted throughout with cedar and iron posts surrounded in most cases with stone mounds. A reconnaissance survey was made of the territory adjacent to the boundary and sustained, intensive effort was involved in traversing the shores of the lakes near the line.

A small, light transit as well as a Dominion Lands reiteration transit theodolite were the instruments mainly used in running the line. Astronomical observations were taken by means of the latter equipment. Lines run in the surveying of Indian Reserves, Dominion lands and mining locations were connected with the boundary work. Intensely cold and generally cloudy weather persisted from the latter part of November to December 11, 1897, when the survey project was completed in the field.

On April 30, 1898, Stewart and Saunders submitted their joint report to Hon. Clifford Sifton in Ottawa and to Hon. J. M. Gibson in Toronto, along with official plans of survey signed by both surveyors. Nearly a quarter-century elapsed before surveying of this interprovincial boundary line was resumed in a second stage of this work. Officially the government of Canada, in 1898, invited Ontario and Manitoba to accept the boundary as marked by Stewart and Saunders in Stage One. Ontario accepted in statutory form (62 Vic. ch. 2) but Manitoba remained silent.

In 1912, by two acts of Parliament and with the legislative consent of the two provinces concerned, vast areas were added to Ontario and Manitoba.[6] Inhabitants of the latter province had increased in numbers from about 62,000 in 1881 to an estimated 360,000 by 1906. This total exceeded the population of either Alberta or Saskatchewan, each of which had been allotted about 175,000 square miles more than Manitoba then possessed. It was felt at Ottawa, therefore, that Manitoba was entitled to a larger territory to enable it to occupy a place among the provinces more in accordance with the spirit that had animated the act of Confederation.[7] The interprovincial boundary was thus carried due north along the same meridian marked by Stewart and Saunders to its intersection with the centre of the road allowance of the 12th Base Line of the Dominion Lands Survey System, thence northeasterly in a right or straight line to the most easterly point of Island Lake, thence northeasterly to the point where the 89th meridian intersects the southern shore of Hudson Bay. Just why the 89th meridian should have been selected as the governing line in this particular connection is open to speculation but there is the matter of its historic relationship, under terms of the Quebec

FIGURE 118. Views of typical Ontario-Manitoba boundary markers erected in 1922.

Act, with the confluence of the Mississippi and Ohio rivers. Nor should it be overlooked that by extending Manitoba's boundaries in 1912 in this way, the total acreage of the province was increased to the point where it more nearly coincided with the amount of territory allotted seven years earlier to each of the newly-created provinces of Alberta and Saskatchewan.[8] In retrospect it is significant to recall that the point at which the 89th meridian strikes Hudson Bay is the only part of the proposed Dennis-Russell line that was finally adopted as the interprovincial boundary.

The necessity of marking on the ground the extension of the boundary of the two provinces became the subject of correspondence between the governments of Canada, Ontario and Manitoba during 1913 and 1914. The two provincial governments made a formal request to Ottawa that the extended boundary line be surveyed by the Department of the Interior at the expense of the federal government. This proposal was not accepted, however, and the matter of continuing the boundary surveys was dropped for a time. In 1920 Herbert Graham Beresford, a Dominion land surveyor, who had been surveying mineral claims for several years in the Rice Lake district of Manitoba, reported that claims were being staked so near to the supposed location of the interprovincial boundary that early official demarcation of the boundary north from the Winnipeg area through the newly-opening mining area was urgently required. Beresford's warning initiated a series of boundary surveys covering five more main stages of the entire project. In the field seasons of 1921 and 1922 surveying of the boundary was completed from the Winnipeg River north to the 12th Base Line. In 1929 and 1930 the seasons' work was continued from that point to Island Lake. The next stage was finished in 1937, namely, from Island Lake to Echoing River. In the 1937 and 1948 field seasons the last gap, that extending from Echoing River to the shore of Hudson Bay, was covered. In 1950 the final stage was completed, involving the monumenting of the line from Island Lake to Hudson Bay.

In all, the 20th century boundary surveying activities covered almost 550 miles of this line. These undertakings demanded the dedicated, reliable, energetic and resourceful services of such surveyors in the field as John Wesley Pierce, Robert Douglas Davidson, Cecil Herman 'Marsh' Ney, John Carroll, Edward Gauer, Edwin Frederick Gorman, J. G. Pierce and D. E. Guard. These men functioned under the direction of such eminent surveyor-commissioners as Edouard Deville, Louis Valentine Rorke, Bruce Wallace Waugh, Frederic Hatheway Peters, G. A. Warrington, Henry Edward Beresford and Frank Weldon Beatty. Along with the last two officials, Robert Thistlethwaite prepared a report on the boundary surveys from 1929 to 1950 and instigated steps leading to legislative action, confirming the laid-down line, by all three jurisdictions involved. An atlas of 39 maps accompanied the report. But the story of the second and subsequent stages in the boundary-marking work is told in a later chapter. Suffice to state here that extending across a period of 53 years the 607½-mile-long Ontario-Manitoba boundary line was effectively and efficiently surveyed so that, in the end, the results were accepted without reservation by the governments directly concerned.

17

EARLY SURVEYS OF INDIAN RESERVES

At the time of the first European settlements in North America the Indian population of what is now Canada was about 200,000. Shortly after the advent of people from the Old World the Indian population on this continent began to decline and continued to diminish for almost four centuries. In recent years, with a marked improvement in their living conditions and in health services, the number of Indians in this country has risen steadily and now exceeds 215,000. These descendants of the original inhabitants of the northern half of North America are organized in about 600 Indian communities or bands within a number of Indian agencies, and reside on more than 2,200 reserves, lands set aside over the years by government authorities for the use of Indians. These reserves are located across Canada, except in Newfoundland. They vary in size from a fraction of an acre to more than 500 square miles. Almost without exception Indian reserves in Canada have been surveyed in respect to outline boundaries or subdivision lines or both.

Under the French regime in Canada there never was an admission on the part of authorities that Indians had any valid title to lands. Territories in the New World were claimed for the French Crown by right of discovery and conquest. Reserves, however, were set apart from time to time for the use of Indians and these arrangements found formal confirmation in Article 40 of the Articles of Capitulation signed in Montreal in September, 1760: "The . . . Indian allies of his most Christian Majesty shall be maintained in the Lands they inhabit; if they chuse [sic] to remain there; they shall not be molested on any pretence whatsoever, for having carried arms . . . ".[1]

In contrast to the French attitude, in earliest British settlements in New England the title of Indians to lands occupied by them had been recognized. Compensation was made for any surrender to newcomers of their natural hunting grounds. This compensation might take the form of land grants, of payments in money or goods, or by combinations of these various types of reimbursement. The Crown invariably reserved to itself the exclusive right to deal with Indians for the surrender of their lands and this basic approach to such transactions, confirmed by Royal Proclamation, October 7, 1763, has been followed ever since. That proclamation, issued by George III, declared in part, "And whereas it is just and reasonable and essential to our Interests, and the Security of our Colonies, that the several Nations or Tribes of Indians . . . who live under our Protection, should not be molested or disturbed in the Possession of such Parts of our dominions and territories, as not having been ceded to Us, are reserved to them as their Hunting Grounds, We do therefore . . . declare . . . that no Governor . . . in any of our Colonies . . . do assume . . . to grant . . . Warrants of Survey . . . beyond the Bounds of their Respective Governments as described in their Commissions . . . upon and Lands whatsoever which, not having been ceded to or purchased by Us as aforesaid, are reserved to the said Indians, or any of them."[2]

In 1755 Sir William Johnson was appointed Indian Superintendent in the Mohawk Valley, now in New York State. The creation of this office marked the genesis of organizations in North America that administered and advanced, on behalf of governments, the best interests of Indian peoples. After the American Revolution the office of Indian Superintendent was moved to Canada. Sir Guy Johnson succeeded his father-in-law in the post in 1774, and remained in charge until 1782 when Sir John Johnson, a son of Sir William, was appointed Superintendent General and Inspector. He held this commission until that office was abolished in 1828, bringing to a close the 73-year-long reign of the Johnsons in this field of administration.

By the middle of the 19th century the Legislature of the Province of Canada had passed two statutes concerning reserves, one of which enacted that "tracts not exceeding 230,000 acres may . . . be described, surveyed and set . . . apart . . . for the use of the several Indian tribes of Lower Canada".[3] The other statute established the position of Commissioner of Indian Lands for Lower Canada, an official who represented the Crown for the purpose of managing reserve properties for Indians.

Over a period of years the whole of Upper Canada was surrendered to the Crown by treaties made by governments with Indians. In addition to the location of reserves within those surrendered territories, as compensation to Canadian Indians, land had to be found also for Six Nations Indians who had arrived in Canada after the American Revolution and who, by their loyal action, gave up their historic lands in the Mohawk Valley. Reserves for them were carved out of lands along the Grand River in what is now southwestern Ontario, and on the Bay of Quinte, Lake Ontario.

By 1830 there were separate departments dealing with Indian matters in both Upper and Lower Canada. Fourteen years later the two organizations were merged. In 1860 costs of Indian administration, previously borne by the British government, became the responsibility of the Province of Canada through the agency of the Crown Lands Department. At Confederation an Indian Affairs Branch was formed under the Secretary of State.[4] Section 29 of the establishing Act provided that the government at Ottawa "may authorize surveys, plans and reports to be made of any lands reserved for Indians" indicating the improved lands, forested areas and lands judged fit for settlement and "such other information as may be required". This provision has come down through the years in much the same wording in legislation except that in the 1952 version there is added the function of locating roads in a reserve. When the Department of the Interior was formed in 1873 the Indian Affairs Branch was transferred to it and the Minister of the Interior acquired the additional title from his cabinet colleague of Superintendent General of Indian Affairs. In 1880 Indian Affairs became a separate department of federal government but continued to report to Parliament through the Minister of the Interior.

From 1796 to 1866, and even later, numerous articles or deeds of agreement were signed between governments and Indian tribes under which lands, now in Ontario, were given up by the latter to the Crown for eventual settlement by non-Indians. In addition, between 1850 and 1923, a number of treaties of major significance were entered into on one hand by govern-

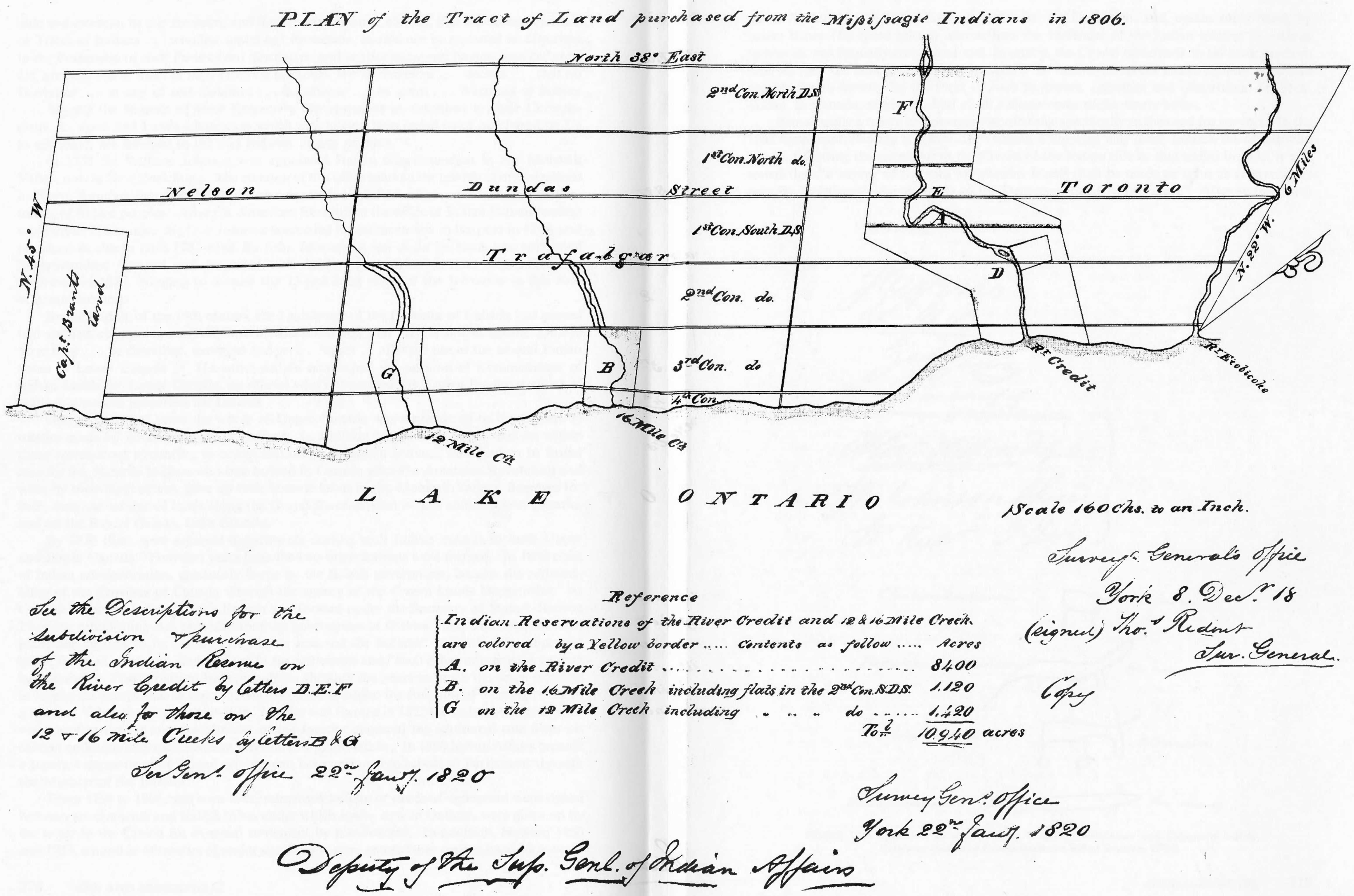


FIGURE 119. Plan of tract of land purchased from Indians, 1806.

ments representing first, the Province and later, the Dominion; and, on the other hand, by native tribes. By these solemn transactions the surrender of the Indian interest in various territories was formally recognized and, in return, the Crown undertook to set aside lands as reserves for "the benefit and use of Indians". In various instances native peoples were also provided with benefits in the form of cash payments, annuities and educational facilities. Today, in Canada, about one-half of all Indians come under treaty terms.

