

served as a volunteer, also, in the rebellion of 1837. The personal acquaintance of these two men, who have rendered such signal service to this country from a scientific standpoint, began in the winter of 1842-43, and the friendship then established continued unbroken till the death of the former in 1875.

Limited as was the area of Canada fifty years ago as compared with the enormous extent of territory now included under that name—the inception and carrying out of a plan of survey such as Logan contemplated was not a thing to be lightly entered upon. Great portions of the country were accessible with difficulty, means of communication were slow and expensive, and the amount of money at his disposal, and the staff necessary for the work were lamentably small. With characteristic energy he addressed himself to the task, and soon formulated a scheme for the carrying on of the explorations required. In the spring of 1843 Logan, who had spent the winter in England, again returned to Canada, reaching Halifax in May, whence he determined to make the journey overland through Nova Scotia, New Brunswick and Quebec in order to obtain some preliminary ideas as to the structure of that section. It was on this trip that his first work was done in Nova Scotia, and particularly in connection with his famous Joggins Section, of which it has been truly said that "it forms a remarkable monument of his industry and power of observation." The remainder of the season was devoted to the study of the Carboniferous and underlying rocks of Northern New Brunswick and of Gaspé where a series of elaborate measurements were carried out similar to those of the Joggins Sections. The conclusions then arrived at by Logan with regard to the value of these so-called coal fields in New Brunswick and Gaspé were to the effect that no deposits of that mineral could even be found there in workable quantity, and the views then expressed have ever since been accepted as definite, thus preventing the useless expenditure of capital in that direction.

While Logan was thus devoting his energies to the working out of the structure of the Eastern Provinces, Murray, his assistant, had been equally assiduous in his labors in Western Canada, and in the preface of the *Geol. Can.*, 1863, Logan says that "he (Mr. Murray) has worked out nearly all that is known of the distribution of the rock in that division of the province." In addition to his work in the field Murray also accompanied Logan in the first great exploration of the Gaspé Peninsula in 1845, during which surveys were made of the Shick, Shock Range and of most of the larger streams that traverse the section.

The Geological Survey can now be said to have been fairly launched, though under circumstances not the most satisfactory. At the Session of the Legislature of 1845-46 the sum of £2,000 was voted for carrying on the work, and in the ensuing year this amount was granted for a period of at least five years. The bill upon which this grant was made was designed by Sir William himself and was to the effect that a certain number of competent persons should be appointed. "Whose duty it shall be, under the direction of the Governor in Council, to make an accurate and complete geological survey of the province and to furnish a full and scientific description of the rocks, soil and mineral, which shall be accompanied with maps, diagrams and drawings, together with a collection of specimens to illustrate the same; which maps, etc., shall be deposited in some suitable place, which the Governor in Council shall appoint and shall serve as a provincial collection, and that duplicates of the same after they have served the purposes of the Survey, shall be deposited in such literary and educational institutions of the Eastern and Western divisions of the provinces, as by the same authority shall be deemed most advantageous."

The first chemist appointed by Sir William was the Count de Rottemund, a student of Le Ecole Polytechnique, Paris; whose connection with the official staff was but brief as he voluntarily resigned the position in 1846. The vacancy thus created was speedily filled by the appointment of Dr. T. Sterry Hunt, who at that date was acting as chemist to the Geological Survey of Vermont. This appointment was a particularly happy one, and for nearly twenty-five years, in his capacity of chemist and mineralogist, Hunt built up, not only for himself but for the Canadian Survey, a reputation which is world wide.

