D. L. Peckstead

A CENTURY
IN THE HISTORY OF THE GEOLOGICAL SURVEY :: OF CANADA ::

BY

F·J·ALCOCK

756

Party of A. P. Low on Lake Mistassini, Que., 1885.

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A Century in the History of the Geological Survey of Canada

BY

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PREFACE

In 1942 the Geological Survey of Canada completed a century of continuous service to its country and to geology. Though Canada was actively involved in a world war at the time it seemed fitting that some recognition should be taken of this important milestone in the Survey's history. Accordingly, an invitation was sent to the Geological Society of America to hold its Annual Meeting that year in Ottawa at which reference could be made to this centennial anniversary and the present booklet was originally prepared for that occasion. The invitation was accepted by the Geological Society but later owing to the stress of war conditions the Ottawa meeting had to be cancelled. The 60th Annual Meeting of the Society is being held in Ottawa in 1947, the one hundred and fifth anniversary of the founding of the Geological Survey.

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"Mente et Malleo" appears with the permission of its author, Dr. A. C. Lawson, a former member of the staff of the Geological Survey.

F. J. ALCOCK,
Curator, National Museum of Canada

OTTAWA, Aug. 31, 1947

A CENTURY IN THE HISTORY OF THE GEOLOGICAL SURVEY OF CANADA

CHAPTER I

ONE HUNDRED YEARS

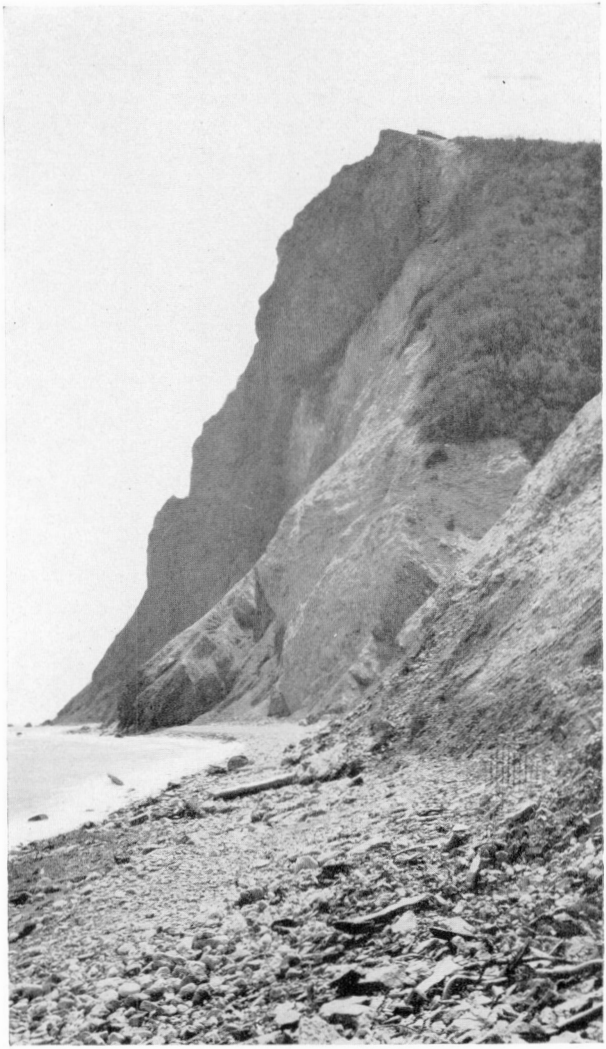
One hundred years ago the word Canada meant a strip of country whose eastern part, known as Lower Canada, bordered either side of the St. Lawrence River, and whose western, called Upper Canada, stretched west from the Ottawa River and faced south on the Great Lakes. Lower Canada or, as it is now known, Quebec, was settled largely by people of French descent. It had been discovered by the St. Malo sea-captain, Jacques Cartier, in 1534, and settlement had begun in 1608 when Samuel de Champlain founded Quebec City. The real beginning of settlement in Upper Canada, now known as Ontario, was much later and dated from the influx of United Empire Loyalists from across the border in 1784 following the close of the American Revolutionary War. From 1791 the two provinces had had their own separate legislatures, but by the Act of Union of 1840, they were united under a single government.

In 1842 the population was around 1,100,000, of whom less than 450,000 lived in Upper Canada and nearly 700,000 in Lower Canada. The chief towns were Quebec, Montreal, Kingston, and Toronto. Kingston was the seat of government, but in 1844 parliament moved to Montreal and later to Toronto. Conditions of life were primitive, with the people engaged largely in clearing and tilling the land and building roads, but there was an insistent belief that a great future lay ahead. A start had been made at better means of communication. In 1836 the first railway had been built, a line 16 miles long between St. Johns on Richelieu River and Laprairie on the St. Lawrence opposite Montreal to shorten the journey to New York by connecting the St. Lawrence steamers with the Lake Champlain boats, but even in 1850 there were still only 66 miles of railway in all Canada. The need for centres of higher

education was felt also, chiefly for the training of young men for the clergy, and in 1842 Queen's University was opened at Kingston, to be followed 1 year later by Kings College, now University of Toronto, at Toronto.

There was a growing feeling, too, that something should be done about gathering information regarding the natural resources of the country. As early as 1832 a certain Dr. Rae had petitioned in the Parliament of Upper Canada for financial assistance to conduct such a survey, but his request, though recommended by the then Lieutenant-Governor, Sir John Colborne, was refused by the Committee of Supply. Later another effort had been made, this time sponsored by the York (Toronto) Literary and Philosophical Society. In this connection the two names chiefly responsible for bringing the matter before the House of Assembly were those of a Mr. Dunlop and Mr. William Lyon Mackenzie, the grandfather of the present Prime Minister, the Right Honourable William Lyon Mackenzie King. In 1836 Mr. Mackenzie moved for a committee to report upon the best means for prosecuting a geological survey. His report was ordered to be printed and was referred to the Committee of Supply, but action was delayed and no definite steps were taken. The next efforts came from Lower Canada. When the first united parliament opened in July 1841 a petition for assistance to carry out a geological survey was presented by the Natural History Society of Montreal, represented by Benjamin Holmes, and the Literary and Historical Society of Quebec, represented by Henry Black. The Government considered the petition and on motion of the Honourable G. B. Harrison, on September 10, 1841, it was resolved "that a sum of money not exceeding one thousand five hundred pounds sterling, be granted to Her Majesty to defray the probable expense in causing a Geological Survey of the Province of Canada." In the following January, the Government began proceedings to select a geologist and an appointment was made in the spring of that year, 1842. The Geological Survey of Canada has had a continuous history from that time to the present and is thus one of the oldest in the world. That of Great Britain had been

PLATE II



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The Murailles at Percé, Que. Logan worked along here in 1843.

established only 7 years previously, and on this continent the only similar organizations in existence at the time were a number of state geological surveys, including those of Massachusetts, New York, Pennsylvania, and Michigan, which had been established in the decade beginning 1830.

The functions of the Geological Survey as set forth in a number of early acts respecting it, which were passed by the Government from time to time, were to furnish full and scientific description of the country's rocks, soils, and minerals, to prepare maps, diagrams, and drawings, and to collect specimens to illustrate the occurrences. Permanent marks were to be left, and their latitude, longitude, and relative levels determined. The work, therefore, in addition to being geological, embraced topographic surveying and the building up of a museum. In fact, the Survey for a long time, although primarily geological, was in reality a natural history one. It was the only organization to collect official information on a great variety of subjects such as botany, zoology, ethnology, forests, water powers, etc. Later, however, as government departments expanded, special branches were organized to look after these different matters. As a result, the Survey staff is at present smaller than at certain times in the past when its functions were wider. The two more important divisions that, although still closely allied, have branched off from it include the Topographical Survey, which prepares the base maps upon which the geologists assemble their information, and the National Museum of Canada, which makes collections and carries out investigations along various lines of natural history. The Geological Survey is responsible for the Museum's geological exhibits and its home is the Victoria Memorial Museum building, which also houses the National Museum.

The history of the Geological Survey, as will be brought out more fully in subsequent chapters, falls into four main divisions. The first coincides with the regime of the first director, during which much detailed information and a good general picture of the geology and resources of Lower and Upper Canada were obtained. The second begins with the appoint-

ment of the second director, about the time when the boundaries of Canada were widened so that the new Dominion stretched from the Atlantic to the Pacific and from the Great Lakes to the Arctic. This was a period of expansion of Geological Survey work caused by the need for the exploration of the newly added territory. During the terms of the second, third, and fourth directors, the chief stress was on this type of work. The third period was one of concentration, resulting from demands made on the Survey in consequence of the

PLATE III

A Gaspe canoe. Canoes similar to this were used by Logan in his ascent of Cap Chat River in 1844.

growing development of Canada's mineral wealth. Instead of confining practically all its attention to exploratory mapping, the Survey now devoted itself largely to the carrying out of detailed geological studies that would be of greatest assistance to the prospector and of maximum aid in mining development. This was a time also of specialization in other lines besides geology, and well-staffed topographic and natural history divisions were set up within the Geological Survey. The fourth period dates from 1934, when a reorganization took place

in which the name Geological Survey became restricted to those parts of the former Survey staff whose duties were purely geological. This shedding of functions has been a natural evolution culminating in the full recognition that the real purpose of the Geological Survey is the study of the geology of Canada.

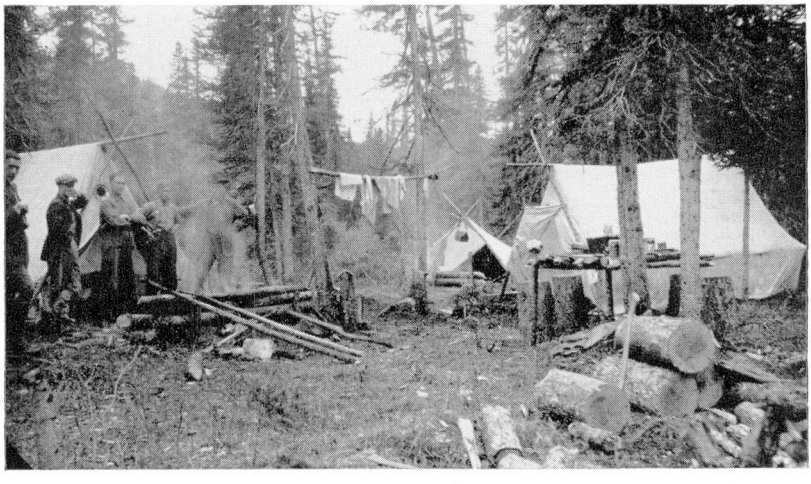
What has the Survey accomplished during those periods of its century of service? The best answer to that question lies in the Reports of Progress, the voluminous Annual Reports, the memoirs on special districts and subjects numbering over two hundred and forty, the bulletins and numerous technical papers prepared by its staff, and above all by the vast number of maps it has issued. The geographical mapping of Canada, as well as the geological, has to a large extent been the work of the Geological Survey. Its activities have extended to the most remote parts of the country. Where it has not preceded the prospector, it has always closely followed him, furnishing the maps and information to aid in development. It has continually endeavoured to meet every geological need as it has arisen, from the making of reconnaissance surveys in hitherto unexplored fields, for the purpose of finding out if the country offers conditions favourable for prospecting, to the most detailed geological studies in mining areas, designed to solve the geological problems in these camps and help in the finding of new orebodies.

In connection with a brief word about what the Survey has accomplished in the various parts of Canada, it is of interest to mention a few names that stand out brightly in Survey history. The mapping of Nova Scotia was largely the work of two men, Fletcher and Faribault, who covered most of the province. More recent detailed studies, in particular those along lines of palæobotany, have, however, written new chapters in Survey work there. The entire province of New Brunswick during the exploration period was covered by geological sheets issued on a scale of 4 miles to 1 inch. These are fifteen in number, and are chiefly the result of work carried out by Bailey, Ells, and McInnes. In addition, for twelve of these sheets, other maps showing the superficial geology

were also published. Later more detailed studies have been made in a number of important areas in the province and a series of 1-mile maps issued.

In Quebec, the Survey mapped the entire southern part of the province from Gaspe westward. Early work was carried out by Logan, Richardson, Selwyn, Ells, Low, McInnes, Adams, Dresser, and others. Our knowledge of the vast northern expanse of the province has come chiefly from the explorations of Low. More recent detailed studies in the

PLATE IV



A Geological Survey of Canada camp in the Appalachian region of southern Quebec.

Eastern Townships and in Gaspe Peninsula have added much new information about the Palæozoic history of the province, and precise mapping in some of the northern mining camps such as Malartic, Rouyn, and Chibougamau has furnished much new information about its Precambrian geology.

Early work in Ontario was carried out by Logan, Murray, Selwyn, Bell, Ingall, Lawson, Barlow, McInnes, and others. Later studies by Collins and his associates added much information about the Precambrian succession in certain key areas

in the northern part of the province. Extensive studies have also been carried out on the stratigraphy of southern Ontario and on the problems connected with gas and oil in this belt.

In Western Canada the story of Geological Survey work is a particularly noteworthy one. The names of Selwyn, Dawson, Bell, McConnell, Tyrrell, Dowling, McInnes, Keele, Cairnes, and Camsell are only some of the better known of the explorers who were the first to traverse uncharted areas, to report on their geology and mineral possibilities, and to point out fields attractive to the prospector. Detailed mapping of many such favourable areas has since followed. Geological mapping with accompanying stratigraphic and structural studies in Alberta has been the basis for the development of the coal and oil resources of that region; similarly, geological mapping in the mountain belt to the west has been of vital importance in aiding mineral development in British Columbia and the Yukon.

It is sometimes asked by the layman just what practical results, aside from the understandable desirability of having all parts of the country explored and mapped, have come from Geological Survey work, and whether the Survey throughout its existence has continually justified the appropriations that have been made for it annually. Perhaps no better answer can be given to this than to cite a single simple problem. Examples could, however, be multiplied from all parts of Canada. In the early days of the Survey the efforts of the first director were devoted to finding out if the country contained valuable deposits of coal. He was soon able to say definitely that neither Lower nor Upper Canada contained such deposits. He had not searched this region everywhere, but he and his assistants had determined that all the strata in this belt are older than the earliest coal-bearing formations and, consequently, there was no possibility of such deposits being found. Geology had quickly settled something that drilling or other methods would only slowly and inconclusively have shown.

Even direct finds of great economic importance have been made by the Geological Survey officers in the course of their field work. The largest deposit of magnesite in Canada, if not

in the world, was thus located in 1932 in British Columbia. In 1938 another field officer while carrying out geological mapping in the northern part of the same province discovered a deposit of mercury. This was merely incidental to his regular work, but it proved to be so important that it has been stated that the value of the discovery exceeded all that has been expended on Geological Survey work in British Columbia since such work was initiated. One further example may be mentioned. Incidental to geological mapping in southern

PLATE V

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A stop for lunch on the Canadian Shield, Northwest Territories.

Alberta, Survey officers found conditions that led them to believe that artesian water could be obtained in a belt whose continued aridity was forcing out the settlers. Drilling proved the conclusions correct and water worth millions of dollars was obtained for the irrigation of an area of approximately 1,000,000 acres.

In subsequent chapters some of the highlights of Survey history will be taken up according to the terms of office of the various directors. Because of the fact that these men determined Survey policy during their respective regimes, these periods correspond in a large measure to the natural divisions already outlined. The following is a list of the directors and their terms of office:

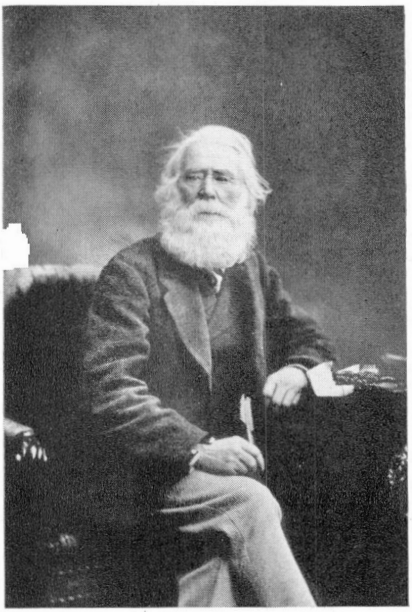
Sir William Logan	1842–1869
A. R. C. Selwyn	1869–1895
G. M. Dawson	1895–1901
Robert Bell (acting)	1901–1906
A. P. Low	1906–1907
R. W. Brock	1908–1914
William McInnes	1914–1920
W. H. Collins	1920–1936
G. A. Young (Chief Geologist)	1924–1943

CHAPTER II

THE FATHER OF CANADIAN GEOLOGY

Sir William Logan was the founder and first director of the Geological Survey of Canada, but he was something more. For the 27 years of his association with it, he, in his own person, practically constituted the Survey. During that time he built up an organization of enthusiastic assistants, but he himself always remained the most active worker, the guiding spirit, and the one whose passion for research and accomplishment inspired all his associates. Throughout his lifetime the worth of his character and the value of his contributions were recognized not only in the country he was serving but everywhere the science of geology was pursued, and the passing time has not dimmed but rather has enhanced his reputation. Wherever more recent workers have followed in his footsteps there has been uniform respect for the conclusions he reached and the work he performed. It is small wonder, therefore, that his name is the most prized heritage that the Geological Survey possesses.

