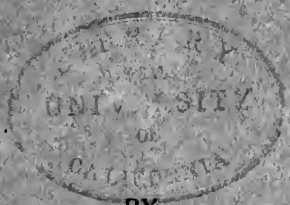
A Book For The General Reader;

THE PROVINCE OF QUEBEC:

Geographical and Social Studies



BY

J. C. SUTHERLAND, B. A.

Inspector General of the Protestant Schools of the Province.

MONTREAL
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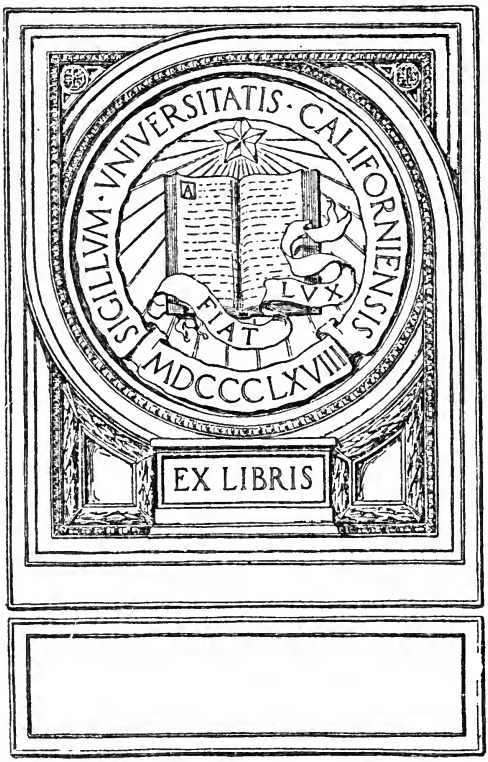
25 McGill College Avenue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ON THE LIÈVRE RIVER

A scene in the valley of the Lièvre, Portland township, Labelle county. The soil through which the river meanders is Pleistocene clay of the Laurentian uplands. The comparatively even sky-line in the distance is typical of the Laurentian Plateau.

Courtesy of Geological Survey of Canada.

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INTRODUCTION

THOUGH written chiefly for the general reader, this book can fairly claim to be a pioneering work in one essential way, because it is the first which has made any connected attempt to describe a Canadian province in accordance with the scientific principles of modern regional geography.

During the last thirty years geographical literature has been developing along new lines of scientific, historical, and human interest. The development, however, has been much more marked in Great Britain and on the continent of Europe than on this side of the Atlantic. So far as Great Britain is concerned credit for the advanced work now being produced in Modern Geography is undoubtedly due in the first instance to the Royal Geographical Society. In the 'seventies of the last century that Society made strong representations to the universities of Oxford and Cambridge on behalf of the recognition of Geography in the university courses. General geographical knowledge was then being added to at a rapid rate by many explorers on land and sea of scientific training and equipment, and the science of Geography itself had been virtually transformed by the discovery of the principles governing the

geographical distribution of plant and animal life. Darwin and Wallace had raised biology out of its indeterminate groping among a mass of facts into a determinating connection between causes and effects.

But the official university view at that time was still confined to the lower plane. Geography was regarded as no more than a primary school subject. The Royal Geographical Society, however, continued its efforts to raise the point of view; and by the 'nineties a remarkable change of mind had been brought about. Geography is now not only recognized at Oxford and Cambridge but at all the other leading universities of the Mother Country. The effect is seen not only in geographical literature at large but also in the school texts of Great Britain.

Conscious as he is of its shortcomings the author trusts that this first attempt to modernise the geography of a Canadian province may draw attention to this important matter in the intellectual development of the Dominion. It is altogether probable, however, that we shall not have a distinctively Canadian geographical literature of the modern type until such time as we have deliberately followed the example of the Mother Country in having the subject adequately recognised in our Canadian universities.

The Annual Reports of the Dominion Geological Survey, the Transactions of the Royal

Society of Canada, and other sources contain abundant material for literary and pedagogical treatment. Scientific research work is still needed to correlate all the elements of the physiography, geology and general geography of Canada in the most suitable and instructive form for educational purposes. When our universities have taken up the subject in the large way that its importance demands an immense service will be rendered to geographical teaching in the schools of Canada.

The National Council of Education, formed at Winnipeg in 1919, provided for a survey of the class text books in geography now used in Canadian schools. The survey was made by McGill University, but the report will not be issued until it has been dealt with by the National Council. From every province there has been a strong demand for more modern text books than those we now possess. The fact is that our school geographies, though mostly produced now in Canada, still retain much of the traditional character that was impressed upon them in the days when we were largely dependent upon the states of New York and Massachusetts for school books of all kinds. A century ago, when English education in Canada was unorganised, and the official authorisation of text books unknown, such dependence could not be avoided. It is true, of course, that here and there energy could and did overcome this dependence in some lines. Thus when a hymn

book was needed in Nova Scotia, a young printer who was in business with his father went down to Boston to learn how to set music type, returned and issued the hymn book. The young man's name was William Dawson; in 1855 he became Principal of McGill University.

It may be stated here that our educational imports from across the border at that period included readers and histories which were far from being calculated to foster British sentiment in the young colony; rather indeed the reverse. In some parts of Canada these books lingered on until several years after Confederation, although as early as 1846 Dr. Ryerson had caused the Irish National School Readers to be imported to Upper Canada with the view of having books of a British tone.

In geographies we remained dependent much longer still upon the United States, chiefly because it was only on this side of the water that books giving adequate attention to the geography of North America were produced, and because the small Canadian market for a long time did not encourage Canadian publishers to undertake the heavy initial expenses of map-making and map-printing. Naturally the books so long supplied from the United States gave more information about that country than about Canada or the British Empire. No doubt they were a contributing factor to the "exodus" of Canadian youth to the United States during a number of years.

When at last Canadian publishers began to issue Canadian geographies the handicap of the small market made it necessary to keep a given book in circulation as long as possible. Thoroughly revised editions were out of the question. A striking example of this fact was the publication of a "revised" Canadian text book in 1915, containing what purported to be a picture of the Victoria Jubilee Bridge at Montreal, but what really was a picture of it in its tubular days !

Of still more consequence is the fact that in text books and teaching methods we have too closely followed a form of presentation set for us by our neighbours in the days when the subject of Geography was made far less interesting than now; this, too, in spite of the fact that our neighbours, thanks to the splendid work of such institutions as their National Geographic Society (founded at Washington in 1888), have been making substantial progress in Modern Geography in recent years. School texts like the latest editions of the Frye and Atwood books are admirable examples of the newer geographical spirit in that country.

The essential character of the newer method is summed up in the one word "regional." The memorising of the natural productions of different countries, with sole reference to their political boundaries, is no longer demanded. The factors which determine the amount of rainfall and annual temperature, and which consequently determine the forest, the grassland (prairie), and

desert areas of the world, are made the basis of geographical teaching, and from this basis the regional areas of different natural productions are deduced. This leads up directly to the other natural "controls" which determine industrial development and trade routes.

As already stated, the present geographical studies of the Province of Quebec are by no means intended as a general class book for schools otherwise than as supplementary reading. They will have served their turn if they help to create more interest in the subject among older pupils, teachers and the general public.

The first five chapters are essentially physiographic and geological. The first, "Above Sea Level," deals with altitudes in different parts of the Province, and gives a list of them in an appendix. The second chapter, "Plateaus, Plains and Mountains," describes the three physiographic units of the Province.

As most educated people to-day are more or less interested in the geological history and structure of their homelands, the chapter on "The Story of the Rocks" endeavours to popularise the geological facts of the Province best worth knowing. There are certain salient facts known to most people; for instance, that the rocks of the Laurentians belong to the oldest in the world and that the hills of the Eastern Townships and the Gaspé peninsula belong to the Appalachian mountain system. There are other salient facts, however, which are not so generally known. Why

Quebec and Ontario have no coal is one of them. Then the Laurentians are often spoken of as a "range of mountains," whereas they do not owe their origin to the mountain building processes which raised the Alps, the Rockies and the Appalachians but are in reality the edge of a vast plateau of different history . Again, the eight Monteregian Hills rising above the Lowland Plain are the silent witnesses of the enormous denudation which in countless ages wore the plain down some hundreds of feet. The volcanic rocks of the eight hills are left standing because they are hard. The softer sedimentary rocks through which they originally broke their way yielded more readily to the disintegrating influences of air and rains. These and other main features of the geology of the Province should be matters of more common knowledge.

The Ice Age is the last great geological age, but is given a chapter to itself. It is of practical as well as of cultural interest. Every alert and educated mind must be interested in the travelled boulders scattered hundreds of miles from their original beds; the "kames" of gravel here and there in the Eastern Townships; the Leda Clay and Saxicava Sand of the Lowland Plain; the striae and grooves on hill sides; the "roches moutonnées" which owe their shape and direction to the moving ice-sheet, and other striking memorials of this great period. Business men know that though Quebec has no coal it has economic compensation in abundant water power. This

power is the parting gift of the last Ice Age. The innumerable rivers, ponds, and lakes of the Laurentian Plateau are all geologically "young." They date from the very close of the Ice Age, which began probably a million or more years ago and ended within only a few thousands years of our own time. The rivers are young, showing their youthfulness by tumbling in cascades everywhere. The lakes are so young that many of them still have several outlets, no one outlet having had time to outstrip the others in wearing down its barrier of rock or rock-rubbish. After imprisonment for countless ages under the ice-sheet a new drainage system awoke to a springlike energy which still continues. It is to the young lakes and rivers that the Province owes its reserves of water power.

These first five chapters lead up to the one on the Economic Geography of the Province. In this chapter emphasis is placed upon the distribution of industries. Industrial progress has been very great in Quebec in recent years. Its permanence will be best assured by wisely conserving the natural resources. The word of science gives the reason here. Why, for instance, were the farmers of the Lowland Plain so long able to "mine" the soil in that area of the Province with apparent impunity, cropping year after year without making proper returns to the soil? Because the Leda Clay, deposited by the Champlain Sea which covered all the lower ground of the Province at the close of the Ice Age, contains

almost incredible millions of the same Leda and other species that now live below the 30-fathom soundings in the Gulf of St. Lawrence. The slowly decomposing fossil shells have long been furnishing a magnificent fertiliser—phosphate of lime—to the soil in this area. But now we must realise that there is a practical limit to the dependence upon this natural process of soil enrichment.

The conservation of our forest wealth is another practical question where the teaching of science should be constantly and more widely heard. How many Canadians yet realise the importance of the geographical facts that the Laurentian Plateau or Canadian Shield, stretching as it does over the greater part of four provinces, covers more than half the whole area of the Dominion; that only a comparatively small fraction of it is suitable for agriculture; and that, in addition to its mineral contents and its water powers, its most valuable resources are its coniferous forest and fur-bearing animals? With a fuller realisation of these salient facts the conservation of plant and animal life on that great area will be more seriously recognised as a national concern and interest. Above all, the effective perpetuation of the immense but by no means inexhaustible forest as a source of lumber and pulp wood requires and demands not only the continued application of wise legislation and modern scientific methods but also the active co-operation of an enlightened public. To the

early pioneers of this continent the tree was an obstruction to be got rid of as soon as possible. It is still too often regarded as an enemy on the farm, although its usefulness in the conservation of the soil is of the highest importance.

The chapter on "Civil Government" gives an outline of the derivation and distribution of legislative and executive powers under our system. Being geographical it is necessarily limited to a description of the machinery of government. This knowledge is fundamental, however, to the proper study of Civics.

In the chapter on the Educational System an outline is given of the Quebec system with special reference to the points in which it differs from the other provinces. The Quebec system has often been misinterpreted by the outside world simply because it has been misunderstood.

The chapter on "Geography and Human Culture" is intended merely to suggest how geographical "controls" are related to human history and civilisation. It is only during the last fifty years that this interesting relationship has been well understood. Among English writers, Sir Archibald Geikie, a former Director of the Geological Survey of Great Britain, was the pioneer in this class of geographical interpretation.

In conclusion, my thanks are due to Mr. Théo. C. Denis, Superintendent of Mines, Quebec, and Mr. J. A. Dresser, M. A., of Montreal, for reading the manuscript of the geological portions of

the book and offering valuable suggestions which were adopted; and to Dr. G. W. Parmelee and Mr. J. N. Miller, English and French deputy-heads respectively of the Department of Public Instruction, for rendering the same services in connection with the chapter on the "Educational System" of the Province.

January, 1922.

CHAPTER 1.

ABOVE SEA LEVEL.

SOME knowledge of the altitudes of a region is the most useful foundation for the study

ERRATA.

Page 99. "Minister of Lands and Forests." Since this was written the sale of colonization lands has been transferred to the Department of the Minister of Colonization, Mines and Fisheries.

Page 121, line 2, *for* "purposed" *read* "proposed."

of the higher altitudes are on the Laurentian Plateau and in the Appalachian district. The measurements are usually made at the top of the rails in front of railway stations, and hence these points are convenient standards for other local measurements which may be required.

Mean sea level is the dividing line above which all heights on the land, and below which all depths in the ocean, are measured. The standard "datum" lines for eastern Canada, determined after observations extending over a year in each case, are marked at Halifax, N. S., St. John, N. B. and Quebec. This mean sea level is not at exactly the same distance from the centre of the earth at every part of the ocean,

the earth not being a perfect sphere. Thus, owing to the bulge at the equator, the distance from the surface there to the centre is greater than in this latitude. Again, in recent years it has been found that where large mountain masses are situated on the coasts the attractive force of these masses "heaps up" the waters for a long distance from shore much more than at a low coast.

The great majority of the people of eastern Canada live at a comparatively low or moderate elevation above sea level. Montreal is a long distance from the sea, but the top of the railway tracks at Bonaventure station is only 48 feet above sea level. The tracks at the Place Viger station are 58 feet above sea level, and those of Windsor station 110 feet.

If the Province were to sink down some sixty feet both the Bonaventure and the Place Viger tracks would be under water. Such a lowering of the land is not expected to happen in the near future, and if it began it is altogether probable that the sinking would proceed very slowly . It is certain that continents do rise and fall with respect to sea level, and that to-day in different parts of the world coasts are rising or sinking, but so slowly that the change is measured usually by a few feet in a century. It is also perfectly certain, as we shall see in another chapter, that only a few thousand years ago the Province of Quebec and surrounding territory sank ten times sixty feet, so that the top of Mount Royal, for

instance, became a mere tiny islet in the sea. It will be seen also that there is clear evidence that we are not yet restored to the altitude which preceded that sinking.

It is an established and fundamental principle of geological science that continents, or larger or smaller portions of them, rise and fall relatively to sea level in long periods of time; that the areas which sink below sea level accumulate the deposits which eventually become the stratified rocks of the earth; that the rising areas become subjected to that process of denudation of their solid materials constantly carried on by the air, the rains, the rivers and other agencies; that this cycle of change from periods of deposition to periods of denudation is a continuous one, and that consequently

"Where now the long street roars hath been
"The stillness of the central sea."

TENNYSON.

These changes, however, are effected slowly and are measured in thousands and millions of years. Hence the main physiographic features of this continent are now what they were in the days of Champlain and La Salle and hundreds of years before them. In their explorations these pioneers followed the natural routes determined by the present physical geography. In the circumstances of the time, La Salle's dream of a New France which would sweep from the known Canada to Louisiana was not unreason-

able geographically. England then seemed to be confined to the Atlantic coast by the Appalachian mountain barrier, while the vast area of moderate elevation which stretches westward to Lake Michigan, and then southward to the Mississippi, is almost a geographical unit. The practical mind of La Salle grasped the advantages which it offered for future colonisation.

The moderate elevation of the valley of the St. Lawrence System (including the river and the Great Lakes) is illustrated by the following figures. Lake Superior is many hundred miles from the Atlantic coast, but its height above sea level is only 602 feet. Niagara river and falls account for 326 feet of this total slope of 602 feet. Yet, the difference in level between Lake Superior and the Atlantic is actually fifteen feet less than the descent from Gould to Cookshire on the Canadian Pacific Railway in the Eastern Townships—a short run of 17 miles! On the other hand the source of the comparatively short St. Francis river is 1762 feet above sea level.

CHAPTER II.

PLATEAU, PLAIN AND MOUNTAINS

WHAT is a mountain? The old definition that it is a very high hill remains as good as any. It is certain, however, that the amount of elevation above sea level does not in itself determine a mountain. The plains of Manitoba, Saskatchewan, and Alberta increase in elevation westward until they are more than four thousand feet above sea level, but they are still plains although they are much higher than the average elevation of our Laurentian highlands. Then we speak of 'Mount' Royal (769 feet) and more reasonably of Brome mountain (1,755 feet), but by way of compromise they are both described as belonging to the eight Monteregian 'Hills'. Nevertheless, any high hill which rises in a dominant way above the surrounding country is frequently and conveniently called a mountain.