With the exception of the department of Palaeontology the Survey was now comparatively well equipped and ready to carry on the purpose for which it was established. The staff was small but the material good, and exploration went rapidly forward. In 1847 Mr. Jas. Richardson was added, and in the course of over thirty years work, examined many portions of the Dominion from the Straits of Belle Isle to the islands in Queen Charlotte Sound on the confines of Alaska. Other persons have been added from time to time as the necessities of the Survey demanded or the funds as its disposal permitted. In the branch of palaeontology it was however found necessary for some years to send abroad for determination, many of the valuable specimens which were rapidly accumulating; and among those who rendered valuable services in this way were Prof. Jas. Hall, of Albany, N.Y., and Messrs Jones and Salter of the English Survey. This difficulty was at length overcome by the appointment in 1856 of Mr. E. Billings of Ottawa, whose love of scientific work in this line was such as to lead him to lay aside his chosen profession of the law, and, at the request of Logan, to attach himself to his small but zealous band of workers. Of him also it may be truly said, that much of the great reputation the Survey has acquired, both at home and abroad, is due to his indefatigable labors. The appointment of Mr. Robt. Barlow, formerly of the Royal Engineers, as chief draughtsman shortly after completed the official equipment of the staff at that time. The work of exploration was carried on for some years by the employment of specialists who were elected to undertake the examination of particular mineral locations, and whose reports were of great value, only what was regarded as permanent employees of the staff who carried forward the work along certain regular lines laid down by the Director himself. The particulars and results of these explorations will be found in the preface of that great volume the *Geology of Canada*, 1863, in which the leading features of the Survey's operations to that date are admirably presented.

In connection with this volume and designed to accompany it, the great Geological Map of Canada and the adjacent Northern States was published in 1869; of which it may be rightly said that no more beautiful work of the kind has ever been presented by this or any other Survey; a work entailing an enormous amount of labor and reflecting the greatest credit upon all engaged in its compilation and in the delineation of the exceedingly complicated geological lines there laid down. This great work will always stand as the map *par excellence* and will always be pointed to with a feeling of pride, not only by the members of the Survey itself but by every Canadian who feels an interest in the successful carrying out of the study of geological science in our own country. During all these years of hard work in the field by the officers and staff, other matters involving quite as serious labor, were being presented from time to time. The great exhibitions at London, Paris and Dublin, to which the Survey sent large and characteristic collections, both of rocks and minerals, which set forth in an attractive and forcible manner the great natural wealth of the country was productive of much good, but involved an immense expenditure of time and energy. The museum and offices were constantly visited by scientific men from all parts of the world who might be passing through the city, as well as others seeking information on various points; and from the old workshop on St. James and

St. Gabriel Streets, much work of very great importance in connection with the development of Canada's mineral resources was produced. But, in 1867, the Confederation of the Provinces opened new fields for the Survey's operations, and the somewhat small amounts hitherto granted were soon found to be inadequate to carry on the work over such greatly extended areas. In the meantime the Survey had lost one of its original members by the retirement of Mr. Murray, who at the request of the Newfoundland Government had undertaken the Survey of that colony. The staff had gradually been enlarged, but the great strain to which the Director had for some years been subjected began to tell upon him severely, and in 1869 Sir William Logan felt it incumbent upon him, in view of the greatly increased area to which the operations had been extended, and the interest he felt in solving certain puzzling problems of structure in the Province of Quebec in which he had for some years been especially interested, to lay aside the direct management of the Survey and to seek a successor. His resignation took effect in that year, and with this date we may close the first stage of the Geological Survey operations. Dr. Selwyn, a gentleman of very extensive experience, not only in the Geological Survey of England and Wales, but as director of the Survey of the great Colony of New South Wales, was chosen as his successor, and with this appointment we may enter upon what one may style the second period in the Survey's history.