Occasionally a treaty or agreement would refer specifically to the need for surveys. In the 1862 agreement creating a reserve for Ottawa, Chippewa and other Indians on Manitoulin Island, following the surrender to the Crown of the Indian title to that island in 1836, it was stated that "a survey of the said Manitoulin Island shall be made as soon as conveniently may be, by or under the authority of the Department of Crown Lands." After setting forth

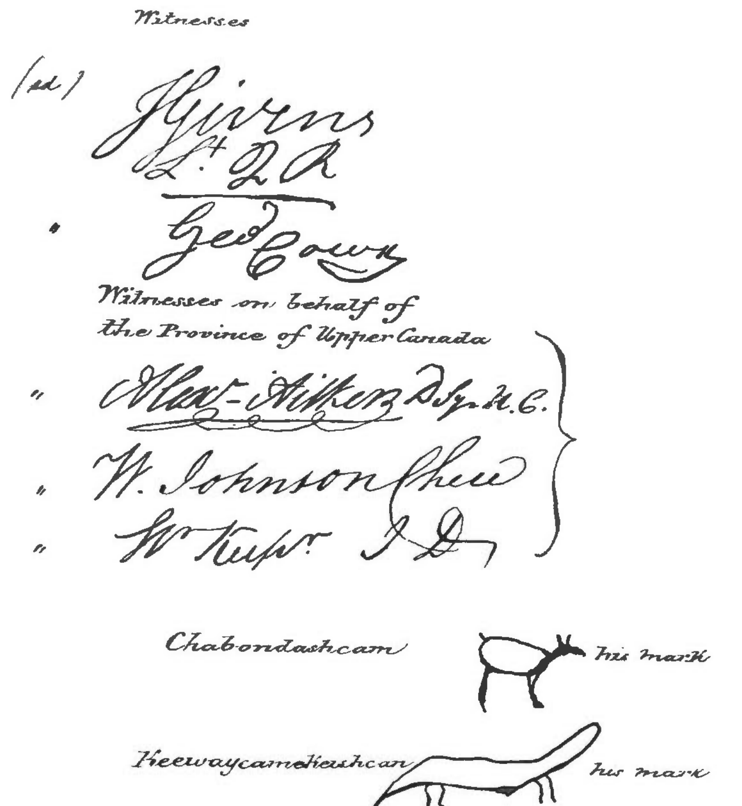


FIGURE 120. Specimens of signatures by Treaty Commissioners and Chippewa Indian Chiefs on cession of Penetanguishene Indian Reserve, 1795.

the conditions for a subdivision of the island and the right of each Indian to make his own selection of any land on the island, it was provided further that "the selections shall all be made within one year after the completion of the survey . . . and plans of the survey shall be open to the inspection of all Indians entitled to make selections."[5]

Major treaties concluded with Canadian Indians, in chronological order, were the Robinson Superior (1850), Robinson Huron (1850), and Manitoulin Island (1862). After Confederation a series of numbered treaties of special importance were negotiated affecting, for the most part, Indians of the western interior. Treaty No. 1, for example, signed in 1871, concerned the Chippewa, Swampy Cree and other Indians in southern Manitoba. Treaty No. 7 (1877) related to the Blackfoot, Blood, Peigan, Sarcee, Stony and other Indians in southern Alberta. Treaty No. 9 (1905) concerned, however, the Ojibwa, Cree and other Indians in that part of Ontario drained into Hudson Bay. The latest treaty of this series, identified by numbers, was Treaty No. 11 (1921), relating to the Slave, Dogrib, Loucheux and Hare Indians located north of Great Slave Lake in what is now the Northwest Territories.

Details of arrangements made under these various and varied instruments differed with circumstances but, in the main, the size of a reserve was dictated by several factors, the most important of which was the total number of Indians to be accommodated on it. In the case of the numbered treaties grants of land were made on the basis of either 640 acres (one square mile) or 160 acres to each family of five. Other factors determining size of a reserve included the nature of the land itself, whether it was mostly rocky or largely arable, as well as the uses to which land would be put. If the reserve happened to encompass a small British Columbia fishing station only, then much less acreage would be required than if prairie farmland was being used.

In some treaties, such as the Robinson Huron document, the location and area of Indian reserves are fairly well defined. Under western interior treaties Indians would make their own selection of a territory attractive to them and a government survey of the land would follow. In treaties concluded with certain tribes in the Northwest Territories it was provided that "the Superintendent General of Indian Affairs shall depute and send a suitable person to determine and set apart such reserves . . . after consulting with the Indians concerned as to the locality which may be found suitable and open for selection".[6]

Almost every aspect of administration of Indian Affairs in this country, in the legal sense, encounters complications arising from the diverse origins of the reserves as well as from varying interpretations of treaty terms. Indian reserves came into being in a variety of ways, by treaty, surrender, order in council, purchase by the Crown, statutory grant and, in some instances, by their existence from 'time immemorial'.

Under the Act of Confederation the Parliament of Canada was given exclusive legislative jurisdiction over subjects enumerated in section 91. "Indians and Lands reserved for the Indians" was the wording of Article 24 of that section of the British North America Act. Accordingly, in 1867, the five provinces of the union transferred to the new Dominion some 119 separate areas as reserves. Quebec and New Brunswick each transferred 19; Nova Scotia 30; Prince Edward Island 2, and Ontario, about 49.

In British Columbia the administrative structure in regard to Indian reserves was peculiar to that province in as much as reserves fell into two main categories, those within and those outside the Railway Belt. But it was not until 1913, by Orders in Council beginning with P.C. 205, that the federal government formally withdrew such areas from settlement by non-Indians.

By the time of the First World War the 119 or so Indian reserves in existence in the five original provinces forming Confederation had increased in number to 1,625 within the then nine provinces and two territories and of that total 1,158 were located in British Columbia.

Surveyors were instructed from Ottawa, when engaged in subdivision work within the reserves, to make careful note of all Indians in occupation of lands, listing names and recording the particular quarter-sections or other acreages on which they resided and indicating whether or not they were treaty Indians. Statutory declarations were not to be taken from Indians but a special report was to be made by the surveyor, accompanied by a sketch showing in each case all improvements made to properties.[7]

One of the earliest post-Confederation surveys on record of Indian reserve lands in Ontario was performed on Manitoulin Island in 1877 by Dominion land surveyor George B. Abrey. In the same field season instructions were issued by the Surveyor General of Canada for the location and survey of a reserve for the Sioux band of about twenty families residing near the international boundary at Turtle Mountain, Manitoba. This task was carried out in 1879 by John McAree as section 31 of a township survey in that area. Also in that season a total of 22 other Indian reserves were surveyed under the terms of Treaties Nos. 2, 3, 4 and 5.

It was in 1877 also that a pioneer in the surveying of Indian reserves became active in Manitoba. John L. Power O'Hanly, after conferring with the Acting Superintendent of Indian Affairs, left Winnipeg for the field on July 14, accompanied by George Parsons and J. M. O'Hanly. At the estuary of the Berens River, which flows into Lake Winnipeg from the east, O'Hanly met Chief Jacob Berens of the local tribe and asked him to point out where he wanted his reserve located. A solemn conference with a number of prominent members of the tribe followed this request. O'Hanly read the treaty text, carefully explaining its terms with the aid of an interpreter. In his field journal O'Hanly described the subsequent discussion carried on "in primitively grave fashion". The Indians wanted the Grand Rapids site on the west side of Lake Winnipeg, rather than the site at Berens River or, for that matter, any other site. At this point in his report O'Hanly wrote that he decided "it was better to abstain from laying out the reserve as originally contemplated" in order to leave the final decision on this momentous issue to the judgment of the Superintendent General of Indian Affairs.

The tribal representatives considered that the allotment of 160 acres for each family of five was inadequate. O'Hanly referred them to the precise words of the treaty and reminded them that he had "not come to make or modify the treaty . . . I must proceed to lay out the reserve in conformity thereto". The surveyor assured the natives, however, that he would make known their representations in the proper quarters but that he now wished them to show him where they wished their reserve to be laid out and if they refused or neglected to make known their choice then "I would proceed to lay it out as I thought best."[8]

The Indians, finding O'Hanly resolute, became more cooperative. On July 26 lines were laid down by the surveyors, defining reserve boundaries and this work was completed on August 17. One passage in O'Hanly's report is of special interest. "From my own observations", he stated, "I consider the departmental map of Lake Winnipeg surprisingly accurate. At each Reserve I made a series of astronomical observations from determining the latitude and variation of the magnetic needle, a detailed record of which, with the computations, is attached. I had no opportunity of finding the longitude at either place, and experience had led me to place little confidence in observations made for this purpose with ordinary surveying instruments and watch. I used a six-inch transit-theodolite for observing and a railroad transit in the field."

Another notable early surveyor of Indian reserves in the western interior was William Ogilvie. On May 20, 1878, Ogilvie left Ottawa, bound for Winnipeg. He arrived at that destination ten days later and lost little time in hiring an assistant surveyor, three helpers and a cook. In addition he acquired for the season four horses and carts along with suitable outfitting. The party left Winnipeg on June 4, arriving in Battleford one month later. During the season's travels Ogilvie and his survey party in early September reached Blackfoot

Crossing, in what is now southern Alberta. There he found many Indians gathered for a treaty payments ceremony. In his field book Ogilvie related that the Indians congregated there had been informed previously of his coming "and some parties either ignorantly or maliciously told them that I was coming to mark out a small piece of land around the Crossing on which they were to be shut up and compelled to devote themselves to agriculture. Not knowing anything to the contrary they were, of course, very much incensed. I immediately sought an audience with Crowfoot, the head chief of the Blackfoot tribes and explained fully and clearly to him the object of the survey which put him and his people in good humor and from the time I commenced the survey until I finished I was not interfered with in any way by the Indians".[9]

This was a considerable triumph in diplomacy but Ogilvie's troubles were not over. After completing the survey of that part of the Blackfoot Reserve located above the crossing Ogilvie began the long return trek across the bleak prairies. The weather had continued to deteriorate rapidly and in early December party rations ran very low. After having been driven at a fast pace for three days his horses, as he put it, "began to fade out". For days Ogilvie and his men had nothing to eat other than small quantities of dried apples and rice. "The day after our departure from Qu'Appelle the axle of our waggon broke and we lost a day searching for and making a new one but the following morning the new one broke after going about three miles. As we could not find any wood strong enough to make one that would stand, we had to abandon the wheel and make sleighs . . . ". On December 30, 1878, the party reached Winnipeg and its members were paid off and discharged for the season.

During the 1878 field season instructions had been issued by the Indian Affairs Branch, Department of the Interior, to the Department of Crown Lands in Quebec to have boundaries surveyed of a five-mile-square reserve on the St. Maurice River. This was one of a number of Indian reserves created under the 1851 statute but which had never been surveyed. Two reserves in Cape Breton county near Sydney, Nova Scotia, containing about 3 and 536 acres respectively, were surveyed in that same year and steps taken to have the land transferred from Crown Province to Crown Canada for the use and benefit of the Indian occupants.

FIGURE 121
Hon. E. Dewdney.

Even after the conclusion of a treaty it was not always an easy matter to win over Indians to the idea of settling on reserve lands, let alone to induce them to make a choice of location. Hon. E. Dewdney, as Indian commissioner in 1883, was to discover this melancholy fact. In October of that year he mournfully reported from Regina to the Superintendent General of Indian Affairs in Ottawa:

"The large sum expended last year in assisting Indians to remove their reserves was, to a great extent, thrown away . . . These Indians, until lately, made the Cypress Hills their point of rendezvous and . . . were constantly tempted to make incursions àcross the border into the camps of United States Indians on horse-thieving expeditions . . . I decided to make another effort to disperse these bands and endeavor to get them to move to those sections of the Territories which they had formerly claimed as their own and had ceded under treaty to the Dominion.

"On being approached in this direction it was discovered that they were desirous of procuring fixed ammunition, of making one final horse-stealing expedition across the line in all the force at their command, return with as many scalps as possible, then after a certain delay, acquiesce with our wishes. Their requests were refused . . . and after two months constant talking and urging, the second of July saw all but some 120 lodges of recalcitrants with their backs towards the hills on the trails leading to their respective reserves."[10]

In the western interior of Canada, in addition to O'Hanly, Ogilvie and McAree the names of a number of other Dominion land surveyors stand out in the records as pioneers in surveys of Indian reserves. Most of these surveys occurred in the 1880s. John Charles Nelson, George Albert Simpson, Archibald W. Ponton, William Wagner, William A. Austin, C.E., Edgar Bray, C. F. Leclerc, Elihu Stewart, Allan Poyntz Patrick, John Lestock Reid, William Pearce and George A. Bayne were prominent among these hardy and resourceful trailbreakers.

Simpson encountered a singular lack of helpfulness on the part of some Indian chieftains of the western interior. When, in the summer of 1880, Simpson was endeavoring to survey Chief Woodpecker's reserve south of Fort Edmonton that Indian leader stopped proceedings by removing the survey instruments. Apparently he felt that the area allotted to this reserve was inadequate. Only five miles of the south boundary remained to be run at the time of the interruption. Later in the same year at Edmonton the chief's brother approached Simpson, asking that the survey be completed and expressing deepest regret on behalf of the chief and band for previous behavior and making extravagant promises as to their future good conduct.[11]

Simpson reported to Dewdney at Ottawa on his field season of 1881 that in mid-April he had broken up his winter camp and left to survey a reserve for Chief Moosomin, who had located himself, in accordance with Treaty No. 6, some 12 miles west of Battleford on the North Saskatchewan River. "On account", Simpson wrote, "of the chief's stubbornness and cloudy weather" work was not started until near the end of April. By mid-June Simpson had undertaken a four-day survey of a reserve on the South Saskatchewan River for Chief White Cap and his band. In eloquent terms the chief deplored the decline in Indian population in the west "whose numbers were [once] as the blades of grass and whose lodges covered the prairie". This reserve was resurveyed by Nelson seven years later. Simpson also reported that, as the third principal meridian ran through Chief One Arrow's reserve, land to the west of this line had been subdivided "as it is always desirable to locate the Indian reserves so as to agree as far as possible with the survey of Dominion lands".[12]

Austin, in that same season, entered the woods at the base of Moose Mountain on June 29 and visited Chief White Bear's reserve at the Heart Hill. Under the terms of Treaty No. 4 the geographical position of the reserve was fixed by him and iron bars planted at its southeast and southwest corners in accordance with the wishes of the Indians. "They are very proud", Austin commented, "of having the corners of their estates marked by iron posts like the

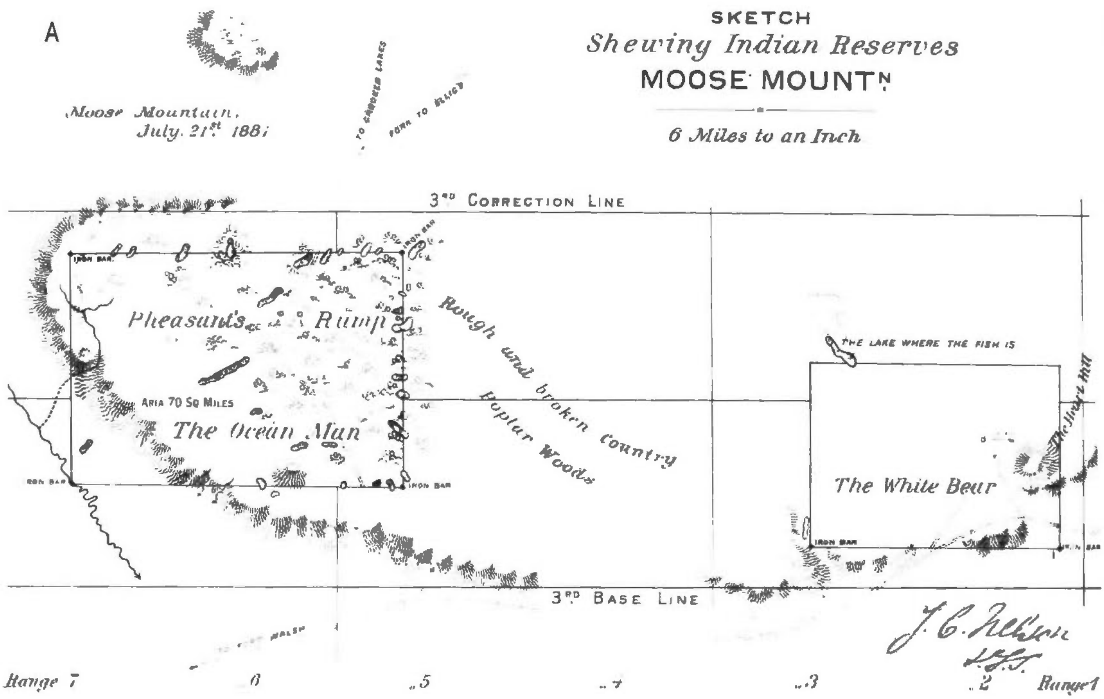


FIGURE 122. Plan of Moose Mountain Indian Reserve, N.W.T., 1881, by J. C. Nelson.

white man".[13] Four years after this survey Austin was promoted to the post of Surveyor and Chief Draughtsman at Indian Affairs headquarters in Ottawa.