In physical structure the Province of Quebec is divided into three distinct areas :- the Laurentian highlands, the St. Lawrence Lowland Plain or Valley, and the southeastern Appalachian mountain and valley district. When Ungava was added to the Province in 1912 the whole area became 703,653 square miles, and it is thus more than three times greater than that

of France or Germany. From north to south the distance is 1200 miles, and from east to west 950 miles. The Laurentian highlands, extending as they do to Hudson Strait, occupy nearly ninety-five per cent of the whole area. The St. Lawrence Lowland Plain, so far as its extension in this Province only is concerned, reaches from the City of Quebec to the borders of Ontario, and has an area of about 10,000 square miles. The plain is fairly triangular, with the apex at Quebec and with the base angles at Lake Champlain and Ottawa respectively. The Appalachian district includes all the hilly and mountainous region of southeastern Quebec extending from Lake Champlain to the end of the Gaspé peninsula.

A. The Laurentian Plateau or Canadian Shield.

We speak of this area as the Laurentian highlands, and sometimes as the Laurentide range of mountains. Mountainous, indeed, the area seems to the traveller on the railroad from Montreal to Mont Laurier, or from Quebec to Lake St. John, and on the Labrador coast facing the Atlantic there are heights which rise to 5000 and 6000 feet. But in general the elevation varies between 500 and 2000 feet, and over a considerable portion of about 200,000 square miles the evenness of the sky-line gives the plateau the appearance of a peneplain (almost a plain). As the physical characters of the area have become better known, the geologists of

Canada have preferred to adopt the name "Laurentian Plateau," while a European geologist (Suess) also proposed the name "Canadian Shield."

What is the difference between a plateau and a high plain? Both names suggest the idea of flatness, although at the same time either may be of a "rolling" character. The essential difference between the two is that a plateau rises visibly with a certain amount of steepness from its surroundings of land or water on at least one side, while the approach to a high plain is gradual and not manifest in the same clear way. The Laurentian Plateau rises with steepness on all sides. Considering only the southern boundary, with which we are most familiar, it rises in a visible and dominant way along the north shore of the Gulf and River St. Lawrence to about 20 miles below the City of Quebec, and then leaving the river it is a dominant feature in the landscape above the lowlands to the county of Pontiac, continuing thence onward in the Province of Ontario. In Quebec Province the plateau is wholly north of the St. Lawrence.

The name "Canadian Shield" is also appropriate. It expresses the massiveness and solidity of the plateau. Its area in Canada is about two million square miles, somewhat less than a third of this total being in the Province of Quebec. It is of great solidity, due not only to the hardness of its rocks in general but also to their

thickness. Long ages ago the average height of the plateau must have been considerably greater than at present. The hills have everywhere the rounded character which declares that the region is an old and "subdued" one. But the "weathering" or wearing-down process, which in time levels the highest mountains and plateaus, works much faster upon "soft" rocks, such as limestones and shales, than upon "hard" rocks. The hardness of the rock formations of the Laurentian Plateau explains its great persistence through vast periods of time.

Then the deep base of the plateau, extending under the younger, and mostly sedimentary, rock strata of the plain to the south, was the strong shield against which was exerted the slow pressure which gave form to the Canadian portion of that wave or wrinkle of the earth's crust known as the Appalachian mountain system. A striking evidence of this resistance is afforded in the "curvature" of the Gaspé peninsula. Looking at the map, it might be supposed that this curvature is due to wave action on the shores, but it is the axes of the mountain folds in this region which are curved. The direction of the fold was determined by the Canadian Shield.

The Laurentian Plateau or Canadian Shield extends more than half way across Canada and northward to the Arctic Ocean. It crosses the St. Lawrence river in Ontario, it rises from there as the Adirondacks of New York state,

and once again it passes into United States territory west of Lake Superior.

Innumerable lakes and rivers, large and small, are found all over the plateau. The drainage is "young," dating only from the Ice Age. The rivers have not had time since that period to saw long channels of the same level . In Quebec the drainage is southward into the St. Lawrence; westward into the Ottawa river and Hudson Bay; northward into Hudson Strait, and eastward into the Atlantic. The lakes are "young." Some have several outlets, no one outlet having had "time" to work faster than the others.

The drainage into the St. Lawrence and the Ottawa has become of immense importance in affording vast stores of water power for manufacturing purposes. Control of the flow at all seasons of the year is necessary in large basins like that of the St. Maurice and its tributaries, and this has been effected in recent years in the St. Maurice basin by the construction of the Gouin Dam by the Government of the Province. It is one of the largest dams in the world.

Another great water power region is that of the Saguenay river in its thirty mile course from Lake St. John to Chicoutimi. At low water, Lake St. John is but 314 feet above sea level, the Lake St. John district being a depressed part of the Laurentian Plateau.

In the southwestern portion of the plateau some hard woods are still found, but in the

greater part of the area the forest growth is composed of the cone-bearing trees, of so much importance in the pulp and paper industries.

In the early days of European settlement in Canada this northern part of the Province was penetrated for considerable distances by the hunters and trappers, at the instance of the various fur companies of the time. Real settlement, however, did not begin until the nineteenth century. The first industry was lumbering. Then followed, upon suitable soils in limited districts, the beginnings of agriculture. It was the lumbering operations in the upper Saguenay district which led, about 1860, to a realisation of the agricultural possibilities of the Lake St. John region. The clay soil of this district is of comparatively recent origin, having been laid down in the Champlain Sea which covered so much of the Province at the close of the Ice Age.

B. **The St. Lawrence Lowland Plain.**

This plain extends on both sides of the St. Lawrence system of river and lakes to Lake Huron. As stated on a previous page, the triangular part in Quebec has an area of about 10,000 square miles. It was the first part of the Province to be generally deforested, the Leda Clay underlying it being of exceptional agricultural value. It is also the area having the largest percentage of the population. Lake Champlain, at the southwestern base of the triangle, is only

95 feet above sea level. This low elevation of Lake Champlain is connected with a salient geographical principle. Montreal owes its position as a commercial metropolis, first, to the fact that it is at the head of ocean navigation, and secondly to the long Hudson-Champlain valley, connecting Montreal and New York directly north and south. It was also the pathway of war-parties in the many struggles in the 17th and 18th centuries between New France and New England, the settlements of the participating Iroquois Indians being in that part of the Lowland Plain which lies south of Lake Ontario, and west of the Hudson-Champlain valley.

The rock formations in the St. Lawrence Lowland Plain are mostly sedimentary, that is, rocks formed mechanically or by chemical precipitation under water. The strata are also flat-lying, that is, undisturbed by mountain folding. But breaking up through these sedimentary strata are eight hills or mountains, of igneous (ignis, fire) origin. After one of them, Mount Royal, they are called the Monteregian Hills. They are composed of minerals, such as nepheline syenite and essexite, which were originally in a molten state, and which arose through the surrounding rock as a soft "magma." The fact that the eight hills are very much alike in their composition indicates that they may have welled-up from the same deep-seated source, although each is some miles from the other. This common origin is the more likely

from the fact that many small "dykes" in intervening and surrounding areas have the same composition as the hills.

In the course of millions of years the softer sedimentary rocks through which the igneous rock penetrated have been considerably worn away. The igneous rock was molten when it arose, but soon hardened. Considerable masses of sedimentary rock are still clinging near the top of two of the Monteregian Hills, as evidence that when they arose the Plain was filled with several hundred feet more of rock strata than it now possesses. These eight isolated Hills, therefore, on a nearly straight line of over fifty miles, are standing memorials of the immense amount of denudation which has taken place in the softer rocks of the Plain in the millions of years since their formation.

"It is probable that some, if not all, of them, represent the substructures of volcanoes which at one time were in active eruption in this region." (Frank D. Adams.)

The area of each hill is determined by the line which separates the igneous from the surrounding sedimentary rock. By this measurement Brome mountain has an area of 30 square miles, while that of Mount Johnson is less than half a square mile. At the line of contact between the igneous and the sedimentary rock, the latter is usually found "baked."

The Monteregian Hills and their heights are as follows:-

	Above sea level (in feet)
Mount Royal	769
Montarville or St. Bruno	715
Beloeil	1,437
Rougemont	1,250
Yamaska	1,470
Shefford	1,725
Brome	1,755
Mount Johnson or Monnoir	875

C. The Appalachian District.

The traveller on the Grand Trunk Railway from Montreal to Sherbrooke is more or less aware of the fact that from Danby to South Durham—a short distance of four miles—the train is going up grade. The elevation at Danby is 437 feet; at South Durham it is 608 feet. In the 66 mile journey from Montreal to South Durham the train has been moving mostly in the St. Lawrence Lowland Plain. Approaching and passing Danby one is apparently still in the Plain, but as a matter of fact an invisible "line of fault," or dislocation of the underlying rock structure, has been crossed, and this line of fault or dislocation is regarded as the geological line of separation between the Appalachians to the southeast and the lowland plain on the northwest. This line of fault was traced many years ago by Sir William Logan from Lake Champlain to the City of Quebec, and thence down the St. Lawrence to the Gulf.

But it is only when the train enters the rock cutting at South Durham that we have the visible evidence of being within the boundaries of the great mountain system which extends from the Gulf of Mexico to Newfoundland.

The Appalachians receive different names in different parts of the United States and Canada. The Green Mountains of Vermont and the White Mountains of New Hampshire are parts of the system, and it is these mountains which extend into Canada. Apart from local names the general name in the Eastern Townships is the Notre Dame Mountains; in the Gaspé peninsula they receive the Indian name of the Shickshocks.

In the Eastern Townships the Appalachians consist of three fairly parallel ridges, about twenty-five miles apart. The first is known as the Sutton Mountain belt, extending from the Province line near Sutton to South Durham, Richmond, Danville and beyond. As it passes eastward it gradually approaches the St. Lawrence, but opposite the City of Quebec the axis is still some thirty miles from the river. Nevertheless, the complicated folds of the rocks at Levis, immediately opposite Quebec, are due to the Appalachian uplift.

The second parallel ridge is that known as the Stoke or Sherbrooke ridge. It includes the hills in the vicinity of Sherbrooke and Capelton.

The third ridge is at the international boundary line, in the vicinity of Lake Megantic, and is of small extent in the Province.

AN ASBESTOS QUARRY AT THETFORD MINES.[1]

The vertical depth of these quarries exceeds 300 feet.

Courtesy Bureau of Mines, Quebec.

Just southeast of the Sutton Mountain belt, and parallel with it, there is another ridge of different origin. This is the Serpentine belt which extends from the Chaudière River to the Province line in Brome county. It is not due to the mountain-building process which raised the three other ridges, but like the Monteregian Hills was originally an igneous "magma," welling up from the depths. Doubtless, however, it was the pressure of the Appalachian uplift which provided the "line of weakness" for the entrance of the molten igneous masses. Mount Orford (2,820 feet above sea level), Owl's Head (2,484 feet), and the other mountains by the west shore of Lake Memphramagog, belong to this igneous Serpentine belt. That is to say, while they are in the Appalachian district they are technically not a part of it.

It is in the Serpentine belt that the asbestos mines are situated, asbestos being one of the altered (metamorphosed) products of the original igneous magma.

But the Sutton, the Sherbrooke or Stoke, and the Lake Megantic ridges are true Appalachian folds. The three ridges may be regarded as types of anticlinal folding or anticlines, that is, upward folds of the earth's crust, formed in the same way that a heap of small towels ridge upward in the centre when pressed inward from two opposite sides. They represent the type of mountain-building due to shrinkage of the earth's crust. This shrinkage developed a pres-

sure from the direction of the Atlantic Ocean which uplifted the rock strata against the resistance (in this province) of the deep base of the Laurentian Plateau or Canadian Shield.

The Appalachians are old, "subdued" mountains, millions of years younger than the Laurentian highlands but millions of years older than the youthful Rocky Mountains.

The Appalachians were uplifted and worn down again more than once in their long history. That even now the mountain-building process is not entirely complete is indicated by the Quebec land-slide of a few years ago, and the minor earthquakes which occur from time to time along the line of junction with the rocks of the northern part of the Province.

In the long ages the Appalachians have undergone much denudation. The ridges are but the cores of the hard rocks which formed the lower portion of the area; most of the soft rocks have been worn away.

Eastward of the City of Quebec the Notre Dame mountains sink into low hills, but they rise again in the Gaspé peninsula to heights of 3500 feet and more. Five distinct folds (anticlinals) are recognised in the Gaspé district, from the south shore of the St. Lawrence River to Percé. These folds are:- 1. The Florillon, 2. The Haldimand, its axis running through Gaspé mountain at Gaspé Basin, 3. Tar Point anticline, on the south shore of Gaspé bay, 4. The St. Peter, meeting the sea at Point St. Peter, 5. The Percé.

The principal rivers of the Appalachian district cross the several mountain ridges in "water gaps." If, as is probable, the ridges were slowly raised, it is possible that the principal rivers were able to "saw" their way across them as fast as they were raised. On the other hand it is possible that the courses of these rivers were determined by the denudation (working backward) which took place after the uplift. But the tributaries which empty into the principal rivers are wholly in the valleys parallel with the ridges. They empty into the principal rivers by falls or rapids, and hence water powers are usually found at the junction of the principal river with a tributary. This has given rise to several manufacturing places. Sherbrooke, at the junction of the Magog with the St. Francis, and Windsor Mills at the junction of the Ouatopekah with the same river, are examples.

Lakes, large or small, are less numerous in this region than on the Laurentian Plateau, but the altitudes of some of them are worth noticing. In chapter I. it was mentioned that the surface of Lake Superior is 602 feet above sea level. This may be compared with the following:—

Lakes	Altitudes (in feet)
Massawippi	525
Little Magog	634
Brome	648
Memphramagog	682

Brompton	784
Aylmer	816
Megantic	1,303

The varied land-forms, the lakes and streams, the wide valleys, the wooded or cultivated hills and hill slopes, of the Eastern Towships, all combine to give this portion of the Appalachian district great scenic beauty. First settled at the beginning of the 19th century, by United Empire loyalists and other immigrants from the United States, and now containing a mixed population of English and French descent, this part of the Province has undergone great development agriculturally and industrially. The abundance of pure water from innumerable springs, and the excellence of its pasture lands, have made the district one of the most important in Canada in dairying, while the numerous water powers have encouraged considerable manufacturing.

The Gaspé peninsula, comprising the counties of Gaspé, Bonaventure and Matane, is also one of magnificent scenery; the two former counties facing Chaleur Bay, and Matane the St. Lawrence. Fishing, lumbering, pulp wood and agriculture are the principal industries. The population along this coast is of French and English origin, with a considerable percentage of people of Channel Islands origin, who with French names either speak English only or both languages.

CHAPTER III.

THE STORY OF THE ROCKS

THE many different rocks of the crust of the earth are divided into three classes according to their physical origin, as follows:—

3. Metamorphic.
2. Sedimentary.
1. Igneous.

All three classes have been mentioned in the previous chapter.

Igneous rocks are those which were originally in a molten condition, such as granite. Igneous rocks are sub-divided into two classes. Those which cooled and crystallised in the depths of the earth are called plutonics; those which reached the surface in the molten condition (such as most lava flows) are called volcanics.

The Sedimentary rocks comprise chiefly those which have been formed under water, in seas or lakes. They consist of the sediments carried by the rivers to the lakes and seas. Where the sediment laid down is sand, the layers are in time hardened by pressure and other causes into sandstone; where the sediment is mud, the layers are gradually hardened into shale. Other sedimentary rocks will be mentioned in this chapter.

Metamorphic rocks are either igneous or sedimentary rocks which have been changed or altered (metamorphosed) by heat, pressure and similar causes. Marble is the most familiar metamorphic rock. It is limestone altered by heat and pressure. That marble is formed under pressure in the depths is shown by the fact that it retains the carbon dioxide of the original limestone. If the latter had been subjected to heat at the surface of the earth, the carbon dioxide would have been driven off into the atmosphere and only quicklime would have been left. Hence when marble is found at the surface it is certain that there has been much denudation of overlying rock since its formation.

The greater part of the Laurentian Plateau consists of igneous and of metamorphic rocks. There are overlying areas, however, of sedimentary rock, as in the Lake St. John district.

The greater part of the Lowland Plain consists of sedimentary strata, lying almost in the same flat position in which they were laid down in the ancient seas. The Lowland Plain, however, is pierced through by the eight Monteregian Hills of igneous origin.

The greater part of the Appalachian district of the Eastern Townships and Gaspé Peninsula (and intervening counties) consists of very much disturbed and folded sedimentary rocks, in which there are areas of igneous and metamorphic rocks.