PLATE VI



Sir William Logan, Founder and first Director of the Geological Survey of Canada. 7333/

William Edmund Logan was born in Montreal on April 20, 1798, of well-to-do Scotch parents. His early education was received at an excellent private school in that city, where in

addition to a grounding in the classics he seems to have acquired the capacity to thrash boys bigger than himself. In 1814 he and his brother Hart were sent to Scotland to attend Edinburgh High School, and 2 years later his father carried out a plan, which he had long been contemplating, of returning to his native land to live. Leaving his eldest son, James, to carry on the Montreal business he brought the rest of the family to Edinburgh, and soon two other sons, Edmund and Henry, joined their brothers at the High School. This was a famous institution that drew its pupils from a wide range of society, noblemen's sons sitting alongside the sons of tradesmen, and it numbered among its graduates many distinguished men. The Logan boys, particularly William, all did well in their studies, but at this time William's heart seems to have been set on a commercial career, and in 1817 he went up to London to enter the counting-house of his uncle, Mr. Hart Logan. For the next 14 years the busy metropolis was his home; his family continued for a time to live in Edinburgh, but in 1820 his father purchased a small estate some 20 miles from Edinburgh, near the Avon, and Clarkstone, as it was called, became the scene of many happy family reunions.

Logan's sojourn in London was occupied largely with business, but there was time for travel, society, and study. His favourite reading was on chemistry, mineralogy, and geology, but it was not until after he left London that he discovered that he wished to make the study of these his life work. In 1831 he went to Swansea, Wales, to join the staff of a copper-smelting business in which his uncle had invested considerable capital. At first his time was employed in the office, where he toiled from early morning until midnight in order to establish a proper system of accounts, but eventually he had to attend to technical matters in connection with copper smelting and with the mining of coal required for the smelting operations. His efforts with the second of these soon aroused his interest in the structure of the local Glamorganshire coal field. He purchased a theodolite, compass, and other instruments and devoted himself to the preparation of a detailed geological map of the region. The work was done with such care and

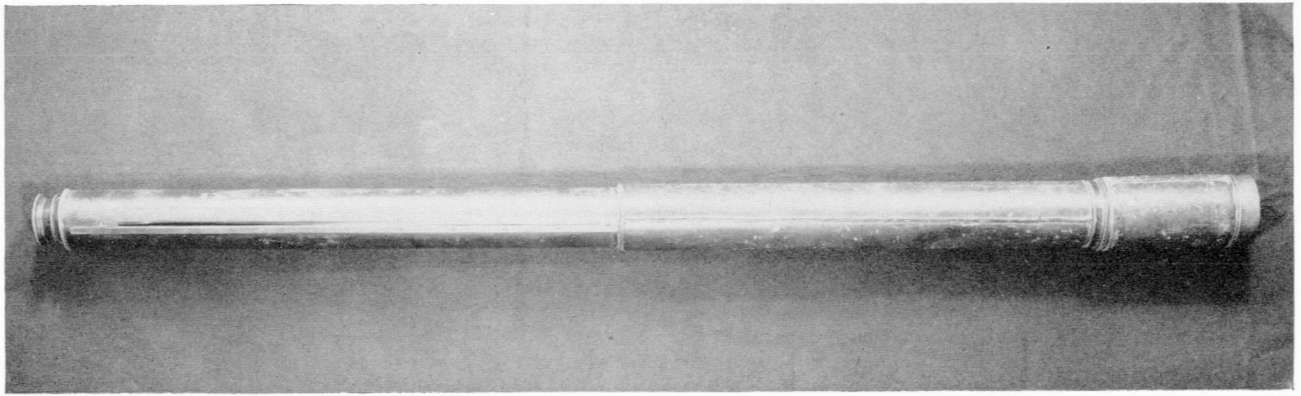
thoroughness that when Sir Henry De la Beche began his geological survey of the region he accepted Logan's offer of his maps and adopted them *in toto* for the government survey. During his work in Wales, Logan's fondness for geology steadily increased. In 1837 he was elected a Fellow of the Geological Society and in 1840 he read a paper before that body on the origin of coal that was regarded as a most important contribution to the subject. It has been recognized that coal is of vegetable origin, but the exact manner in which it has accumulated was in dispute. Some regarded the seams as having been deposited in the manner of driftwood in lakes or at the mouths of rivers draining wooded country, whereas a second school was of the opinion that they had grown in the manner of peaty swamps. Logan's observations showed that beneath the coal seams he had investigated there was everywhere a layer of clay in which were roots of the trees from which the coal was produced, and his conclusions were that the coal had grown *in situ*.

During his long stay in Britain, Logan never lost his love for his native Canada and now that geology was his chief interest in life he longed to study the rocks that he had seen as a boy, and that still remained a virgin field for investigation. In 1840 he went to Montreal on a visit, and in the following year, before returning to Britain, he spent considerable time in Nova Scotia and the eastern United States looking over geological sections and studying in particular the coal measures of these fields. At this time the Government of Canada, which then comprised the two provinces Upper and Lower Canada, now Ontario and Quebec, was considering a proposal to have a geological survey made of the country, and Logan was very desirous to undertake the work. His name was suggested by friends in Montreal to the Governor, Sir Charles Bagot, and recommendations came from Sir Henry De la Beche, Director of the Geological Survey of Great Britain, and from other eminent British geologists, with the result that in the spring of 1842, Logan was offered the appointment. He secured, as assistant, Alexander Murray, a young man with naval training, and very much interested in geology, who

subsequently became the Director of the Survey of Newfoundland, and in 1843 the two began field work in Canada, Murray in the region between Lake Huron and Lake Erie, and Logan in Gaspe.

At that time small settlements composed chiefly of fishermen were scattered along the Gaspe coast, but of the interior of the peninsula little was known except locally to a few lumbermen and Indians. There were rumours of coal, however, and Logan felt that here was an excellent place to begin work. Accompanied by a helper named Stevens, and an Indian, John Basque, he spent his first field season examining the rocks of the coast from the towering cliffs near Cape Rosier, at the eastern end of the peninsula, to Paspebiac on Chaleur Bay, a distance of about 100 miles. Distances were measured by pacing along the shore while the Indian followed with the canoe and equipment, occasionally ferrying Logan around projecting cliffs or over places too deep to wade. In the evening camp was pitched, the notes of the day were written up, survey measurements plotted, often by the glare of the camp-fire, and then came the well-earned rest on a bed of spruce boughs.

In the following year Logan, with a larger party, including Murray, mapped the north shore of Gaspe and then made an exploration across the middle of the peninsula. Cap Chat River was ascended and surveyed in canoes to its headwaters in the mountains. Adjacent summits were climbed, on the highest of which a Union Jack was planted, and to which Logan's assistants insisted on giving the name Mount Logan. Where the stream became too small for further travel in canoes, these were sent back and the remainder of the party continued southward on foot, Logan keeping a pace and compass traverse as he went. Eventually southward flowing waters were reached at Goashore Brook, a headwater tributary of Cascapedia River. New canoes of spruce bark were then built and in them the party descended to Chaleur Bay. Logan's survey, when plotted, tied in almost exactly with the two end points as they appeared on the admiralty charts. In addition, he had secured a geological section across the whole peninsula



Sir William Logan's Rochon micrometer.

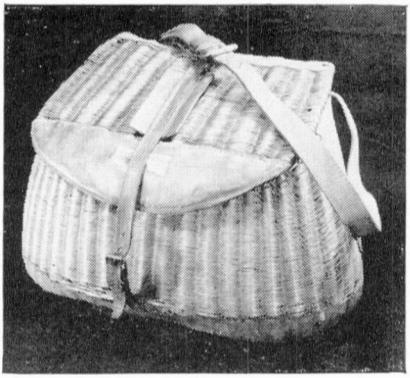
and was able to say that, because all the rocks were older than those that carry coal, no coal deposits are present in the peninsula. Since Logan's day much geological exploration has been carried out in Gaspe, but his work laid the foundation of our geological knowledge and settled the larger problems.

In the early days of the Survey, Logan had many problems other than those of geology. He required quarters for his specimens and for an office, and for this he first of all obtained from his brother James the use of an "upper chamber" in the latter's warehouse on St. Gabriel Street, but early in 1844 he hired a house at No. 40 Great St. James Street, which served as Museum, office, and laboratory. Then, by the end of 1844, the £1,500 that the Government had voted for the work of the Survey had all been spent together with £800 of Logan's own money. He was requested by the Government, however, to prepare an estimate of the cost of continuing the Survey. This was done and a bill was also drawn up and submitted for the consideration of the members of the Legislature. It met with approval and was enacted on March 17, 1845, providing £2,000 a year for 5 years. Scarcely, however, had this matter been settled when Logan was called upon to make an important decision. An offer came to go to India to take charge of a Geological Survey there. It was very tempting but Logan decided that he preferred to continue the work in which he had become so much interested in his own country.

In 1846 the Survey's offices were moved to a larger building in Little St. James Street that was leased from the Natural History Society. Here they remained until 1852 when once more they were removed to more commodious quarters, the former residence of the Honourable Peter McGill, St. Gabriel Street, where they remained for the rest of Logan's regime. In 1850 the vote of money for the Survey was renewed for another 5 years, and in 1855 a Select Committee, appointed to inquire into the operation and usefulness of the Geological Survey, recommended that increased facilities be provided for the work. The result was that a new Act was passed affording $20,000 annually for 5 years and a sum of $8,000 for publishing a map and a report on the geology of Canada.

After the expiration of this renewal act supplies of money were voted annually until 1864 when another act was passed making provision for the Survey for another 5-year period.

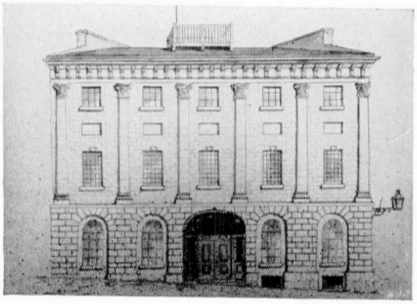
PLATE VIII



Logan's collecting basket.

Logan's troubles over quarters and funds did not hamper his field work or his scientific investigations. Surveys were carried westward, up the Ottawa, through Lake Timiskaming, and on to Lake Superior. Throughout this region he had to deal with Precambrian rocks, and though he had had no previous experience in this branch of geology his conclusions have won the respect of later specialists in this field. Extensive surveys were also made in the Eastern Townships and other parts of Quebec. Detailed topographic maps were made to serve as a base on which to show the geological information, specimens were collected, mineral deposits visited and reported upon, and Annual Reports of Progress issued. His magnum opus, however, is the Geology of Canada, 1863, a volume of 983 pages in which he reviewed and revised all the work of the Survey up to that date. Three years later appeared his geological map of Canada, showing the geology and geography of southeastern Canada as far west as Manitoba and as far north as Lakes St. John, Timiskaming, Nipigon, and St. Joseph.

PLATE IX



Close-up view of the old McGill Residence, St. Gabriel Street, Montreal.

Still another phase of Logan's activity was his efforts to advertise Canada's resources abroad. In 1851 he took an exhibit of Canadian minerals to London for the "Exhibition of the Industry of all Nations." This received very high praise and Logan was presented with a medal by Prince Albert, President of the Committee for the Exhibition. He was also at this time made a Fellow of the Royal Society, the first native Canadian elected for work done in Canada. In 1855 he showed another exhibit at the Paris Exposition, and for this he received the Grand Gold Medal of Honour and in addition he was presented by the Emperior Napoleon III with the Cross of the Legion of Honour. A greater distinction, however, awaited him at the hands of his own sovereign. Queen Victoria paid a visit to the Exposition and Logan had the honour of explaining the Canadian exhibit to her. She was impressed by his enthusiasm and by his charming manner and shortly after, on January 29, 1856, she knighted him at Windsor Castle. About this time, too, he received from the Geological Society the highest honour in its power to bestow—the Wollaston Medal. Laden with all these distinctions Logan returned to Montreal to be presented by his many friends in his home city with a magnificent silver fountain with several basins, one above another, on which were engraved pictures of Carboniferous flora, symbolical of his researches in the coal-bearing rocks.

Logan had looked forward to the time when the activities of the Geological Survey would be carried both eastward and westward through British North America. Especially was he interested in reports of the occurrence of coal in what is now Alberta and British Columbia. When Confederation of the Maritime Provinces with Canada came in 1867 and the western provinces were added soon after, this opportunity to extend the work of the Survey became a reality. By this time, however, Sir William was approaching 70 years of age, and he reluctantly appreciated the fact that the added responsibilities of exploring this new vast territory required the energy of a younger man. Accordingly, in 1869, he tendered his resignation, which was accepted, and A. R. C. Selwyn became

his successor. For the remainder of his life Logan continued, however, his interest in geology, carrying on investigations in that area of many problems, the Eastern Townships. Part of his time was spent in England and he took occasion to visit his old friend Murray in Newfoundland. The end came in 1875 when he was visiting his sister in Wales, and he was laid to rest beside his brother Hart at Llechryd.

PLATE X

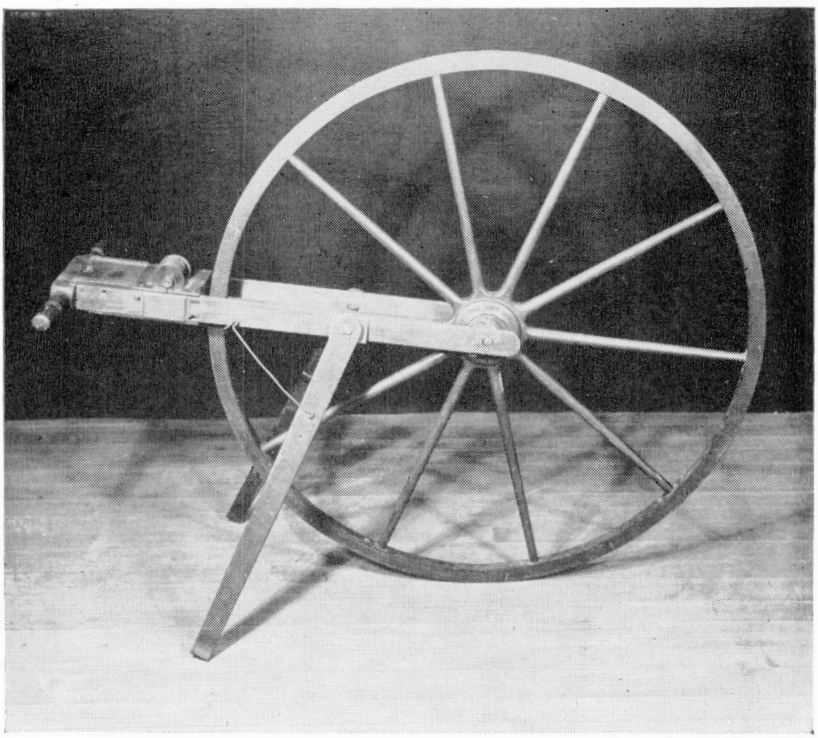
The Logan medals: Nos. 11, 16, 29, 36, International Exhibition, London, 1851; No. 27, Grand Gold Medal of Honour, Paris Exposition, 1855; Nos. 25, 26, 28, 31, and 37 are copies in silver or bronze; Logan was made Chevalier of the Legion of Honour by the Emperior Napoleon III; Nos. 9, 19, Exhibition at London, 1862; Nos. 3, 13, 15, International Exhibition at Paris, 1867; No. 32, Wollaston Medal; No. 22, Royal Medal (1867) from the Royal Society of London.

What kind of a man was he who left such an imprint on Canadian geology? His work and his organization that continued after him speak for themselves. Side-lights on his

personality, however, have come from some of those who worked with him. Physically a small man, but strong, and energetic, of great charm, beloved by his subordinates and by his many friends, Logan's chief characteristic perhaps was his devotion to his duties. In the office he laboured from early in the morning until six or seven in the evening, taking no lunch, and except when he went out to dine with friends he always came back to work at night. He made a daily round of visits to every member of his staff for instruction or consultation, kept all his accounts with his own hand, carried on by longhand an extensive correspondence, plotted all his own surveys, wrote his reports and edited those of his assistants, examined all the fossils, minerals, and rock specimens collected during the year, studied the geological reports of the American state surveys and of other countries in order to correlate the Canadian work with theirs, and gave interviews to numerous visitors. For a number of years four manuscipt copies of all the reports, including the annual Reports of Progress, were required, one for the Governor-General, one for the House of Assembly, one for the Legislative Council, and one for the printer, and Logan wrote out all of them in his own hand. In the field he worked even harder, if that were possible, than he did in the office. In a letter to Murray he describes his survey of the Ottawa and Mattawa Rivers: "The bearings have been taken with a theodolite, and the whole of the map has been carefully protracted in the field on drawing paper as the work went on, on the scale of one mile to an inch. Every sight in levelling, every bearing, sometimes twenty at a station, every micrometer angle, every reduction of the distance to chains and links, and every line of the protraction has been worked by my own hands. You may think, therefore, that I have been a little busy. I was up every morning at four and five o'clock to rouse my Indians (not one of whom would ever stir unless he had my special command), to be ready for an early breakfast and start. We seldom left our work until we could no longer see distinctly, and it was often one, two and three hours after midnight before my protraction was finished and I could creep into my blanket."