In early September, 1881, Nelson arrived at Nut Lake in what is now the province of Saskatchewan. He reported that "the Indians of Yellow Quill's band had been away all the summer at Qu'Appelle to see His Excellency and to receive their annuities . . . On the following day I was visited by a section of Yellow Quill's band, headed by his brother, who is said to be a bitter enemy of that chief. This Indian informed me that they did not wish to have any surveying done in the country and they were much dissatisfied. I explained to him the objects of the survey and how desirable it was that they should direct their attention to farming operations . . . They subsequently assented to my going ahead with the work. After the pow-wow I was informed by them that a small present of tea and flour was customary on such occasions and would be most acceptable. I gave them a small quantity of these commodities and reminded them that they had forgotten to ask for some tobacco and sugar . . . The survey of Fishing Lake Reserve was completed on September 29 and the bell mare had a colt which caused a great commotion among the mules".[14]

John C. Nelson who, in 1889, prepared for Dewdney a most useful volume of descriptions and plans of Indian reserves in the western interior, is on record as well concerning some extreme weather conditions faced by him and his party in the 1882 field season on the prairies. On May 20 they experienced a severe snowstorm, preceded by a high west wind and followed by a hard frost. Water in a pail outside Nelson's tent was frozen to the depth of one inch. Snowdrifts were piled high on all sides. Nelson observed that many birds were frozen to death in that fierce and most unseasonable storm. Nelson's report continued:

"On the 24th the party started for Muskowpeetung's to complete the survey of the reserve for his band. At this time my mules were all more or less attacked by mange, a fact I first discovered after they swam the Qu'Appelle River. A few washings with carbolic acid soap and the application of a mixture of train oil, sulphur and turpentine completely extirpated these pernicious parasites."

In another part of his report for that season Nelson commented that "although it is desirable to locate the boundaries of the reserves so as to coincide with the legal subdivisions of the Dominion Lands Surveys still, in this case, it was not practicable to do so, and at the same time meet the wishes of the Indians, who preferred to have the rear, or south, boundary a straight line as shown on the plan".

Surveying Indian reserves in British Columbia began in earnest in the late 1870s. In a report to Sir John A. Macdonald, the then Superintendent General of Indian Affairs, concerning the year ended June 30, 1878, note is made of the activity during the early part of that summer of two survey parties on Vancouver Island under the leadership of Edward C. Mohun, C.E. These were surveys to establish boundaries of reserves as decided upon by Indian commissioners in 1877. Survey work on the mainland was in the hands of Capt. William S. Jemmett, R.E. and Ashdown Henry Green, R.E. All three men had been authorized, prior to 1891, to practise in the coast province as fully qualified land surveyors. Jemmett, in his diary of the 1881 season, reported laconically "June 3: Finished reserve at 1 p.m. in beaver dam, 4 feet of water. Hot day. Chained a mile checks . . . river much swollen. Return to main reserve at 4.30 p.m.".

Another noted surveyor of Indian lands in early days in the coast province was Ernest Meeson Skinner who reports in his diary of May 25, 1885: "Went down to Skoon Koonh [Skoonkoon] and looked over land which is worthless. Heavy storm came on, came back and finished Reserve at 79 mile post. Had to give much more land than was at first supposed, to include graves. Land is good for nothing, most of it is old river bed and slide from opposite bank".[15]

Indian reserves in British Columbia took many forms and represented a variety of functions. Sometimes these special areas enclosed one tiny fishing station, another, a few small islands, on occasions a graveyard, some oyster beds or a village. In addition to original surveys of these properties, as well as other much larger areas, any increase or decrease in the size of such reserves called for additional survey work.

The Indian Superintendent in Victoria informed Sir John A. Macdonald in 1880 that "Indians who have reserves surveyed are very anxious to have these marked off, and divided into individual allotments. I think it is very desirable that this should be done, and it will constitute one of the first and most important duties of local agents to be appointed in the province. A great stimulus will be given to the industrious Indian by giving him a tract of land and defining its boundaries within which he may recognize his own estate. I know of no plan more calculated to discourage barbarous customs which tend to destroy individuality, or to induce the improvement and general cultivation of their reserves. The first and distinguishing principles of civilization, no doubt, consist in the recognition and protection of individual property rights . . . ".[16]

The experiences of most of the early surveyors of Indian reserves in this country, as recounted in their journals and diaries, indicate that the functions of survey party chiefs were not, in pioneer times, confined to purely surveying operations. They were, in fact, called upon to serve in a variety of important roles. They acted as negotiators, interpreters, mediators and census takers. They were called upon frequently to advise Indians on such matters as soil comparisons, land values and the ultimate precise location of reserves in order that maximum advantage would redound to Indian occupants from actual surveys. On the whole, members of the surveying profession discharged their varied, important and sometimes highly sensitive tasks with tactfulness and understanding, blended with firmness when that quality of character was required. In this field of public service surveyors made a worthy, lasting contribution, at a critical stage in the development of the nation, to the peace, order and good government of Canada and to the ultimate well-being of its Indian population.

18

THE GEOLOGICAL SURVEY OF CANADA: FIFTY YEARS OF MAPPING: 1867-1917

In 1868, the year before he ended his 26-year term as first Director of the Geological Survey of Canada, Sir William Logan (1798-1875) made a topographical survey of the Pictou coalfield in Nova Scotia. Despite his retirement from leadership of the organization Sir William maintained an active interest in mapping. Until 1874 he continued map work by himself in the Eastern Townships, a task he had commenced in 1848. Others in the Survey organization, such as James Richardson and Arthur Webster, were engaged from time to time during this period in the same region. The paced measurements of roads and of exploration lines by these three men totalled about 17,000 miles and covered an area of 26,380 square miles.[1]

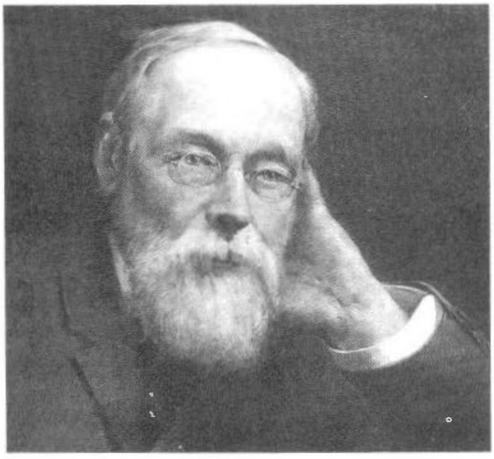


FIGURE 123
A. R. C. Selwyn.

Logan's successor, Alfred Richard Cecil Selwyn (1824-1902), was confronted, after 1871, with a survey problem of awesome dimensions. Vast territories in the western interior had been acquired by Canada from the Hudson's Bay Company in addition to the newly-joined provinces of Manitoba and British Columbia. Selwyn, at the outset of his term of office, presided over a staff of only five geologists, namely, Edward Hartley, Robert Bell, James Richardson, Charles Robb and H. G. Venor. Other staff members included T. Sterry Hunt, mineralogist; E. Billings, palaeontogist; and two draughtsman-topographers. An artist, Horace Smith, and a museum preparator, T. C. Weston, completed the tiny organization. Under Selwyn the staff was expanded substantially by the addition of a number of men of outstanding ability. Among those who were attracted to the Geological Survey during Selwyn's administration were G. M. Dawson, A. C. Lawson, R. G. McConnell, J. B. Tyrrell, A. P. Low, R. W. Ells, Willian McInnes and A. E. Barlow. In this chapter it is possible only to summarize the extensive surveys of these and other scientists by selecting individual achievements that are fairly representative of the nature and immense scope of all the work performed.

With Richardson as assistant Selwyn travelled in the interior of British Columbia from late July to mid-November in 1871 on the heels of engineering parties searching for the most advantageous rail route through the Rocky Mountains. The mission of the two men was to investigate the geology and mineral resources of the areas being probed by the engineers. It was during this survey that Selwyn, on one memorable occasion, discovered that his hungry horse had eaten his priceless notebook.[2]

Selwyn also instigated systematic mapping of the Maritime Provinces and of southern Quebec, also gathering information on the mineral resources and natural history of these regions. On three of his early expeditions he was accompanied by John Macoun, the eminent botanist. Selwyn was keenly interested in the expansion of museum contents and facilities. When the head office of the Survey was moved from Montreal to Ottawa in 1880 he reported on the transfer of 1,729 boxes, 101 barrels and 162 packages of specimens, the complete shipment weighing 282,585 pounds.

During the first 53 years of its existence the principal direction and administration of the Geological Survey of Canada was shared over nearly equal terms of office by Logan and Selwyn. Under their able, farsighted supervision the organization was given a sense of direction, a loftiness of purpose and a strength of impetus that has since continued to feature its growth and increasing usefulness. The story of these formative years would be quite incomplete, even in a relatively brief chapter, without special comment on the brilliant careers in the federal service of Joseph Burr Tyrrell (1858-1957) and Alfred Ernest Barlow (1861-1914). Tyrrell, appointed to the Survey in 1881, became Dawson's assistant when, two years later, they explored and mapped the Rocky Mountains region between the 49th parallel and the Red Deer River. Dawson, Tyrrell and McConnell, in the mid-1880s, conducted extensive surveys in the western interior and their work was published, on a scale of 8 miles to the inch, in maps of the Bow and Belly river regions, Cypress Hills, and what is now northern Alberta, covering an area of 100,000 square miles.[3]

Tyrrell's chief claims to fame as a reconnaissance surveyor derive, however, from his epochal journeys in the Barren Lands in 1893 and 1894. On the first of these missions he was accompanied by his brother, James William Tyrrell (1863-1945), who acted as topographer and who later wrote a book on his experiences during this expedition.* After graduating from the School of Practical Science, Toronto, in 1883, J. W. performed topographical and geological surveys in the vicinity of the Lake of the Woods as assistant to A. C. Lawson in the

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*"Across the Sub-Arctics of Canada" J. W. Tyrrell, C.E., D.L.S. Wm. Briggs, Toronto, 1897.

compilation of maps published on a scale of 2 miles to the inch. Following this project Tyrrell was appointed a hydrographer and weather observer on the vessel *Alert* that transported the federal government expeditions of 1885 and 1886 to Hudson Bay and prepared related maps. A Dominion and Provincial (Ontario) land surveyor, J. W. Tyrrell was appointed Engineer and Surveyor for the city of Hamilton in 1888. At the turn of the century he made a report to the Surveyor General, Ottawa, on his explorations of the season of 1900 between Great Slave Lake and Hudson Bay. He prepared a large sheet map of the country traversed. In seven months Tyrrell travelled 4,600 miles although his actual survey extended to 1,729 miles only. He brought back with him, after numerous privations, about 100 photographs, a large number of astronomical and magnetic observations together with some notes and specimens of rock formation and minerals.[4]

FIGURE 124
J. B. Tyrrell.

On the first of the two journeys made by J. B. Tyrrell into the northland he and his party, travelling in three canoes manned by six crewmen, descended the Athabasca River and surveyed the north shore of Lake Athabasca by boat-log and solar compass. Their instructions were to conduct an exploratory survey of the Barren Lands, then a largely unknown area of some 200,000 square miles lying north of the 59th parallel between Great Slave Lake and Hudson Bay. Although the party's topographer mentions that some crude sketch maps were obtained from local Indians, it is likely that for guidance the group placed more reliance on the rather imposing collection of instruments taken along, namely, one sextant, one solar compass, two pocket compasses, one prismatic compass, one fluid compass, two boat-logs, two chronometers, one aneroid barometer, one pocket chronometer and three good watches.

From Black Lake, just to the east of Lake Athabasca, the party ventured northeasterly toward Chesterfield Inlet, reaching its shores on September 12. The last stage of the trip, down the open coast, from the Inlet to Fort Churchill, proved to be the most dangerous and trying experience of all the men had endured. Provisions ran low and opportunities to obtain game were scanty. Snowstorms, menacing ice formations, sickness, and frostbite plagued the members of the expedition at this point. An utterly exhausted group finally reached their destination on Hudson Bay. When sufficiently rested the party continued on by snowshoe and dogteam, reaching West Selkirk on January 1, 1894, en route to Winnipeg. They had survived a gruelling 3,200-mile journey that had commenced on May 30 of the previous year. The topographic map, 25 miles to the inch, accompanying the Tyrrell report of 1896 was compiled by D. B. Dowling.

In the summer of 1894 J. B. Tyrrell embarked on a second expedition to the Barren Lands, travelling to Kasba Lake by way of Reindeer Lake, then down the Kazan River. Avoiding Chesterfield Inlet on this trip the party portaged to Ferguson River, descending that stream to Hudson Bay. The canoe trip along the open coast to Churchill was repeated and that port reached on October 1. These two journeys into the Barrens in successive years provided much geographical and geological information. It was established, for example, that in the Pleistocene age a centre of glaciation existed west of Hudson Bay from which a continental ice mass, now known as the Keewatin Glacier, extended in all directions. The distance surveyed by the two Tyrrell expeditions totalled 2,900 miles, of which 1,312 miles were travelled by canoe. Distances obtained were checked by numerous observations for latitude.

J. B. Tyrrell retired from the Geological Survey in 1898 to become a leader in the Canadian mining industry as well as in other varied fields of activity. He became President of the Champlain Society, the Royal Canadian Institute and the (Royal) Canadian Geographical Society. The Tyrrell Medal of the Royal Society of Canada is awarded annually for the best historical work published in this country. In 1905-06 his brother served a term as President of the Ontario Land Surveyors Association.