The main facts of the Story of the Rocks, (that

is, the geological history of the earth) have been made out within the last two hundred years. In the decipherment and unravelling of that history the sedimentary rocks have been the most important. Where sedimentary rock strata are found in the undisturbed position in which they were laid down in the sea, it is certain that the lower strata are the older, and that the succession is to be read upward from the bottom, just as we know in the case of a brick-wall that the lowest layer was laid first and so on upward to the topmost or youngest layer. In the sedimentary strata, also, are found entombed the "fossils"—the forms of animal and plant life which lived at the time that the mud or sand or limestone were being deposited.

In no one part of the world is that succession complete, but by comparing the strata in different parts of the world the general history has been made out. All geological time is divided into four great Eras, namely: 1. Pre-Cambrian, 2. Paleozoic, 3. Mesozoic, 4. Kainozoic. Each of these Eras is again divided into distinctive Periods, while each Period has its systems, groups, formations, etc.

The name Pre-Cambrian for the first great Era is a non-committal or compromise one. At one time it was called the Azoic (meaning "without life"), but when evidence of life seemed to be certain, Sir William Dawson proposed the name Eozoic (meaning "dawn of life"). These and other names, however, were abandoned for

the present one, which merely asserts that the periods of the era preceded the Cambrian.

Almost the whole mass of the Laurentian Plateau belongs to this most ancient era, the Pre-Cambrian. Rocks of the same era are found in northern Europe and elsewhere in the world, and doubtless underlie the younger strata everywhere.

It is believed that the Pre-Cambrian lasted very much longer than the three great eras which have succeeded it. It is estimated that the duration of the Pre-Cambrian must have been considerably more than a hundred million years, and that about a hundred million years have elapsed for the formation of the Paleozoic, the Mesozoic and the Kainozoic, allowing sixty million years for the Paleozoic, twenty-five million for the Mesozoic and fifteen million for the Kainozoic. While these enormous figures are far from exact, they are far from being purely speculative and are below the mark if anything. Two considerations which are taken into account in estimating the duration of geological time may be mentioned. The one is that the materials which are deposited in the ocean to eventually form rock strata are deposited very slowly. The rate of deposition varies, but a long period of time is required in all cases to form one foot of rock. Yet there is one formation of altered (metamorphosed) sedimentary rock of the Pre-Cambrian in the Laurentian Plateau — the Grenville crystalline limestone

of Argenteuil county and elsewhere — which has a total thickness of nearly eighteen miles !

The other consideration is that although the strata of the different geological periods are thousands of feet in thickness, in many places the formations are only the remnants of what was originally formed, owing to the constant denudation of all rock surfaces above sea level. Darwin's chapter on the Imperfection of the Geological Record in the "Origin of Species" was the first great exposition of this truth.

The Pre-Cambrian was undoubtedly an era of enormous duration, as measured not only by the time required for the forming of the sedimentary rocks just mentioned above, but also on account of the time required for the immense volcanic and metamorphic activity which had been, apparently, completed before the on-coming of the next great era, the Paleozoic.

Of the several areas in the world where the Pre-Cambrian rocks are largely developed, the Laurentian Plateau or Canadian Shield is the most important. Some years ago a joint committee of the Geological Surveys of Canada and the United States was appointed to study the area with the view of determining the order in which the different members of it had been formed. There is no problem in geology more difficult. Whatever order originally existed in the sedimentary portions has been largely masked by subsequent volcanic action and the crushing and other forces of earth-movements. Life no

doubt existed in the Pre-Cambrian. The altered crystalline limestones of the Grenville formation were once ordinary limestones, and this fact speaks of the existence then of lowly animal life at any rate, while the graphite found in rocks of the same era speaks of the existence of lowly forms of plant life. But except for the doubtful fossil, Eozoon Canadense, there are no evidences in this Province of the general character of the life in that early age of the world's history.

The Pre-Cambrian in geology is often compared with the pre-historic of human history—a record containing many hints but through which we have to grope in more or less uncertainty. The latest Canadian determination of the era gives the following order for the members represented in the Province of Quebec:—

5. Keweenawan.
4. Huronian.
3. Laurentian.
2. Grenville series.
1. Keewatin.

As in geological tables generally, the oldest member is placed at the bottom and the succeeding members in order of time are numbered upward.

The oldest, the Keewatin, consists of green schists of igneous origin. The essential fact about the Keewatin rocks is that, although the oldest known in the Pre-Cambrian, they are not

the base of the era. So great has been the volcanic activity in that era, and throughout its area, that no set of rocks has yet been found of which it could be said that they formed the original basement upon which the others had been formed.

The Grenville series, as already stated, was originally a sedimentary series of rocks, which by their great thickness must have required a vast period of time for their deposition, and now consist of altered rocks — crystalline limestones, greywacké, quartzite, slate and iron-bearing rocks.

The Laurentian consists of vast masses of granite and syenite which invaded the Keewatin and Grenville, and folded, crumpled and altered the older rocks to schists and gneisses. In the original classification by Sir William Logan many years ago, the Laurentian was regarded as the oldest. The present classification makes it third in the order of time, and invading the two earlier. The Laurentian rocks form by far the larger part of our area of the Plateau.

The Huronian is composed of thick beds of conglomerate, quartzite and arkose.

The Keweenawan is represented by large dykes and smaller bodies of igneous rocks which invaded Lower Huronian rocks in Northwestern Quebec.

Penetrating the gneisses of the Laurentian are vast masses of igneous (plutonic) rock called anorthosite, from which the beautiful

mineral labradorite is obtained. The Morin anorthosite area begins at the edge of the Plateau about 30 miles north of Montreal. Railway cuttings from St. Jerome to St. Agathe are in this rock. The Morin anorthosite has an area of 990 square miles. Another area about the headwaters of the Saguenay River occupies not less than 5,800 square miles of territory. The mineral labradorite is abundant in other areas nearer Labrador.

In brief, the Pre-Cambrian is a vast mineral complex throughout the whole Canadian area of the Laurentian Plateau, and is almost wholly composed of igneous and metamorphic rocks, the gneiss (banded granite) being the most abundant.

When the vast era of the Pre-Cambrian ended, a new and clearer volume of earth-history began, and it has lasted, up to the present, for fully a hundred million years. It is a clearer volume of history than the Pre-Cambrian in that its records are chiefly sedimentary rocks containing the fossils which tell much of the story of the long succession and evolution of plant and animal life on the globe. Many a page, it is true, is missing from that history, swept away gradually by the same forces which are to-day denuding the solid rocks and depositing their fine particles once more in lakes and seas. It is estimated that the rivers of the world carry to the oceans each year the enormous amount of fifteen thousand million (fifteen billion) tons

of sediment. Every day the Mississippi River carries about a million tons of mud and sand to the Gulf of Mexico. This load of a single day would require 750 railway trains of 50 cars each, and each car holding 25 tons to transport it.

This sediment from the rivers is the rock waste continually being formed by the chemical action of the atmosphere, by the mechanical action of frost, by the rains, and by other agencies. The sediment is carried by every rill and brook to the rivers, and by the rivers to the lakes and the seas. Here it is re-assorted on account of the differing specific gravities of its particles. The heavy sand is naturally deposited nearer the shore than the lighter particles of mud which travel farther out before they sink to the bottom. The accumulations of sand eventually harden into sandstone, and the accumulations of mud into shale. Masses of gravel and boulders deposited nearest the shore are in time formed into conglomerates or "pudding stones."

Pressure from the weight of water above, and also from the upper portions of the accumulated sediment upon the lower portions, is the chief factor in hardening the loose deposits into rock strata. In addition to the effect of pressure, the particles are often cemented together by the infiltration of limestone or silica in solution, which eventually crystallise.

But there are other sedimentary rocks than

sandstones, shales and conglomerates. Common limestone is one of the most important and interesting.

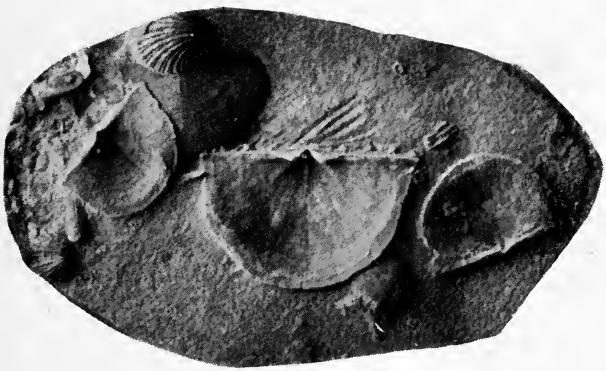
While the rivers of the world carry, as already stated, about fifteen thousand million tons of suspended sediment to the oceans each year, they also carry about five thousand million (five billion) tons of dissolved rock, and a considerable portion of this dissolved and invisible load is limestone. The daily load of carbonic acid gas (carbon dioxide) in the atmosphere, produced by the burning of wood and coal, by the decay of organic matter, etc., is continually being dissolved in the rains and thus carried into the soil. Here it attacks the rocks. In the case of limestone it changes the carbonate of lime into a soluble bi-carbonate By way of the springs the solution ('hard water') reaches the surface of the ground, and by the brooks and rivers is finally carried to the sea.

As the water of the St. Lawrence comes from Lake Ontario it is remarkably free from suspended sediment in the form of mud, the great lake having acted as a 'settling basin,' but this clear water contains a large amount of dissolved limestone, gathered from the extensive limestone areas of the Province of Ontario. Then, when the solution reaches the sea, it becomes the armor of the shell-fish, by the same kind of wonderful chemistry that the plants of the land gather the substances needed for their growth

1

2

3



FOSSILS FROM ANTICOSTI.

Nos. 1 and 2. Ventral and dorsal views of an Ordovician brachiopod (Orthis lamellosa).

No. 3. Group of fossil brachiopods from the same Ordovician rocks of Anticosti.

Courtesy of Geological Survey of Canada.

from the soil and the air. These shell-fishes in turn become part of new beds of limestone, their armor is either ground to powder or they retain their natural forms and become buried in the mass as the 'fossils' which record the life history of the past.

The dissolved limestone now passing down the St. Lawrence to become the covering of shell-fish of to-day was the covering of shell-fish which lived many million years ago. The story of the sedimentary rocks is, therefore, one of endless destruction and re-construction.

The preserved fossils of animal and plant life in the rocks speak of a constant development from lower to higher forms, although some lowly forms met with in the early periods have persisted to the present. It is also true that some of the species found in the ancient sedimentary rocks had reached a high development of form in their class. This makes it certain that life had long existed in the Pre-Cambrian, although most of the records are destroyed by the volcanic action of that era.

The names of the three great eras which have occupied the long period of time from the Pre-Cambrian to the present have reference to the life indicated by the fossils. The Paleozoic is the era of ancient life forms; the Mesozoic is the middle era of life development, and the Kainozoic the era of the development of the principal recent forms of life, plant and animal.

Each era is divided into distinct periods. The

Paleozoic, with its sixty million years or more, is divided into six periods, each being marked by the prevalence of certain distinctive life forms. The six periods are named as follows, the first or oldest being placed at the bottom of the list and the youngest at the top:—

6. Permian.
5. Carboniferous.
4. Devonian.
3. Silurian.
2. Ordovician.
1. Cambrian.

All the solid rocks of the Province of Quebec, other than the Pre-Cambrian, belong to the Cambrian, Ordovician, Silurian, Devonian and to Lower Carboniferous, although the red rocks of the Magdalen Islands have been tentatively referred to the Permian. As for the Lower Carboniferous, the rocks belonging to this period are the sandstone conglomerates of the Gaspé peninsula, known as the Bonaventure formation. These are the youngest rocks of the mainland of the Province, and as they are of a transitional character they are usually described as Devono-Carboniferous rather than Lower Carboniferous.

As the Carboniferous proper was the great Coal Period (although coal was formed in later periods) it is well, perhaps to retain the name Devono-Carboniferous for the Bonaventure formation. It serves to keep in mind the fact that neither Quebec nor Ontario received the

deposits of the Carboniferous proper, that favour of past geological history being reserved to New Brunswick and Nova Scotia in the east of Canada and to British Columbia in the west.

Coal is found in periods later than the Carboniferous (as in the Prairie Provinces) but not in rock strata earlier than the Carboniferous. Nevertheless, although the lowland plains of Quebec and Ontario have no rocks later than the Carboniferous and never received the deposits of the Carboniferous proper, there were 'coal fevers' in both provinces in the years before Confederation. Sir William Logan, the great founder of the Geological Survey, had much difficulty in persuading intelligent business men that it was useless to look for coal in these ancient rocks. Real coal, it is true, was brought to the surface at some of the prospects, but one lot raised at Bowmanville, Ontario, in the presence of intending investors, happened to be mixed with the fresh bread and cheese of a workman whose duty it was not only to get coal up from the "hole in the ground," but also to get it down into the hole beforehand ! (Harrington's Life of Sir William Logan, pp. 263-265.) Compensation for the economic loss of coal is afforded, however, in the abundant water-powers.

The Mesozoic is divided into three periods:—

3. Cretaceous.
2. Jurassic.
1. Triassic.

This era, lasting probably some 25 million years, was above all the era of Reptiles. The gigantic saurians whose fossil remains, weighing many tons, are found in the Cretaceous rocks of the western provinces, are representative of the era.

The Kainozoic era has six periods, as follows:—

6. Modern.
5. Pleistocene or Ice Age.
4. Pliocene.
3. Miocene.
2. Oligocene.
1. Eocene.

The names of these periods, other than "Modern" which explains itself, have reference to the proportion of modern shells they contain. The periods were classified on this basis many years ago by Sir Charles Lyell. The letters "cene" are from the Greek word for "recent" (kainos). Thus, Eocene (eos, the dawn) means the dawn of the recent, and the others indicate increasing proportions of recent shells. The whole era has lasted, at least, some fifteen million years.

In the Province of Quebec there are no solid rocks either of the Mesozoic or the Kainozoic eras. We have, however, the loose surface deposits (not consolidated rock) of the last two periods of the Kainozoic, namely, the Pleistocene or Ice Age and the Modern soils.

All the solid rock formations of the Province, therefore, are very ancient, and all the loose surface deposits (as will be seen in the next chapter) are very young.

The most ancient rocks — the Pre-Cambrian formations of the Laurentian Plateau — have been described already. We have now to consider briefly the formations belonging to the several periods of the Paleozoic era.

Overlying the Laurentian Plateau there are some areas of rocks of Paleozoic age. The Lake St. John district is one such area. It contains strata of the Ordovician period, the lowest being Trenton limestone, the next Utica shale, and the upper Richmond limestone. Unlike the Pre-Cambrian rocks that they overlie, these Ordovician rocks are "undisturbed" and contain fossils. Their presence in that district proves that the sea in which the Ordovician rocks of the Lowland Plain were deposited "transgressed" the Plateau. Their preservation in that district is due to the fact that the Lake St. John area is a "sunken" area, due to extensive surrounding "faulting."

The Appalachian district of the Eastern Townships is highly complex geologically, owing to the mountain-building processes to which it was subjected, and also to the immense amount of denudation which has ensued since the mountain ridges were raised. The cores of the denuded hills expose rocks of Pre-Cambrian age. Its "Quebec Group," which extends as far as

the Gaspé peninsula, consists of sedimentary strata of Cambrian, Ordovician, Silurian and Devonian age. The strata contain, however, comparatively few fossils. This is due in some places to the destructive alteration (metamorphism) the district had undergone by great compression; in other cases it appears that sedimentation took place under conditions which prevented the accumulation of fossil remains.

In the other portion of the Appalachian district, the Gaspé peninsula, rocks of the same geological periods have a greater abundance of fossils, and are more readily interpreted. The important formations of this area are:—

Devono-Carboniferous.	Bonaventure.
Devonian.	Gaspé sandstones.
"	Grande Grève limestones.
"	Bon Ami.
"	St. Alban shales.
Silurian.	Black Cape.
Siluro-Ordovician.	Cap Blanc and Corner of Beach.
Cambro-Ordovician.	Rosiers shales.
Cambrian.	Western part of Matane county.

The Gaspé peninsula is full of interest to the geologist. The first work of Sir William Logan (1843) was in that district.

The sedimentary rocks of the St. Lawrence Lowland Plain are sandstones, limestones and

shales of Cambrian, Ordovician and Silurian age. The strata, although slightly tilted, are mostly in the undisturbed position in which they were formed in the sea. They are more or less fossil-bearing.

The lowest member is the Potsdam of Late Cambrian age. The Potsdam sandstone "covers considerable portions of the counties of Huntingdon, Chateauguay, Beauharnois and Vaudreuil, and skirts the Pre-Cambrian on the Lower Ottawa and in places as far east as the St. Maurice River. In the vicinity of Montreal it is seen at Ste. Anne's, Vaudreuil, Beauharnois, and at various other places on the Ottawa River." (Sir William Dawson.) The most common fossil in the Potsdam, in this Province, is a brachiopod, Lingula acuminata. There are also markings which were probably made by a large crustacean.