Logan was a bachelor, financially very well-to-do, generous in his givings, but most unconcerned about his own comfort. In the Survey's quarters on St. Gabriel Street he occupied a fairly large room on the second floor that served for office, draughting room, reception room, bedroom, and wardrobe.

PLATE XI



Sir William Logan's wheel odometer.

The one window had no curtain nor screen; the floor no carpet or rug. A plain table and a cheap chair stood in the middle of the room and a common washstand with basin and pitcher in one corner. An ingenious contraption served for bedstead and chair. During the day it stood in a corner and looked like an easy chair, but Logan was never known to sit

in it; at night the caretaker of the building unfolded it revealing inside the blankets that Sir William used in camp. A long row of worn boots occupied a considerable part of the circumference of the room and field clothes hung on pegs or nails on the wall. Surveying instruments and a large collecting basket stood about or hung by straps at the back of the door. About 1860, a new feature appeared in the room. This was a slab of sandstone from Perth, Ontario, marked with crustacean trails, and so large that it almost entirely covered one end wall. Every morning Sir William would gaze fondly at this while performing his ablutions.

If Logan was unconcerned about his comfort he was even less concerned about his personal appearance. When he happened to come to town during the field season, he would not always put on his city clothes, but as a rule waited until he returned for the winter. About 1862, he purchased a coat of durable brownish grey Irish freize for city wear and he wore it every winter until he finally left Canada in 1874. This coat and a waistcoat with large squares formed by narrow white lines in time seemed to his staff to be part of the man himself. In the field he was even more careless about his appearance. In one of his notebooks he gives a description of himself on an occasion when he and his party stopped at the house of a settler named Barton: "We are all pretty-looking figures. I fancy I cut the nearest resemblance to a scarecrow. What with hair matted with spruce gum, a beard three months old, red, with two patches of white on one side, a pair of cracked spectacles, a red flannel shirt, a waistcoat with patches on the left pocket, where some sulphuric acid, which I carry in a small vial to try for the presence of lime in the rocks, had leaked through—a jacket of moleskin, shining with grease and trousers patched on one leg in four places and with a burnt hole in the other leg; with beef boots—Canada boots as they are called—torn and roughened all over with scraping on the stumps and branches of trees, and patched on the legs with sundry pieces of leather of divers colours, a broad brimmed and round-topped hat, once white but now no colour and battered into all shapes. With all these adornments, I

am not surprised that Mrs. Barton, speaking of her children and saying that here was a little fellow, frightened of nothing on earth, should qualify the expression by adding, but I think he's scared at you, Sir."

Many stories have come down about embarrassing situations in which Logan found himself as a result of his carelessness about his clothes, his good nature, and his absorption in his work. On one occasion after roughing it for some time in the back country he sent his assistant, as much the better dressed of the two, ahead to make arrangements at a hotel for their Saturday dinner. The assistant returned and reported favourably and the two filled in the time by examining some fossiliferous rocks nearby. After a while the hotel-keeper appeared. He looked very doubtfully at Sir William's trousers, which were tucked into a pair of rusty long boots, and then drawing the assistant aside he asked him if he wished separate tables to be set or if he would allow *his man* to eat with himself. On another occasion while working north of Ottawa River, Sir William boarded a steamer to go to Montreal and took his place in the upper saloon. An officious cabin boy told him his place was below, and he and the steward were about to eject him when a passenger who knew Sir William arrived and explained the situation. On still another occasion while working in the Eastern Townships he was returning to his stopping place late one evening very tired and hungry, when, passing the railroad station, he came upon the wagon belonging to a tavern whose young driver was engaged in rolling a barrel that had just been unloaded from a train. He asked the latter if he might drive up to the village with him. "All right" came the reply, "as soon as I get up this whiskey barrel." The barrel was rolled up a plank into the wagon and the backboard fastened, and then the driver said, "Now, old man, jump up and sit astride of the barrel to keep it from rolling about and I'll give you a ride up for nothing." Sir William did as he was ordered and had a grand ride up town, but, as he remarked later in describing the incident, he was glad he did not meet any of his city friends while he was thus endeavouring to make himself useful. In

days when the ordinary person took no interest in rocks and could not imagine why any one should, Logan's hammerings at rock exposures were often mystifying to the local people and sometimes looked upon with grave suspicion by them, and many a tale had he to relate of the occasions on which he had been taken for a lunatic.

Though devoted to his duties and studies, Logan took great pleasure in the society of his friends, and when he did spare an evening from his work he was the centre of attention. He seemed to have an inexhaustible supply of amusing anecdotes and stories and often at the Survey office when he got into conversation with a congenial spirit his merry, hearty laugh would echo through the building. He enjoyed music and himself sang Scotch songs in a voice of rare sweetness. He appreciated art and his notebooks are filled with many charming sketches, which show an ability not only to bring out clearly the points he wished to illustrate but also to choose and skilfully delineate the unusual and beautiful.

It is perhaps, however, in his relations to those who worked with him that we get the best picture of the man. He tried to surround himself with the most capable men that he could secure and he did his utmost to assist them in their work and to promote their welfare in every way in his power. He took pleasure in giving the fullest credit to each and availed himself of every opportunity to speak highly, even flatteringly, of them to strangers. Though he was an undemonstrative man they knew of his regard for them, and in return they gave him their most loyal support and were proud of the great respect and esteem in which their chief was held by the leaders in science of both America and Europe.

Succeeding generations of geologists of the Geological Survey of Canada, including those of the present day, though they have not known Logan personally, have always felt in much the same way about him as did their predecessors who worked with him. The Survey club, which meets during the winter months to discuss geological questions and other matters of concern to the Geological staff, is known as the Logan Club, and in front of the geologists' office at the

Museum in Ottawa is another reminder of him. This is a great boulder of Ottawa gneiss, from a formation Logan named and which he made classic by his studies. On it is a bronze plaque bearing his likeness and an inscription that reads:

SIR WILLIAM LOGAN
K.B., LL.D., F.R.S.
1798–1873
The Father of Canadian Geology
Founder and First Director of the
Geological Survey of Canada
1842–1869
Erected by the Twelfth
International Geological Congress
Canada
MCMXIII

PLATE XII

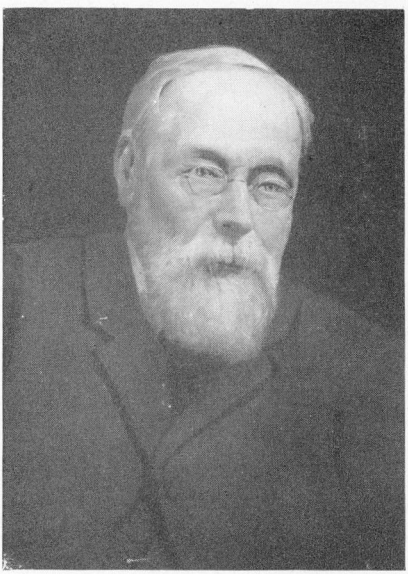
The Logan boulder.

CHAPTER III

SELWYN AND EXPANSION

The man chosen to succeed Logan was the Director of the Geological Survey of Victoria, Australia, who took over his new duties on December 1, 1869. Alfred R. C. Selwyn had been born at Kilmington, Somersetshire, England, in 1824, the son of the Reverend Townsend Selwyn, canon of Gloucester Cathedral, and his wife Charlotte Sophia, daughter of Lord George Murray, bishop of St. David's, and grand-daughter of John, fourth Duke of Athol. His studies were carried on first at home under private tutors and subsequently in Switzerland where, among other things, he became proficient in mountain climbing, a training that later stood him in good stead in his work in Wales, Australia, and Canada. In 1845, at the age of 21, he was appointed to the staff of the Geological Survey of Great Britain under De la Beche, and for 7 years he was actively engaged in geological mapping and stratigraphical studies in Wales and England. His work brought him into close contact with Ramsay, Playfair, Jukes, and other noted scientists, all of whom formed a very high regard for the enthusiastic young geologist. His work was regarded as of a very high order and he was the first to recognize and interpret the great unconformity in Anglesey between the

PLATE XIII



Alfred R. C. Selwyn 1824-1902; Director of the Geological Survey, 1869-1895.

basal Cambrian strata and the Precambrian schists upon which they rest. When the newly formed colony of Victoria decided to inaugurate a geological survey, Selwyn, in 1852, was chosen as its first director, a position he occupied with energy and distinction for 17 years. His regime as Director of the Geological Survey of Canada lasted for the next 25 years, a period almost as long as that of Logan, and his policies were continued for another 12 years by his two successors, Dawson and Bell.

The task confronting Selwyn on his arrival in America was a great one. Until 1867 Canada had consisted of only the southern part of what are now the provinces of Quebec and Ontario. Confederation by the British North America Act brought in New Brunswick and Nova Scotia to form the Dominion of Canada; in 1870 Manitoba and the Northwest Territories were added as the result of the purchase of the lands of the Hudson's Bay Company; British Columbia joined in 1871, and Prince Edward Island in 1873. A certain amount was known about the geology of the Maritime Provinces from the labours of private individuals and from provincial investigations such as those of Abraham Gesner, who from 1838 to 1844 had been provincial geologist of New Brunswick, but the whole region required mapping and detailed examination. Regarding the vast territory newly acquired in the west, much less was known. The only settlements were around Fort Garry in the Red River Valley, and on Vancouver Island and the adjacent part of the Pacific mainland. Elsewhere the few centres of civilization consisted of the scattered fur trading posts and the meagre information concerning the region was from journals and maps of the explorers of the North-West and Hudson's Bay Companies—men such as Hearne, Pond, MacKenzie, Thompson, Fidler, and Fraser—and the writings of the British explorers, Franklin, Richardson, and Back, who had penetrated into the northern part of the region, and Hind and Hector along its southern part. Most of this work had been confined, however, to a few of the main travel routes, and even along these had yielded for the most part only slight geological information.

PLATE XIV

A. Travel on the Cariboo road.

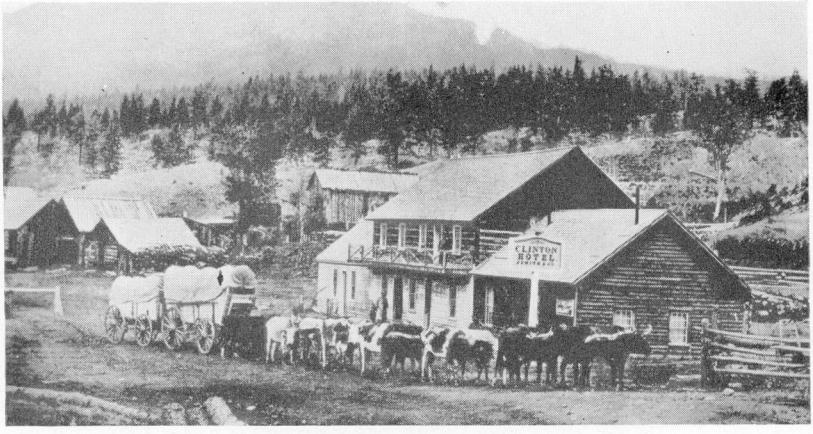
B. Travel in northern Saskatchewan.

It now fell to the Geological Survey, as the only Government organization available for the work, to explore all this vast territory. The staff, when Selwyn took over from Logan, consisted of only five geologists besides himself—Edward Hartley, Robert Bell, James Richardson, Charles Robb, and H. G. Vennor; in addition, there were T. Sterry Hunt, mineralogist, Elkanah Billings, palæontologist, Robert Barlow, and his son, Scott Barlow, topographers and draughtsmen, Horace Smith, artist, and T. C. Weston, museum preparator, a small group for so great a task. Under the new director, however, the Survey was to rise to its increased responsibilities and opportunities, and to add another great chapter to that which had been written by its founder. New geologists and assistants were gradually acquired and trained and the number of parties sent out each summer was steadily increased. In 1870 six parties were at work in the field, in 1880 eight, and by 1890 the number had risen to fourteen. The following are only some of Selwyn's appointments to his staff, names that have written themselves indelibly into the story of Canadian geology: Fletcher and Ells were added in 1872, Dawson and Whiteaves in 1875, McConnell and Adams in 1880, Tyrrell in 1881, Low, McInnes, Lawson, and Faribault in 1882, Barlow in 1883, Dowling and Ingall in 1884. These men and their associates had not merely to be geologists. They found it necessary to make their own maps, to collect information on the natural history and resources of every kind in the regions they were exploring, and at times to be proficient in living off the country.

Though during the later part of his regime Selwyn's time was largely taken up with his office duties as Director, his early years with the Survey were occupied to a large extent with his own field work. In 1870 he investigated the gold fields of Nova Scotia, and in the following year he began work in the extreme opposite part of Canada. One of the terms on which British Columbia had entered Confederation was that a railroad should be built joining its Pacific coast to eastern Canada. Several engineering parties were to search for the most feasible route through the mountains, and Selwyn's

first task here was to investigate the geology and mineral resources along these possible lines. Taking Richardson with him as his assistant, he crossed by rail to San Francisco and thence north by boat to Victoria, a journey that occupied 3 weeks. He decided he would first ascend the North Branch of the Thompson to Tete Jaune on the upper Fraser, then proceed through the Leather Pass to Jasper House and to return by a route from Tete Jaune to Richfield in the Cariboo gold field.

PLATE XV



Scene on the Cariboo road.

Equipment was purchased at Victoria, and on the morning of July 25 Selwyn, Richardson, and three assistants embarked on board the steamer *Enterprise* for New Westminster at the mouth of the Fraser, 95 miles from Victoria, where they arrived at 6 o'clock in the evening. The next morning they started upstream in the stern-wheel river steamer *Lillooet* and on the morning of July 27 reached Yale, 90 miles above New Westminster and the head of navigation on the Fraser.

The route to be followed in the next lap of the journey was along the Cariboo road up Fraser Valley, a famous highway that had just recently been opened up. Up to 1850 the mainland of British Columbia had been an almost inaccessible

wilderness, inhabited by scattered Indian tribes and with only here and there a Hudson's Bay Company trading post. The report, however, that the Company's chief factor at Kamloops had, in 1852, purchased from Indians gold that had been obtained from gravels on Thompson River 9 miles above its junction with the Fraser had soon spread and an army of gold seekers from California, barely recovered from the great stampede of 1849, started northward. In the spring of 1858 over twenty thousand people had reached Victoria by sea, and turned that village into a tented city. Other thousands arrived overland. The route to the new Eldorado led by boat to Yale, but beyond this a narrow gorge flanked by precipitous rock cliffs from 2,000 to 7,000 feet high and occupied by a tumultuous strip of water barred further progress by river. Up the canyon led a perilous trail, but in winter this became blocked by snow and it was necessary to find other routes. By these some of the gold seekers had soon penetrated to the mouth of Quesnel River where they found placers, and shortly after to the rich central region of Cariboo. Early in 1859 a detachment of Royal Engineers had arrived in the region to maintain law and order. They opened a route to Lillooet on the upper Fraser by way of Harrison Lake, and in October of the following year had completed a road through Fraser Canyon to Lytton at the mouth of the Thompson. Four years later the road had been carried forward into the Cariboo country and the era of freighting by wagons had set in.

The equipment and provisions for Selwyn's party amounted to 3,600 pounds, and not being able to secure either teams or pack-horses he engaged four Indians as packers, and with these and the rest of his party started on, leaving most of his material to be forwarded by wagon at the first opportunity. Richardson made a pace and compass survey of the road and notes were taken regarding the geology. At Lytton where Thompson River joins the Fraser, one of Bernard's wagons was secured, which took the party on to Cache Creek, and from there along a branch road east to Savona's Ferry at the outflow of the Thompson from Kamloops Lake. Selwyn proceeded on to Kamloops opposite the mouth of the North

Pack-train crossing river, British Columbia.

Thompson by canoe and the remainder of the party and the supplies arrived later. Here he divided his party. Richardson was instructed to work along the South Thompson Valley and afterward along the wagon road from Cache Creek to Cariboo, and later, if time permitted, to proceed to Vancouver Island to investigate the coal deposits there.

Selwyn's route led up the North Thompson along the line being explored by the McLennan railroad survey party, and on August 19, the Geological Survey group of eight men with fifteen horses started north. The passage of the narrow zig-zag trail around Assiniboine Bluff, the crossing of the North Thompson at Clearwater by the pack-train, the long, difficult detour through the mountains beginning at the mouth of Mad River to avoid rocks and canyons on the Thompson, and the occasion when he discovered that his hungry horse that he had tied to a tree had eaten his notebook, were all incidents of great interest to Selwyn. From the headwaters of the North Thompson at Alfreda Lake, the route led across Canoe River, a tributary of the Columbia, and on through Leather Pass into the valley of the Upper Fraser. This stream was reached by Selwyn himself on October 11, and his whole party arrived at Tete Jaune Cache on October 16. It was now too late to proceed to Jasper, and as no trace was found of the railroad party that had been expected from Cariboo, Selwyn found it necessary to return by the route he had come. At the crossing of the Thompson below Alfreda Lake the horses, which were now too weak to go farther, were abandoned, four canoes were built, and in them the Thompson was descended. This involved many adventures in the rapids, including the loss of two of the canoes. Kamloops was reached on November 17. At Yale it was found that ice in the Fraser had stopped the steamboats and the journey by canoe had to be continued. Selwyn reached Victoria on November 29 and Montreal on December 26. Richardson, who had been working on Vancouver Island, arrived home on January 9.