Another pair of brothers, along with their father, made notable contributions to Canadian geological surveying and related topographic mapping. The father, Robert Barlow, R.E., and a son, Scott Barlow, were appointed to the Survey staff by Logan. Robert Barlow's contributions to the 1863 geological map of Canada helped to make it one of the most interesting and useful examples of Canadian cartography up to that time. Another son, Alfred Ernest Barlow (1861-1914) studied geology under Sir J. W. Dawson at McGill University. He proved to be a brilliant student and won the Logan Medal. In 1883, the same year in which G. M. Dawson was made Assistant Director of the Survey, A. E. Barlow joined its staff.

In work that spanned a quarter-century, performed mostly in Ontario, A. E. Barlow left an indelible impression upon the history of Canadian geological surveying and mapping. He was an able topographer, as evidenced by the results of his investigations published in 1910. In the year following his admission to the Geological Survey of Canada Barlow, Ellis and Giroux made chain and paced surveys totalling 1,003 miles in order to complete information for publication of the Cumberland, Nova Scotia, coalfield map, a project started by Scott Barlow some years previously.[5]

In 1885 Barlow assisted A. C. Lawson in making a detailed mapping survey of the Lake of the Woods and Rainy Lake areas as well as along the Winnipeg River, for publication on a scale of 2 miles to the inch. In 1888 to 1891 Bell and Barlow completed information for the Sudbury and French River sheets. In the seasons of 1892 and 1893 Barlow, with W. A. Johnston as his assistant, surveyed the western portions of Lake Nipissing and roads in the Nipissing and Temiscaming map-areas, totalling 1,295 miles. In 1895 he did similar work in the Pembroke and Cornwall districts and, for the following four seasons, he was engaged in mapping and detailed geological studies of the Haliburton and Bancroft districts. At the turn of the century Barlow made examinations of the nickel and copper resources of the Sudbury area.

On the retirement of Selwyn it was natural that George Mercer Dawson (1849-1901), who had served as Chief Geologist and as Assistant Director of the Survey since joining the staff in 1875, should become its Director. This latter promotion took place in 1895. His untimely death in Ottawa, only six years later, was widely mourned. Though his term as Director was relatively brief, Dawson proved to be, in every respect, a worthy successor to Logan and Selwyn.

The twenty years Dawson spent in the field were remarkably fruitful. His precise, first-hand knowledge of the far west and northwest of Canada and the effectiveness with which he disseminated that knowledge was unmatched in his day. His fame is fittingly perpetuated in the name of Dawson "City", the important and historic community so closely associated with the mining industry of the Yukon since its infancy. "Doctor George", as he was familiarly known, was not only an eminent geologist but as well a foremost naturalist, ethnologist and palaeontologist, in addition to being a prolific collector of specimens.[6] In addition he hammered away intelligently and persistently at problems of administration and of pure geological science. His reports, maps and papers are models of careful description and lucid exposition. Dawson's contributions to the literature of geology and other sciences in Canada are illuminating in content and far-ranging in scope. When he functioned as Acting Director of the Survey during an extended absence of his chief, Selwyn expressed in writing his "high appreciation of the very valuable and efficient manner in which Dr. Dawson has performed all the work".

FIGURE 125
Dr. G. M. Dawson.

Dawson's topographical work ranged over the entire region from Cypress Hills in the western interior to the Queen Charlotte Islands and from the 49th parallel to Yukon Territory. His achievements in the interior of British Columbia were especially noteworthy. In the seasons of 1875-76, for example, he surveyed trails, lakes and streams in the largely unexplored area between the Fraser River and the Coast Range. In 1879 he made a traverse from the Skeena River to Edmonton. From 1888 to 1890, with his topographical assistant, James McEvoy, he resurveyed the country depicted on the Kamloops map sheet. A network of triangles, based on the Canadian Pacific Railway and other surveyed lines, was established between points, each of which was occupied as a transit station and sketching place, elevations being determined barometrically and by angles of elevation. Other topographic details were filled in from paced and track surveys, checked by latitude determinations. During the same two-year period Dawson made surveys with boat-log of the Arrow Lakes and the northern part of Kootenay Lake.

Any map by Dawson had the reputation of being as good as a "well-defined trail, a literal photograph of the country and containing information phenomenally complete and accurate". His surveys achieved a high degree of excellence partly because he made great exertions and underwent severe physical ordeals in order to get all the facts possible and to verify such information by personal observation. Short of stature and frail in appearance, Dawson nevertheless accomplished astounding feats of endurance in the field. Afflicted by a chronic chest weakness, and with his back humped by a boyhood mishap, he somehow contrived to rival the Indians in surmounting extreme hardships in the wilderness without complaint. A cheerful, amiable disposition, combined with an indomitable will and an insatiable passion for exploration and discovery, helped sustain Dawson through the most strenuous adventures.

There was something also of the poet and minstrel in Dawson's soul. From time to time he committed to his field journal and other records fragments of verse that reveal his basic views on life. His innate sense of humor flashes brightly through lines he penned in awe of that tireless tormentor of surveyors through the ages on this continent, the ubiquitous mosquito. The verse concludes,

"Oh smudge, oh glorious smudge,
let me entrench in thy noxious cloud
and nose and eyes all smarting from the stench,
then comes the winged crowd!"

On occasion his verse had a distinct geological flavor. In the wilds of British Columbia he was inspired to write:

"Contorted bed, of unknown age,
My weary limbs shall bear,
Perhaps a neat synclinal fold
At night shall be my lair.
Dips I shall take in unnamed streams,
Or where the rocks strike, follow
Along the crested mountain ridge
Or anticlinal hollow . . .
Where long neglected mountains stand
Just crumbling into shreds
And laying bare on every hand
The treasures of their beds."[7]

The fame of this versatile surveyor-scientist, administrator and author lives on not only in the name of Dawson in Canada's northland but as well in the names of a Manitoba bay, a British Columbia glacier and mountain, and the Dawson Range in Yukon Territory.

Dr. Dawson was succeeded by Dr. Robert Bell (1841-1917) as head of the Survey. At the age of 15 Robert Bell had worked with one of Richardson's survey parties in the Gaspé Peninsula. In fact, for several summer seasons thereafter the young student worked for the Geological Survey of Canada in the same region. Bell also worked in western Ontario in the 1870s where he continued topographic mapping begun by Murray. He explored Manitoulin Island and the north shore of Lake Huron as well as working with Selwyn along the English and Winnipeg rivers. In fact, there were not many areas of Ontario that he failed to visit and examine during the last three decades of the 19th century. In 1878 he received his Doctor of Medicine and Surgery degree from McGill University. In the seasons of 1895-96 Dr. Bell was in Labrador, part of the time with Brock.

In the field Bell's regime was Spartan-like and the story is told by his canoeman, likely an apocryphal yarn, that on one occasion when the survey party had reached civilization after a long period in the wilderness it pitched camp not far from a store. For weeks beans, bannock and fish had formed the staple, and often the only, items of diet. The cook of the party expected something of a more exotic nature to be added by the chief to the evening meal in view of their happy proximity to a source of more varied food supplies. Dr. Bell, at an appropriate moment during the preparations for the drab repast, dramatically announced, "Joe, the boys have had a long, hard trip. They have worked well and I think we ought to give them a treat tonight. *Here is a can of tomatoes!*"[8] (author's italics)

During Bell's term as Acting Director of the Survey from 1901 to 1906 emphasis continued to be placed on exploration, with increased attention to the geological investigation of mining areas.

The name of Albert Peter Low (1861-1942) has become almost synonymous with Labrador, the geological and other resources of which were explored, reported upon, and mapped by him so accurately and so extensively in the 1890s. A graduate with honors from McGill University, Low joined the Geological Survey staff in 1882 and began a career as a member of that organization covering a quarter-century and culminating in his appointment as Director in 1906.[9] In two principal ways Low's brief period as Director of the Survey was noteworthy. First, he raised qualifications of technical personnel by setting higher standards for admission to the ranks of the Geological Survey of Canada. Second, during his term of office a new federal government department was formed, the Department of Mines. It consisted of a Mines Branch and the Geological Survey, and the new organization reported

FIGURE 126
A. P. Low.

to the Minister of the Interior.* Although his health was beginning to deteriorate, Low was named first Deputy Minister of the Mines Department and this appointment terminated his service as Director of the Survey after 19 months in the post. He retired from the public service in 1913.

*In accordance with Chap. 29, Statutes of 1907, and by Order in Council P.C. 1184, the Department of Geological Survey was abolished as a separate department, and from May 3, 1907, formed part of the new Department of Mines.

In Low's first season with the Survey he was assistant to R. W. Ells in the Gaspé region. By 1885 he was engaged in highly important surveys on his own responsibility but not before undergoing a unique physical test. In the previous year a joint federal-provincial expedition had been sent to Lake Mistassini in central Quebec, the head of Rupert River. John Bignell, a land surveyor, represented the province of Quebec. The party arrived at the Hudson's Bay Company post on the lake on December 23. The last ten days of the journey involved travel by snowshoe on low rations and in temperatures ranging to 40 degrees below zero. Arguments occurred during the winter over whether Low or Bignell was party chief. In order to clarify the situation Low packed his toboggan, donned snowshoes and set out for Ottawa. The outward trip took him from February 2 to March 2 to complete. Armed with a letter from his superiors placing him in full charge of the expedition Low returned to the field party, five arduous weeks after leaving the capital. That summer the survey of Lake Mistassini was completed, after which Low descended Rupert River to James Bay.[10]

Low is best known, however, for his geological investigations in Labrador extending over eight consecutive seasons from 1892 to 1899. In several of these seasons D.I.V. Eaton, C.E., acted as Low's assistant and topographer. Low is on record as stating in characteristically generous fashion that "it is entirely to Eaton's careful work that the exact surveys of these years are due. Mr. Eaton, since his return to Ottawa, has compiled the map which accompanies this report".[11] In the initial season of this series of surveys Low and his party crossed from Lake St. John to Lake Mistassini and from there to James Bay by way of the Upper Rupert and Eastmain rivers. The summer of 1894 was occupied in mapping lakes and streams in the headwaters region of Hamilton River. During the seasons of 1893-94 Low travelled 5,460 miles, 1,000 of this total on foot.[12]

In the following season Low made his way along the Manicouagan River, involving passage through a narrow, perilous, 45-mile-long gorge where portages were impossible and rapids continuous. At this stage of his narrative Low reports that "while descending this portion of the river, owing to the accidental upset of a canoe, one of the Indian guides named Paul Bacon was reported drowned in the heavy water . . . ".[13] Above Lake Mushalagan Low reported "some thirty miles . . . of crystalline limestones are developed in great thickness . . . There is an extraordinary band of iron which appears to belong to the beds associated with the limestone". Low, in fact, made known for the first time that from the upper reaches of Hamilton River to Koksoak River there was a belt of stratified rocks containing high-grade iron ore estimated in millions of tons.[14]

Within a span of 12 miles Hamilton River drops nearly 900 feet. Low, in his official survey report of 1895, displayed marked literary talent in his graphic description of "one of the greatest and wildest descents of any river in eastern America". The final 300 yards of rapids above Grand Falls of the Hamilton are, in Low's words, "down a very steep grade, where the confined waters rush in a swirling mass, thrown into enormous long-surging waves, at least twenty feet from crest to hollow, the deafening noise of which completely drowns the heavy boom of the great falls immediately below. After a final great wave, the pent up mass of water is shot down a very steep incline of rock for 100 feet, where it breaks into a mass of foam, and plunges into a circular basin below, the momentum acquired during the first part of the fall being sufficient to carry it well out from the perpendicular wall of rock at the bottom, leaving almost a free passage between the foot of the cliff and the falling water. The total fall from the crest of the incline to the basin below is 302 feet. The Indians believe that the space between the falling water and the rocky wall is occupied by the spirits of two maidens who were accidently carried over the falls, and who now pass their time in dressing and preparing deer skins. On this account, or more probably because of the feelings of awe inspired by the grandeur of the surroundings and the enormous power displayed in this rush of waters, those who hunt in the vicinity cannot be induced to visit the falls or the canyon below . . . The noise of the fall has a stunning effect and, although deadened because of its inclosed situation, can be heard for more than ten miles away, as a deep, booming sound. The cloud of mist is also visible from any eminence within a radius of twenty miles".[15]

In 1896 Low descended Moose River to James Bay and sailed in a government fishing vessel some 450 miles along the east coast of Hudson Bay to Richmond Gulf. From the Gulf he crossed the height of land and paddled down the Stillwater, Larch and Koksoak rivers by canoe to Fort Chimo. In the next season Low and his party surveyed the north coast of Labrador along Ungava Bay and the south side of Hudson Strait, exploring and mapping by boat. In the two following seasons he examined in similar manner the east coast of Hudson Bay along its entire length.

In 1903 Low led a federal government expedition into northern waters in command of the 465-ton *Neptune*, carrying a crew of 43. On this 15-month-long mission Low, in the name of Canada, took formal possession of Southampton, Ellesmere and adjoining islands in the Arctic Archipelago. In his book "Cruise of the Neptune" Low provides a memorable account of this 10,000-mile voyage.* One of the important objectives of the expedition was to conduct topographic surveys of areas covered by it. C. F. King of the Geological Survey was in charge of this mapping activity.

Pioneer geologists in Canada were never provided in advance with accurately contoured topographic maps so essential to the effective presentation of the geological information they gathered. Accordingly, in the early stages of national development both the mapping process and the assembling of data had to be carried on concurrently by geologists in the field. This burdensome condition obtained for some years after the turn of the century because the staff of draughtsmen employed by the Survey was limited in numbers and thus unable to cope with rapidly expanding requirements. The opening up of the country at an unprecedented pace had stimulated a lively demand for accurate topographic maps. Pressures continued to mount steadily for improved map-making services.

Frequently the obligation of the working geologist to function in a dual capacity interfered with the accurate definition of geological boundaries. All too often this state of affairs prevented him from recognizing in the field those aspects of his information that needed amplification. Geologists in those formative times seldom got back to the same field to revise their maps before publication. Various schemes were improvised to deal with this unsatisfactory situation. Copies were made of all serviceable maps and plans in Crown Lands Offices of Upper and Lower Canada, and geological surveys were often carried out by means of important corrections made on these documents.[16] Later, when explorations and surveys were made for railway-building purposes, boundary lines and timber limits, tracings of resulting maps and plans were obtained by the Geological Survey. Copies of a number of plans of government surveys of the Canadian Pacific Railway were preserved intact in this way when the record office in Ottawa was destroyed by fire in 1872.