In order of geological time the Sillery and the Lévis formations, now regarded as belonging to Lower Ordovician, may be mentioned here, although they are only partly in the Lowland Plain. The Sillery, the older of the two, consists of red and green shales, with masses of red and green sandstones. It is developed at Sillery, near Quebec City, and appears at various places on the south shore of the St. Lawrence River. The Lévis formation consists of hard, grey, green and red shale, and thick and thin beds of limestone conglomerate. The fossils in the Lévis indicate that it is of the same age as

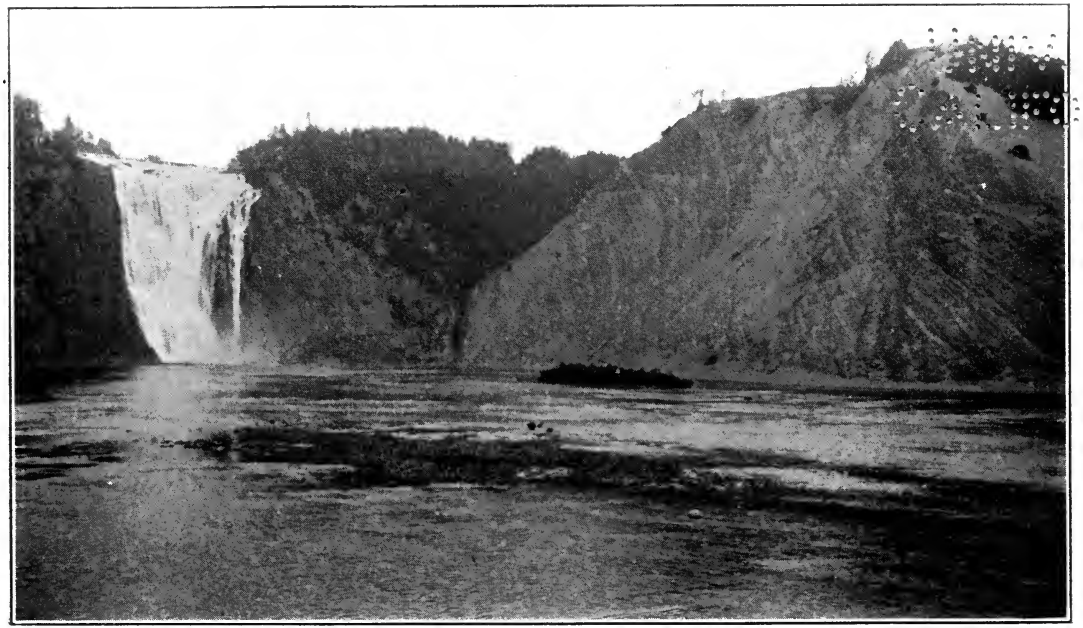
the Beekmantown or Calciferous, to be next mentioned. The Lévis, however, is heavily over-turned and complicated, having shared in the Appalachian mountain-building.

The Calciferous of the Lowland plain is an undisturbed formation "consisting largely of dark-coloured impure dolomite, immediately overlying the Potsdam and in places graduates into it. It covers considerable areas adjoining the Potsdam in Huntingdon, etc., and is well seen at Ste. Anne's, near Montreal, at Beauharnois and Lachute. In these places it affords characteristic fossils, as Ophileta compacta, Murchisonia Anna, Pilocera amplum, Orthoceras, etc." (Sir William Dawson.)

Above the Calciferous is the Chazy formation, consisting of sandstones, shales and limestones. The Chazy limestone in the vicinity of Montreal, as at St. Martin Junction, Cartierville and Bordeaux, contains abundant fossils.

Next is the Black River formation, a limestone near Montreal, but above the Black River is the more important Trenton formation.

The Trenton limestones are widely extended in Canada and the United States. They appear against the southern border of the Laurentian Plateau below Quebec City (the rock of this city being largely of middle Trenton age) and extend far beyond the western boundary of the Province. They pass along the south shore of the Ottawa River and re-enter Quebec Province at Ottawa. The formation contains many



MONTMORENCY FALLS.

The Montmorency river here falls over a ridge of hard Laurentian rocks. Resting against the Laurentian gneiss on both sides of the falls is the Trenton limestone, and upon this again the Utica and Lorraine shales.

Courtesy of Geological Survey of Canada.

characteristic fossils. The beds of the limestone are frequently thick, making the stone valuable for building purposes.

At Montreal the Trenton extends from the base of the mountain to St. James street, where it is succeeded by the softer Utica shale, and this latter formation re-appears at St. Lambert and underlies much of the Lowland Plain on the south side of the St. Lawrence.

The Utica shales are succeeded by the Lorraine shales. An excellent study of both, and of the underlying Trenton, is afforded at Montmorency Falls. The Montmorency River there falls over a high cliff (higher than Niagara) of hard Pre-Cambrian gneiss. Against the side of the cliff on both sides of the falls rests the Trenton limestone, and against the latter, but thrown down by a "fault," the Utica and the Lorraine shales.

All the foregoing, from the Sillery to the Lorraine, are of Ordovician age.

The next period above, the Silurian, is represented in the Lowland Plain by the Medina shales of Nicolet county, and rocks of this period occupy, in the Gulf, the southern part of Anticosti Island.

Overlying these solid rock formations throughout the Lowland Plain are the immensely younger loose deposits of the Ice Age, Leda Clay and Saxicava Sand, which will be dealt with in the next chapter.

That a greater thickness of Paleozoic rocks

once covered this area, and that the strata have been worn away in the course of millions of years, is certain. There are several proofs of this fact, but one of the most interesting is that afforded at St. Helen's Island, opposite Montreal. While the western end of this small island is underlain by the soft Utica shales, the rest of the island is a "breccia," composed of fragments, large and small, of rocks of various ages abundantly distributed through a matrix of igneous rock. The fragments range from Laurentian to Devonian age. We must therefore picture to ourselves a body of igneous rock smashing its way from below to the surface, and "brecciating" all the formations through which it passed. Innumerable fragments of Laurentian gneiss and Cambrian Potsdam sandstone, which were brought from below, are here mingled with fragments of Devonian rocks which descended from a height considerably above the present surface. The Devonian fossils are unmistakably of the Helderberg and Oriskany formations, and their presence in these fragments indicates that rocks of the same formations once widely extended on the Lowland Plain, but are now swept away by age-long erosion.

The preservation of the various fragments in this breccia of St. Helen's Island is undoubtedly due to the fact that the volcano was one which "missed fire" after it got started ! If it had managed to "clear its throat" successfully, not a

fragment of sedimentary rock or a fossil would have remained in the original shape to tell the story of their origin.

So, too, the eight Monteregian Hills, Mount Royal included, smashed their way up as molten masses through the sedimentary strata, but they did not "miss fire." They fused the rocks through which they passed completely, and incorporated the substances of the sedimentary rocks with the igneous to form new rock species. In all probability the Monteregians only reached what was then the general surface of the ground. By their hardness they have persisted as hills, while hundreds of feet of softer sedimentary rock throughout the Plain have been worn away. The fact that two of the hills retain blocks of sedimentary rocks attached near their tops makes this probability a certainty.

CHART 1

GENERAL GEOLOGICAL CHART

Eras.	Periods.	Life Forms.
Kainozoic	Modern.	Modern man.
	Pleistocene.	Early man.
	Pliocene.	Apes, horses, camels,
	Miocene.	elephants and other
	Oligocene.	mammals.
	Eocene.	Earliest horse.
Mesozoic	Cretaceous.	Reptiles, toothed birds,
	Jurassic.	fishes, great reptiles.
	Triassic.	Earliest mammals.
Paleozoic	Permian.	Marsupials.
	Carboniferous.	Reptiles and amphibians.
	Devonian.	Armour plated fishes.
	Silurian.	Earliest fish and insects.
	Ordovician.	Graptolites.
	Cambrian.	Sponges, worms, corals and trilobites.
	Pre-Cambrian and Archaean.	Doubtful forms of early life.

This general chart represents geological history throughout the world. Nowhere is the succesion found complete in one place, but rocks of every period are found distributed in North America, and almost every period in the Dominion of Canada. The succeeding four charts show the distribution of different formations of the periods represented in the Province of Quebec.

From the beginning of Cambrian time to the present it is estimated that at least one hundred millions have elapsed. The Pre-Cambrian and Archaean must have lasted fully as long if not longer.

CHART 2

LAURENTIAN PLATEAU

Period.	
Modern.	Recent soils.
Pleistocene or Ice Age.	"Young" lakes and rivers, Saxicava sand and Leda Clay on lower southern levels, Sub-glacial clays of Abitibi, Boulders and much transported loose material.
Devonian.	Small area southeast of James' Bay.
Ordovician.	Richmond, Lorraine and Utica formations in the Lake St. John district.
Pre-Cambrian.	Huronian, Laurentian gneisses, etc., Grenville crystalline limestones, Keewatin.

It is possible that Devonian and even later rocks at one time spread over considerable areas of the Laurentian Plateau and were removed by denudation. It is probable, however, that this vast Canadian Shield remained above sea level during the many million years of Mesozoic and Kainozoic history, until the arrival of the Ice Age.

CHART 3

GULF OF ST. LAWRENCE AND LOWLAND PLAIN

Period.	
Modern.	Recent soils.
Pleistocene	Saxicava sand, Leda clay, Laurentian boulders, Boulder clay.
Permian.	It is possible that the red rocks of the Magdalen Islands may be of Permian age.
Devonian.	The volcanic Monteregian Hills intruded through the Paleozoic strata of the Plain, probably in late Devonian or early Carboniferous time (Dresser).
Silurian.	South half of Anticosti. Medina shales of Nicolet and elsewhere.
Ordovician.	Lorraine, Utica, Trenton, Black River, Chazy, Levis and Sillery formations.
Cambrian.	Potsdam sandstone (late Cambrian).
Pre-Cambrian.	The isolated mass of Rigaud mountain of Laurentian age.

The Ordovician formations are rich in fossils and therefore interesting geologically. Most of them, also, are of high economic importance, the Lorraine and Utica shales being utilised for bricks and other purposes, and the Trenton limestone is of exceptional value as a building stone.

CHART 4

EASTERN TOWNSHIPS

(Appalachian)

Period.	
Modern.	Recent soils.
Pleistocene	Patches of Leda clay on lower levels, gravels, kames, Laurentian boulders, boulder clay.
Devonian.	Sedimentary strata of Devonian, Silurian, Ordovician and Cambrian age extend throughout the Eastern Townships, but owing to alteration by mountain building, pressure and other causes, contain comparatively few fossils, and hence are not directly comparable with formations of these periods elsewhere.
Silurian.	
Ordovician.	
Cambrian.	
Pre-Cambrian.	Some areas brought to the surface by denudation of mountain ridges.

The general structure of the Eastern Townships is clear enough—the three Appalachian ridges about 25 miles apart and the volcanic intrusions of the "serpentine" belt and of the Orford, Owl's Head and other mountains west of Lake Memphramagog—but the rocks in general are much folded and denuded and in consequence their stratigraphical relationships are often difficult to determine. The difficulty is increased by the general scarcity of fossils.

CHART 5

GASPE PENINSULA

(Appalachian)

Period.	
Modern.	Recent soils.
Pleistocene	Leda clay and some boulders, but in general fewer marks of glaciation than elsewhere.
Devono-Carboniferous.	Bonaventure formation.
Devonian.	Gaspé sandstone, Grand Grève limestone, Bon Ami, St. Alban shales.
Silurian.	Black Cape.
Ordovician-Silurian.	Cap Blanc to Corner of the Beach.
Ordovician.	Rosiers shales.
Cambrian.	Western part of Matane county.

The Gaspé peninsula is rich in geological interest. It was here that, in 1843, Sir William Logan began the work of the newly formed Gelogical Survey of Canada, the first problem being that of finding whether the coal seams of New Brunswick extended into "Canada," the present national name being restricted in its meaning until 1867.

The Bonaventure formation is the youngest solid rock formation in Quebec unless it is proved that the red rocks of the Magdalen Islands are really of Permian age. The Bonaventure formation is the reminder that on the mainland at any rate we nearly reached the Coal Period but not wholly.

CHAPTER IV.

THE GREAT ICE AGE.

ONLY by inference can we know anything of the land forms in this Province during the millions of years which elapsed between the formation of the red sandstones and conglomerates of Gaspé (Bonaventure formation) and the oncoming of the Ice Age, or Glacial Period, described on the geological chart as the Pleistocene. If the Province did sink anywhere below sea level in that long interval of time, the sedimentary rocks which were formed have left no trace. The Bonaventure formation of Gaspé constitutes the youngest strata of solid rocks, and is very old.

But we may be sure that during those long ages an enormous amount of rock denudation occurred. Much of the Laurentian Plateau must have been worn away, and whatever rivers there were in that region must have become slow and lazy, having worn their channels down to common levels. Whatever lakes had existed must have filled up with sediment and disappeared. The Appalachian district must also have been considerably reduced in height, and "dissected" by the wearing away of the softer rocks. Lastly, the St. Lawrence Lowland Plain

clearly displays the evidence of this denudation in the Monteregian Hills, left standing above the plain because of the hardness of the volcanic rocks of which they are composed.

It is altogether probable that before the Ice Age arrived the Labrador peninsula had become much elevated above its present level. Denudation had lowered the Plateau, but earth movements again raised it. The facts in this connection will be best considered, however, in the succeeding chapter on the Great River.

This elevation of the Plateau was, no doubt, one of the factors which determined the Ice Age. As to other contributing factors, astronomical or meteorological, there is still some difference of opinion, but whatever theory may be held as to the causes of the Ice Age there is abundant evidence as to its work and effects. That the whole of Canada and part of the northern United States were covered with a vast ice sheet several thousand feet in thickness, during a period of time variously estimated at from half a million to a million of years, is as certain as that the Red man preceded the European in the occupation of our continent. As Greenland is covered to-day with an ice-sheet fully four hundred thousand square miles in extent, so in the Ice Age (which only came to a complete end some few thousand years ago) an ice-sheet covered an area of about four million square miles in North America.

There were three centres of accumulation of

the ice, 1, The Cordilleran, or British Columbia section, 2, The Keewatin, just west of Hudson Bay, and 3, The Labradorean or Laurentide glacier, the largest and greatest, which deployed from the northern highlands of this Province.

That there were three centres of accumulation is proved by the directions in which the striae (scratches and grooves on the underlying rocks caused by the load of pebbles and boulders pushed along by the ice) radiate from these three centres, as well as by the character of the boulders and rock-rubbish transported long distances by the ice-sheet. Boulders are found everywhere far-travelled from their northern home. Many of them belonged originally to the Laurentian Plateau, and the striae point steadily and continuously back to that source. During the last three quarters of a century the work of thousands of trained observers in Canada and the United States, recording the directions of millions of striae and the sources of millions of travelled boulders, has made possible the definite mapping of the movements of the ice-sheet from the three centres mentioned.

An ice-sheet is produced in the same way as the ice of a glacier is formed. It is compacted snow. As a hard snowball can be made only in mild weather, so a certain amount of warmth is required for the formation of ice in glaciers. The necessary heat, in the case of glaciers or of ice-sheets like that of Greenland, is produced partly by the pressure of the mass of snow upon

the lower portions and partly by seasonal changes.

We are not obliged, therefore, to conceive of the Ice Age in this latitude as altogether one of constant and intense cold. Not only would each summer bring a certain amount of warmth, but it is also evident that, both in Europe and in North America in this period, there were prolonged stages when the vast ice-sheets retreated northward or possibly wholly disappeared. The name **interglacial** is applied to these intervening stages. In these mild stages, animal and plant life were active. That the interglacial stages were of considerable duration is shown by the nature of the deposits they have left behind, such as extensive beds of **peat**, composed of vegetable matter, sometimes twenty-five feet in thickness. Beneath these beds are the clays and gravels of the previous advance of the ice-sheet, and above them the similar evidence of the subsequent advance of the ice-sheet. At Toronto, and at Scarboro near Toronto, remarkable interglacial beds are found, indicating that in one of these stages the paw-paw tree and the osage orange flourished there —trees now found only several hundred miles south of Toronto. Other beds in the same locality show that one of the interglacial stages was marked by cold climatic conditions. As a matter of fact each interglacial stage necessarily went through five climatic changes. When the ice-sheet had just left a locality the first clim-

atic condition would be of an Arctic character, the second a cool temperate, and the third a warm temperate (corresponding to the northward retreat of the ice). Then as the ice-sheet came south there would again be a cool temperate and, lastly, again an Arctic climate.