In the following field season we find Selwyn at work in June investigating the iron ore deposits of Londonderry, Colchester county, and the Spring Hill coalfield of Cumber-

A Red River cart brigade—Selwyn's party, 1873.

land county, Nova Scotia. Later in the summer he studied the silver-bearing region around Thunder Bay, Lake Superior, and then, assisted by Robert Bell, he made an exploration westward from that lake to Fort Garry. Three special reports on these investigations appear under his name in the Report of Progress for the year 1872-73.

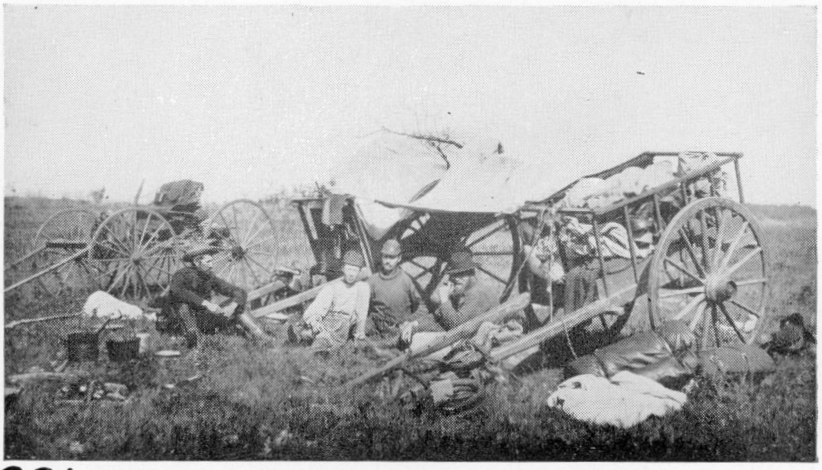
The summer of 1873 saw him again in the west examining the region westward from Fort Garry to Rocky Mountain House on North Saskatchewan River. Leaving Montreal on July 7 he went by way of Toronto, Chicago, St. Paul, and Moorhead, reaching Fort Garry on July 14 where outfitting for the season's work occupied 11 days.

This was the period when freighting across the prairie was by means of the famous Red River carts, four to five thousand of which used to leave Fort Garry annually to carry supplies to the various trading posts to the west and north. The cart was a unique affair made entirely of wood, and had the reputation of being able to go anywhere no matter how rough the country. It was drawn by a single animal, either ox or horse, carried from 800 to 1,000 pounds, and when in motion gave out a melancholy squeak of a type all its own. The carts, in brigades, often one hundred strong, usually travelled in single file along trails that are followed year after year. On some of the more commonly used routes, such as those to Edmonton and Battleford, as many as twenty parallel ruts marked the course.

Selwyn secured four carts, a buck-board wagon, and eleven horses, and his party was joined by two Englishmen with three carts and five horses. The horses were used as required, either for saddle or harness, five or six being allowed to run loose in turns. The journey to Edmonton, a distance of about 900 miles, was made in 50 days, and here Selwyn sold his carts, horses, and harness for about what he had paid for them at Fort Garry. Leaving the rest of his party at Edmonton, Selwyn with one local guide continued another 180 miles with the buck-board and four horses to Rocky Mountain House on Clearwater River, about 3 miles above its junction with the Saskatchewan. Here a half-sized Hudson's Bay Company

York boat was secured and in it Selwyn, his guide, and a half-breed boy descended the Saskatchewan to Edmonton. Picking up five members of his party that he had left there, Selwyn continued downstream to Lake Winnipeg and Fort Garry. None of the six had ever before descended the river so they had to find their own way through its intricate channels, sand bars, shoals, and rapids. Four of the men worked at the

PLATE XVIII



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A stop for lunch, Selwyn, 1873, Red River carts.

oars, the fifth took the steering sweep, and Selwyn himself acted as bowman; in addition, as he went along he made notes of distances and bearings to each bend, plotted his readings, sketched the river, and wrote his geological notes. On October 26 he reached Winnipeg after having completed a circuit by land and water of some 2,300 miles.

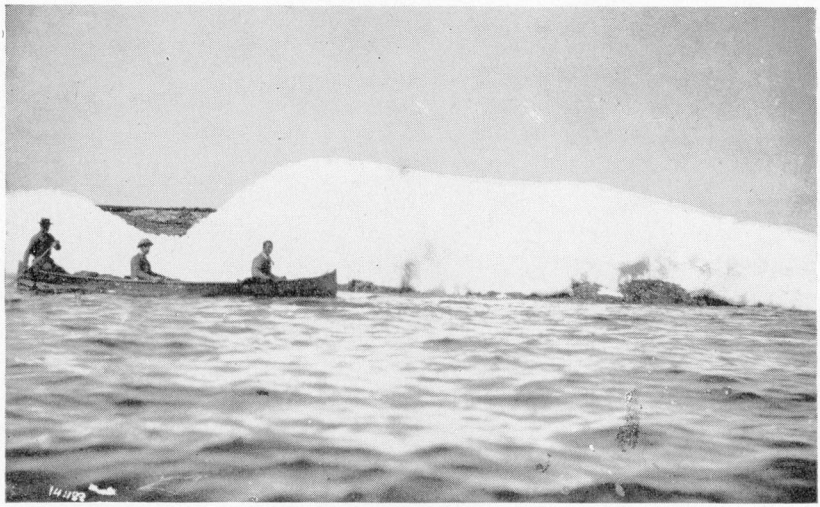
These expeditions were typical of much of the exploration work that was carried out by Selwyn and the field officers of his staff. Such work with minor variations took place under his direction from coast to coast throughout his entire regime. Space does not permit even the mention of many noteworthy traverses. Reference will, however, be made to one piece of work, that of Joseph Burr Tyrrell, carried out during the

closing years of the Selwyn period in the vast stretches of the Barren Lands west of Hudson Bay.

Lying between Great Slave Lake and Hudson Bay and north of latitude 59 degrees, was an area of more than 200,000 square miles of practically unknown country. It had been crossed on foot by Samuel Hearne of the Hudson's Bay Company in 1769-72, but his description and sketches of his journeys were very vague. In 1892 Tyrrell had obtained some information regarding canoe routes through this region from Indians in the Lake Athabaska region and in the following year he was sent by Selwyn to explore it. The party, which consisted of the leader, his brother J. W. Tyrrell, and six canoemen, in two 18-foot Peterborough canoes, and one 19-foot basswood canoe, descended Athabaska River, proceeded to the eastern end of Lake Athabaska, and ascended Stone River to Black Lake. From there, with only a crude Indian map to guide him, Tyrrell commenced his journey north into unknown country.

The first part of the route was through a chain of small narrow lakes along Chipman River and involved many long, hard portages. The head of the river proved to be a large lake, to which the name Selwyn was given. Here some Indians were encountered who endeavoured to dissuade the canoemen from proceeding farther saying the route ahead was full of impassable rapids and the country swarmed with cannibal Eskimos. From this lake a portage led across the divide to Daly Lake and on July 22 the outlet of this body of water was reached, the northward flowing Telzoa River. On July 27 the party passed from the wooded country into the treeless Barren Lands, and 2 days later they encountered a most welcome sight—a vast herd of barren-ground caribou numbering many thousands, on a good feeding ground on the eastern shore of Carey Lake. Some eighteen or twenty were secured to replenish the larder, and while the meat was being dried the Tyrrells spent several days roaming over the hills and wandering through the caribou herd armed only with their camera and causing no more alarm than they would have done had they been walking through a herd of cattle in a field.

PLATE XIX



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J. B. Tyrrell on Dubawnt Lake.

PLATE XX

Barren-ground caribou, Carey Lake.

On August 2 the journey was resumed and 5 days later they entered a broad expanse of water, Dubawnt Lake, whose northwestern and northern shores were searched for a measured distance of 117 miles for an outlet. The surface was still almost entirely covered with ice, but in most places there was a lane of water between the ice and the shore. Eleven days were spent on the lake during 5 of which heavy storms prevented travel. The route led on downstream through the rapids of Dubawnt River and then east through Aberdeen, Schultz, and Baker Lakes to Chesterfield Inlet, the mouth of which was reached on September 12.

The most difficult part of the journey remained ahead, the 400-mile trip in small canoes down the open coast of Hudson Bay. Provisions were about exhausted and the chances of obtaining game were small. The flat shores where low tide water was usually several miles distant from the lines reached by the high tides made it impossible to land or launch canoes more than once in 12 hours, the time of flood tide. Snowstorms, floating ice, which cut the canoes, sickness, and frost bites among the men, were further features of the journey. The shooting of a polar bear and some ducks supplied some food, but it was a thoroughly exhausted party that eventually reached Fort Churchill. From there they proceeded by snowshoe and dog-team to Winnipeg, a distance of some 800 miles.

In the following year Tyrrell was off on another voyage through the Barren Lands. This time his route led northward through Reindeer Lake to Cochrane River, across a height of land to Kasba Lake, and thence northeastward down Kazan River. At Hearne's Yath-Kyed Lake, in order to avoid coming out again at Chesterfield Inlet, he took a portage route eastward to Ferguson River and descended that stream to Hudson Bay, which he reached on September 18. Once more there was a long canoe journey to be made down the open coast, but on October 1 Churchill was again reached. These journeys furnished much important geographic and geologic information. Among other things, they established the fact that in Pleistocene time there had been a centre of glaciation west of Hudson Bay from which a continental ice

mass, to which the name Keewatin Glacier was given, had spread out in all directions.

Though Selwyn was chiefly concerned with his task of exploring Canada, it was his aim to make the Geological Survey of as wide service to his country as possible. He began the systematic mapping of the Maritime Provinces and southern Quebec, and the gathering of records of mines and mineral statistics. He was interested in collecting information about the natural history of the country along lines besides those of geology. On three of his early expeditions he took along with him John Macoun, who had become the acknowledged authority on Canadian botany, and on January 1, 1882, the latter was given a permanent appointment as botanist to the Geological Survey. Selwyn was also most interested in building up a museum. When the Survey moved from Montreal to Sussex Street, Ottawa, in 1880, he reported that there had been shipped 1,729 boxes, 101 barrels, and 162 miscellaneous packages, weighing 282,585 pounds, which gives some indication of the extent to which the Museum collections had grown.

As in the case of the first director of the Survey, a word about the personality of the second may be mentioned. Tall and graceful, quick and alert, of a rather nervous disposition, Selwyn had a keen and observant eye, and was able to take stock of a situation quickly and to make prompt decisions. In the office he was a strict disciplinarian, insisting on order and system, and on courtesy and deference towards superior officers. He was an English scholar of note, and his manuscripts were always most carefully prepared.

He received many honours in his day. In 1873 he was made Chevalier of the Legion of Honour, Paris. He was one of the twenty original Fellows in Section IV of the Royal Society selected by the Marquis of Lorne in 1882. In 1886 Queen Victoria summoned him to Windsor Castle to make him a Companion of the Order of St. Michael and St. George. He was granted his superannuation from the Survey on January 7, 1895, and on October 19, 1902, he passed away at his home in Vancouver, British Columbia.

CHAPTER IV

DAWSON AND CORDILLERAN TRAILS

George Mercer Dawson was the second son of Sir William Dawson, Principal of McGill University, and himself a noted geologist. George received his early college training under his father, but did not graduate from McGill. Instead he went to London in 1870 to attend the Royal School of Mines, where he studied under Huxley and Ramsay, carried off a number of honours and prizes, and was graduated in 1872. In the following year he was appointed geologist and botanist to Her Majesty's British North America Boundary Commission, and his report on the Geology and Mineral Resources of the 49th Parallel from Lake of the Woods to the Pacific Ocean, published when he was only 25 years of age, was regarded as a most noteworthy piece of work. On July 1, 1875, he was appointed to the staff of the Geological Survey as Chief Geologist; in 1883 he was made Assistant Director, and on Selwyn's retirement he became Director.

PLATE XX

George Mercer Dawson, 1849-1901; Director of the Geological Survey, 1895-1901.

What the name of Logan signifies in relation to the geology of eastern Canada, that of Dawson stands for in the west. One of the greatest scientists that Canada has produced, he carried out extensive work in the Great Plains belt, and more particularly in the Cordilleran country to the west, that laid

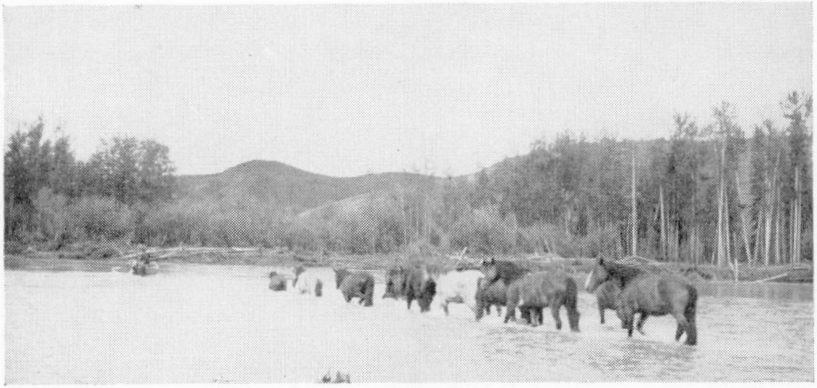
the foundation of much of our knowledge of these regions. Short in stature and of apparent delicate constitution, he laboured in regions in which travel was difficult and prolonged exertion of the most strenuous character was required; but an indomitable will and a passion for discovery always sustained him. Great as were his services as field officer, those as Director were equally important, and his sudden death on March 2, 1901, while still in office, was a very heavy blow to the Survey.

Dawson's early work with the Survey was chiefly in that central part of British Columbia known as the Interior Plateau, a region the complicated geology of which he did much to work out. The seasons of 1875 and 1876 were devoted to explorations in the northern part of this belt lying between Fraser River on the east and the Coast Range on the west. The work was performed in more or less intimate connection with that of surveys for the Canadian Pacific Railway, whose depots and trails greatly facilitated the geological work. In the following year he worked farther south in the region of the Thompson Valley and around Shuswap, Kamloops, Nicola, and Okanagan Lakes, a section of country easier of access and already partly settled.

The summer of 1878 was spent in mapping geographically and geologically a part of the Queen Charlotte Islands where, in addition to his main work, he made extensive studies regarding the natural history of the islands and the Haida Indians there. In the following year he was again at work on the mainland carrying out a reconnaissance survey, lasting 7 months, across the whole Cordilleran belt from the mouth of the Skeena to Edmonton on the North Saskatchewan. In this season, his work took him by rail and steamboat 6,160 miles and by pack-train, canoe, and wagon about 2,380 miles.

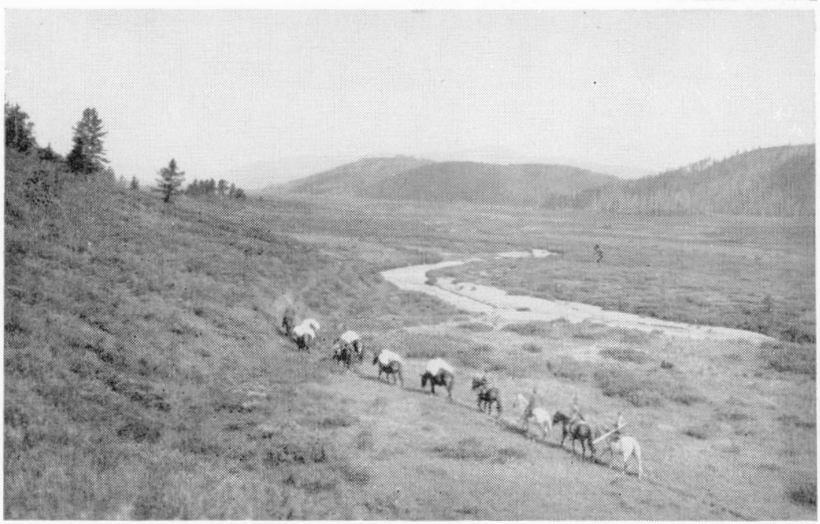
In 1881 Dawson, with R. G. McConnell as assistant, carried out work in the region of Bow, Belly, and St. Mary Rivers, Alberta, investigations that were continued the following field season by McConnell, an officer whose pioneer geological explorations in western Canada rank second only

PLATE XXII



Geological Survey pack-train.

PLATE XXIII



Geological Survey pack-train on the move in the Foothills, Alberta.

to Dawson's. During the years 1883 and 1884 Dawson investigated the Rocky Mountain region between the International Boundary line and Red Deer River. The summer of 1886 was spent mainly studying the Pacific coast region.