During the opening decade of the 20th century it became clearly evident that the most logical solution of the problem would be the appointment of a permanent staff of trained topographers, directed by a man well-versed in the arts of mapping. Such an arrangement, it was reasoned, would make possible the assignment of a topographer to assist the geologist in the field by providing him with a map of the area even before the examination of it began.[17]

Consequences of a tragedy that occurred in the Canadian Rockies early in the new century spurred mappers of the Geological Survey of Canada into special activity and placed their work in the spotlight of public attention. Early on a spring morning in 1903 a disaster of

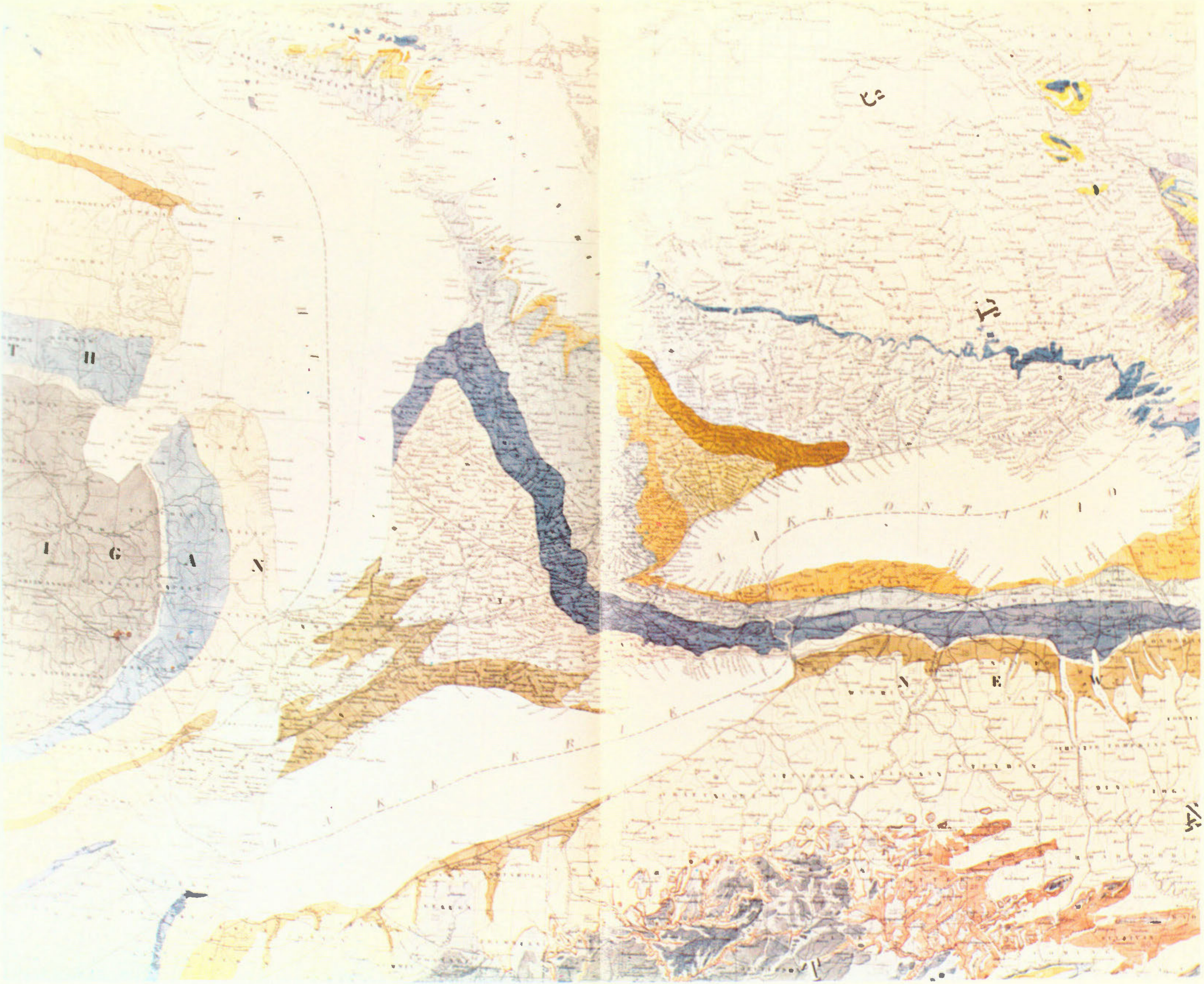
*Government Printing Bureau, Ottawa, 1906.

FIGURE 127. Photo of the Frank slide.

awesome magnitude struck the Alberta town of Frank, located in the Crowsnest Pass, nestling at the base of Turtle Mountain. The town had come into being two years previously when the Canadian American Coal and Coke Company had commenced mining operations. By 1903 more than 1,000 tons of high grade steam coal were being produced daily by this community, named after A. L. Frank, the company president. At the end of the early morning shift on April 29 a wedge of limestone rock, estimated at 70,000,000 tons, broke away from the mountain top and crashed down, without warning, on the sleeping community and mine workings. Within 100 seconds the town was almost completely buried, the entire coal mine workings wiped out, the course of the Old Man River altered and the Canadian Pacific Railway line through the pass was covered to a great depth. A dense pall of dust hung over the affected area for many hours after the avalanche. There has never been any reliable count of the lives lost in this calamity but officially the total was set at 66. In June, 1903, R. W. Brock and R. G. McConnell of the Geological Survey staff were appointed a commission by Interior Minister Sifton to make a report to him about the Frank Slide and, in part, their verdict was that the slide had been due "not to a single cause but to a combination of causes, among which the opening of a large chamber in the mine, situated under the base of the mountain, may have been a contributing cause".[18]

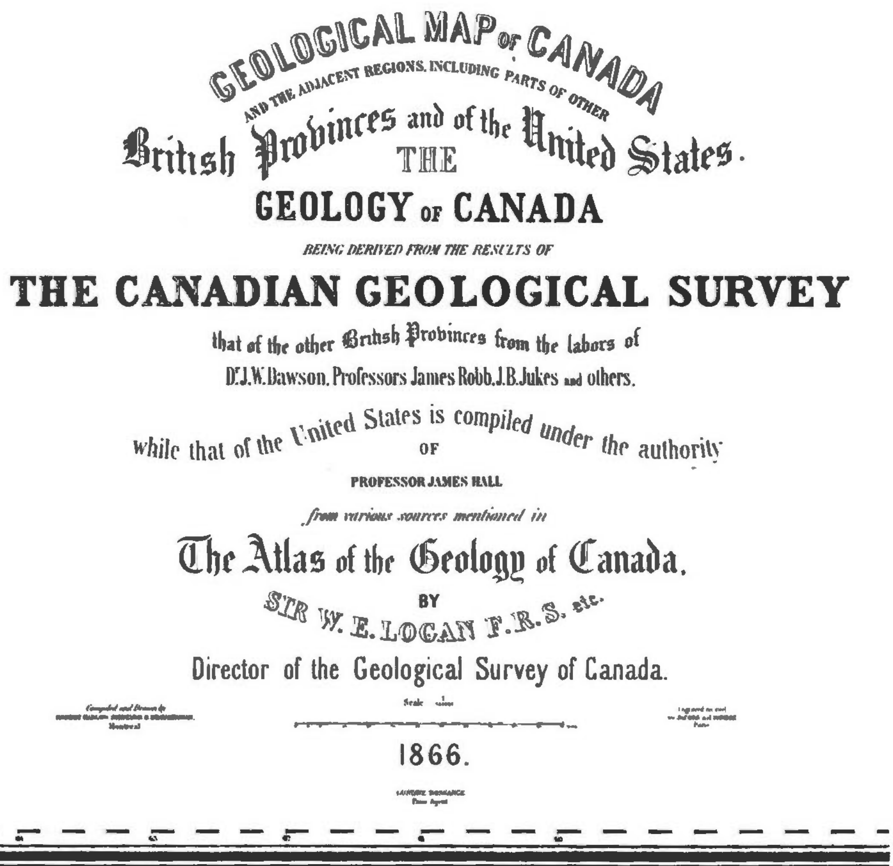
Following the catastrophe the Survey kept Turtle Mountain under close inspection. In October, 1910, Brock and Boyd of the staff visited the site of the slide in company with Provincial Mines Inspector Stirling and three representatives of the coal mining company. As a result of their findings it was recommended that the coal seams at the base of the peak be not disturbed because of the unstable condition of the northwest peak and shoulder of Turtle Mountain. In the field season of 1910 Boyd and his assistants made a topographic map of the area and this map, in manuscript form, was placed at the disposal of a government commission of three men who investigated post-slide conditions in 1911. In addition to the detailed map he supplied, Boyd contributed a useful miniature model of the mountain, using the map as a guide.[19] The report of this commission confirmed opinions previously expressed by officers of the Geological Survey of Canada on the dangers inherent in any continuation of coal mining in the immediate vicinity of Turtle Mountain.

Reginald Walter Brock (1874-1935) early recognized the need for specialization within the Survey organization and decided to do something about it. In 1908, when he succeeded Low as Director, Brock concentrated on the task of improving the over-all efficiency of the Survey. He fathered the formation of the Topographical Division as an agency staffed by men capable of preparing all topographic maps required for the effective presentation of geological data. In Walter Halcro Boyd (1878-1960) Brock found the man he wanted to be chief of the new division. The 22-year-old Boyd, an outstanding athlete and gifted map maker, had joined the Geological Survey as a topographer in the early summer of 1900. The son of Sir John and Lady Boyd of Toronto, the newcomer to Ottawa was a graduate of Upper Canada College and the University of Toronto.



MAP 16. Portion of Sir William Logan's geological map of Canada, 1866.

Brock and Boyd made an ideal team in organizing and promoting the development of a new topographical division. Yet something more was required to advance this staff-building program. What was needed was the contribution that could be made by a geological surveyor of long experience in the field who possessed also administrative abilities of a high order.[20] The United States Geological Survey was approached on this problem and as a result, and at his own request, Major Robert Hollister Chapman (1868-1920) of that organization was loaned to help train a corps of qualified Canadian topographers serving the Geological Survey of Canada. At the time of this transaction Chapman had upwards of thirty years of service with the American government agency, much of it in the field. He had explored and mapped wilderness areas in the southwestern states, including famous Death Valley. His topographical skill had impressed Canadian authorities and the Survey readily agreed to employ Chapman for three successive seasons, commencing in 1909. During his stay in Canada he introduced American mapping techniques and instructed newcomers to the Topographical Division in this type of field work. It was not an easy matter in those days to assemble a suitable group of trainees. Brock, in fact, complained officially about the difficulty "in securing the right type of qualified men" for the new division.[21]



Legend from Logan's 1866 map (see facing page).

Despite recruitment problems there was one appointment to staff at this time that Brock never had any reason to regret. Kenneth Gordon Chipman (1884-   ), born in Berwick, Nova Scotia, the son of a merchant, went to Boston to continue his education there. Dr. R. A. Daly, a professor at the Massachusetts Institute of Technology had served for a time with the Geological Survey of Canada and had recommended this promising young student to Brock's attention. Following his graduation from the Institute in 1908 Chipman received word from Brock to report to him in Ottawa. Chipman, on arrival, was promptly employed on summer work with the Survey at the monthly rate of $45.00. His preliminary work was so satisfactory that he was appointed to the permanent staff of the Survey in September, 1908, at the annual salary rate of $1,300.00. Because of a tangle in red tape formalities Chipman had to wait, however, until the following March for his first pay cheque! He was the first to join the staff of the Topographical Division after Boyd was made its chief. Chipman's long, distinguished career in federal government topographic work extended over forty years, more than a quarter-century of that period with the Geological Survey of Canada.

In the summer of 1909 Chapman was placed in charge of several Geological Survey parties engaged in topographic mapping of southern parts of Vancouver Island, with Chipman as his senior assistant. The Canadians were introduced to what were considered by their American instructor to be advantages of military discipline and procedure. Camp tents, in the tidiest possible arrangement, were dominated by a tall, central flagpole from which flew the Union Jack and the red and white pennant of the Survey. There is little hard evidence, however, to support the yarns of some veterans of these Island surveys who claim that topographers were marched in formation from camp to their field stations and back. But semi-military garb was issued to each man, consisting of khaki jacket and trousers. The jackets could be fastened snugly at the neck by special bronze buttons of Survey design. A light Stetson hat completed the impressive ensemble. Chapman's plan in recommending the adoption of this uniform was not, apparently, that it should be worn in the field but rather on visits to nearby communities. Work clothes inevitably got soiled, wrinkled and out of shape. In Chapman's view it was important that men under his authority possess a smartly-turned-out appearance in their contacts with the general public. Most of the quasi-military trimmings introduced by Chapman failed, however, to capture the imagination or approval of Canadian surveyors and were promptly discarded after the Major's departure to the United States.

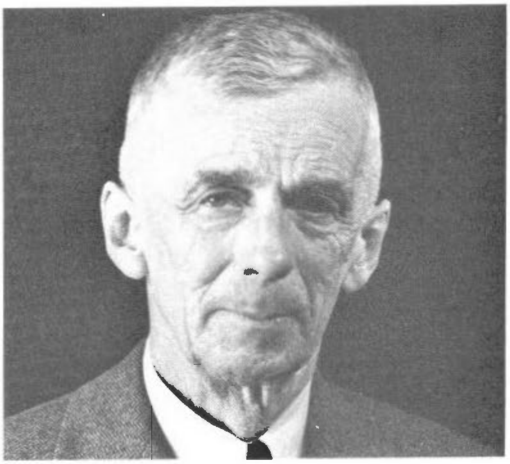


FIGURE 128
K. G. Chipman.

The first season's work on Vancouver Island extended from early June to November. All of the Saanich Peninsula and a part of Saltspring Island as well as a number of smaller adjacent islands were mapped, the total area involved being about 150 square miles. The plane table was used and it was Chipman's first important contact with this map-drawing method. But he quickly mastered the technique. Field maps were drawn on a scale of 1:48,000, with 20-foot contour intervals. Eight assistants, including T. A. McElhanney, worked on these tasks. The topographer would complete a pencil drawing in the field, leaving only the inking and lettering for the office at season's end. Meanwhile at Slocan in British Columbia, Boyd and a party were busily mapping some 276 square miles, including principal towns and mines of the district. In the Lake Simcoe district of Ontario, W. A. Johnston and party were continuing the mapping of areas first investigated by Alexander Murray in the early 1850s.

Four parties took to the field on Vancouver Island under Chapman in the second season of his direction, beginning work in May. Chiefs of party were K. G. Chipman, S. A. Wookey, B. R. MacKay and T. A. McElhanney. Although the topographers were much handicapped by forest fires and dense smoke, followed by days of heavy, continuous rains, about 1,000 square miles were mapped during 1910. Brock, by now Director of the Survey, was enthusiastic in his report on the season's accomplishments under Chapman's supervision. "A corps of carefully selected topographers", Brock reported, "is being trained and our standard maps now being made will compare favorably with those produced anywhere. No part of the Geological Survey's work is of more economic value."[22]

In 1911 the topographic work was resumed on the island with Chapman's party working on the Alberni sheet, Chipman and one assistant on the Cowichan Lake sheet. Although delays were experienced because of foggy conditions and because travel overland was made exceedingly difficult by dense underbrush and a lack of trails, the two survey parties together mapped 2,805 square miles. Scales of these maps varied from 400 feet to the inch to 4 miles to the inch, with contour intervals ranging from 10 to 500 feet.