While certainty cannot be said to have been established as to the number of the advances and retreats of the ice-sheet, a chart given by the American geologists, Chamberlin and Salisbury, in the third volume of their "Advanced Geology," has the merit of correlating many of the known facts in a convenient order. As usual in geological charts, the latest stages are given first and the earliest last. The history of the changes is to be read upwards from No. I to No. XIII.

PLEISTOCENE.

XIII. The Champlain sub-stage (marine).
XII. The glacio-lacustrine sub-stage.
XI. The Later Wisconsin, the sixth advance.
X. The fifth interval of deglaciation, as yet unnamed.
IX. The Earlier Wisconsin, the fifth invasion.
VIII. The Peorian, the fourth interglacial interval.
VII. The Iowan, the fourth invasion.
VI. The Sangamon, the third interglacial interval.

V. The Illinoian, the third invasion.
IV. The Yamouth, or Buchanan, the second interglacial interval.
III. The Kansan, or second invasion.
II. The Aftonian, the first known interglacial interval.
I. The sub-Aftonian, or Jerseyan, the earliest known invasion.

Only Nos. IX, XI, XII and XIII have a direct interest for us in the Province of Quebec. So far as the several inter-glacial intervals are concerned, the evidence of them in the form of special deposits indicating animal and plant life have not been found here. These evidences are naturally found chiefly towards the outer boundaries of the ice-sheet, where it was greatly diminishing in thickness, and where consequently previous deposits of loose material were not destroyed by the several advances. Then, too, it is possible that the several retreats of the ice-sheet were partial only, not extending to the more northerly areas. And again, each advance of the ice in the territory nearest to the Labradorean centre of accumulation, where the ice-sheet was thickest and heaviest, would necessarily sweep away most of the deposits formed in the mild climate intervals more effectually than elsewhere. In any case it is certain that, apart from the deposits at and near Toronto, most of the evidences of the interglacial stages are found

in Wisconsin and other states across the boundary line, where the ice-sheet was thinner.

In support of the probability that each retreat of the ice-sheet was partial only, is the fact that in this Province there seem to be but two sets of striae, one more "weathered" and therefore older than the other. It is assumed that they belong respectively to the Earlier and Later Wisconsin ice-sheets. There are also evidences in this territory of "local" glaciers which descended from the higher hills, probably during the last or Champlain Sea stage.

The advancing ice-sheet always accomplished an enormous amount of work. Undoubtedly in the long preceding millions of years a considerable thickness of soil had accumulated on the Laurentian Plateau by the slow disintegration of its hard rocks. All this was swept away. Some of it is now in Indiana, in Ohio, in New York, in New England, and some of it, no doubt, was dumped into Boston harbour in prophetic anticipation of the destiny of certain boxes of tea at a much later period of the world's history. The countless thousands of boulders from the Plateau scattered over the Eastern Townships gave considerable labour to the early settlers of that district in clearing their farms. Here and there, also, the ice-sheet deposited considerable areas of gravelly soil unsuitable for cultivation.

But the Ice Age brought about beneficial effects as well. Not only was a new soil scraped from the rocks of the highlands and deposit-

ed, at the end of the period, in the lowlands, but a new and greater lake and river system was established to lay the foundation of the industrial developments of the present. The thousands of lakes, ponds and streams of the Laurentian Plateau, with their "youthfulness" so plainly marked, are the gift of the Ice Age.

Before passing, however, to these features of the Pleistocene we may consider further the deposits which were due either to the advancing or retreating ice-sheet. First and lowest of all is the "till" or boulder clay, in which the stony portions are usually much "scratched" or striated. This boulder clay was undoubtedly the work of the advancing ice-sheet, as shown by the similar effects of the glaciers of to-day. The finer material of the boulder clay is the rock-flour ground up by the ice-sheet and its load. Next come the surface boulders, varying in size from a few inches to many feet in diameter, and in weight from a few pounds to many tons. The "travelled" ones are distinguishable from local boulders by their mineral character. Most of the travelled boulders in the Eastern Townships are gneisses from the Laurentian Plateau.

The striae or scratches and grooves on the solid country rock—well seen everywhere on the higher land in the Eastern Townships—are the work of the advancing ice-sheet. So, also, are the "roches moutonnées", or low projecting rock masses which have been rounded into forms like a sheep's back. Invariably these

roches moutonnées have more of a slope, and are smoother, on the north end than on the south end, showing the direction in which the ice-sheet moved, namely, roughly from north to south. Then the rounded character of hill tops in all glaciated areas is another result of the work of the advancing ice-sheet; so, also, the U-shaped valleys which lie between hills. If a valley has been made by a river, and not by ice, it is V-shaped.

A retreating ice-sheet is simply melting backward, and consequently performs less abrading work. Its effects are rather due to the streams of water which issue from within and below it. The streams of water are heavily loaded with rock débris of all kinds and hence spread out wide areas of gravel and soil. "Kames," "drumlins" and "eskers" are different masses of gravel and soil of distinctive shapes left standing on the ground, and formed either in front of the retreating ice sheet or under it.

The ice-sheet was undoubtedly thick. The top of Mount Orford, near Lake Memphramagog, is more than 2800 feet above sea level, and more than 2000 feet above the surrounding country, but it is heavily glaciated, and a few feet below the top there are numerous pebbles and boulders from the Laurentian Plateau.

We now come to the two concluding stages of the period. In No. XII, the glacio-lacustrine or ice-and-lake stage, it will be seen how slowly the last ice-sheet melted backwards.

This ice-and-lake stage was the one in which great lakes were formed, the predecessors of the present Great Lakes which are also "young." During the many years that this stage lasted the ice-sheet still covered the area of this Province, though in a constantly dwindling condition.

The melting of the ice-sheet began in the west. Various large lakes were formed. One of these was Lake Agassiz, which covered a large part of the present area of Manitoba. The lake no longer exists, but the sediment deposited in it constitutes the wheat soil of Manitoba. Lake Iroquois occupied the territory of the present Lake Ontario, but its ancient beaches are now some 200 feet above the lake. The waters of Lake Iroquois did not reach the sea through the St. Lawrence River as do the waters of Lake Ontario to-day. That outlet was closed in the Thousand Islands by the ice-sheet. The waters of the ancient lake went down to the sea by way of the Rome outlet in New York state and the Hudson River. The terraces formed by that temporary river are now important road-ways in New York state.

The formation of the five Great Lakes of the St. Lawrence system — Superior, Michigan, Huron, Erie, Ontario — followed in five stages.

Stage 1. The ice-sheet spanned the Lake Huron area from side to side, forming a lake to which the name Early Lake Algonquin has been applied. The waters from the melting ice passed down through Lake Erie and the Niagara

River — that river having just begun its existence by flowing over the precipice at Queenston. Since that time to the present the river has cut back a gorge seven miles in length, the soft shales underneath being rapidly undermined by the plunging waters and causing the harder limestone above to fall off in blocks. At this Early Lake Algonquin stage it is estimated that as much water was passing through Niagara River as at the present time.

Stage 2. This is named the "Lake Algonquin, Kirkfield Stage." Owing to tilting of the land the outlet was changed to a point at Kirkfield, Ontario, and most of the waters crossed that province in the Trent Valley to Lake Iroquois, instead of through Niagara. At this stage it is estimated that the volume of water passing through Niagara River was reduced to about 15% of its present amount.

Stage 3. This is called the "Lake Algonquin, Port Huron Stage". The Trent Valley was abandoned, and once more the waters returned in full force to the Lake Erie and Niagara River channel. The evidence goes to show that during part of the time in this stage the volume was 10% greater than at present.

Stage 4. Once more there was a tipping of the land which caused the waters of the Upper Lakes to find a new outlet at North Bay, Ontario, and to make their way eastward through the Mattawa and Ottawa rivers. Great lakes were formed near the outlet, of which the present

Lake Nipissing is the remnant. Once more only 15% of the present volume of water was pouring through Niagara River. This stage is named the "Nipissing lakes".

Stage 5. This is the present stage, in regard to which a report of the Dominion Geological Survey says:—

"Continued uplift of northern lands raised the outlet at North Bay, Ontario, and sent the discharge of the three upper lakes to Port Huron and thence to Lake Erie and Niagara. In the transition both outlets were active at once, but this arrangement did not last long. The change of outlet to Port Huron brought the Nipissing great lakes to an end and inaugurated the present lakes. Thus the present volume of Niagara river includes the entire discharge from the four great lakes above, and this arrangement of overflow has continued ever since the last change of outlets."

This wonderful lake history, which has been made out in the last fifty years by the many geologists who have studied the old beaches and shore lines of the territory, finds a remarkable confirmation in the gorge of the Niagara River. The lake history as stated had been worked out independently, and as a report of the Geological Survey puts it, was "established beyond peradventure", before the indications in the gorge of Niagara had been considered.

The gorge is seven miles in length. At the present time it is being cut by the river at a

rate of about four feet a year. At this rate it would seem to follow that not much more than 7000 years have been required to make the whole gorge. If the volume of water passing through the river had been the same at all times this conclusion would be inevitable, as the rock formation — soft shales below and hard limestone above — is remarkably uniform throughout. But there are two stretches of the gorge— one of three quarters of a mile and one of a mile and a quarter — which are narrower by some hundreds of feet, and shallower by some eighty feet, than the rest of the gorge. These two stretches undoubtedly correspond to the second and fourth stages of the early lake history when only fifteen per cent. of the usual flow of water was passing through Niagara River.

The reduced amount of flow at these two stages undoubtedly greatly retarded the river's excavating force. Hence from this and other considerations it is altogether likely that a period of nearer 30,000 years, instead of 7,000, has elapsed since Niagara River began to flow over the heights at Queenston.

But to return for a moment to the second or Kirkfield stage. The waters coming down to Lake Iroquois (the predecessor of Lake Ontario) passed out, as has been said, to the Atlantic in the Thousand Islands. By the time of the fourth stage, however, the period of the Nipissing Great Lakes when the waters came

down the Mattawa and Ottawa rivers, the ice front had receded into the area of this Province. One portion of it stood at Covey Hill in Huntingdon county, and thence sent the waters to the Atlantic through the Champlain and Hudson valleys. At Covey Hill the plunging waters formed a remarkable gorge.

Such is the history, in brief outline, of the glacio-lacustrine or ice-and-lake stage of the Ice Age.

We now come to the last stage of the Pleistocene, the Champlain Sea or marine stage. The Province then sank slowly some six hundred feet below its present level. The sea invaded the land, covering a large part of this area, as well as of Eastern Ontario and adjoining states of the United States. It is not certain that the ice-sheet had wholly disappeared, and it is possible that some of it remained on the highlands.

The beaches of this recent Champlain Sea are a marked feature of the Province of Quebec. The higher beaches are, of course, the older. The land rose gradually, and there were long pauses in the ascent. Thus, Dorchester and Sherbrooke streets in Montreal are two of the sea-beaches. Their width indicates the considerable length of time that was necessary for their formation. Montreal has seven distinct Champlain Sea beaches. The 220-foot terrace at the water-works on Mount Royal is one, and extends up the Ottawa Valley, being plainly seen at Lachute and other places on the North

CLAY TERRACE AT NEW RICHMOND.

This clay terrace extends some distance along the shore of Chaleur Bay at New Richmond in the county of Bonaventure.

Courtesy of Geological Survey of Canada.

Shore Railway. At one beach on Mount Royal, at an elevation of 568 feet above sea level, Sir William Dawson found the distinctive fossils of this period—the shells of species now living in the Gulf of St. Lawrence.

The Champlain Sea deposited the thick mantle of clay which covers the St. Lawrence Lowlands, the Lake St. John district and other lower portions of the Province. In the Lowlands it is sometimes 50 to 100 feet in thickness. If the ice-sheet removed accumulated soil from the Laurentian Plateau in the early stages of the Pleistocene, large compensation was made by the Champlain Sea at its close. The clay is the "rock flour" ground up by the ice-sheet, aided by the load of rocks and pebbles it pushed along. The clay is not only a good soil in itself but is rendered more valuable by the immense quantities of phosphatic shells it contains. These shells constantly decomposing furnish plant food to the soil.

Several species of Leda predominate in the clay, hence the name Leda Clay. All the species are those of the shell fish now living below the thirty-fathom soundings in the Gulf of St. Lawrence.

As the waters receded, marginal deposits of sand were formed, chiefly along the northern borders of the St. Lawrence Lowland Plain. In these sands the shells are those of species now living in the shallower waters of the Gulf, and one of the most abundant, Saxicava rugosa,

gives its name to the beds and terraces—Saxicava Sands. At Beauport, near Quebec, there is a terrace of the sands with a greater volume of shells than of sand. It is several hundred feet above sea level.

Finally the sea left the land, most probably several thousand years ago, and once again the forest invaded highlands and lowlands. During long centuries the Indian reigned supreme in the renewed and rich wilderness of an old continent, to be followed at last by Cartier and Champlain and the beginnings of modern Canadian history.

That the land has not fully recovered its former level, and that the St. Lawrence River, up to Three Rivers, is but an "arm of the sea" will be seen in the next chapter.

CHAPTER V

THE GREAT RIVER.

When, nearly four hundred years ago, Jacques Cartier ascended the St. Lawrence River he found that the Indian name for it was the "Hochelaga." He spoke of it as "la grande rivière."

Since the beginning of European occupation the Great River has attracted in turn the adventurer, the artist, the poet, the historian and the scientist. Its economic importance as a navigable highway was and is of such magnitude that it is a question if a consolidated Dominion of Canada as a political unit would have been possible without it. From the days of the heroic Jesuit missionaries and the intrepid fur traders who followed its long course and its chief tributaries in canoes, down to the present time of ocean steamships, the St. Lawrence has been a great artery of Canadian commerce and civilization.

Its history in the far off geological ages is not certain, but in all probability the St. Lawrence River is much larger to-day than in the period immediately preceding the Ice Age, half to a million years ago. For one thing, the Great Lakes, at least the present ones, did not exist then. It was only at the close of the Ice Age, a few thousand years ago, that still greater lakes

came into existence from the melting of the ice sheet, and then disappeared to be followed by the present lakes.

All lakes above sea level are necessarily "young." In the course of time they either become drained by the wearing away of their exits, or as settling basins they become filled up with the sediment brought into them by their tributary streams.

Nevertheless, it is probable that the St. Lawrence system as a whole from Lake Superior to the Gulf is an old drainage path—in existence for millions of years—but deepened and broadened in the area of the Great Lakes by the ice sheet in the Ice Age. The system as a whole, as shown on a map of the Dominion, is V-shaped; so, also, is the great Canadian Shield. Doubtless the hard-rock "control" of the Canadian Shield determined the whole drainage way. As for the river proper, it is believed that, before the Ice Age, the head waters came down the Ottawa River and that the western river was a mere tributary.

But however speculative and uncertain these points may be, the history of the lower end of the River is clear and definite. In the last chapter it was stated that the Laurentian Plateau must have been considerably uplifted before the Ice Age came on. There is ample proof that the eastern portion at any rate was upraised. The Gulf of St. Lawrence, the Chaleur Bay, and the estuary of the River cover "drowned lands."

When that area was dry land a much smaller St. Lawrence River traversed it.

Below the waters of the Gulf the narrow channel of the old river which existed before the Ice Age has been traced and sounded. It passed out between Cape Breton and Newfoundland, and has been sounded indeed far out to the edge of the continental shelf, that shallower part of the ocean which extends from the coast for about 100 miles. As rivers emptying into the sea can only cut down their channels when above sea level, it is certain that when that channel was cut the Gulf area was dry land. Hence the whole adjoining area must have stood much higher than at present.

The long ascent of the ocean tides to Three Rivers is a clear indication that the depression of the land which took place in the Champlain Sea period has not been fully recovered.

The St. Lawrence River system as a whole includes the Great Lakes. From its source to the sea it has a length of 1900 miles. The total amount of slope from Lake Superior to the sea is 602 feet. This lake has a water surface of 32,060 square miles, and it drains an area of 80,660 square miles. Lakes Huron and Michigan are 581 feet above sea level. The area of Lake Huron is 22,978 square miles and it drains an area of 52,100 square miles. The St. Clair River drains from Lake Huron, widening out into the comparatively small Lake St. Clair (area, 503 square miles), and the Detroit River carries the

waters on to Lake Erie, which is 572 feet above sea level and has an area of 9,968 square miles. The Niagara River and Falls constitute a drop of 326 feet to Lake Ontario, whose altitude is 246 feet and area 7,243 square miles.

From Galops Rapids in Ontario to Pointe des Monts in Quebec, the official limits of the river proper, the area is 5,395 square miles, and the watershed, exclusive of the Ottawa and Champlain basins, is 129,385 square miles. Lakes St. Louis and St. Francis above Montreal, and Lake St. Peter above Three Rivers, are important widenings of the river. The permanent wide expanse begins below the Island of Orleans below Quebec.