The next summer Dawson devoted to explorations in northern British Columbia and adjacent part of Yukon around the headwaters of Yukon River. Leaving the Pacific coast in May, he, with McConnell again as his assistant, ascended the Stikine to Telegraph Creek at the head of navigation, and from there went by trail across the divide to Dease Lake. Here boats were built for the descent of Dease River, a stream flowing into the Liard, which, in turn, is a tributary of the Mackenzie. At the confluence of the Dease and Liard the party divided. McConnell was instructed to descend the Liard, winter on the Mackenzie, and in the following season to descend that river, cross the northern extremity of the Rocky Mountains to Porcupine River, and by following that stream to the Yukon and ascending the latter river and its tributary, the Lewes, to come out to the Pacific coast at Lynn Canal, a circuit that he duly made. Dawson himself ascended Liard and Frances Rivers to Frances Lake, a difficult and tedious journey up swift water and through three dangerous canyons. From Frances Lake an overland journey of about 70 miles was made to the Pelly, for which the party had to make its own trail. However, on the 13th day from their start, the bank of the Upper Pelly was reached with a very meagre equipment and supplies sufficient to last four people for a month. A canvas canoe was built and the junction of the Pelly and the Lewes was reached on August 11, but they were still 400 miles from the coast. For the journey up the swift waters of the Lewes a boat was built. When the headwaters were reached, the boat was abandoned, and the mountains were crossed by way of Chilkoot Pass to the head of Lynn Canal, which was reached on September 20. During the season a circuit of 1,322 miles had been made surrounding an area of 63,200 square miles, that, except for the accounts of a few prospectors and Indians, had been hitherto an unknown region. As a result of this work, Dawson has been called the

real discoverer and first describer of the Yukon region, which later became such an important producer of placer gold, and its capital and chief town was named after him.

Some of Dawson's more important geological reports are those on the East and West Kootenay districts, Kamloops district, Queen Charlotte Islands, Vancouver Island, Cariboo district, and on the mineral wealth of British Columbia. To

PLATE XXIV

82916

On Babine portage, B.C.

mention only some of the conclusions he reached and contributions he made: he paid particular attention to the relations of the late Cretaceous and early Tertiary formations; he discovered in the Cretaceous of southern Alberta an important set of beds, the "Belly River," which he regarded as of fresh-water origin; the coal-bearing "Kootenay" was recognized as of Lower Cretaceous age. In the Interior Plateau belt of British Columbia he established the existence of a great thickness of mica-schists and gneisses, his "Shuswap series," which he regarded as of early Precambrian age. He showed that in Pleistocene time there existed in the mountain region a confluent ice mass, the Cordilleran Glacier, the surface of

which stood at an elevation of 7,000 feet above the sea, and that in the northern part of the belt it had a northward flow down the valleys of the Pelly and Lewes branches of the Yukon.

As has been mentioned, Dawson's interests were not confined to geology. They covered nearly every field of natural history. This can be seen from the subjects concerning which he collected information. For example, his report on the geography, geology, and mineral resources of the Queen Charlotte Islands, prepared as a result of the explorations he carried out in 1878, is followed by seven appendices entitled as follows: "On the Haida Indians of Queen Charlotte Islands"; "Vocabulary of the Haida Indians"; "On Some Marine Invertebrates from the Queen Charlotte Islands"; "Notes on Crustacea"; "Plants Collected on the Queen Charlotte Islands, 1878"; "Meteorological Observations on the Coast of British Columbia, May 28 to October 17, 1878"; "Notes on latitudes and longitudes, etc.".

Next to geology, Dawson was perhaps most interested in ethnology, and he was one of the pioneers in obtaining accurate information about the North American Indians. In addition to his work on the Haidas, he published papers on the Indians of the Yukon and adjacent northern portion of British Columbia, on the Kwakiutl people of Vancouver Island, and on the Shuswap people of central British Columbia. When, in 1884, the British Association for the Advancement of Science appointed a committee to study the physical characters, language, and social conditions of the tribes of northwestern Canada, Dawson was made a member and upon him fell most of the work. Later, in 1896, an Ethnological Survey of Canada was initiated and Dawson was chosen as head of the Survey Committee.

In the years 1892 and 1893 Dawson served as one of the commissioners appointed by Queen Victoria in connection with the arbitration concerning the Behring Sea seal fisheries. It was largely his studies concerning the conditions and facts regarding seal life that furnished Britain's strongest argument in the case. For his services on this Commission he was

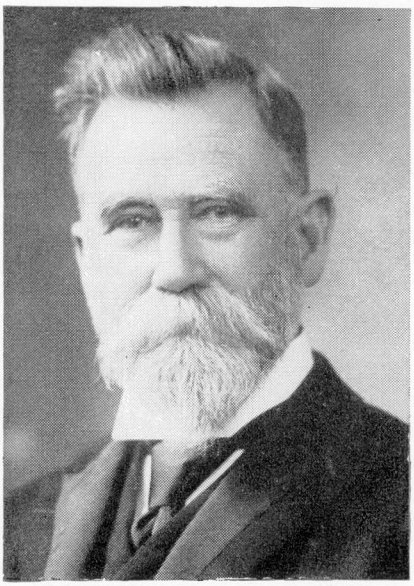
rewarded by his sovereign with a companionship in the Order of St. Michael and St. George. Other honours he received included the degrees of Doctor of Science from Princeton in 1887, and Doctor of Laws from Queen's in 1890, and from McGill in 1891; the Bigsby medal for eminent researches in geology, given by the Geological Society of London and open only to men up to the age of 45; and the gold medal awarded by the Royal Geographical Society of London. He was president of the Royal Society of Canada in 1893, of the Geological Section of the British Association for the Advancement of Science in 1897, and of the Geological Society of America in 1900.

CHAPTER V

BELL AND EXPLORATION

The death of Dawson left the Geological Survey without a director, and as senior geologist who had been with the Survey for 45 years, Robert Bell was made Acting Director, a position he held until his retirement in 1906. The present chapter is a brief review of his career as typical of that of a number of his contemporaries on the Survey staff, and reference will also be made to some of the work that was carried out under his instructions while he was head of the Survey.

PLATE XXV



Robert Bell, 1841-1917; Acting Director of the Geological Survey from 1901-1906.

Bell was born in 1841 in the township of Toronto. His father, the Reverend Andrew Bell of L'Orignal, Ontario, was keenly interested in the natural sciences, especially geology, and made extensive collections of the rocks and fossils of the Palæozoic formations of the lower Ottawa River district. Robert inherited a similar interest, and as a boy assisted his father in his collecting hobby. At the age of 15 he turned this liking and training to practical effect when he became attached to the Geological Survey party of Richardson working in Gaspe Peninsula. He continued during succeeding field seasons to work for the Survey, but in the winter months most of his time for a number of years was occupied with university work. He attended lectures in the Faculty of

Engineering at McGill University and graduated as a civil engineer in 1861. Later he studied medicine at the same university, and took his degree as Doctor of Medicine and Surgery in 1878, a training that he felt might often prove of service when he was away on his long trips among natives in distant parts of the Dominion. From 1863 to 1867 he taught during the winter months at Queen's University. Bell was a Fellow of the Geological Society of London, an original or foundation Fellow of the Royal Society of Canada, and a Doctor of Laws from Queen's University. In 1906 he was awarded the Kings or Patrons Royal Geographical medal of the Royal Geographical Society of London for his exploratory work, and also the Cullum medal of the American Geographical Society. Another honour he received was the Edward VII Imperial Service Order. He died at Rothwell, Manitoba, in 1917.

The field work that Bell carried out under the first three directors was extensive, and took him into very many parts of Canada. As has been mentioned, it began when, in 1857, he accompanied Richardson on his survey of Madeleine River in Gaspe. In the following field season the two were again associated carrying out explorations in the country between Rivière-du-Loup and Ste. Anne des Monts, in this same general region. Subsequently Bell carried out independent surveys in Gaspe along York and Dartmouth Rivers, the results of which were incorporated by Logan in his 1863 report. Another field in which Bell early worked was western Ontario, where he continued the mapping that had been begun by Murray. He explored the north shore of Lake Huron in the vicinity of the Manitoulin Islands where he collected a fine series of Upper Ordovician and Silurian fossils and mapped the distribution of the geological formations west of the Niagara escarpment in southern Ontario. He also explored Manitoulin Island. In connection with this work, Logan speaks very favourably of the interest that Bell took in the superficial as well as the bedrock geology of the region.

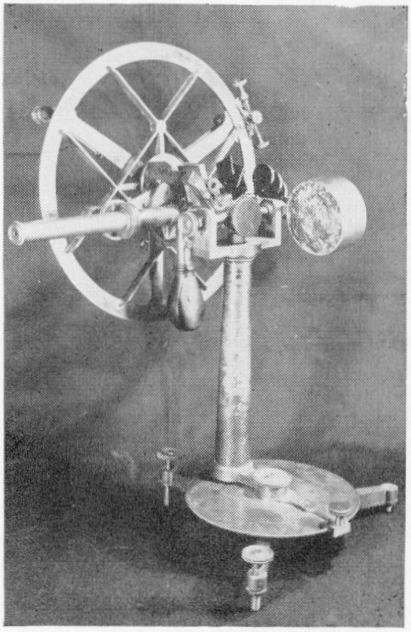
It is perhaps, however, for his numerous surveys in that vast region lying between Lake Superior and Hudson Bay

PLATE XXVI

Camp at Hudson's Bay Company post, Northern Saskatchewan.

and extending far to the west that Bell is best known. These explorations were mainly of the preliminary or reconnaissance type, and the method of survey was often that of the "track" variety along river and lake routes. Travel was mainly by canoe; bearings were taken by compass, distances estimated by the time it took to paddle from point to point, and positions were checked, as often as convenient, by sextant readings for latitude. On still water a boat log formed an alternative method for measuring distance, and for still more accurate work a Rochon micrometer and disks might be used. The maps produced as a result of this type of field work were satisfactory for travel purposes, but the information they provided concerned only narrow strips of country. Sometimes, however, an attempt was made to partly

PLATE XXVII



Repeating circle—Robert Bell.

fill in some of the vacancies between the surveyed routes by employing sketches drawn by Indians. The geological information collected was on a par with the topographical work. Notes were taken about the outcrops observed along the way but time rarely permitted a detailed study of rock relationships or the tracing out of geological boundaries. In the Canadian Shield belt the rocks observed were commonly referred to as either "Laurentian" or "Huronian" largely on a colour basis, Laurentian being the light-coloured granites and gneisses, and the Huronian the darker schists and sediments.

This type of work, rapid as it was, was recognized as having quite a definite value. Much information was collected about the geography of the country and, in addition, about its general geology, natural history, resources, and possibilities. The cost, moreover, was very low. A party commonly consisted of only two canoes and four or five men, mostly Indians or half-breeds, familiar with river travel. Wages were cheap and the party lived to a considerable extent off the country. The officers, too, had been brought up in a tradition of economy, as the following anecdote will illustrate. One summer the writer had as cook on his party working in northern Saskatchewan a canoeman named "Joe" who many years before had worked as cook and canoeman for Dr. Bell. Joe had a favourite story that he loved to relate concerning how the Survey parties were sometimes operated in those days. It ran as follows. Towards the close of a particular season's work, supplies had fallen low and the party had had a long session in which beans, bannock, and fish had formed the regular meals. As they approached civilization, the men's minds naturally turned to that first meal they would have when they finally reached the land of plenty. The day at last came and camp was pitched not far from a store. Joe hopefully waited, but when nothing was said about buying anything extra for the evening meal he went ahead to prepare the routine supper with what he had on hand. While he was thus engaged, the "Doctor" came up and said to him: "Joe, the boys have had a long, hard trip. They have worked well and I think we ought to give them a treat to-night. *Here is a can of tomatoes!*"

PLATE XXVIII

33182

On Churchill River, Manitoba.

Some of the more important surveys that Bell conducted were along the north shore of Lake Superior and in the Lake Nipigon region—the east shore of Lake Superior and the Michipicoten River region—west from Lake Superior to Fort Garry—the region of the Manitoba Lakes and the Qu'appelle valley—westward across the plains to the Athabaska, a journey in which he and a single assistant, A. C. Lawson, each drove a buck-board,

PLATE XXIX

A York boat on Echimamish River, northern Manitoba. Boats like this long carried on the trade between York Factory on Hudson Bay and the Hudson's Bay Company's posts inland.

and for days and sometimes weeks saw no habitation—north to Great Slave Lake—and along the Nottaway and some of the other canoe routes in the region between Lake Huron and James Bay. He also mapped the Hayes River route from Norway House to York Factory, part of Nelson and Churchill Rivers, and Gods and Island Lakes. His work on this last and on other occasions took him to Hudson Bay. As early as 1875 he had explored part of the east coast of the bay and continued this work in 1877. In 1884 he was on the staff of the *Neptune*, exploring the Bay, and in the following year he was again at work there, this time on the steamship *Alert*. Later, in 1897, he was in charge of exploratory work along the north side of Hudson Strait, made possible by the co-operation of the Department of Marine and Fisheries with the Hudson Bay Expedition under Dr. Wakeham. During this work he explored the coast of Baffin Land westward from Big Island for a distance of 250 miles and journeyed inland from the head of Amadjuak Fiord to the vicinity of Amadjuak Lake.

Some of his investigations carried out during his later years of field work consisted of geological mapping of a more detailed nature, as, for example, that done for the Sudbury and French River sheets, which was performed in the years 1888 to 1892. In this work he was assisted by a group of young men who later made important contributions to Canadian geology.

During his term as Acting Director, Bell pursued the policies that had been followed by his predecessors, Selwyn and Dawson. Though the main stress continued to be placed on exploration, increasing attention was paid to the more detailed investigation of mining areas and of the mineral possibilities of the country. The important report of Barlow on the nickel and copper deposits of Sudbury, in which it was first suggested that these remarkable orebodies are to be considered as of magmatic origin, was brought out during Bell's first year as head of the Survey. The reports that were also issued during his regime on the oil fields of Gaspe, the Albert oil-shales of New Brunswick, the copper-bearing

rocks of the Eastern Townships, and the Nova Scotia gold deposits, are other examples of this kind of work.

Bell was keenly interested in many branches of natural history, and he contributed considerably to our knowledge of the plants, and of the freshwater and other shells of various regions he explored. He was also fond of astronomy, forestry, and folklore. As a result, his writings were extensive and covered a great variety of subjects other than geology.

CHAPTER VI

LOW AND LABRADOR

Albert Peter Low became Director of the Geological Survey on April 1, 1906. His term as active head lasted for only $1\frac{1}{2}$ years for in November 1907 he was seized with a very severe illness from which he never wholly recovered. As a result he was obliged to forgo his duties, which were taken over by R. W. Brock. Though so brief, Low's period as Director was, for two distinct reasons, an important one in the Survey's history. The first of these was the fact that he appreciated fully that, with the growing development of Canada's mineral resources, new opportunities and responsibilities were opening up for the Survey, which called for men with specialized training. He, therefore, began to raise the qualifications of the technical officers by setting a higher standard for new appointees to the staff and by affording opportunities for those already appointed to take graduate university work. This policy was continued and amplified by his successor and will be referred to more fully later.

PLATE XXX

Albert Peter Low, 1861-1942; Director of the Geological Survey 1906-1907.

72071

The second reason for the importance of Low's term of office was the fact that during it a new government department was organized, the Department of Mines. From its founding in 1842 until 1877 the Geological Survey has been an independent

organization with the status of a department but without that title, and the Director addressed his reports either to the Governor-General or to the Secretary of State. By an act passed in 1877 the Director became responsible to the Minister of the Interior: by another, enacted in 1890, the Survey was formally recognized as a department, still under the Minister of the Interior, and from then on Selwyn and his successors signed their reports as Deputy Head and Director. In 1901 the Minister of the Interior created in his department another organization, entirely separate from the Geological Survey, whose duties were to collect mineral statistics and other information about the mining industry. By the act of 1907 this division became the Mines Branch and it and the Geological Survey together constituted the new Department of Mines, the minister for which was to be the minister of one or another of the existing government departments. Of this new department, Low became the first Deputy Minister.

Important as were Low's contributions to the Survey as Director, it is not for these that he is best known. His explorations in Hudson Bay and more important still those carried out in Labrador Peninsula were such that no account of the Survey's history, however brief, would be complete without some reference to them.

Low was born in Montreal on May 24, 1861. He graduated in Applied Science from McGill University in 1882, and was appointed to the staff of the Geological Survey on July 1 of that year. He had worked during the summer of 1881 with R. W. Ells in Gaspe and he assisted the latter again in 1882 in that region. The following year he carried out independent exploration in the central part of Gaspe, among other things a journey across the peninsula by ascending Ste. Anne River to Ste. Anne Lake, portaging to the west branch of Little Cascapedia River, and descending that stream to Chaleur Bay, a traverse paralleling that of Logan in 1844.

His next field of work was Labrador Peninsula. In 1884 a joint federal and provincial expedition was sent to Lake Mistassini at the head of Rupert River, with Mr. John Bignell, a Quebec surveyor, in charge, and with Low responsible for

the geological investigations. The route led from the St. Lawrence up Bersemis and Peribonka Rivers and thence across the divide to the Rupert waters. The greater part of the distance was covered by canoe, but the last part was on foot and it was only after a long and difficult tramp on snow-shoes, during the last 10 days of which rations were very low and the temperature ranged to 40 degrees below zero, that the Hudson's Bay Company's post on Lake Mistassini was finally reached, on December 23.

PLATE XXXI

2201

S.S. *Diana* off Big Island, Hudson Strait, A. P. Low, 1897.

The party was to spend the winter in the region and continue work the following year. Certain disagreements arose, however, between Low and Bignell regarding the operations of the party, and to clear up the matter Low packed his toboggan, put on his snow-shoes, and started for Ottawa, which he reached on March 2. On March 23 he received instructions to return to Mistassini in full charge of the party. He left the following day, and after another difficult journey arrived there on April 29. He completed the survey of the lake and in the autumn descended the Rupert to James Bay.