Chapman returned to the United States after the 1911 season. In 1913 he was placed in charge of Glacier National Park, Montana, as superintendent. It was an area he had helped to map in other days. As an enthusiastic mountain climber he returned briefly to British Columbia in 1915 to scale Mount Sir Sandford, highest peak in the Selkirks. He died in New York City on January 11, 1920, at the age of 52 and his remains rest in Arlington National Cemetery. Mount Chapman in the Selkirks is a permanent monument to his distinctive, valuable contribution to Canadian geological surveying and topographical mapping at a critically important stage of development. A high peak in the Rockies of Glacier National Park also bears the name of this eminent geologist.

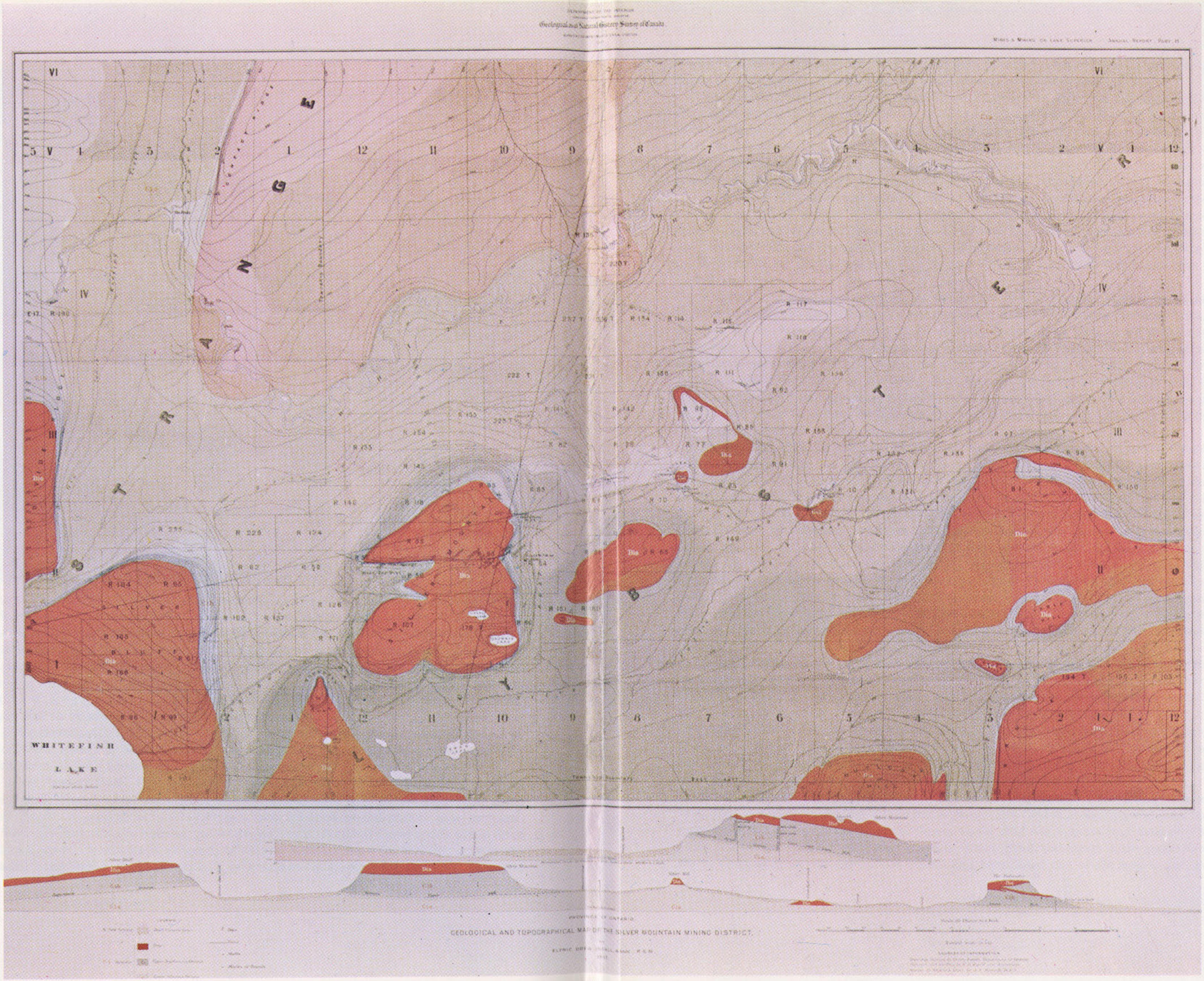
In the summer of 1912 Chipman, while engaged in a photo-topographical survey of Windermere Valley in British Columbia, had a narrow escape from death. One day, after a climb of about 1,000 feet he was suddenly confronted by an angry grizzly bear mother with her two cubs. Chipman tried to leave the spot with some celerity but the bear caught him and tore one knee severely with fang and claw. She was about to sink her teeth into his foot when she hesitated, turned and then decided to amble off with her cubs. The incident, though painful, failed to diminish Chipman's enthusiasm for survey work in the great outdoors. His knee mended without complications and he was soon back in the field.

In 1913 the Geological Survey and the Department of Naval Affairs, Ottawa, cooperated in the formation and despatch of the Canadian Arctic Expedition in that year. The expedition was organized into two parties, all personnel sailing aboard three vessels, namely the flagship *Karluk*, the *Alaska* and the 30-ton schooner *Mary Sachs*, with Herschel Island as their destination. The northern party, under Vilhjalmar Stefansson, expected to probe for new land

FIGURE 129
R. H. Chapman.

north of the Beaufort Sea. The southern party, composed in the main of scientists under Rudolph Martin Anderson of the Geological Survey, was to map along the Arctic coast of Canada, survey channels among islands at the mouth of the Mackenzie River in the interests of navigation, make a geological survey of as much as possible of the Arctic coast of this country, and to gather information on the flora and fauna of the region. Chipman was named second in command, or "next senior officer", of the southern party. The *Karluk* was to sail northward along the line of the 141st meridian until blocked by ice or by land. This latter project had to be abandoned, however, when the *Karluk* was firmly caught in ice and was lost to the expedition. The little fleet left Victoria with high hopes on June 17, 1913, and sailed out of Nome, Alaska, at the end of July. The vessels soon became separated in stormy weather but Point Barrow, Alaska, was rounded by the *Karluk* on September 12.

Three "geographers" were attached to the expedition, all of them from the Geological Survey staff, namely Chipman, George S. Malloch and John R. Cox, the latter being listed as an "assistant geographer". Malloch was also assigned to the project as a geologist. Skilled in his profession he had mapped in the vicinity of Portland Canal and in many other parts of Canada. Malloch was a casualty of the expedition, dying from nephritis on Wrangel Island.[23] In addition to the geographers, J. J. O'Neill was in the party as a geologist. Diamond



MAP 17. Portion of the Silver Mountain sheet by E. D. Ingall, 1887. This is the first contoured Canadian geological map.

Jenness and Henri Beauchat served as ethnologists, the latter also meeting his death in the Arctic on this mission. F. Johansen was assigned as a marine biologist.

The scientific work of the southern party was kept strictly under the jurisdiction of the Geological Survey. The full implications of this arrangement were not foreseen by all in the northern party, including its leader. This lack of complete understanding, along with Stefansson's determination to test his long-held theory that Arctic explorers could live off the country, even on ice floes, led to ill-feeling between Stefansson and Anderson, an attitude of hostility which continued to manifest itself long after the termination of the expedition.

In the three summer seasons, 1914 to 1916, Chipman and Cox carried out a topographic survey from the 141st meridian along the Arctic coast to a point well down in Bathurst Inlet, roughly half of the coastline distance to Hudson Bay, including a number of islands in Coronation Gulf and Bathurst Inlet regions. Their maps were made on a scale of 10 miles to the inch. In the 1915 field season Cox made a survey of Rae River which runs into the Gulf from the west.

Chipman had considerable respect for the natural ability of some Eskimos and Indians to draw maps and to accurately judge and remember distances. On one occasion, when he asked an Eskimo boy what Herschel Island was like, the youngster drew with a pencil a very close approximation of the island's outline, complete with its little harbor. Another time Chipman inquired of an Eskimo woman the distance by foot along the south shore of Great Bear Lake from the mouth of the Great Bear River to the eastern extremity of the lake. After some thought she replied, "29 sleeps". An Indian, when asked by Chipman to give him an estimate of a certain distance on the Mackenzie River, told him, after reflection, "19 bends", information that later turned out to be quite accurate.

On April 12, 1916, Chipman left Bernard Harbour with Eskimo assistants and a Mounted Police corporal as aide and finished surveying the south shore of Coronation Gulf eastward from the mouth of Rae River to Cape Barrow, N.W.T. (not to be confused with Point Barrow, Alaska). The entire survey was completed by May 20. Chipman left the ship's party at the mouth of the Coppermine River on June 1 in the belief that he would reach Ottawa earlier by travelling overland than those sailing on the *Alaska* and thus convey reassuring news to "outside" about the ship, its crew and passengers, in the event that, for any reason, their return cruise met with delays. Accompanied by a trader, D'Arcy Arden, Chipman trekked across country to the Mackenzie River by way of Great Bear Lake and thence southward, reaching Peace River settlement on August 18, and Ottawa at the end of the month. In doing so he had the satisfaction of contradicting by his presence in the capital previous reports in the Ottawa daily press of his demise in the silent snows of the Canadian North.

The Canadian Arctic Expedition 1913-16 added materially to Canada's knowledge of the geography, geology and natural history of the Arctic. Canada's claim to Prince Patrick Island was re-asserted. The venture also yielded results of economic significance, including information on the area of copper-bearing rocks near Coronation Gulf. In later years Chipman's well-lined, weathered face would break into a disparaging smile over any attempts to compliment him on his notable cartographic accomplishments. But this modest, durable and gifted Nova Scotian made an outstanding contribution to the accurate mapping of many parts of Canada, including much of its Arctic mainland coastline.

Following the resignation of James White as Geographer and Chief Draughtsman in 1899, the Geological Survey official in Ottawa responsible for the processing and printing of maps produced by topographers of the Survey in the field was Clovis-Omer Senécal (1863-1939). At the time Senécal succeeded White the maps, plans and charts in the possession of the Geological Survey totalled about 20,000 and constituted one of the largest and most

FIGURE 130. These rare photographs by James Richardson, G.S.C., in the earliest years of the camera's development possess remarkably high quality. Taken during a field survey on the Labrador coast, 1860.

valuable collections of its kind in Canada. Senécal, who echoed the complaint of his predecessor about "the congestion of mapping work" drew attention to the need of "one or two additional map compilers to catch up with the work."[24]

Two categories of early maps were issued under Senécal's supervision after the new division came into operation. First, there were preliminary maps on scales ranging from 8 to 25 miles to the inch. These maps were the outcome of reconnaissance and exploratory surveys in northern Canada. Second, there were detailed maps of standard size, drawn to scales of 1, 4 and 8 miles to the inch. Maps varied from rough, illustrative diagrams to highly accurate topographic sheets. These cartographical products were classified, in turn, as topographic, geographical, route maps, plans and diagrams. As to accuracy these productions were classed as standard, graded or inferior. Contoured topographic maps depicted relief in addition to water resources and cultural features. Geographical maps were not contoured. Route maps showed lines of early exploration. The cartography labelled as 'inferior' consisted of sketches drawn without the advantage of survey controls, although these drawings did provide a fairly general idea of the geography and geology of areas thus portrayed.

Senécal developed into an authority in Ottawa on the use of color in the printing of geological maps. The lithographic process of color printing had been in constant use since 1899 for reproduction of maps of the Geological Survey of Canada.[25] In all, 26 color distinctions were employed as it was found that this variety of tints would meet all ordinary requirements for effective printing of geological maps.

Senécal's career in the public service of Canada covered more than forty years. His appointment to the permanent staff as an Assistant Draughtsman in the Geological Survey of Canada was made in January, 1895, but he had then been in the service as a temporary for a number of years previously. Senécal retired in August, 1931, not long after his treatise on a projection suitable for maps of Canada was published by the King's Printer.[26]

In 1914 Brock, who had become Deputy Minister of the Department of Mines early in that year, was succeeded in that position by R. G. McConnell before the year was out. Brock resigned to become Dean of the Faculty of Applied Science at the University of British Columbia. Subsequently he enlisted in the Canadian Army and had a distinguished career as an officer in the forces during the First World War. His successor as Director of the Geological Survey was William McInnes (1858-1925). McInnes was a New Brunswicker by birth and upbringing. For a number of years he carried out geological investigations in his native province, first as an assistant and then as an associate of Dr. L. W. Bailey of the staff of the University of New Brunswick and sometime member of the Geological Survey of Canada. McInnes held the directorship of the Survey for six years, serving under two deputy ministers, namely, R. G. McConnell and then, briefly, under Charles Camsell.

One telling indication of the rate of expansion of the Survey, in the decades immediately following the Logan-Selwyn period, is to be found in a comparison of annual budgets of the organization. For the year ended March 31, 1895, the total sum voted by Parliament to the Survey for all its purposes was $129,000, of which $48,000 was designed for salaries. For the fiscal year ended March 31, 1917, the corresponding totals were $571,000 and $195,000.

The Geological Survey of this country won much well-earned praise and respect for its many worthwhile achievements during the half-century of its progress after Confederation was established. On many occasions members of its staff were the first to survey and to record for posterity natural and geographic features. An exhaustive listing of all early geologists active in Canada cannot, of course, be provided here but the names of Elfric Drew Ingall, Donaldson Bogart Dowling (1858-1925) and W. McQuat ought to be added to those already mentioned. The cartography of the field and office staffs of the organization was most commendable and in an era of limited revenues of government the costs of producing these maps, including original topographic surveying as well as the draughting and compiling up to the finished engraving, were extremely small compared with the immeasureable utility and value of such documents to the nation and to the world. The combined efforts of geologists and topographers had served to open up, to an impressive extent, important parts of half a continent to mining development and to settlement. Yet nothing in the pioneer years of the Geological Survey was nearly as remarkable as the men who created and expanded it and who helped to make its name well and favorably known not only throughout Canada but in many other countries as well.

19

THE ASSERTION OF CANADA'S SOVEREIGNTY IN THE ARCTIC ARCHIPELAGO

The period of discussions leading up to Confederation coincided with the completion of an era of exploration and discovery in the islands of the Arctic Ocean. With the end of the Franklin search men's minds turned from the task of finding a usable northern passage from the Atlantic to the Pacific and toward a new goal, the North Pole. With the exception of Capt. Otto N. Sverdrup's Norwegian expedition, 1898 to 1902, the known islands of the Arctic Archipelago had been discovered by British explorers. After Confederation had been successfully launched all of the territories of that vast region, over which Great Britain exercised sovereignty, except Newfoundland and its dependencies, were formally transferred to Canada.[1]

For the first time the act of transfer awakened in Canadians generally an interest in the polar north as an area of prospective importance to them and to the future of their country. This transformation in attitude did not come about suddenly but developed only gradually. A quarter-century elapsed before this growing Canadian interest was translated into earnest exploratory activity. But once a program of probing the North was adopted, it was promoted with zeal, persistence and courage during the first two decades of the twentieth century.