From Lake Ontario to Montreal there is a total fall of 227 feet, accounted for by the several rapids, which begin near Prescott, Ontario. The first group comprises the Galops, the Rapide Plat and the Long Sault. Between Lakes St. Francis and St. Louis there are the Coteau, the Cedars and the Cascades rapids.

Of the larger tributaries the Ottawa and the Richelieu are the most important in Canadian history, while the Saguenay is the most interesting from the scientific point of view. From Chicoutimi to Tadoussac it is a fiord—a gorge that may have originated long ages ago by an earth-rift, but which was undoubtedly deepened in the Ice Age. The action of the ice on the high rocky sides of the river may be clearly observed even from mid-stream.

Colonel William Wood, the Canadian historian, in a paper on "Laurenciana" read before the Royal Society of Canada in 1910, said:—

"Nature has divided the whole St. Lawrence into seven distinctive parts. But man has not given them seven distinctive names; and no part requires a name more than the part between Quebec and the Saguenay, the part of all others that Nature and Man have united in making unique. In default of a better, let us call it the "Quebec Channel," as the next part above is sometimes, and usefully, known as the "Montreal Channel." Then, if we acknowledge all the straits connecting the Gulf with the sea as the real mouth, we shall have our seven names complete. "The Mouth" should cover all the lands and waters of the actual outlets, the Atlantic straits of Canso, Cabot and Belle Isle, and the islands of Cape Breton and Newfoundland. "The Gulf" is too well known to need defining. "The Estuary" runs up from Anticosti to the Saguenay; "The Quebec Channel" from the Saguenay to Quebec; "The Montreal Channel" from Quebec to Montreal; and "The Upper St. Lawrence" from Montreal to the "Lakes," which speak for themselves."

The same writer adds:—

"For scenery and historic fame together the Quebec Channel easily bears the palm. The south shore, with its picturesquely settled foreground, undulating up to wooded hills behind, and the north, with its forest-clad mountains

rising sheer from the water's edge, are admirably contrasted and harmonized by the ten-mile breadth of the River which divides them. Opposite the lower end of the Island of Orleans, thirty miles below Quebec, both north and south shore ranges sweep back in gigantic semicircles, which only approach each other again in the same distance above the city; so that when you stand upon the Heights of Abraham you find yourself on a Titanic stage in the midst of a natural amphitheatre two hundred miles around. Here the salt water meets the fresh, the Old World meets the New, and more than half the history of Canada was made."

CHAPTER VI

ECONOMIC GEOGRAPHY OF THE PROVINCE.

On an isothermal chart of the northern hemisphere, that is, a chart showing the connecting lines of places with equal average temperature for a month or a year, the isotherms (each being usually ten degrees Fahrenheit apart) are crowded considerably together as they approach the coast of Labrador from the Atlantic. On the west coast of Europe the same lines are spread widely apart. They are pushed southward on the Labrador coast, and pushed northward on the coast of Europe. Each isotherm representing a difference of ten degrees in temperature, it naturally follows that where they are crowded together, as on the Labrador coast, the differences in climate (so far as climate is dependent on temperature) take place in much shorter distances than on the west coast of Europe where the same lines are widely spread out.

The lines of equal average temperature are crowded together on the Labrador coast on account of the influence of the cold Arctic or Labrador ocean current which descends along this coast. The same lines are widely spread out on the west coast of Europe on account of the modifying influence of the warm west-wind

drift from the Gulf Stream. The crowded lines at the Labrador coast, however, begin to diverge on the land and are affected by various influences (nearness to large bodies of water such as the Great Lakes, etc.) in crossing the continent.

The effect of the Labrador current upon the climate of Quebec is well seen in the three distinct sections that Dr. J. C. Chapais, the well known agricultural authority, divides the Province for practical purposes. One extends from Gaspé to Rimouski, its temperature, winter and summer, ranging from thirty degrees below zero (Fahrenheit) to eighty degrees above, and affording the farmer nearly five months for farm operations from May 20th to October 15th. The second section extends from Rimouski to Three Rivers. Here the temperature ranges from thirty below zero to ninety above, with nearly six months, namely from May 5th to November 1st, for farm operations. In the third section, from Three Rivers to Soulanges County, on the western border of the Province, the temperature range is from twenty-seven below zero to ninety-three above, with seven months (April 20th to November 20th) for farm work.

Climate is determined chiefly by three components—average temperature, amount of rainfall, and the character of the winds. The lines of equal average rainfall (isohyets) in the world are irregular, like the lines of equal average temperature (isotherms). The annual rainfall

in the coast portion of British Columbia is over 100 inches. The winds from the Pacific Ocean are warm and laden with moisture. As they ascend the western slopes of the high mountains in that Province the air expands because of the diminished weight of the column of air above it. In expanding it is chilled, and in chilling the moisture is precipitated as rain, cool air holding less moisture than warm air. Because of its heavy rainfall British Columbia is a great "forest" area.

But if the high mountains thus send down an abundant supply of water on their western slopes they also act as a "rain-shadow" to a considerable extent for the provinces immediately east of them. The winds coming down the esatern slopes have not only lost much of their moisture, but in descending to lower levels they become warmer again, owing to compression by the increasing weight of the column of air above them. Being warm winds they are absorbing or drying winds. Hence in the southern part of Alberta and Saskatchewan the annual rainfall is only about ten inches, but increasing to fifteen and twenty inches northward. In the southern part there is no tree growth; the insufficient rainfall makes it "grassland" or prairie. As the annual rainfall increases to fifteen and twenty inches northward forest growth appears and increases. Where the rainfall decreases to much less than ten inches annually, "desert" conditions arise, as in parts

of the southwestern United States. The three chief natural regions of forest, grassland and desert are determined by the amount of annual rainfall, and this annual amount is estimated both as rain and snow, about ten inches of snow being considered equal to one inch of rain.

In the southern part of the Province of Quebec the annual rainfall is forty-five inches, diminishing gradually northward until at Lake Mistassini it is only twenty-five inches. This decreasing amount of rainfall northward, as well the differences in annual temperature, changes the character of the forests. In the southern part of the Province the hardwood (deciduous and broad-leaved) type is abundant, but steadily northward it gives way to a much larger proportion of the cone-bearing (coniferous) trees, such as pines, firs and balsams. At the extreme north of the Province, near Hudson Strait, the "barren lands" appear, tree growth having become stunted towards the 58th parallel and being finally replaced by mosses, lichens and scrub berry bushes.

In summer the southwest winds, arising from the Gulf of Mexico, carry the moisture which gives us our rains.

The winters of Quebec are long, but decrease in length from the eastern to the western end of the Province. Spring conditions come later than in areas a few degrees south, but they come rapidly. Vegetation bursts forth in the first warm days after the frost is out of the ground. This

snow and frost are gone is due in part to the rapid growth of vegetation so soon after the following cause. The inconsiderable amount of snow, ice and ground frost on areas a few degrees south of the Province is soon disposed of by the spring sun. But when the sun has "northed" so that its rays are falling on the southern part of Quebec at the same angle that they were previously falling on areas a few hundred miles south, there is a great deal more work to be done by the sun. In equal areas Quebec has considerably more snow, thicker ice on the lakes and rivers, and more frost in the ground. There is, in short, a much greater supply of "stored up cold" to be disposed of, more work to be done by the sun, and consequently more time required to accomplish it.

But on account of this extra amount of time required, the sun has travelled much further north in its journey to the Tropic of Cancer. It has mounted higher in the heavens; its rays are falling more directly, and its heating power is much greater after several weeks of the thawing process than would be the case if the "stored up cold" had been disposed of in a few days. The increased amount of heat is at once available for vegetation, and spring conditions come with a burst.

The greater length of the summer days in northern latitudes, and the consequent greater amount of sunlight (insolation), as compared with more southerly latitudes, ensures also a

more rapid maturity for vegetation. This is the factor which accounts for wheat growing in the Lake St. John district and other areas of the Laurentian Plateau.

Nevertheless, the northward extension of grain growing has been immensely aided by the application of the principles of modern science. Some years ago Dr. Saunders, and in more recent years Seager Wheeler, produced new wheat and oats, by means of seed selection and cross-fertilization, which matured some seven to ten days earlier than other seed, and this apparently slight difference has extended grain growing some 700 miles northward in the western provinces.

Climate is one of the chief factors in determining the economic and industrial development of a region, particularly in regard to the natural productions of the soil.

Another important economic factor is that of the physical geography of a region. It might seem to be an unimportant fact from this point of view that the two great mountain systems of North America (the Appalachians and the Rockies) run north and south, whereas the chief mountain system of Europe run east and west. But this difference happens to account for another fact, namely, that the great forest of northern Canada has many more tree species than the great forest of northern Europe! When the ice-sheet of the Ice Age spread over Canada and northern Europe it drove all vegetation

southward. On this continent it was driven into the wide space between the Appalachians and the Rockies, but in Europe it was driven across the mountains which traverse the southern part of that continent in an east and west direction. In North America there was no barrier against the return of the species northward after the Ice Age had passed away; in Europe there was a mountain barrier. On both continents, however, Arctic or sub-Arctic species of shrubs were left stranded to flourish on the higher mountain-tops, far south now of their true habitat.

HISTORICAL. The economic development of the Province of Quebec began, in a sense, with the fur trade in the period of Champlain's rule (1608-1635). The fur trade soon became and has long remained, an important industry, but in the early days it was the enemy of colonization and of sound general development. The energy and judgment of Champlain could do no more than lay the foundation for future general economic activity. With the constant menace of the Iroquois who prowled along the St. Lawrence from the mouth of the Ottawa River to Quebec, lying in wait to cut off every straggler, agriculture was out of the question. Posterity therefore holds in esteem the names of the first farmers, Hébert and his son-in-law Couillard, whose efforts were necessarily undertaken amid danger.

It was not until 1665, when Talon arrived as

intendant, with the Marquis de Tracy and Governor Courcelles, that anything like a sound economic development of the country became possible. Fortunately the three men agreed that the first essential step was the long-needed punishment of the Iroquois. This was not long delayed, and it at once opened the way for colonization. The whole population at this date was only 3000, mostly in the three forts of Quebec (founded 1608), Three Rivers (1634), and Montreal (1641). There was no great rush of immigration such as we are familiar with in modern times on this continent; ocean navigation at that period did not encourage a rush. Only a few thousand were added to the population, but they were sufficient to ensure a permanent beginning in agriculture. The Lowland Plain was a dense forest, but clearings and farms soon appeared along the St. Lawrence and Richelieu rivers. It is astonishing to read that three years after the Iroquois had been driven to a peace, three vessels had been built by the colonists and had carried cargoes of salmon, eels, fish-oil, lumber and flour to the French West Indies. It was Talon who induced the colonists to undertake the building of the vessels. It was he, also, who advised the farmers to make potash. In the clearing of the soil much wood was burned, and the ashes could be turned to good account. The potash was shipped to France in competition with that supplied from Russia.

Iron mining and smelting, and the manufacture of stoves, kettles, pots, smoothing irons, and axes began at the St. Maurice forges near Three Rivers in 1730. The ship building which had begun in 1666 developed into considerable importance in the eighteenth century, and the ships were built of the woods of the country. It was essentially a native industry. The St. Maurice forges supplied the needed iron parts; home grown hemp was made into the required ropes, and the pitch and tar were produced in the local forests. In this period, also, the important export lumber trade began. Talon had established tanneries in 1670, and the manufacture of boots and shoes began in Quebec City three years earlier.

The economic development in the French régime was considerably greater than is usually supposed. The chief geographical factor which then made the resources and products of the country available to the outside world was undoubtedly the transportation facilities to and from the interior afforded by the Great River.

The present economic development of the Province, in so far as it seems connected with geographical factors, may now be considered under the headings of Agriculture, Forest, Products, Manufactures, Mining and Fish and Game.

AGRICULTURE. The prairies of Western Canada and the United States are eminently suited for the industries of cattle grazing and wheat growing. Hence when the western

United States, and later the western Canadian provinces, were opened up, the competition in wheat growing particularly became so considerable that production in this Province was diminished. As stated on a previous page, surplus flour had been exported to the French West Indies in the latter half of the seventeenth century. As late as 1850 no less than 410,043 acres in the Province were seeded to spring wheat. But under the pressure of the western competition the wheat acreage gradually diminished, until in 1914 it was reduced to 55,000 acres. The campaign for increased production in the Great War, however, resulted in more wheat being grown, the acreage in 1918 being 365,670.

The competition in western beef has not prevented a considerable development in stock-raising. The interests of progressive production in butter and cheese have made stock-raising of increasing importance.

The changes in the soils effected in the Ice Age have been referred to in a previous chapter. The effects of that period were in part helpful and in part injurious. Thus the ice-sheet covered, among other states south of us, New York and Massachusetts. The soils given to New York state by the ice-sheet have made it one of the greatest agriculturally in the United States, while Massachusetts, on the other hand, has much of its area rendered useless for farming on account of the glacial débris it received.

The wheat fields of Manitoba owe their fertility to the mud which was deposited in the vast lakes which, for a time, spread over that territory at the end of the Ice Age.

The best soil in Quebec is that which was deposited, only a few thousand years ago, by the Champlain Sea. The Leda clay covers the Lowland Plain, the Lake St. John district, and valleys in the Eastern Townships. The slowly disintegrating fossil shells it contains — Leda and other species living below the 30-fathom soundings in the Gulf — furnish a valuable fertilizer, phosphate of lime.

By far the greater part of the Lowland Plain is underlain by the Leda clay, but the northern margin of this area has considerable stretches of the Saxicava sand deposited by the Champlain Sea as it was receding from the land. The sandy areas are less valuable for farming, and north of them (on the Plateau) are areas of glacial débris covered with a thin soil of no value.

The Appalachian District, and particularly the Eastern Townships, retains in its valleys much of the original soils which the ice-sheet did not disturb, as well as the glacial clays.

The annual rainfall of 45 inches in the southern part of the Province, and other favourable conditions of climate and soil, make the hay and clover crops the most important. Much is fed on the farms and converted into products of higher value. The cities of Montreal and

Quebec alone now consume over ten million dollars worth of milk and cream annually. The production of butter and cheese has reached the sum of thirty-five million dollars per year.

Other field crops, in the descending order of their comparative values, are oats, potatoes, buckwheat, mixed grains, spring wheat, barley, fodder corn, turnips. Tobacco is grown on the slopes from the base of the Laurentian Plateau.

FOREST PRODUCTS. As elsewhere on this continent, there was great waste of forest resources in the early days of colonization in Canada. Clearing the land for agriculture was pursued at first, with some excuse, ruthlessly, and some ruthlessness has continued, here and there into very recent times, with no excuse. In the seventeenth century, it is true, much of the wood ashes was utilized for the manufacture of potash. In the eighteenth century considerable quanties of oak, pine and elm were used for ship building and other woods were exported.

During the nineteenth century lumbering was one of the important industries of the Province, and it remains so to-day. Apart, also, from the amount exported the consumption within the country, for such purposes as railway ties, telegraph and other electric poles, furniture, shoe lasts and matches, has greatly increased.

But in the second half of the nineteenth century the development of processes for the manufacture of paper from wood fibre added a new source of wealth to be derived from the

forest. In the twentieth century this industry has increased rapidly in importance in Quebec, not only on account of the large forest reserves but also on account of the available water powers on the forest areas, and the 'floatable' rivers for the easy transportation of the pulp wood. The available resources have been recognizably increased of late by the discovery that several abundant tree species are equally suitable for paper-making as the few which were alone so considered in the earlier days.

The rapid expansion of the manufacture of pulp and paper fortunately coincided with a general movement in the United States and Canada for the conservation of the natural resources of the continent. The days of waste and of wasteful methods have by no means come to an end. There is still much to be done to conserve the natural resources of the forests, but much has been accomplished as a direct result of the conservation movement. Public opinion has been aroused to the need of fire prevention in the forests, and fire fighting activities have been increased along scientific lines, even the aeroplane being brought into requisition for the discovery of incipient fires. Much waste of manufacture in the past is now being converted into useful by-products. In the making of wood pulp into paper, either the 'mechanical' or the 'chemical' process is employed. In the case of the chemical process the liquid waste affords various by-products accord-

ing to the chemicals used. Among the by-products obtained from the waste may be mentioned turpentine, resinous oils, acetone, acetic and oxalic acid. Re-forestation of cut areas is another step in the direction of conservation which has been started on a large scale in Quebec.

When it is realized that there are 130 million acres of forest in the Province, valued at six hundred million dollars, but that enormous quantities are required and cut every year, it will be seen that the maintenance of these reserves for an indefinite period of time can only be assured by wise laws and regulations based upon scientific principles. This responsibility has been undertaken by the Government of the Province, through the Department of Lands and Forests, and the various manufacturing companies are co-operating in the matter with good will.