For the next few years Low was employed in other fields. In 1886 we find him in the region between Lake Winnipeg and Hudson Bay. Berens River was ascended, the divide crossed, and the Severn descended to the bay, the return journey being made from York Factory by the Hayes River route to Nelson House at the head of Lake Winnipeg. In the following year he descended the Missinaibi to map the islands of James Bay. He was next engaged in carrying out geological mapping northwest of the St. Lawrence River, chiefly in Portneuf and Montmorency counties.

In 1892 began the most important of Low's explorations of what is now northern Quebec. Of the very extensive work he carried out in that field during the next 10 years only the briefest mention can be made. The Ungava or Labrador Peninsula was crossed in both an east and west and in a north and south direction. Many of the larger rivers and lakes were mapped and some of the coast examined. The winter of 1893-1894 was spent in the field. In these 2 years alone, Low travelled 5,460 miles; by canoe 2,960 miles, on vessel 1,000 miles, with dog-teams 500 miles, and on foot 1,000 miles. To mention only two of the more important results of his geological work in this region; extensive deposits of iron-bearing sediments were discovered, which have recently become recognized as of great economic importance, and it was shown that the heart of Labrador Peninsula had been one of the main centres of Pleistocene glaciation from which ice had radiated out in all directions. He also reported on the iron deposits of Nastapoka Islands, on the east side of Hudson Bay.

In 1903 Low was appointed to the command of a Canadian Government expedition to northern waters. The ship chosen was the *Neptune*, which had been employed for the Hudson Bay Expedition of 1884. It was a stout sealing steamship of 465 tons register, capable of carrying about 800 tons of coal and cargo. It was built of wood with sides, where a contact with ice was expected, nearly 18 inches thick, and its bow was further reinforced by a heavy sheathing of iron plates. The expedition left Halifax on August 22 with a

total company of forty-three, proceeded up the Labrador coast, and then on to Cumberland Gulf on the east coast of Baffin Island. Returning south to Hudson Strait, Low made calls at Charles Island and Cape Wolstenholme, and then studied the geology along Bell Peninsula at the eastern end of Southampton Island. Fullerton Inlet at the northwest angle of Hudson Bay was chosen as the site for winter quarters.

PLATE XXXII

A portage.

The *Neptune* was roofed in and banked all around with a wall of snow, making it dry and comfortable. In April and May excursions were made by Low and his assistants to survey and explore some of the adjacent region, and then on July 19 the *Neptune* quitted her winter quarters and sailed north. Lancaster Sound was found to be clear of ice and, had his instructions permitted, Low could probably have made the northwest passage. Returning, ship and party reached Halifax on October 10 and on the 17th Low arrived at Ottawa after an absence of 15 months. In his volume, "The Cruise of the *Neptune*," Low gives a most readable account of his voyage, which covered some 10,000 sea miles.

CHAPTER VII

BROCK AND CONCENTRATION

During its century of service the fortunes of the Geological Survey have not always taken an equally smooth course. There have been occasions when doubt concerning what was being done or more particularly about what was not being done was raised in various quarters. There have been other periods in which, underwise and energetic leadership backed by governmental sympathy and encouragement, the Survey moved forward to meet new responsibilities and, as a result, rose in both prestige and usefulness. The regime of Brock was of this latter type. If Selwyn built a larger Survey, Brock can as truly be said to have created a new kind of Survey.

PLATE XXXIII

Reginald Walter Brock, 1874-1935; Director of the Geological Survey 1908-1914.

Reginald Walter Brock was born at Perth, Ontario, on January 10, 1874, the son of a Methodist minister. He matriculated from Ottawa Collegiate Institute in 1890, and entered the University of Toronto that autumn. In the following spring he received his initiation into Geological Survey work when, as a youth of 17, he was attached to the party of Robert Bell, working in the Sudbury district north of Lake Huron. During this and succeeding summers he was associated with Willet G. Miller, a senior assistant on Bell's party, and a friendship resulted that induced Brock to

transfer to Queen's University where Miller was lecturer in geology. Brock graduated with the degree of Master of Arts in 1895, studied the following winter at Heidelberg, under Rosenbusch, and in the succeeding year lectured at Queen's. The summer of 1907 was spent by him in British Columbia working as assistant to R. G. McConnell in West Kootenay. In the autumn he was appointed to the staff of the Geological Survey by Dawson, who selected him to continue his own geological investigations in British Columbia. Succeeding summers were spent in the West Kootenay, Boundary, and Lardeau districts.

In the autumn of 1902 when Miller resigned from Queen's to become the first Provincial Geologist in the Bureau of Mines of Ontario, Brock was appointed to the chair of geology in that university, a position which he occupied for 5 years. During this time he continued field work for the Survey in the summer months, devoting further attention to southern British Columbia. On November 28, 1907, at the age of 33, he was appointed Acting Director of the Geological Survey, in the following year Director, and on the superannuation of Low in 1914 he was made Deputy Minister of the Department of Mines.

Of the numerous changes effected by Brock as Director of the Geological Survey, perhaps none was more important than that of rigidly continuing and developing the policy initiated by Low of demanding higher qualifications in the technical officers appointed to the staff. In the earlier days the Directors had added men as funds became available. They naturally endeavoured to secure the best candidates available, but the selection was often made not because of any special training the men had received, but because it was felt that they had natural aptitude for the work and would make successful officers. For example, the first man chosen by Logan was Murray, a naval officer, who had developed an interest in geology. While carrying out his work with the Survey in Canada Murray devoted part of his time to agriculture at his farm near Woodstock, Ontario. When Logan required a palæontologist he appointed in 1856 Elkanah

PLATE XXXIV

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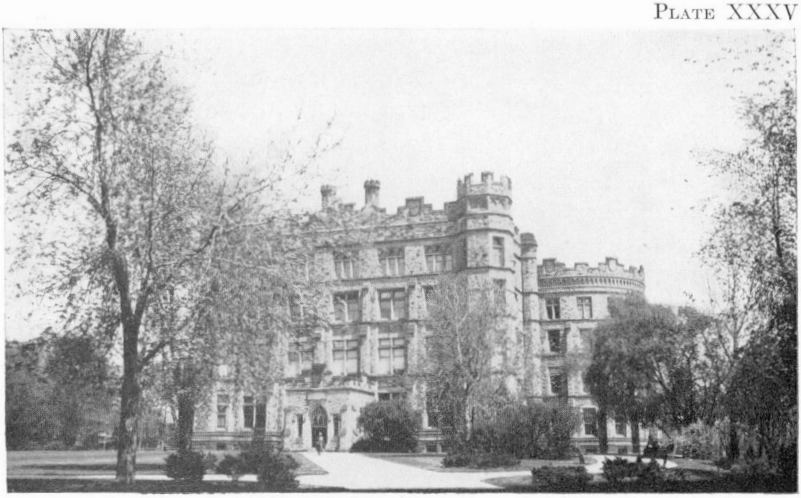
Geological Survey of Canada party, British Columbia.

PLATE XXXV



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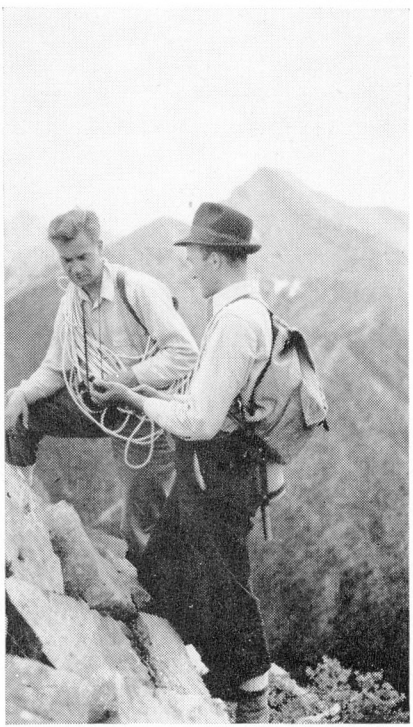
National Museum, Ottawa, the home of the Geological Survey since 1911.

Billings, a barrister, who had taken up the study of fossils as a hobby. Another early appointment, made in 1846, was that of James Richardson, a farmer of Beauharnois, who became a most useful field man and made careful observations, but whose reports had to be written by Logan and Selwyn. As time went on and progress was made in geological science it was felt that the task of ascertaining the extent and value of the country's mineral resources demanded the best trained men that could be obtained. A Select Committee of the House of Commons on Geological Surveys submitted a report in 1884 pointing out the need for paying greater attention to the mineral industry and for the collection of mineral statistics, and a Survey Act passed in 1890 stated that "No person shall be appointed to this Department . . . unless he is a graduate of either a Canadian or Foreign university, or of the Mining School of London, or the Ecole des Mines of Paris." Brock went much further. He laid down the rule that all new appointees must have professorship qualifications, i.e., the degree of Doctor of Philosophy in geology or its equivalent. A scheme whereby students interested in geology received help in carrying out graduate studies was evolved. Summer work on field parties at better wages than had formerly been paid was provided for men from the various universities who had been recommended for such employment by their geological professors, and thus their geological training was continued throughout the year. When the time came that the student required a thesis subject, a geological problem or an area to be studied geologically was assigned him, usually with the supervision of a senior officer of the Survey, and when the task was completed publication of the results was taken care of by the Survey. This plan led to a large number of Canadian geological students receiving advanced training at the graduate schools of American universities. A considerable number of these joined the staff of the Geological Survey, some to make this their life work, others for a period before taking up teaching or commercial work. Under the youthful director, the field staff soon came to consist dominantly of young men.

Brock fully appreciated the necessity for specialization. The staff he built up was a balanced one and included men who had majored in the various fields of geology so that any problem that might arise could be adequately looked after. Special attention was given to Precambrian geology, as about two-thirds of Canada is directly underlain by rocks of that age, and a number of the men who had taken their doctorate were given the opportunity to take an extra year's training in that field. This plan of specialization was applied not only to geology but also to the other branches of natural science that came under his direction as head of the Geological Survey—botany, zoology, ethnology, and anthropology. Scientists of standing were appointed to these divisions, and with the completion of the Victoria Memorial Museum building, into which the Geological Survey moved in 1911, a start was made towards the development of a worthy National Museum. Every facility was given for advancing the work by securing good taxidermists, preparators, and other help.

PLATE XXXVI



At work in British Columbia.

A further important change initiated by Brock was the formation within the Geological Survey of a separate Topographical Division to prepare accurate topographic maps to serve as a base for the geological information. Up to this time the geologist had found it necessary to do his own survey-

ing, and even down to the present day he is occasionally called upon to do some of it. He had to be familiar not only with methods suitable for rapid reconnaissance work, such as micrometer and compass and odometer in settled regions, but also more precise methods such as transit and plane-table work for more detailed investigations. The first contoured topographic map prepared in Canada, that of Silver Mountain region, was made by a Survey geologist, E. D. Ingall, in 1886, the topography being mapped at the same time as the geology. Brock, however, recognized that better maps could be made by men who gave their full time to such work, and that in turn the geologist could carry out his own work better and quicker if he was relieved of this task. Mr. W. H. Boyd, as Chief Topographer, was charged with the organizing of the new division. The draughting and photographic divisions were also enlarged and modernized.

Brock also created, in 1908, a Borings Division to collect records of wells drilled in search of natural gas and petroleum, and to gather data regarding the extent and quality of underground water supplies. The organization of this division was entrusted to E. D. Ingall, who remained in charge of it until his retirement in 1928.

The geological world was given an opportunity to see the reorganized Survey and its new quarters when, in 1913, the Twelfth International Geological Congress, of which Brock was General Secretary and Treasurer, was held in Canada. In preparation for this event the Survey had spent several seasons mapping interesting key areas, studying important sections, preparing guide books, and planning excursions for the visitors. The universal praise that the Survey received on this occasion was a high tribute to its Director.

Though Brock emphasized the importance of detailed geological studies he appreciated the fact that it was still the function of the Survey to carry out exploration in those parts of Canada about which little or nothing was known. In 1914, to mention only one example, an expedition was sent under Charles Camsell to explore the country between Lake Athabaska and Great Slave Lake, map Tazin and Taltson

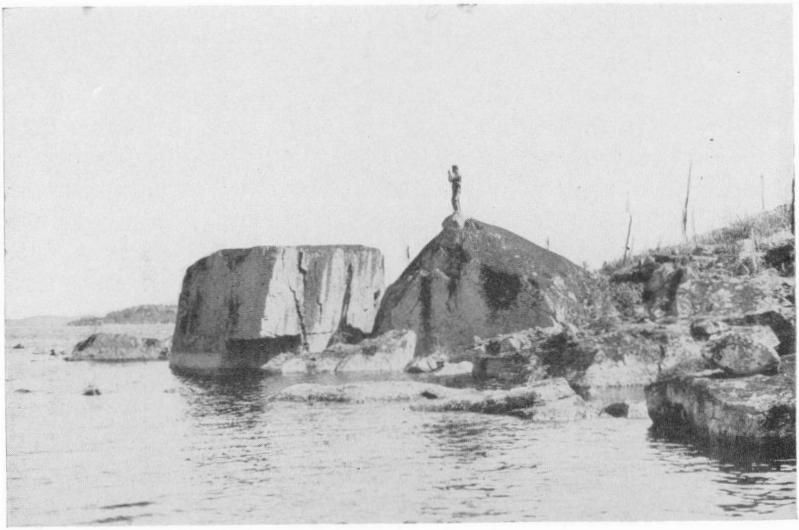
28890

A Geological Survey party tracking a scow up Athabaska River, Alberta, October 1914.

Rivers, and report on the geology and natural history of the region in the manner in which so much of northern Canada had been earlier covered. In the preceding year also the Geological Survey had co-operated with the Department of Naval Affairs to organize the Canadian Arctic Expedition. This was divided into two parties, a northern one under Mr. V. Stefansson, the leader of the expedition, who was to explore the Beaufort Sea north of Herschel Island and western Prince Patrick Land, and a southern scientific party under R. M. Anderson of the Geological Survey whose field of operation was to be the neighbourhood of Coronation Gulf, Coppermine River, and Victoria Land. In addition to Dr. Anderson, the Geological Survey supplied J. J. O'Neill, geologist, George Malloch, geologist and geographer, K. G. Chipman, geographer, J. R. Cox, assistant geographer, D. Jenness, ethnologist, and H. Beauchat, ethnologist. The scientific work of these men was kept under the jurisdiction of the Geological Survey and much very valuable information was collected. A regrettable feature was the loss of Malloch, who had been attached to the northern party.

In 1914 Brock resigned as Director of the Geological Survey and Deputy Minister of the Department of Mines to become Dean of the Faculty of Applied Science at the new University of British Columbia. When war broke out he joined the 72nd Regiment Seaforth Highlanders of Canada, in which he rose in 1915 to the rank of major. He helped organize the Western Universities Battalion. He saw service in Palestine under General Allenby, where he used his geological training to report on water supply and to make a geological survey of that country. Later, after his return to the University of British Columbia, he was entrusted by the British Government with making a detailed geological survey of the island of Hong Kong, a task in which he secured assistance from other members of his university staff. In 1934 he accepted the chairmanship of the Harbour Commission of Vancouver, which necessitated his taking leave of absence from the university. On July 30 of the following year he and Mrs. Brock were killed in an aeroplane accident at Alta Lake.

PLATE XXXVIII



76330
Coppermine River, Northwest Territories. A scene on the northern part of the Canadian Shield.

PLATE XXXIX

The Arctic Expedition.

CHAPTER VIII

McINNES AND WAR YEARS

Brock was succeeded on December 1, 1914, as Deputy Minister of the Department of Mines by R. G. McConnell, a valued senior member of the Geological Survey, to whose important explorations reference has already been made. To assist him the new Deputy chose William McInnes to serve as Directing Geologist in charge of all geological and field parties, and in 1919 the latter officially became the Director of the Geological Survey. His regime as head of the Survey was a time of retrenchment and disruption, and the fact that the Survey survived it as well as it did was due largely to the tact, kindness, and sympathy that marked all his dealings and decisions.

PLATE XL

William McInnes, 1858-1925; Director Geological Survey 1914-1920.

McInnes was born at Fredericton, New Brunswick, on January 1, 1858. He received his training at the University of New Brunswick, from which he graduated in 1879. He began field work for the Geological Survey in 1881, acting as assistant to Wallace Broad in western New Brunswick, and in the following year he was appointed to the Survey staff. The next 8 years were devoted largely to carrying out geological investigations in his native province, first as assistant to, and later as an associate with, Dr. L. W. Bailey, professor of

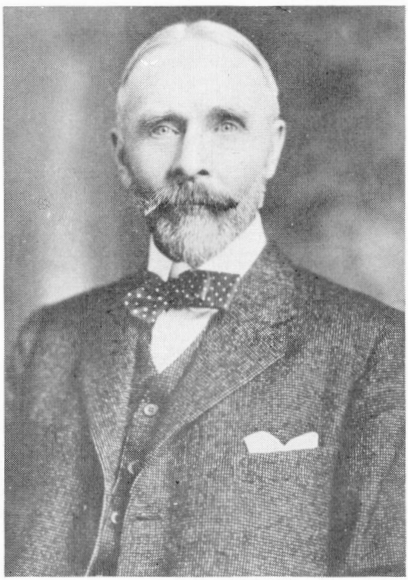
chemistry and natural history at the University of New Brunswick, who spent his summers carrying out field work for the Geological Survey.