During the immediate post-Confederation period British expeditions into the Arctic diminished as the attention of the motherland became more and more attracted to Antarctic regions. Enterprising citizens of the United States began to fill the vacuum left by Britain in the work of penetrating farther into the polar north. Other nations began to display initiative also in the Arctic. Sverdrup (1855-1930) and Roald Amundsen (1872-1928), hardy representatives of the Scandinavian stock responsible for pre-Columbus ventures across the Atlantic out of Europe, contributed substantially to man's growing knowledge of that remote part of the world. In 1898, for example, the winter bases of Peary and Sverdrup were less than ten miles apart in a direct line. In 1903 to 1906 Amundsen commanded the *Gjoa* on the first voyage to be made from the Atlantic to the Pacific by way of the Northwest Passage.

Amundsen, the Norwegian, in reaching Nome in August, 1906, had realized the dreams of many mariners, striving over the span of at least three centuries, to accomplish that formidable crossing. Intrepid explorers of the British Navy had left tokens of their gallant ventures in many harbors and bays. Today, in the Far North, cairns, station relics and other memorials of their heroism and hardships, testify in silent eloquence to the sacrifices they made willingly in the cause of safer and wider navigation in regions barely reached by the sun.

Canadian expeditions to the Arctic, with which this chapter is mainly concerned, began late in the nineteenth century. During the first two decades of the present century these probes, carried out under the authority and with the financial aid of the federal government, assumed ambitious proportions. The later investigations resulted in a fair amount of coastal, geological and hydrographic surveying as well as in some mapping. But their principal function, viewed in the light of after events, was in "showing the flag", performing overt acts of annexation by Canada of lands ceded in the Arctic to this country by Great Britain.

Canadian government expeditions into Hudson Bay were despatched in three successive seasons, commencing in 1884. All three ventures, which concentrated upon gathering scientific information, were under the command of Lieut. Andrew Robertson Gordon, R.N. Aboard the *Neptune* on the first voyage of this series were Dr. Robert Bell as medical officer and geologist and W. W. Fox, photographer, who made free-hand sketches of the coastal profile at a number of points. At Port Burwell in Hudson Strait the harbor and a part of the adjacent coast was surveyed by the Dominion land surveyor, W. A. Ashe, appointed as one of the observers on the expedition. He also surveyed the harbor at Ashe Inlet, on Big Island off the south coast of Baffin Island. Gordon reported, "At all other stations I have myself, besides making determination of position, variation and dip, made surveys of the harbors and written out the necessary sailing directions for entering the ports. I have also made a hurried survey of the harbor at Marble Island, and obtained a plan of Churchill Harbour from one of the Hudson's Bay Company's officers."[2]

The 1884 report of the Gordon expedition was accompanied by a chart of the track of the S.S. *Neptune*.

In the following season, extending from late in May to mid-October, Gordon commanded the vessel *Alert* of 700 gross tons, a barque-rigged, screw ship, rebuilt for the 1876 Arctic voyage under Sir George Nares. Six officers and a crew of 26 manned the *Alert* on its 1885 venture under Canadian auspices. Dr. Robert Bell had James McNaughton as assistant geologist. The Dominion land surveyor J. W. Tyrrell and four other observers were also on this cruise. Although the season's work added little to hydrographic knowledge of the Hudson Bay or Strait, a track survey was made by Bell and Tyrrell from a steam launch of Outer Digges Island. In addition a running survey was made of the west side of the north group of Ottawa Islands and a series of soundings undertaken across Hudson Bay. The maximum depth found during these investigations was 94 fathoms. Some tidal observations were made of the harbor at Churchill. The 1885 report by Gordon was accompanied by a chart of the Ottawa Islands, based on an approximate survey by Lieut. Gordon; also by a track chart showing the drift of D.S.S. *Alert* in the ice during June and July of that year. This latter chart was published by authority of the Department of Marine, Ottawa.

Again, in 1886, Dr. Bell and J. W. Tyrrell were among the 43 persons aboard the *Alert* which Gordon took out of Halifax on June 26, returning to that port on October 10, following a full season's work. Tyrrell, as an observer, took some survey notes at Ashe Inlet.

In the 1903-04 season A. P. Low took the *Neptune* to islands of the Arctic Archipelago, a cruise to which reference has been made in the chapter preceding this. The voyage of the *Neptune* marked the beginning of an era of Canadian Arctic expeditions, sailing under instructions to take formal possession for Canada of lands transferred to it in 1880.

In the summer of 1904-05 a new Canadian star entered the firmament of notable northern explorers. Capt. Joseph Elzéar Bernier (1852-1934), the son of Capt. Thomas Bernier, had studied Arctic navigation since the 1870s and had formed a plan for reaching the North Pole

MAP 18. Explorations in Northern Canada and adjacent portions of Greenland and Alaska, a map by James White, published in 1904.

by way of Bering Strait. In 1904 he was given command of C.G.S. *Arctic*, a three-masted, propeller ship, 165 feet in length, of 650 gross tons. She had been the *Gauss*, a German ship designed for work in the Antarctic. In the following 21 years Capt. Bernier led 12 expeditions into the northern seas but never achieved his personal ambition of reaching the North Pole. Nevertheless he accomplished the more important objective of exploring the waters north of Canada's mainland and asserting, on the ground, Canada's sovereignty over thousands of square miles of the Arctic Archipelago.

During his first season in command of the *Arctic* Bernier was instructed to sail to Hudson Bay, in order to establish Royal Northwest Mounted Police posts and to obtain information on ice conditions and on navigation in Hudson Bay and Hudson Strait. With Major Moodie of the Mounted Police and a detail of that force aboard, the *Arctic* reached Fullerton on the west side of the bay opposite Southampton Island, and wintered there. The *Arctic* sailed for Quebec City on July 1, 1905. In his report on this voyage Bernier expressed the view that any well-engined, well-built steamer under the command of an experienced ice captain could enter the bay and strait early in July.

The first of Bernier's three most important expeditions into the north polar seas commenced at Quebec on July 15, 1906. All three voyages began and ended at Quebec and all were free of any major mishap, a considerable achievement in itself and a feat that testified eloquently to Bernier's able seamanship, observance of sensible precautions and regard for the general safety and welfare of his officers and crews.

The *Arctic*, which had demonstrated her ability to operate in heavy ice, was repaired and fitted out at Sorel under the supervision of Superintendent Desbarats of the federal government shipyard there. The expedition, consisting of 9 officers and a crew of 32, called in at Chateau Bay, Labrador, on August 3. Two days later, at sea, two icebergs were sighted heralding the approach of many months when ice would form a constant navigational menace, if not a complete prison. By the 18th the *Arctic* had entered Lancaster Sound and penetrated Navy Board Inlet. During the 1906 season Capt. Bernier formally "took possession" for Canada of Bylot, Griffith, Cornwallis, Byam Martin, Bathurst and Melville islands, constructing a cairn at each point of landing and leaving a record on the spot of his visit. At Arctic Point, Melville Island, Bernier also claimed for Canada the Prince Patrick and Eglinton islands as well as islands adjacent to them. On the return voyage to winter base at Pond Inlet on the north coast of Baffin Island, the *Arctic* found her way into Admiralty Inlet as far south as Moffet Inlet. From September 10, 1906 to July 27, 1907, the *Arctic* remained winterbound at Pond Inlet.

On the King's birthday, November 7, 1906, Bernier recounts that a Royal salute was fired. "The holiday was celebrated on board and on shore. Fifteen natives came to the ship upon our invitation to take part in the celebration . . . We also took possession of Baffin Island and caused the flag of the Dominion of Canada to be hoisted . . . I addressed the natives, telling them that they had become Canadians, that they must live in peace with one another and conform themselves to the laws of Canada. We held a rifle competition and discovered that there were some good shots aboard and that the natives are accurate with the rifle. All the Eskimos were invited to have dinner on board, and they certainly enjoyed the celebration very much."[3]

On July 27, 1907, the *Arctic* began to move again. Bernier reported that on that day "we got under way at 10 a.m. and proceeded to sea. At 2 p.m. we made ship fast to the ice, about five miles east of Albert Harbor. We took soundings and we found no bottom at 160 fathoms". Six days later an annexation ceremony was held on Cobourg Island and on that same day Bernier observed that "we took soundings and found 420 fathoms of water". On Ellesmere Island, later in August, Bernier took possession for Canada of "North Lincoln, Grinnell Land, Ellesmere Land, Arthur Land, Grant Land, King Oscar's Land, North Kent, and several islands, namely, Axel Heiberg Land, Ammund [Amund] Ringnes Land, Ellie [Ellef] Ringnes Land, King Christian Land, formerly named Finlay [sic] Land, North Cornwall, Graham Land, Buckingham Island, Table Island and all adjacent islands".[4] Bernier reported that on August 22 ". . . the sea is very smooth; we take soundings in 178 fathoms of water, mud bottom". The *Arctic* then headed southward, making a number of calls along the coast of Baffin Island. Bernier's account reads, "September 1. The fog set in and while crossing the [Hudson] Strait during the night we took the following soundings: 208, 405, 450, 425 and 420 fathoms." Soundings were also taken at Port Burwell.

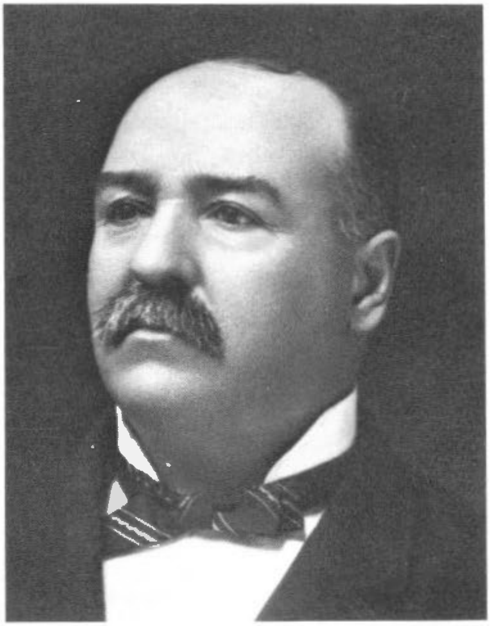


FIGURE 131
Captain J. E. Bernier.

Capt. Bernier concluded his official report on the 1906-07 expedition by urging that "it is of the utmost importance that the Dominion takes possession of all northern regions as far north as the pole. Those regions abound in valuable islands which contain vast quantities of coal and other minerals".[5] Included in the official report is a map of the Geological Survey of Canada bearing the name of Dr. Robert Bell as its Acting Director. It is titled, "Map of the Northeastern Part of the Dominion of Canada To illustrate the Report on the Cruise of the D.G.S. *Arctic* to The Arctic Islands. Capt. J. E. Bernier in Command, 1906-07". The scale of this map is given as 50 statute miles to the inch. C. O. Senécal's name is on the map as Geographer and Chief Draughtsman of the Geological Survey of Canada. Sources of information for this map include Admiralty charts "corrected by later information obtained by the Peary and Sverdrup Expeditions; by surveys made on the *Neptune* in 1903-04 and by surveys made on the *Arctic* in 1906-07."

Apart from various soundings made on this Bernier probe the principal scientific information contained in the numerous appendices to his report consisted of meteorological observations, data on ice conditions and geological information with special reference to coal deposits. Capt. Bernier, in his autobiography, noted that the Canadian government, in 1930, paid Capt. Sverdrup the sum of $67,000.00 for all his maps, charts and other data resulting from his Arctic experiences, partly, so Bernier surmised, in the nature of a quit-claim notice to Norway in regard to northern territories discovered by that intrepid Norwegian explorer.[6]

On his second voyage to the polar seas Bernier left Quebec on the *Arctic* on July 28, 1908, with 6 other officers, a scientific staff of 5, and a crew of 31. The scientists included a medical officer, meteorologist, historian, geologist (J. G. McMillan) and an assistant naturalist. In late August Lancaster Sound was entered and a landing made at Erebus Bay, Devon Island, on the 24th. The ultimate destination was Winter Harbor on Melville Island.

It was during this season, in the absence of heavy, impeding ice formations, that Bernier felt he could have navigated through the entire Northwest Passage. But he had no instructions to do so. He was convinced that the route through M'Clure Strait offered the best prospects for success. Larsen and Stefansson, in later statements, disagreed with Bernier on this point, claiming that the Barrow Strait, Viscount Melville Sound and Prince of Wales Strait, passing to the south of Banks Island, rather than to the north of it, was the shortest, deepest and easiest route to navigate in order to reach the Beaufort Sea.

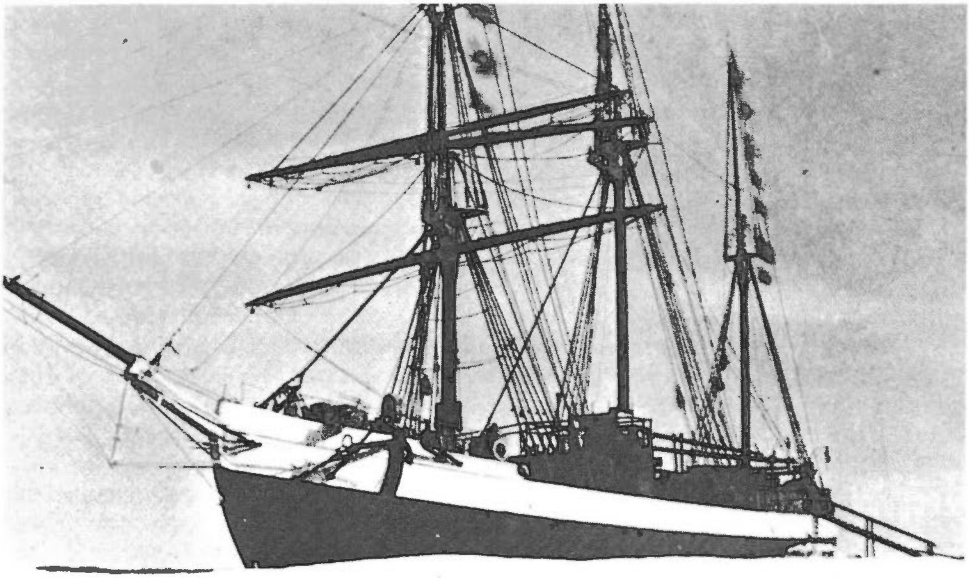


FIGURE 132. C.G.S. *Arctic* in Winter Harbor, Melville Island, 1908.

The *Arctic* remained in Winter Harbor from August 28, 1908, to August 12, 1909. Bernier reported, "Officers Morin and Green and their men deserve the highest praise for the able manner in which they carried out their orders to annex Victoria and Banks islands . . . Incidentally they found coal on Banks Island and an extinct volcano and samples of iron ore".[7]

In the season of 1909 Bernier tried unsuccessfully to penetrate Byam Channel to make soundings to discover whether the sea bottom toward the northwest was shelving or deep. The *Arctic* re-entered Barrow Strait, proceeding to Pond Inlet and, after touching at a number of points along the coast of Baffin Island, reached Quebec on October 5, 1909.