The larger pulp and paper mills are situated in the forest areas of the Eastern Townships, the Gaspé coast and the Laurentian Plateau. The latter area is naturally the one in which expansion and development has been the greatest, as the chief area of the coniferous forest.

The establishment of manufacturing industries on the Plateau, far back from the larger centres of population, has necessitated attention to the 'human' factor. Institutions for general welfare — religious, educational and other — are essential in all industrial places. In the more

isolated centres where pulp and paper mills have been established the companies have not only assisted the building of churches and schools, but in some cases have provided hospitals, club houses, and entertainment halls.

MANUFACTURES. The foundation of cities at strategic points, and the tendency towards the settlement of population in areas of low or moderate altitude, are commonplaces of geographical thought. New York owed its first growth to the fact that it had a natural harbour at the mouth of the Hudson River, that river and its valley being the one pathway for trade from the Atlantic to the Mississippi valley lying beyond the Appalachian mountain barrier.

Quebec, Three Rivers, and Montreal were chosen in the first instance as the sites of forts to protect the two great interests of the early days of the French régime, the fur trade and the propagation of the Christian faith among the Indians.

Quebec, with its long rocky ridge beside a considerable narrowing of the river, was admirably suited for defence. The rocky ridge is about eight miles long. It is a salient of the earth movement which raised the Appalachians; it is actually a great rock-mass moved some miles from its original place by the mountain-building forces. A mile or so north of Quebec, sedimentary rocks are "undisturbed." The rocky ridge of Quebec is a "jammed" mass.

Three Rivers, at the foot of the St. Maurice

valley extending over a considerable area of the Plateau, was a convenient depot for the fur trade from that valley.

The choice of Montreal was determined by its position at the lower end of the several rapids, with the Ottawa River some distance to the west and the Richelieu River some distance to the east. It was therefore convenient for the fur trade from the Great Lakes and the northern parts of the Province, as well as for trade with the English colonies to the south. With Mount Royal at some distance from the river it was not entirely suitable for defensive purposes, but the courage of Maisonneuve and his associates made up for this defect.

Under the economic conditions of the nineteenth century these three cities have developed steadily. Quebec is an important port for ocean navigation, and a distributing point for trade along the river and gulf, and by rail to the Plateau. Boots and shoes, leather, and tobacco are the chief manufacturing industries. It is a centre for the lumber trade, and some ship building has revived in recent years at Quebec and Lévis.

Three Rivers has developed rapidly in the twentieth century in virtue of its nearness to water power, and its shipping facilities by water and rail. It is a distributing point to the St. Maurice valley. Here also ship building was undertaken recently on a large scale. Cotton, and pulp and paper mills are the chief industries.

Montreal became the chief city of the Dominion on account of its position at the head of ocean navigation, and, in the railway period, owing to its direct connection south with New York through the Champlain-Hudson valleys' "gap". These advantages, together with nearness to the water power furnished by the rapids of the St. Lawrence, have made Montreal the greatest industrial centre in the Dominion.

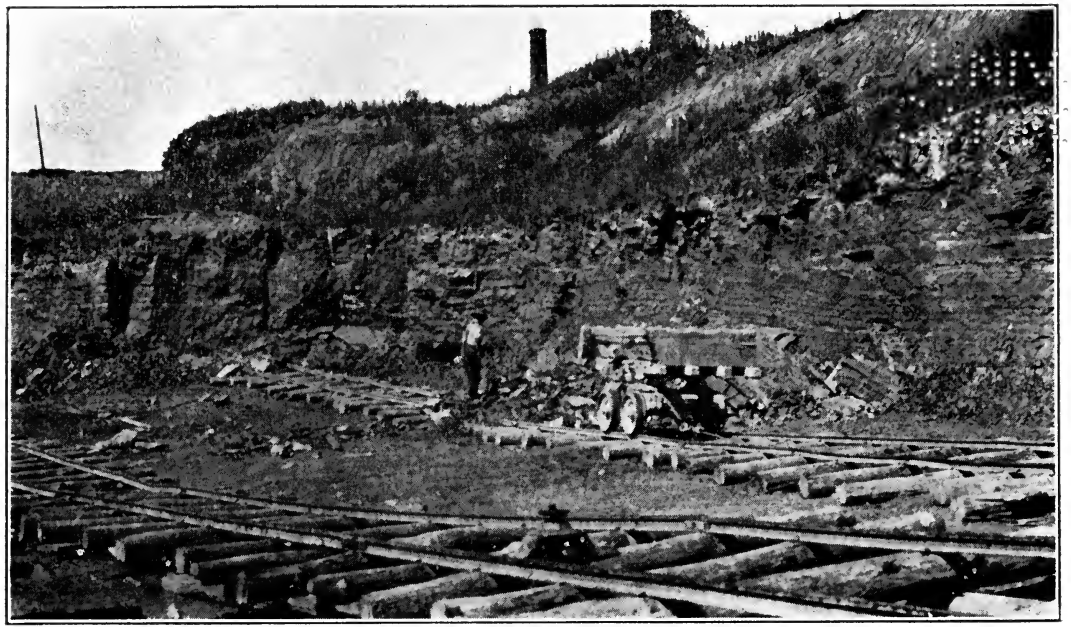
Sherbrooke had abundant water power in the early days, thanks to the descent of the Magog River into the St. Francis River at that point. But it possessed no water transportation. Hence the interesting fact that in 1844 Mr. (afterwards Sir A. T.) Galt and other Sherbrooke citizens were the pioneers of railway building in the Province, although a very short line had already connected Laprairie with the Richelieu River. Sherbrooke was then but a village, but its possibilities as an industrial centre were realized.

The first proposal was to build a railway from Montreal to Boston, by way of Sherbrooke. Curiously enough, Montreal was indifferent on the subject. The summer navigation was apparently sufficient for that city's purposes in those early days. Soon, however, Mr. Galt grasped the fact that the best route from Montreal to Boston would not touch Sherbrooke at all but go through the Champlain valley many miles to the west. Hence he and his associates interested the small town of Portland, Maine,

in the question, and the Montreal and Portland line was the result.

In the nineteenth century, manufactures in general were placed beside the "mill pond" or "falls" providing the power, and consequently there was a limit to the number of industries which could be accommodated locally. The principle of the electrical transmission of power to long distances from its source now considerably alters the effects of the earlier geographical "control". Places on the "power line" have an equal chance with places at the source of the power, if the transportation facilities and nearness to raw materials are also equal. Established manufacturing centres, however, have the advantages derived from the local institutions which have grown up in such centres and the more or less inherited adaptability of the local people to the industries. It is not out of place to add that an essential industrial attraction of increasing importance to-day is wise, progressive, and above all, honest municipal administration.

MINING. The valuable metals are not found in undisturbed sedimentary rock formations like those of the Lowland Plain, but such rocks yield in different parts of the world more or less extensive deposits of an economic character, such as crude oil, natural gas, salt and gypsum. These are not found in the Lowland Plain of Quebec but the sedimentary rocks afford stone for building purposes ,limestone for lime and the



ASCOT BRICK WORKS.

High level Pleistocene clay at Ascot, near Sherbrooke and Lennoxville.

Courtesy of Geological Survey of Canada.

manufacture of calcium carbide, and the materials for bricks, tiles, and Portland cement. The Lorraine shales of Montmorency Falls are burned for bricks; the Utica shales, mixed with Leda clay, are burned at Delson and Laprairie for the same purpose; the Leda clay alone is burned for bricks and for the making of agricultural tiles, and with limestone is used in the manufacture of Portland cement.

Bog iron ore and ochre are surface deposits both on the Lowland Plain and on the Laurentian Plateau. The bog iron ore is that which was smelted at Three Rivers nearly two hundred years ago. In recent years it was worked for a time at the Radnor forges north of Three Rivers. The ore is formed in bogs and swamps by the action of the organic acids arising from the decay of plant life. The ochre is of similar origin, and is used as red paint.

The more valuable ores and minerals are found in veins and masses in those regions where the rock strata have been much disturbed, folded and cracked by earth-movements such as those involved in mountain-building, and where volcanic activity in the past is evident. The Appalachian district is such a region, and the Eastern Townships in particular have produced a considerable amount of mineral wealth. The greater part of the world's supply of asbestos comes from this district of the Province, the chief deposits being at Thetford, Black Lake, Broughton and Asbestos (near Danville). The

serpentine rock in which it is found was originally a soft "magma" which welled up through a "line of weakness" in the earth's crust due, undoubtedly, to the Appalachian movement.

The copper deposits of the same area are often found in sedimentary rocks but invariably they are immediately beside masses or dykes of igneous rock. The copper ores at Capelton contain much sulphur which is converted into sulphuric acid. Gold is found in the copper ores at Capelton and Eustis.

Chromite (chromic iron) is associated with the serpentine rock which carries the asbestos. It yields chromic acid, in the form of chromate of soda or potash, used extensively in the tanning of leather.

Gold has been washed from the alluvial soils of the Chaudière River and its tributaries.

Granite is worked in the Eastern Townships, and also roofing slate, at New Rockland.

The Laurentian Plateau, the scene also of vast volcanic activity in the past, is another mineral region. So far only the southern fringe has been developed to any extent. Among the economic minerals in that region are graphite, mica, apatite, molybdenite and magnesite. As graphite is one of the forms of carbon its presence in these rocks indicates that plant life existed in the Pre-Cambrian. It is used as a lubricant for machinery, for the making of crucibles used in the manufacture of steel, and is the substance of the so-called "lead" pencils. Mica is extens-

ively used as a non-conductor in all kinds of electrical construction and apparatus. Some years ago the mineral apatite (phosphate of lime) was shipped from Labelle county to Capelton in the Eastern Townships, where it was converted, by means of sulphuric acid, into the fertilizer known as superphosphates. Molybdenite, found in Pontiac county, was in large demand during the war, and is now used in the manufacture of steel for tools and for parts of automobiles. Magnesite, found in Argenteuil county, is used as a furnace lining in metallurgical processes.

Gold has been found at the head waters of the Harricana River in the Abitibi district.

The mineral possibilities of large portions of the Plateau are still unknown. An important memoir on the geology and mineral resources of Canada, issued by the Geological Survey, Ottawa, says:—

"Upon the knowledge already gleaned concerning the economic deposits of the Dominion, by geological exploration, by prospecting, and by actual mining, it is safe to predict that the mineral industry will become a very great and valuable one. Its development will render essential a close study of the geology of the country. The geological field in Canada is as rich and inviting as the mining. Perhaps half the rock history of the world is written in the Pre-Cambrian, and it is of this portion that most remains to be deciphered. Since the great-

est spread of these old rocks occurs in Canada, much of this work will fall to Canadian geologists, and the careful solution of the problems presented will be as valuable to science as to the mining industry."

The general development of the Laurentian Plateau will doubtless take place when railway construction becomes more extended. It was railway construction which disclosed the nickel resources of Sudbury, the silver of Cobalt, and the asbestos of Thetford and Black Lake.

It may be added that "wild cat" mining speculation may be guarded against in these modern days. Investors in this Province should always consult the Department of Mines, Quebec.

FISH AND GAME. The Gulf of St. Lawrence, with its arm the Chaleur Bay, is one of the great fishing grounds of the world. The waters are cool and not too deep, the characteristic of those ocean areas where the edible fish are found in the greatest quantity. Fish feed upon the microscopic plants and animals, the general name for these organisms being 'plankton'. The plankton flourish most abundantly in water sufficiently shallow to reflect sunlight from the bottom.

The St. Lawrence River furnishes fresh water plankton, and the Labrador current salt water plankton; these meet in the waters of the Gulf. Cod, lobster, salmon, mackerel, and herring,

constitute the principal economic resources of the Gulf.

The inland fish of interest to the sportsman are salmon, ouananiche, trout, pike, black bass, perch, pike-perch, and maskinongé. The three principal species of trout are the American brook trout (salvelinus fontinalis), Great Lake trout (christimover namaycush), and the Rainbow trout (salmo irideus) introduced from the Pacific coast.

The principal wild game of the Province are moose, caribou, and red deer. The Laurentian Plateau is exploited for the fur-bearing animals.

The conservation of the desirable forms of wild life in general, fur-bearing and other, is more fully recognized on this continent to-day than formerly. The idea of carrying out this conservation by means of "animal sanctuaries" and "bird sanctuaries" was first proposed by Lt.-Col. William Wood, the Quebec historian.

The recent introduction of the reindeer on the North Shore of the St. Lawrence, Saguenay county, is an interesting fact of economic geography. The fishermen along that coast have long depended upon the Eskimo dog for transportation. The reindeer now bids fair to replace the dog for that purpose, and in addition to furnish milk, butter and meat for the people, to whom not only the horse but also the cow and the pig have been unknown.

CHAPTER VII

CIVIL GOVERNMENT.

The Dominion of Canada is a self-governed country in the three forms of Federal, Provincial and Municipal government. The British North America Act (1867) is the written constitution or instrument of government which defines the powers of the Federal or Dominion parliament and of the Provincial legislatures. It confers upon the Provincial legislatures the right of determining the powers and organization of municipal government.

Although passed and sanctioned in the British parliament the British North America Act was drawn up by the representatives of the people of Canada, the details having been discussed during several years before 1867 in the joint parliament of Upper and Lower Canada, and in conferences in which New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland took part. At that time there was but a small population in what are now the Western Provinces. The Act expressed the will of the people of Canada in that it embodied the principles which their elected representatives deemed best suited to the country. All who seriously study the history of Canada must be convinced that the Fathers of Confederation

deliberated and acted with great judgment and wisdom in laying the constitutional foundations of our laws and legislative institutions. The British North America Act has proved to be a workable instrument of government.

The Act confers upon the parliament of the Dominion of Canada exclusive powers in regard to the following subjects:— the public debt and property; the regulation of trade and commerce; the raising of money by any mode or system of taxation; the borrowing of money on the public credit; postal service; census and statistics; militia, military and naval service and defence; the fixing of and providing for the salaries and allowances of civil and other officers of the government of Canada; beacons, buoys, lighthouses and Sable Island; navigation and shipping : quarantine and the establishment and maintenance of marine hospitals; sea coast and inland fisheries; ferries between a province and any British or foreign country, or between two provinces; currency and exchange; banking, incorporation of banks and the issue of paper money; savings' banks; weights and measures; bills of exchange and promissory notes; interest; legal tender; bankruptcy and insolvency; patents of invention and discovery; copyright; Indians and lands reserved for Indians; naturalization and aliens; marriage and divorce; the criminal law, except the constitution of the courts of criminal jurisdiction; but including the procedure in criminal matters; the estab-

lishment, maintenance and management of penitentiaries; and such classes of subjects as are expressly excepted in the enumeration of the classes of subjects assigned exclusively to the legislatures of the provinces.

Most of the subjects assigned to the Dominion parliament are readily seen to be of general or national interest, such as the postal service, weights and measures, militia, customs tariff, banking, etc. In the case of "census and statistics" the reference is simply in regard to the Dominion as a whole; provincial governments also gather and publish statistics of their respective provinces, and local municipalities take an annual census.

The various subjects that the Dominion Government has to deal with necessitates the organisation of Departments. There is not, however, a separate Department for each of the enumerated subjects. Thus, census and statistics are under the control of the Department of Trade and Commerce, and the Department of Agriculture has the additional charge of patents and copyrights.

Each Department has as its head a responsible Minister of the Crown, who must be a member either of the House of Commons or of the Senate. In practice he is now almost invariably a member of the House of Commons, and thns more directly responsible to the people, the members of the House of Commons being elected and the members of the Senate appointed.

The Ministers, with the Premier or Prime Minister, form the Executive Council, more frequently known as the Government or Cabinet. When a Government enters upon office it does so in virtue of the fact that it has the support of the majority of the members of the House of Commons, this majority having been elected because of the 'policy' advocated by the leaders of the party. Control of the reins of government is not for a fixed period of time, as in the United States, but is based essentially upon the support of public opinion. In this and other constitutional respects Canada follows British custom and precedent.

Our federal and provincial system is outwardly the same as the federal and state system of the United States, but is different in its essential features. Thus, the president of the United States and the Governors of the individual states are given large discretionary and even executive powers, while the Governor General of the Dominion and the Lieutenant Governors of the Province exercise their functions upon the "advice and consent" of the Executive Council of the Dominion or the Province, as the case may be. On this account, the phrases "Governor-General in council" and "Lieutenant-Governor in council," as applied to executive acts in Canada are sometimes misunderstood by writers in the United States.