In 1890 McInnes' field of operations was shifted to western Ontario, and from then until 1901 he was actively engaged in carrying out exploratory surveys in the country lying between Lake Superior and Lake of the Woods. The next 3 years were spent farther north in Ontario in the region drained by the headwaters of Winisk and Attawapiskat Rivers.

In 1906 he was sent to Manitoba to carry out geological exploration along the proposed line of the Hudson Bay Railway, and from then until 1910 his field work consisted in making reconnaissance surveys in the northern part of that province and in northern Saskatchewan. The results of this work were embodied in a valuable memoir on the basins of Nelson and Churchill Rivers. This and others of his reports demonstrated his ability for clear writing. This ability was later put to further use during preparation for the International Geological Congress of 1913 when much of the heavy editorial work that it involved was entrusted to him.

McInnes' appointment as head of the Geological Survey came in the early days of the first World War and it fell to his lot to pilot it through that difficult period. When the call to the colours came, members from the different branches of the staff joined up for active service; in addition, many of the geological graduate students at the universities who would otherwise have served on field parties in the summer months were soon also in uniform. Work that was regarded as of most value to the war effort was continued by the Survey with those that remained. When the war was over most of the men returned to their former duties. Not all, however, did so. Major W. E. Lawson, one of the senior topographers, had been killed in France. Captain O. E. LeRoy, who had been chief geologist in charge of field work under Brock, and who had helped him organize "D" company of the Western Universities Battalion, had lost his life at Passchendaele in his first engagement. Some of the men returned handicapped by injuries. J. D. MacKenzie carried out field work for several

PLATE XLI



R. G. McConnell, Deputy Minister of Mines 1914-1920.

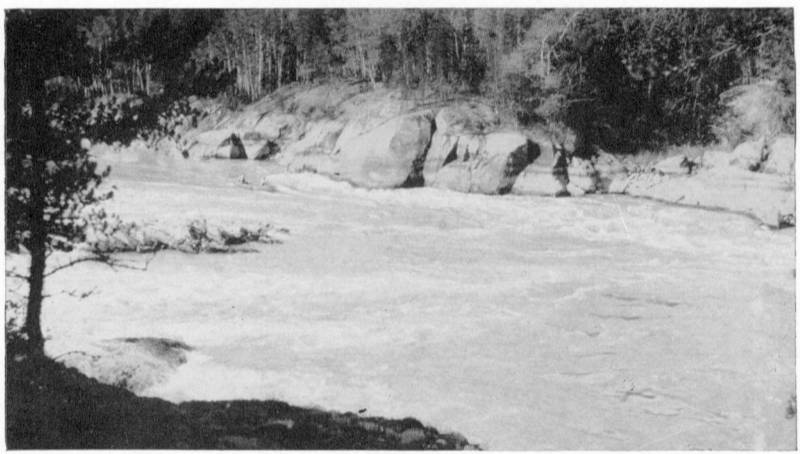
PLATE XLII

37363

Travel in northern Manitoba.

seasons in British Columbia after his discharge from military duties, but on December 16, 1922, succumbed to an operation upon a wound received in 1918 in France. Even after the war there was still a considerable problem regarding staff. Salary increases were slow in coming and when attractive offers came to many of the men to take positions with universities, mining companies, and oil exploration companies, a large number of the staff accepted. The fact that the field officers were sought from so many directions was a high tribute to the quality of the personnel that had been built up but the departure of the men was a severe loss to the Survey and one that could only gradually be made good.

PLATE XLIII



Running "The Elbow," Nelson River, Manitoba.

The war years also saw the work of the Survey hampered by change of quarters. On February 3, 1916, the main Parliament Building was burned and the Senate and the House of Commons moved to the Victoria Memorial Museum, with the result that the Geological Survey, with the exception of its large library, was forced to find temporary quarters in various buildings throughout the city. Early in 1920 Parliament returned to its new building. The Museum was then

refitted and the Geological Survey moved back to it in August. Part of the building was, however, allotted to the National Art Gallery, which greatly reduced the space available for the Museum exhibits.

In June 1920 McConnell relinquished his duties and was succeeded as Deputy Minister by Charles Camsell, a member of the Geological Survey staff. In November of the same year a change was made in the directorship of the Survey. Its museum activities were in large part transferred to a new branch of the Department of Mines, the Victoria Memorial Museum. This was entrusted to McInnes as Director, while the geological, topographical, and other work was placed under W. H. Collins, who assumed the title of Director of the Geological Survey. In addition to being given charge of the Museum, McInnes also became Editor-in-Chief of the Department of Mines. He occupied this dual rôle until his death on March 10, 1925.

McInnes was a Fellow of the Geological Society of America, and a Fellow of the Royal Society of Canada. In 1920 he received the honorary degree of Doctor of Laws from the University of New Brunswick. Like his predecessors, Logan and Dawson, he was a bachelor. Like them, too, he was a man who had the esteem of every one with whom he came in contact. Of a retiring disposition, all honours and advancement came unsought. Those who knew him best were the ones who most fully appreciated his worth.

CHAPTER IX

COLLINS AND REORGANIZATION

The term of William Henry Collins as Director of the Geological Survey of Canada included the period from the beginning of 1920 until the reorganization of the Department in 1936, and was exceeded in length only by those of the first two Directors, Logan and Selwyn; in work accomplished and in contributions made to geological science in Canada it takes a very high place in the Survey's history.

PLATE XLIV

William Henry Collins, 1878-1937; Director of the Geological Survey 1920-1936.

Collins was born in Chatsworth, Ontario, on October 26, 1878. He was educated at Owen Sound Collegiate and the University of Toronto, from which he graduated with first class honours in geology in 1904. The following year was spent as assistant in the Department of Mineralogy at that university and in 1905 he was appointed as geologist to the staff of the Geological Survey. He later carried out graduate studies during the academic seasons at Heidelberg University, at the University of Chicago, and at the University of Wisconsin, from the last of which he received his degree of Doctor of Philosophy, in 1911.

His particular field of research was the Precambrian rocks of northern Ontario, chiefly the belt north of Lake Huron. In 1913 appeared his memoir on the Gowganda Mining

Division. In this and a companion report on the adjacent Onaping map-area, published in 1917, he described the members of the Cobalt series and showed the widespread distribution of two of its formations, the Lorrain and the Gowganda. His study of the classic "Original Huronian" area of Logan and Murray along the north shore of Lake Huron was begun in 1911. He worked out the succession of the Huronian rocks and showed that they were made up of two series, the Bruce

PLATE XLV

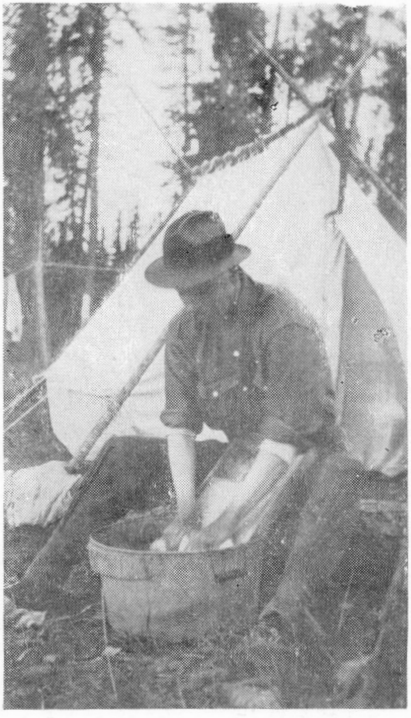
81990

Geological Survey of Canada party in northern Ontario.

and the Cobalt. He correlated the rocks of the Bruce Mines area with those of Sudbury and those of Sudbury with the formations of the Gowganda area. In 1916 he concluded that the sedimentary rocks at Killarney, formerly regarded as Sudburian or early Precambrian, were highly deformed Huronian rocks intruded by a younger granite to which he applied the name Killarnean. His later work was carried out in that perplexing field in which so much geological work

has been done, the Sudbury district. Even while occupied with administrative duties he endeavoured to find time to return there summer after summer and his conclusions on the geological succession, the structure, and particularly on the petrogenesis of the Sudbury irruptive were most important contributions to geological science.

PLATE XLVI



Sunday washday.

Both as a field officer and as an executive, Collins carried out his duties thoroughly and conscientiously, assuming the major labours himself. His regime as Director was marked by strict economy with maximum results demanded for every sum spent. Fields of work were chosen where it was believed that the greatest practical results might be obtained, but every encouragement was given to the field officers to secure all the information possible along the lines of what may be described as pure or theoretical geology. It was realized that what is regarded as the purely scientific of today becomes the extremely practical of tomorrow. Areas of work were planned with precise geographic boundaries so that the regional mapping might progress in an orderly manner. Collins early foresaw, too, the part that the aeroplane would play in aiding Geological Survey work, especially in northern Canada, and served as a member of the Interdepartmental Committee on Air Surveys

and Base Maps. He instituted a number of services additional to the ordinary survey work. A series of geological maps on a scale of 8 miles to an inch were compiled covering certain important belts, and these proved to be of great value and of wide demand. He also began the publication of a special set of memoirs, "The Economic Geology Series," summarizing all the known information about the occurrence in Canada of certain minerals and metals. These reports became so popular that extra editions of a number had to be issued.

PLATE XLVII

A flying boat used by the Geological Survey in northern Saskatchewan, 1934.

A year after the death of McInnes in 1925 Collins, in addition to his other duties, was given charge of the Victoria Memorial Museum, and his interest in it was second only to that in the Geological Survey. Honours that came to him in recognition of his contributions to geological science included Fellowship in the American Philosophical Society in 1932, the presidency of the Geological Society of America in 1934, and the honorary degree of Doctor of Science from his Alma Mater, the University of Toronto, in 1936. He represented the Dominion of Canada at the 15th International Geological Congress in South

Africa in 1928 and at the 16th Congress held in the United States in 1933.

The latter part of Collins' term as Director was, however, one of those difficult periods that the Geological Survey has passed through at various times. Forces were at work that caused questions to be raised concerning the Survey. From most of those interested in the development of Canada's mineral resources, the only criticism of the Survey's activities was that not enough of this kind of work was being done. This criticism could have only been answered by enlarging the technical staff and by increasing the appropriations for field work. In certain other quarters it was felt that as the provinces had control of their own natural resources they should look after the development of them. Ontario long had had a provincial Bureau, later Department, of Mines, which carried out extensive geological work; Quebec was building up a similar one, and most of the other provinces did a certain amount of geological investigation. It was not fully realized by these critics, however, that a Federal Survey with specialists in various fields, capable of undertaking any geological task that might present itself, could perform these duties much more economically and efficiently than a number of separate provincial institutions, most of which necessarily have a limited personnel and equipment. Other criticisms heard were that the reports issued by the Survey were too technical

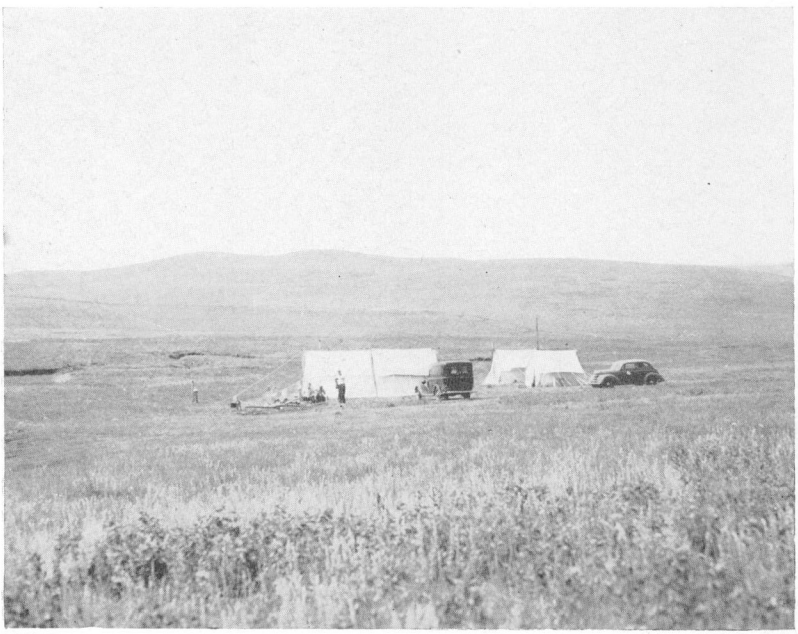
PLATE XLVIII

Charles Camsell, Deputy Minister of Mines 1920-1946.

for many of those most anxious to use them and that both the reports and the geological maps often appeared too late to be of maximum service.

The amount of money voted for Geological Survey work continued to decrease in successive years; in order to avert what appeared to be an approaching crisis and to strengthen the position of the Survey it was decided to emphasize to

PLATE XLIX



88851

Camp in southern Alberta.

the public the practical side of the work that was being done. It was thought that a name might serve to advertise this and a new bureau was accordingly created—"The Bureau of Economic Geology." Mr. F. C. C. Lynch, who had had a most successful record as head of a branch in the Department of the Interior—The Natural Resources Intelligence Branch—which had been disbanded following the transfer to the western

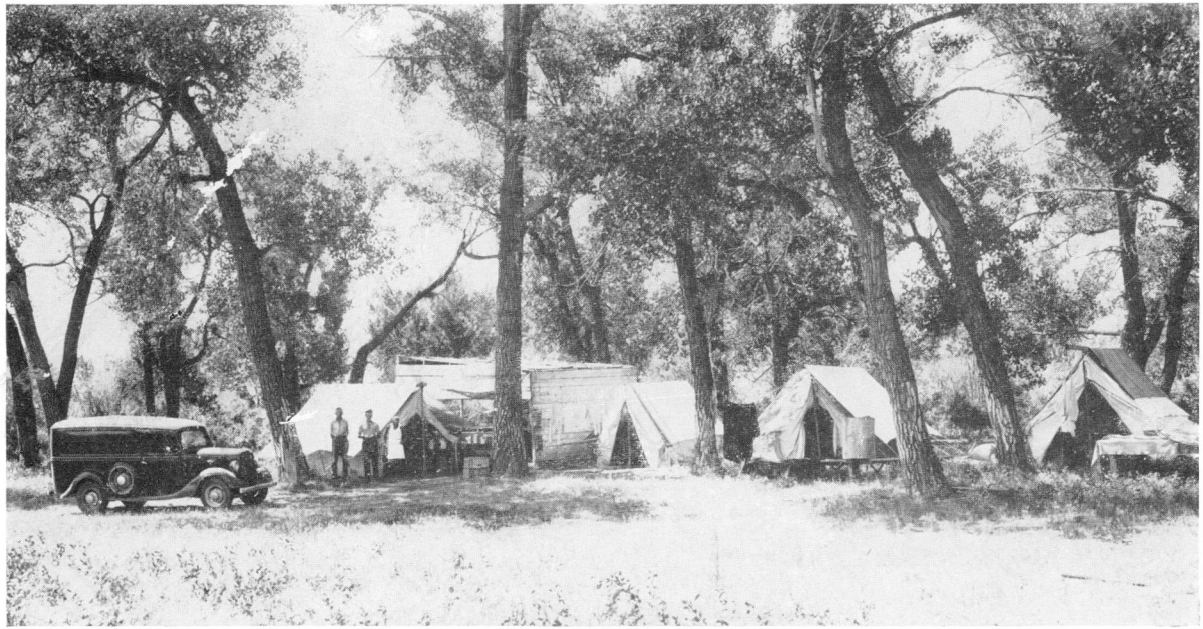
provinces in 1931 of the control of their natural resources, was chosen as Director of the new bureau, and took charge in 1934. The Bureau assumed the functions of the former Geological Survey and the latter name was now restricted to one of its divisions, whose work included that of the geological staff only.