No new coastline was explored on this expedition but the official report contains many references to tides, currents and ice conditions. A number of cairns and monuments were erected. Maps and charts included as contents of the Bernier report include a geological sketch map, map of Winter Harbor, track surveys of Morin and Green on Melville, Banks and Victoria islands, beacons (in aid of navigation) in Winter Harbor and a facsimile track chart of H.M. Sledge *Success*, Barrow Strait, 1851. Also included are a chart of Jones Sound, a facsimile of Bering Strait, 1852; Depot House, Dealey Island, 1853, and showing winter quarters of Franklin, M'Clure and Kellett. A plan of Churchill Harbor by Lieut. A. R. Gordon, R.N., assisted by J. W. Tyrrell, P.L.S. with details of soundings, and a chart of York Roads, Hudson Bay, by the same two men, with soundings, are also contained in this report.

In January, 1910, W. Bell Dawson wrote a letter to Bernier that was much treasured by him in later years. The Superintendent of Tidal Surveys wrote, "The tidal observations obtained by your expedition at Melville Island are especially interesting in being from an entirely new region. Your officers deserve much credit for their perseverance in obtaining such full detail by continuous observations day and night."

In a communication dated April, 1910, addressed to Deputy Minister G. J. Desbarats, Department of Marine and Fisheries, Bernier stated, "I have the honour to submit my report of voyage of Dominion Government Steamer *Arctic* to northern waters of this continent for the purpose of patrolling waters contiguous to that part of the Dominion of Canada already annexed and for the further purpose of annexing territory of British possessions as far west as longitude 141 degrees".

The daily food ration considered sufficient to sustain a man travelling and working in the Arctic is described in the report. The ration consists of one pound of pemmican, one and a half pounds of chocolate along with fractions of a pound of biscuit, sugar, tea, potatoes, tobacco, curry and onion powder as well as pepper and salt for soup.

A lengthy geological report by J. G. McMillan was incorporated in the Bernier document. It is addressed to the Minister of Marine and Fisheries and includes a section of the topography of Devon Island. A complete record of ship positions was included in the main report as well as a number of magnetic observations taken by W. E. Jackson, the meteorologist. His instruments consisted of a dip circle by Dover, a horizontal force magnetometer by Bausch and Lomb, chronometer and hack watch, sextant and artificial horizon. These instruments were made available to the expedition by the Director of Terrestrial Magnetism, Carnegie Institute, Washington, D.C.

On July 7, 1910, the *Arctic*, again under the command of Capt. Bernier and with a total complement of 36, sailed from Quebec City on the third and last of his major voyages into the north polar seas. On this occasion Bernier was authorized to attempt a passage through the Arctic islands and Bering Sea to Vancouver or Victoria. The advisability of making this attempt to navigate the Northwest Passage was left to Bernier's judgment "after ascertaining the ice conditions on the spot". About August 18 the expedition arrived at Erebus Bay and the westward voyage was resumed almost at once. Ice conditions, however, proved most difficult. Winter Harbor was entered by the aid of stone beacon ranges established by Bernier in 1909. "All the beacons were found in position and saved the trouble of making soundings for several miles as was done in the previous entry."[8]

Soon after leaving Winter Harbor progress through M'Clure Strait was blocked by solid ice and the *Arctic* was forced to turn back. The disappointment felt by Bernier can be imagined, especially in the light of his firm conviction that the Passage could have been accomplished easily during the previous season. Bernier decided to put into Arctic Bay on Admiralty Inlet, near the eastern entrance to Lancaster Sound. By October 1 all was in readiness for the long winter months. On the basis of lessons learned from past experiences in the region, good practical use was made of the *Arctic's* winter station. Sled parties were organized and travelled extensively along Admiralty Inlet. Much of the Brodeur Peninsula was resurveyed.

Among the scientific personnel on the 1910-11 cruise of the *Arctic* were J. T. E. Lavoie, listed as "meteorologist and geologist" and Arthur English, described as "prospector and taxidermist". English reported a discovery of copper ore and promising indications of mineralization along Adams Sound. On October 10 Lavoie left the ship with an assistant and three Eskimos to map the west coast of Brodeur Peninsula. Mr. Morin, the first officer of the *Arctic*, accompanied Lavoie as far as the head of Admiralty Inlet to survey that part. Bernier claimed that Morin was the first white man ever to set foot on this coast.

On March 15, 1911, Lavoie again left the icebound ship, accompanied by two Eskimos and headed for Fury and Hecla Strait with instructions "to trace the shores of the strait, to make surveys when possible, and to observe movements of the ice". These tasks were carried out under great difficulties and completed about a month later. On this project Lavoie suffered extreme hardships, including the effects of severe burns on his face incurred in an unfortunate accident. Not until July 19, 1911, was the *Arctic* released from the grip of ice. Ten days later the vessel broke into open sea off Elwin Bay. Pond Inlet was reached on August 6. After surveys of the south shore of Eclipse Sound, south of Bylot Island, Bernier sailed north through Navy Board Inlet, thence westward along the south shore of Lancaster Sound. Once again heavy ice foiled plans to continue investigations. On September 25 the ship reached Quebec City, concluding its 10,000-mile voyage without incurring any undue amount of damage. Winter side trips by means of sleds totalled an additional 4,000 miles.

The official report of this voyage included geological reports, mostly pertaining to areas of Baffin Island. Maps attached to the report included a plan of Arctic Bay, drawn by Lavoie and marked with soundings and elevations; a plan showing the route followed by Lavoie and his party on the 1910 coast survey of Prince Regent Inlet, and a map titled "Surveys and Discoveries in the Arctic Regions with additions and changes to 1911 on the Coast of Baffin Island" by J. T. E. Lavoie, C.E.

More than a decade later Capt. Bernier made one more voyage to the north polar seas aboard the *Arctic* but this probe was considerably less impressive in its scope and results than the four previous ventures of that vessel under his able command. In addition, in its chronological aspects, this 1922 patrol of the Eastern Arctic is beyond the scope of this volume.

Vilhjalmur Stefansson (1879-1962), during the course of the large expedition (1913-1918) to which reference has been made in a previous chapter and which was sponsored by the Canadian government, travelled extensively in western portions of the Queen Elizabeth Islands, as these are now known. Stefansson added immensely to geographical knowledge of that area and, during this period of discovery, he brought into Canada's domain the important Brock, Borden and Meighen islands. Borden Island, contrary to Stefansson's supposition at the time, turned out to be not one but two islands, separated by Wilkins Strait. The northerly one retains the original name but the more southerly one has been named Mackenzie King Island. In addition, Stefansson's resurvey of King Christian Land resulted in the separate delineation of Lougheed Island.

In his busy exploration season of 1916 Stefansson completed a survey of parts of Borden Island and made a trip around most of the coastline of Meighen Island. He then crossed to Amund Ringnes Island and surveyed its west coast. In this general area of the north, Stefansson corrected a former survey showing the Findlay Group as consisting of three main islands.

In concluding this outline of Canadian surveying and mapping in the Far North we may, at this point, permit ourselves a glance into the future. As Andrew Taylor expressed it in his excellent volume, *Geographical Discovery and Exploration in the Queen Elizabeth Islands*, "the first vessel to have made the Northwest Passage from west to east, first vessel to have made the passage in both directions, and the first vessel to have made the passage in a single season—these are honours that belong to the R.C.M.P. schooner *St. Roch*". Three hundred and sixty-eight years after Martin Frobisher first attempted to enter the Arctic, seeking a northern water route to the Orient, the *St. Roch* in 1944 under its Master, Staff-Sergeant Henry A. Larsen, completed the passage in a single year from east to west in 86 days, reaching Vancouver on October 16.

In Larsen's modest yet memorable words, "We were lucky and we had the breaks. No one can predict the ice or navigation conditions in the Arctic. What we accomplished this year might be repeated the next, or it might be many years. Much would depend upon the type of vessel used, and the ice conditions of that particular year. Our voyage showed that the Northwest Passage can be traversed in a single year, but does not prove that this could be accomplished every year."[9]

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In a rather extensive appendage to Volume One of this history I endeavored to express, as comprehensively as I could, my deep appreciation to individuals and organizations whose advice and assistance have been of special value to me in my research and writing. But as the work on this project continues, new sources of help have developed and in order to make my acknowledgments more complete I wish to take this opportunity to add to my catalogue of thanks the Air Photo Library, Ottawa, under the direction of G. Whitcher; officials of the Indian Affairs Branch and its library staff, Ottawa, with special mention of H. T. Vergette, J. Raichman, Bernie Downie and A. R. Goulet of the Surveys and Titles Section of that Branch; the Municipal Archives of the City of Montreal and, in particular, Director Gérin-Lajoie and the Guardian of Official Maps and Plans, René Lanthier; and to the following persons; Dominion land surveyors Carl Engler, Hans Kihl, L. M. Sebert and C. C. J. Bond; Mrs. Lois Winslow-Spragge, Montreal; Malcolm M. Thomson and Miss M. Burland of the Dominion Observatory staff, Ottawa; W. Ron Young, Chief, Geographic Division, British Columbia Surveys and Mapping Branch, Victoria; Ernest C. Elliott and John Imsley, Photographic Section, Geological Survey of Canada; J. G. Côté, Research and Development, Canadian National Railways headquarters, Montreal; George O. Wood, International Boundary Commission staff, Ottawa; E. Roy Logie, formerly Chief Engineer, Central Division, Canadian National Railways, Toronto; G. Babbage and S. Kitaljevich, Legal Surveys and Aeronautical Charts Division, Ottawa; Kenneth B. Jackson, Staff Scientist, The De Havilland Aircraft of Canada Limited; W. J. Gordon Wadsworth, Director of Surveying, City of Toronto and Mrs. N. C. Carico, U.S. Geological Survey staff, Washington, D.C.

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Don W. Thomson.

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MAP AND FIGURE GUIDE

MAPS

NOTE: Maps 3 and 18 were in poor condition for reproduction. It was felt advisable, however, in view of their importance in the story of Canadian surveying and mapping, to include reproductions in this volume.

FIGURES

FIGURES

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Maps 1, 3, 4, 7, 9, 11, 12, 15, 16, 17 and 18 are reproduced through the courtesy of *The Public Archives of Canada*, Ottawa.

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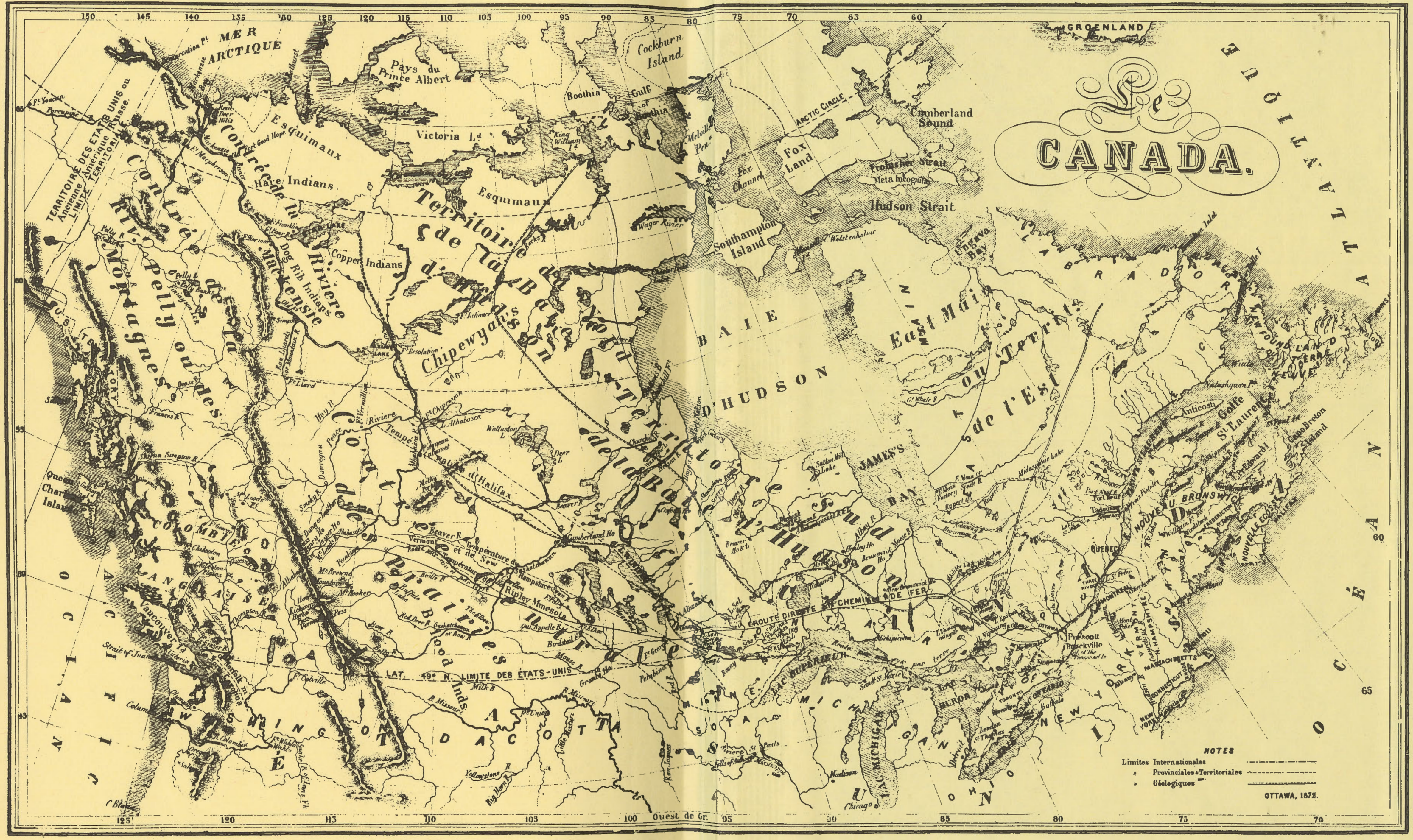
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CANADA.
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MER ARCTIQUE
OCÉAN ATLANTIQUE
OCÉAN PACIFIQUE
TERRITOIRE DES ETATS UNIS ou Ancienne Amerique Russe.
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Boothia
Gulf of Boothia
Cockburn Island
Melville Pen.
Fox Channel
Fox Land
Cumberland Sound
ARCTIC CIRCLE
Frobisher Strait
Meta Incognita
Hudson Strait
Southampton Island
Ungava Bay
LABRADOR
NEWFOUNDLAND
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Hare Indians
Dog Rib Indians
Copper Indians
Chipewyans
Contrée de la Rivière Mackenzie
Contrée de Pelly ou des Montagnes
Territoire du Nord
Territoire de la Baie d'Hudson
Territoire du Sud
East Main ou Territoire de l'Est
BAIE D'HUDSON
JAMES'S BAY
Contrée des Prairies
COLOMBIE ANGLAISE
Queen Charlotte Islands
Vancouver Id
Wollaston L.
L. Athabasca
Cumberland Ho
Anticosti
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Cape Breton Island
NOUVEAU BRUNSWICK
NOUVELLE ECOSSE
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