Hitherto the work had for the most part been confined to the Provinces of Ontario and Quebec. Henceforth it had to include in its scope not only the distant areas of British Columbia, the great plains of the North West Territories, the rugged masses of the Rocky Mountains and the wide expanse of the Peace and MacKenzie Rivers basins, but the Maritime Provinces of Nova Scotia, New Brunswick and Prince Edward Island as well. It can readily be seen therefore that the task now entered upon by Dr. Selwyn was one of no small magnitude, especially when we consider that of our own great western areas our information was of the most meagre kind, not only as regarded its geological structure, its mineral wealth, its agricultural capabilities, and its natural history and climatic conditions. New and more detailed investigations had also to be undertaken in the older provinces, in connection with the metamorphic and metalliferous rocks, and in the great country lying between Lakes Huron and Superior and the Hudson and James Bays. It is probably not saying too much, nor, I trust, will it appear to savor of adulation, if we state that probably no enterprise so great as the complete Geological and Natural History Survey of a country embracing over 3,000,000 square miles, was ever undertaken by a staff so small in numbers or carried on with an expenditure so insignificant as was attempted by the Geological Survey of Canada. And it is well within the bounds of truth, if we say that to the work of the members is due, in very large part, much of the information we now possess as to the greatness of the country's resources, both agricultural and mineralogical, between the waters of the Atlantic and the distant shores of Labrador on the East and the distant shores of the Arctic Ocean and the boundary of Alaska on the north and west. It will scarcely be necessary to mention individual names in this connection. The various officers of the staff and their various fields of labor are too well known to require any special personal reference when addressing a Society such as this.

It would be impossible in the time at our disposal to give any detailed account of the work of the Survey during the last quarter of a century over such an enormous area, and we can only summarise the result of the investigations of the several parties in the briefest manner. Thus, in the East the carefully detailed maps of Cape Breton and Eastern Nova Scotia have been presented to the public and have received the highest praise. We have now also a very good general idea of the structure of the other portions of the province including the horizons and distributions of the great gold-bearing series which extends from Yarmouth on the west to Guysborough on the east. The structure of the great coal fields of Cape Breton, Pictou and Cumberland have been carefully studied, and the geological horizons of the ores of iron and manganese which are of very great importance in connection with the future development of the country, have been clearly and satisfactorily determined. The geological maps of both New Brunswick and Prince Edward Island have been completed and the complex question of structure in the southern part of the former province which for years was of an exceedingly puzzling character has been thoroughly solved. The outlines of the great central Carboniferous basin, occupying an area of over 12,000 square miles in the province, have been carefully determined, and its presumptive value from the economic standpoint ascertained, while some of the most important work in Canada, in connection with the palaeontology of the oldest fossiliferous formations, has been and is still being carried out with the greatest care.

In Quebec East the great problem of the age and stratigraphical relations of the various members of the "Quebec group," a problem which for more than forty years has engaged the attention of geologists not only of Canada, but to some extent of the United States and Europe as well, has, it is hoped, been placed on a satisfactory basis of settlement. While to the north of the St. Lawrence the mysteries of the great region of the Mistassini have been cleared up, and great progress made in the study of the Laurentian rocks north of the St. Lawrence and Ottawa rivers. The great wilderness country between the Ottawa and James Bay has been traversed in many directions along the great natural avenues of lake and river, by which alone this otherwise pathless area can be explored. Concerning the great extent of country about the Hudson and James Bays as well as of the great inland plateau of Labrador, we have now very clear ideas, not only of its geology and mineral wealth, but also of its fauna and flora, and of its adaptability for settlement; while much of its topography has been carefully mapped by means of instrumental surveys.

The economic problems of the occurrence of iron, gold, phosphate, asbestos, copper and mica have also been investigated and much valuable information relative to their distribution, their geological position and the manner of their occurrence has been obtained. Some of these have already appeared in the publications of the Survey or in the *Bulletins* of the several scientific societies in Canada and the United States. In Ontario while a large amount of detailed work has been carried on in the older and more settled portions of the province tending to the more accurate determination of the better known formation and to the determination of the economic mineral wealth, much careful work of a very high order has also been done in the area north of Lakes Huron and Superior and further west, where some of the great questions as to the age and origin of the fundamental or lowest rocks of our systems, are now in a fair way of being definitely settled. The geological relations of the copper bearing series, of the great deposits of iron ores and of the gold bearing rocks of the Lake of the Woods areas, and the horizon and distribution of the nickel ores of the Sudbury district have been among the questions of the greatest economic nature. In the more settled portions of the provinces the distribution of the gas bearing strata, and the problems of the origin of the gas itself have been carefully studied, and the assertion of the great American gas expert, Ashburner, that no deposits of natural gas would ever be found in workable quantity in Canada has been thoroughly exploded.

To be Continued.