Abruptly came a swing of the pendulum. Parliament

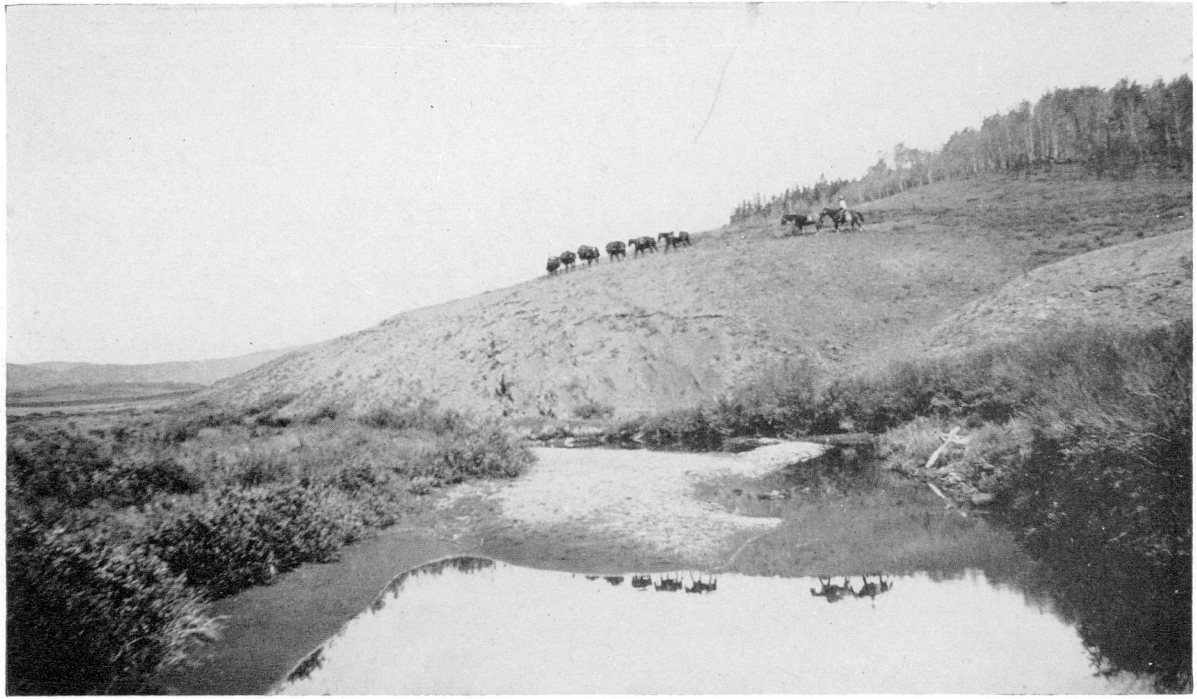
PLATE L

A Geological Survey group on Athabaska River, Alberta, 1935.

suddenly in 1935 voted in the relief estimates a special grant of $1,000,000 for geological surveys and investigations in addition to the regular yearly allotment for field work. In consequence, the field parties for that year had to be greatly increased in both size and number, men from the universities and the mining profession secured to take charge of additional parties and sub-parties, student assistants selected not only



Collecting vertebrate fossils, Alberta.



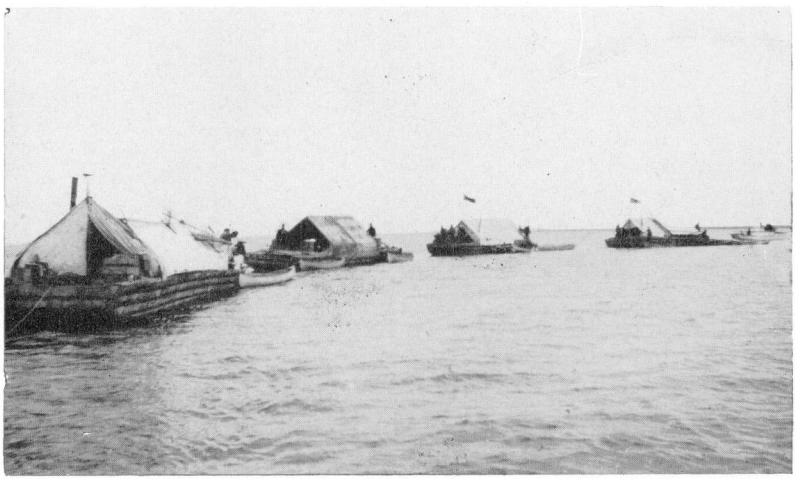
77784

Pack-train in the Foothills, Alberta.

from the geological departments but also from the engineering branches of the various Canadian universities, and a large amount of equipment and surveying material purchased. It was a challenge to which the new Bureau successfully rose and a great deal of very valuable work was accomplished.

The Geological Survey was affected by another reorganization in 1936. A union of four departments, Mines, Interior, Immigration and Colonization, and Indian Affairs into a single one, which received the name of Department of Mines and

PLATE LIII



52288

Crossing Great Slave Lake, Northwest Territories.

Resources, was effected, and Dr. Charles Camsell, C.M.G., who since March 7, 1921, had been Deputy Minister of Mines, became its Deputy. The new department was divided into a number of branches, of which that of Mines and Geology corresponds in a general way to that of the former Department of Mines. Mr. John McLeish, who had been Director of the Mines Branch, became Director of this new branch, and he was succeeded in 1941 by Mr. W. B. Timm, who at present occupies the post. The Mines and Geology Branch in turn is composed of two main units, the Bureau of Mines,

which is the successor of the Mines Branch, and the Bureau of Geology and Topography, which, under Mr. Lynch, became largely the equivalent of the former Bureau of Economic Geology. The latter of these two bureaus is, in turn, made up of several sub-units, including the Geological Survey, the Topographical Survey, the Draughting and Reproducing Division, and the Development Division, each under their

PLATE LIV

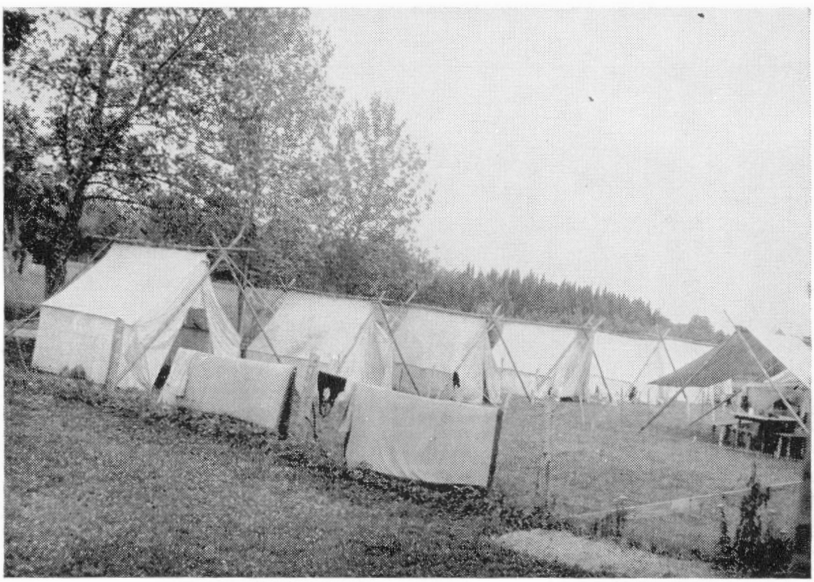
Fossil collecting in Alberta. Panel trucks of this type are a familiar sight where Survey parties are working in settled regions.

respective chiefs. Although his health was poor, the ability and experience of Dr. Collins were made available to the new Department in the capacity of Chief Geological Consultant. His period of service as such was short, however, for his death occurred on January 14, 1937.

An appreciation of Collins, written by a fellow geologist, Dr. T. T. Quirke, who was long associated with him in research work, gives an excellent picture of the man. The following is

taken from it: "It is hard to think how or when a national service could have a more devoted or enthusiastic officer. His pride in the organization of which he was a part was a very fine and sincere influence in his whole career. He gloried in the achievements and recognition of any former or contemporary officers of the Geological Survey of Canada. The 'Survey' he saw as a perpetuation of all the efforts of all its members,

PLATE LV



Geological Survey camp, near Tetagouche River, New Brunswick.

not for past or present generations alone, but for the life of the nation. . . . All his professional life it was his ambition to make the Geological Survey of greatest value to his country. To him his official capacity was not a personal career; it was a public service. . . .

"In his prime of life he was a very tall muscular man of the lean type and stood about six feet two inches in height. His habitual posture denoted the athletic, active man that his daily work in the field showed off to such advantage. He was

the finest white canoeman the writer ever saw; this estimate has been endorsed by many others better able to judge. He was a good packer, always taking a heavier load than he expected most of his assistants to carry. In camp he was often silent without being moody. . . . When at leisure he often showed his love of the ludicrous. Nothing amused and delighted him more than to talk over some absurd adventure of earlier years in the field. No one who can remember him around the camp fire can easily remember him long as the retiring and somewhat uncommunicative person that he appeared to be in Ottawa as Director of the Geological Survey. It is hard to say how many younger geologists have learned from him in actual field study. For all of them, the writer humbly renders tribute to a man patient under hardship, modest of his own achievement, generous to all who worked beside him, and always in deed as well as title, 'the chief'."

CHAPTER X

PRESENT AND FUTURE

The head of the Geological Survey since the reorganization of 1936 has been the Chief Geologist. His staff consists of an Assistant Chief Geologist, some thirty field geologists, and a small number of office helpers. Though the main work is along lines of general and economic geology, there are several special subdivisions of the Survey, including the Palæontological Section under the Chief Palæontologist, the Mineralogical Section under the Chief Mineralogist, the Water Supply and Borings Section, and the British Columbia Office. Dr. George Albert Young served as Chief Geologist until his retirement in 1943 when he was succeeded by Dr. George Hanson.

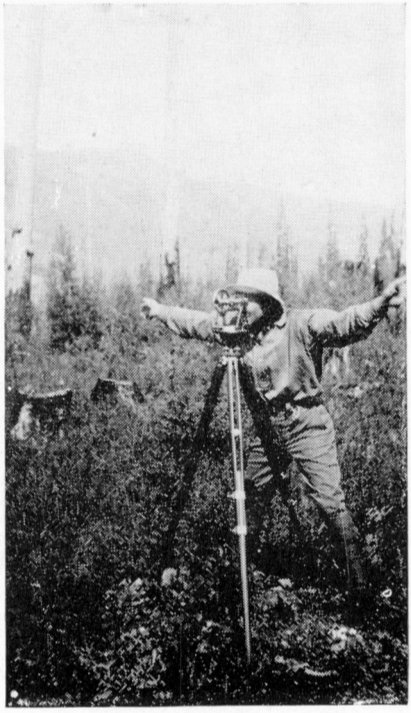
PLATE LVI

George Albert Young, Chief Geologist 1924–1943.

The Second World War to a considerable extent interrupted the regular work of the Survey, a number of the field officers having been assigned special investigations in connection with minerals of strategic importance. The main task before the Survey remains, however, as throughout the past, the systematic mapping of the geology of Canada. Geological Survey mapping is now of two main types, that done for publication on a scale of 4 miles to 1 inch, and that for publication on 1 mile to an inch. The 4-mile mapping is carried out chiefly in the northern part of Canada,

and has practically entirely replaced the old type of exploratory traverses and reconnaissance or preliminary surveys. The base maps used for this work are prepared by the Topographical Survey from ground surveys and from air photographs, and show all the details of lakes and streams, etc. Armed with these maps and photographs, the geologist works quickly

PLATE LVII



Surveyor at work.

and colours in all parts of his area. Planes equipped with pontoons are of great help in transporting parties and in bringing in supplies at regular intervals.

Mapping on a scale of 1 mile to 1 inch is carried out in settled and mining regions where it is desirable to show the geology in more detail. This has been found to be a most

satisfactory scale in most regions from the point of view of both topography and geology, and it is the aim of the Survey to have much of Canada thus covered. In certain mining areas the search for new orebodies involves the making of even more detailed geological maps on larger scales. In such work every rock outcrop is indicated and all available

PLATE LVIII

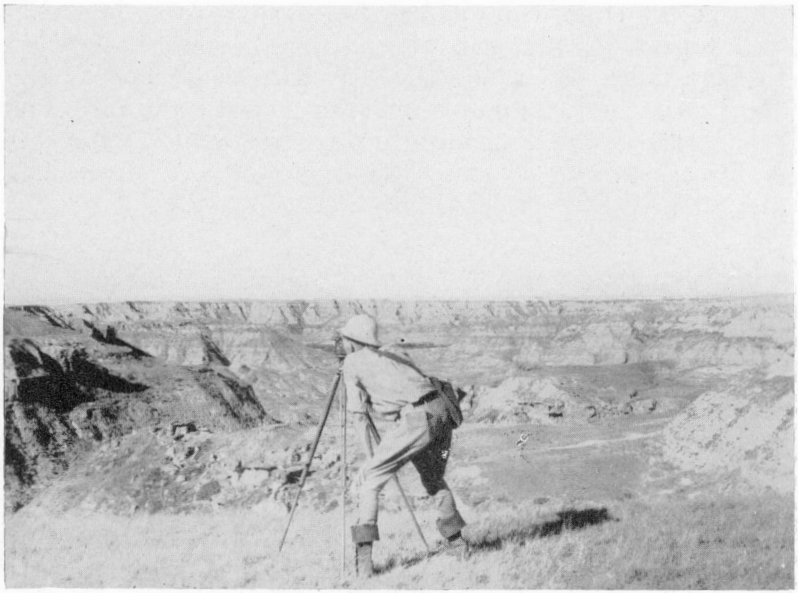
75581

G. S. Hume party, Waterton Lakes area, Alberta.

information from diamond drilling and underground development is also made use of to determine the details of succession and structure. Large scale mapping of this type has been of great value in western Quebec.

In April 1947 the Geological Survey was strengthened by the appointment of one of the senior members of its staff,

PLATE LIX



82132

At work in Alberta.

PLATE LX

83076

Travel by canoe in the Yukon.

Dr. G. S. Hume, O.B.E., Ph.D., F.R.S.C., to the vacancy left by the retirement of Mr. Lynch as Chief of the Bureau of Geology and Topography. Dr. Hume's wide experience, particularly in the geology of Canada's oil fields, is of great value in connection with his new responsibilities.

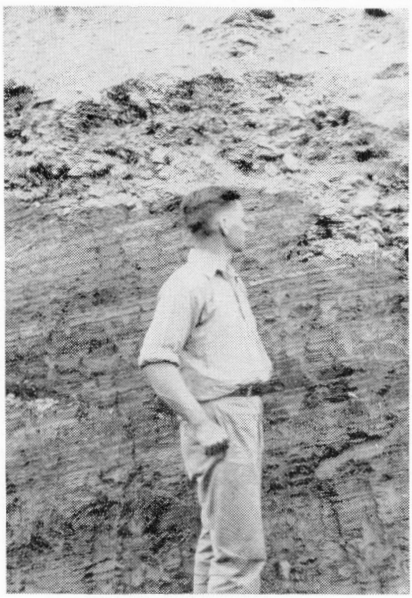
PLATE LXI

Moving camp by plane — the pontoon-equipped aeroplane has become of tremendous assistance in carrying out Geological Survey work in the lake-dotted "Shield."

At the close of a century of Geological Survey work it is of interest to take stock in order to see how much of Canada has been surveyed geologically and how much more work remains to be done. The total area of the Dominion, including the 444,032 square miles of Arctic Islands on which the Geological Survey has carried out comparatively little work, is 3,694,863 square miles. Aside from these islands, exploratory work has been carried out in practically all parts of the country, so that something at least is known about the geology everywhere. Concerning 80 per cent of the country the only

information available is from such exploratory route traverses. For the other 20 per cent, which for the most part includes the settled and more easily accessible parts, better maps have been issued. Of this surveyed 20 per cent more than one-half, or approximately 400,000 square miles, has been covered by maps on a scale of 4 miles to 1 inch or better, and the remainder by poorer or reconnaissance maps. It was estimated in 1944,

PLATE LXII



Studying Pleistocene geology, southern Quebec.

by Dr. Hanson, that only 11 per cent of Canada has been adequately mapped geologically and that at the present rate of progress it will take several hundred years to complete the task. As the Survey commences its second century of service it faces, therefore, a challenge almost as formidable, and one certainly as fascinating, as that which confronted Logan 100 years ago.

POSTSCRIPT

In October 1947 the Honourable J. A. Glen, Minister of Mines and Resources, announced a reorganization of his Department under the Deputy Minister, Dr. H. L. Keenleyside. In place of the Mines and Geology Branch, a new branch known as Mines, Forests and Scientific Services has been set up, of which Mr. W. B. Timm becomes Director. This new Branch includes:

1. Administration
2. Bureau of Mines
3. Dominion Forest Service
4. Geological Survey of Canada (Chief, G. S. Hume)
5. Surveys and Mapping Bureau
   - Topographical Survey
   - Hydrographic Survey
   - Geodetic Survey
   - Legal Surveys
   - Map Compilation and Reproduction
6. Dominion Water and Power Bureau
7. Geographical Bureau
8. National Museum of Canada
9. Dominion Observatories.

MENTE ET MALLEO

("By Thought and Dint of Hammering")

Dedicated to the Logan Club on the Occasion of Its First Annual Symposium

By thought and dint of hammering
Is the good work done whereof I sing,
And a jollier crowd you'll rarely find,
Than the men who chip at earth's old rind,
And often wear a patched behind,
By thought and dint of hammering.

All summer through we're on the wing,
Kept moving by the skeeter's sting;
From Alaska unto Halifax,
With our compass and our little axe,
We make our way and pay our tax
By thought and dint of hammering.

We crack the rocks and make them ring,
And many a heavy pack we sling;
We run our lines and tie them in,
We measure strata thick and thin,
And Sunday work is never sin,
By thought and dint of hammering.

Across the waters our paddles swing,
O'er wind and rapids triumphing;
Through mountain passes our slow mules trudge
As if they owed us a heavy grudge,
And often can't be got to budge,
By thought and dint of hammering.

To the stars at night our thoughts we bring
But no maiden fair to our arm doth cling;
She, at Ottawa, with smiling lips,
The other fellow's ice cream sips,
You can't prevent these feminine slips
By thought and dint of hammering.

To array the "chiels that waunna ding"
Is our winter's work far into spring;
Some people think us wondrous wise,
Some maintain we're otherwise:
We're simply piercing Nature's guise,
By thought and dint of hammering.

ANDREW COWPER LAWSON