The classes of questions which the British North America Act reserves to the exclusive

authority of the provinces are as follows:— The amendment from time to time, notwithstanding anything in this Act, of the constitution of the province, except as regards the office of lieutenant-governor (who is appointed by the Governor-General in council, that is, by the Dominion Government); direct taxation within the province in order to the raising of a revenue for provincial purposes; the borrowing of money on the sole credit of the province; the establishment and tenure of provincial offices, and the appointment and payment of provincial officers; the management and sale of the public lands belonging to the province, and of the timber and wood thereon; the establishment, maintenance and management of public and reformatory prisons in and for the province; the establishment, maintenance, and management of hospitals, asylums, charities and eleemosynary institutions in and for the province, other than marine hospitals; municipal institutions in the province; shop, saloon, tavern, auctioneer, and other licenses, in order to the raising of a revenue for provincial, local or municipal purposes; the incorporation of companies with provincial objects; solemnization of marriage in the province; property and civil rights in the province; the administration of justice in the province, including the constitution, maintenance and organization of provincial courts (but not including the appointment of judges), both of civil and of criminal jurisdiction, and

including procedure in civil matters in those courts; the imposition of punishment by fine, penalty, or imprisonment for enforcing any law of the province made in relation to any matter coming within any of the classes of subjects enumerated in this section; generally all matters of a merely local or private nature in the province.

The provinces have control, also, in all local works and undertakings, except lines of steam or other ships, railways, canals, telegraphs, and other works and undertakings connecting the province with any other or others of the provinces, or extending beyond the limits of the province; lines of steamships between the province and any British or foreign country, and such works as, although wholly situate in the province, are before or after their execution declared by the parliament of Canada to be for the advantage of two or more of the provinces.

Education comes under the control of the individual provinces. Art. 93 of the British North America Act, however, reserves to the religious minority in any province, having a system of separate or dissentient schools, the right of appeal to the Governor-General in council against any act or decision affecting any right or privilege of the minority. The parliament of Canada has also the power to make 'remedial laws' in such cases.

Each province having the right to model its law and institutions in its own way, in all

subjects in which they have exclusive rights, it naturally follows that the laws and institutions of the nine provinces differ more or less from one another. Thus, French civil law is the basis of civil law in the Province of Quebec. Quebec and Nova Scotia are the only provinces having a Legislative Council as well as a Legislative Assembly.

The Legislature in Quebec, therefore, consists of three branches: the Lieutenant-Governor, the Legislative Council, and the Legislative Assembly.

The powers and functions of the Lieutenant-Governor (who is appointed by the Governor-General in Council) are parallel with those of the Governor-General. Each represents the sovereign, the one in provincial and the other in federal affairs, and each acts upon the advice of his responsible ministers, the Executive Council.

The Legislative Council consists of 24 members appointed for life by the Lieutenant-Governor in council. Each member represents one of 24 divisions of the Province.

The Legislative Assembly at present (1920) consists of 81 members elected from 82 different constituencies.

The three branches of the Legislature correspond to King, House of Lords and House of Commons of the Imperial parliament, and to the Governor-General, Senate and House of Commons of the Dominion.

The Executive Council (Government) is composed chiefly of members of the elective House—the Legislative Assembly. The Executive Council of Quebec consists of the Premier; the Attorney General; the Secretary of the Province and Registrar; the Treasurer of the Province; the Minister of Public Works and Labour; the Minister of Agriculture; the Minister of Colonization, Mines and Fisheries; the Minister of Lands and Forests; the Minister of Roads; the Minister of Municipal Affairs, and one or more Ministers "without portfolio," that is, not administering any department of Government.

The Premier is the leader of the Government, and advises the Lieutenant-Governor as to the persons whom he desires to have as his responsible Ministers. The Premier may have a Department under his control, and it is usually that of Attorney General.

British parliamentary principles are followed in the governmental system of the Province. Ministers are the responsible heads of their Departments in all departmental acts and decisions, and only retain office while the Government to which they belong remains in power.

Nevertheless the routine work of each Department is carried on by deputy ministers and their staffs of officials and assistants, and forming what is called the Civil Service. The deputy ministers and civil servants are permanent officers. The deputy minister of the Department of the Provincial Secretary has the title

of Assistant Provincial Secretary; the deputy minister of the Attorney General's Department is the Deputy Attorney General, and the deputy minister of the Treasury Department is the Assistant Treasurer. The English and French Secretaries of the Department of Public Instruction are deputy ministers.

The functions and duties of the several Departments are defined in the Revised Statutes of Quebec; a brief outline is sufficient to indicate their general nature:—

ATTORNEY GENERAL. The Attorney General sees that the administration of public affairs in the Province is in accordance with the law, and he has the control and management of the judicial organization of the Province, including registry offices. The Department is essentially the Law Department.

PROVINCIAL SECRETARY AND REGISTRAR. The Provincial Secretary represents the Department of Public Instruction in the Legislature as well as his own Department. He also deals with all matters concerning the technical schools, night schools, reformatory and industrial schools. The Bureau of Statistics; letters patent incorporating companies; hospitals, insane asylums, and charitable institutions generally; statistics of births, marriages and deaths, are among other matters under the control of this Department.

PROVINCIAL TREASURER. The Provincial Treasurer is the adviser of the Crown in financial matters. He is charged with the duty of preparing the annual "budget" of ways and means for carrying on the work of Government. The budget speech of the Treasurer is one of the most importants events in the annual sessions of the Legislature. In that speech he reviews the finance of the past year — the revenues and the expenditures — and outlines the policy of the Government in this connection for the coming year. Among the provincial revenues may be mentioned the monies derived from lands and forests owned by the Province, succession duties, motor vehicle fees, licenses, commercial corporations, and others. The larger expenditures of Government are upon education, agriculture, asylums, maintenance of various institutions and good roads.

MINISTER OF LANDS AND FORESTS. He has the oversight, control and management of everything connected with the administration and sale of public lands belonging to the Province; the managements of escheats, and in general the forest reserves. This Department has under its control the very important task of administering the laws of the Province in regard to the cutting of timber and the protection of forests against fire.

MINISTER OF AGRICULTURE. He has the management and control of everything con-

nected with agriculture in the Province. He has the control and supervision of provincial agricultural schools and colleges and model farm grants from the Province; permanent exhibition committees, agricultural and horticultural societies, farmers' clubs and institutions for teaching agriculture, and beet sugar manufacturies receiving Government grants. The Dairy Association of the Province, farmers' and dairymen's associations, and societies for the manufacture of butter and cheese, report to him each year. In general, this Department aids and encourages agriculture and agricultural education.

MINISTER OF COLONIZATION, MINES AND FISHERIES. He is charged with the control and management of everything connected with colonization, immigration and emigration; colonization works and roads; administration and sale of mining lands; fisheries within the jurisdiction of the Province, and the carrying out of the game laws.

MINISTER OF PUBLIC WORKS AND LABOUR. He has the management, custody, and control of all public works, immoveables and public buildings belonging to the Province, and all buildings destined for the residence of the Lieutenant-Governor or for offices for the public departments. He controls the collecting and publication of statistical and other information relating to the condition of labour; institutes

and controls enquiries into important industrial questions and those relating to manufactures, and has supervision and control over all proceedings under the Quebec Trade Disputes' Act. The Council of Arts and Manufactures and mechanics' institutes are under his control.

MINISTER OF ROADS. He has the charge of the establishment of roads and highways in the Province, in accordance with the provisions of the law whereby municipalities are aided by loans and otherwise to build improved, or, as they are generally known, Good Roads.

MINISTER OF MUNICIPAL AFFAIRS. This Department was recently established. Among other things, it supervises the loans and sinking funds made by municipalities upon the authorization of Government.

There is also the DEPARTMENT OF PUBLIC INSTRUCTION, whose head is the Superintendent, and who is not a member of the Government. In the succeeding chapter this Department will be referred to more fully.

In logical order a statement in regard to the Legislature should have preceded this outline of the functions and duties of the executive departments. But this general view of the various responsibilities of government departments may serve to indicate more clearly the kind of matters with which the Legislature deals. The making of the provincial laws, and voting the annual sums of money required to

carry on the public business in all its branches, constitute the principal functions of the Legislature. At its annual sessions, usually lasting two months or more, bills are presented on various matters. Certain classes of questions, and particularly all "money" bills, originate only with the Government. Private members, however, may propose bills on many matters. The bills are submitted to special committees of the Legislative Council and of the Legislative Assembly; and after being "reported" to the chambers they are "debated." After passing a third reading in each chamber a bill becomes an "act," when sanctioned by the Lieutenant-Governor.

As in other legislatures under the British system, the presiding member of either chamber — Legislative Council and Legislative Assembly — is the "Speaker." He is the choice of the Government in power, the nomination being endorsed by the majority vote of the members. The duty of the Speaker is to maintain the rules of procedure and debate.

MUNICIPAL GOVERNMENT. There are three classes of municipalities in the Province of Quebec, 1. Those governed by a special charter of the Legislature, 2. Those governed by the Cities and Towns' Act, 3. Those governed by the Municipal Code. The great majority are under the Municipal Code.

The councils of the village and rural munici-

palities under the Municipal Code consist of a Mayor and six councillors, all elected for terms of two years, three councillors retiring each year. The county council consists of the mayors of the different municipalities in the county governed by the Code. The presiding officer of this council is the Warden, who is chosen by the Mayor from among themselves. The executive officer is the secretary-treasurer.

In general, the duties and functions of municipal councils are the maintenance of peace and order and the provision and maintenance of utilities in the public interest. The range of matters thus concerned varies greatly. The maintenance of peace and order in a rural municipality is a much less difficult matter than in a large city; in the latter, also, the provision of public utilities such as water supply, public parks, and so forth, entails a much greater expenditure.

An English writer of the eighteenth century, who wrote under the name of "Junius," said that "the submission of a free people to the authority of the Chief Magistrate is no more than a compliance with laws which they themselves have made." If it was true then, when only a small proportion of the people of England or of any other country had the right to vote, that we "make" (through our representatives) the laws we are required to obey, it is surely more true to-day when almost everybody has a vote. But this increase of democratic power

carries with it an increased responsibility. Good local government in city, town and country is a matter of ever-growing importance. Federal, provincial and municipal government are three parts of a connected whole. The same principle of responsibility is attached to each. The welfare of Canada depends upon the extent to which the moral sense of this responsibility is an active one in the individual communities. And to this end we must look, for one thing, to the great means of the diffusion of general and sound education.

The chief function of parliaments and legislatures is to make and amend the laws. The progress of legislation in modern countries is to a large extent the measure of the moral worth and enlightenment of the people. It is not always, however, an absolutely certain indication of enlightenment and moral worth. Thus, some years ago, both Turkey and Abyssinia adopted compulsory education laws, in keeping with that movement elsewhere; but so far as the results show, the object in view was, apparently, not to provide schools for the people at large but to have something on the statute books that would look well to other countries from whom they wished to borrow money. This is an extreme case, but in western countries today there is a tendency to overload the statute books with much legislation which by its very nature is apt to be a dead letter.

At the same time, sound, wise and progressive

legislation is a reality, and should be a matter of general concern. Great measures which liberate vast moral and economic forces, and immensely change the social conditions of a country, may not appear more than once in a lifetime, but lesser measures may often quietly effect beneficent changes in the public welfare.

CHAPTER VIII

EDUCATIONAL SYSTEM

As explained in the previous chapter, Education is one of the matters under the exclusive control of the individual provinces of the Dominion, subject only to the provisions of Art. 93 of the British North America Act. In the United States also the schools are under the control of the individual states and not under that of the federal government.

There is no Minister of Education under the Quebec system. The Secretary of the Province is the member of the Cabinet who represents the interests of education in the Legislature.

The Department of Public Instruction, however, is separate from that of the Secretary of the Province. All matters of an administrative character concerning the public schools and normal schools of the Province are under the supervision of the Department of Public Instruction, and all correspondence connected therewith should be addressed to the Superintendent of Public Instruction, Quebec. It may be added here that the words "public school" include in Quebec all schools under control of commissioners or trustees — whether kindergarten, elementary, intermediate (model), academy or high schools.

Technical schools, night schools, reformatory and industrial schools, are under the control of the Department of the Secretary of the Province, and all correspondence concerning them should be addressed to the Secretary of the Province, Quebec.

Department of Public Instruction. The Superintendent is the head of this Department. He is assisted by two secretaries — a French Secretary and an English Secretary — each of whom is a deputy-minister. At present, also, the French Secretary is the Secretary of the Roman Catholic Committee of the Council of Public Instruction, and the English Secretary the Secretary of the Protestant Committee. In this double capacity, therefore, the two secretaries of the Department are charged with responsible duties in connection with the schools they respectively represent.

The School Law is contained in Arts. 2521 to 3051 of the Revised Statutes of Quebec, 1909, and subsequent amendments, The Regulations of the two Committees of the Council of Public Instruction do not form part of the School Law proper but they have all the force of law. Art. 2532 states that "The Superintendent, in the exercise of his functions, shall comply with the directions of the Council of Public Instruction or with those of the Roman Catholic and Protestant Committees as the case may be."

The Superintendent is ex officio member and chairman of the council of Public Instruction,

and is a member of each committee thereof, but he has a right to vote only in the committee of the religious belief to which he belongs.

Among the duties of administration performed by the Department may be mentioned the following:—

1. Receiving the annual reports of the school municipalities of the Province.
2. Receiving the autumn reports and spring bulletins of the school inspectors.
3. Administering the public school grants, and also the Superior School and Poor Municipality grants recommended by the two Committees of the Council of Public Instruction.
4. Preparing the Annual Report of the Superintendent.
5. Receiving petitions in regard to changes in the boundaries of school municipalities, annexations, or erections of new municipalities, and other such matters in which the School Law directs that the assent of the Lieutenant-Governor in council is given "upon the recommendation of the Superintendent."
6. General correspondence.

COUNCIL OF PUBLIC INSTRUCTION. The Council of Public Instruction as a whole consists of Roman Catholic and Protestant members; practically of the two Committees, with the exception of the associate members of each referred to later on. The members of the Protestant Committee who are members of the Council are

equal in number to the lay members of the Roman Catholic Committee.

The Council is seldom called together. Joint consultation of the two Committees is required only when questions affecting the joint interests of Roman Catholic and Protestant schools are proposed. Ordinary matters are readily dealt with by communication from one Committee to the other.

Upon each Committee, however, separately and equally, very large powers are conferred. Each makes its own Regulations for the organization, administration and discipline of its respective schools, Elementary and Superior. In other provinces the power of making regulations is conferred upon the Minister of Education.

The Committees meet separately to perform the duties conferred upon them by the School Law. The Protestant Committee meets four times a year; in February, May, September and November, usually on the last Friday of the month. Certain Sub-committees, as for instance the one which reports upon the course of study and text books, meet more frequently. The Roman Catholic Committee meets three times a year, in February, May and September, with Sub-committee meetings also during the year.

As to the membership of the Committees, Art. 2540 reads:

"The Roman Catholic Committee consists of:

"The bishops, ordinaries or administrators of

the Roman Catholic dioceses and apostolic vicariates, situated either wholly or partly in the Province, who are members ex-officio.

"An equal number of Roman Catholic laymen appointed by the Lieutenant-Governor in council during pleasure.

"The Lieutenant-Governor in council may add to the said Committee four officers of instruction, two of whom, being priests, shall be principals of normal schools in this province, and two of whom shall be laymen, officers of primary instruction; such appointment being made for a term not exceeding three years."

"The Protestant Committee consists of:

"A number of Protestant members, equal to the number of Roman Catholic lay members, and appointed by the Lieutenant-Governor in council during pleasure.

"The Protestant Committee may associate with themselves six persons, and the Provincial Association of Protestant Teachers may, each year, at their annual meeting, elect one of their members to be an associate member of the Protestant Committee, for the following year."

While the four appointed officers of instruction of the Roman Catholic Committee, and the Associate members of the Protestant Committee are not members of the Council they are full members of their respective Committees.

As already stated, the Roman Catholic and the Protestant Committees have the same and

equal powers in regard to their respective schools; and all schools under control, whether elementary, model or intermediate, academy or high school, are either Roman Catholic or Protestant, that is, they are conducted under the Regulations of either the one or the other Committee.

The matters upon which the Committees independently make Regulations are the most important in all that relates to a system of public instruction. Art. 2548 reads:—

"The Roman Catholic or Protestant Committee, as the case may be, and as the provisions which concern them require, may, with the approval of the Lieutenant-Governor in council, make regulations:

"1. For the organization, administration and discipline of public schools;

"2. For the division of the Province into inspection districts and for establishing the boundaries of such districts;

"3. For the government of normal schools;

"4. For the government of boards of examiners;

"5. For the examination of candidates for the office of school inspector;

"6. For determining the holidays to be given in schools."

This enumeration is more comprehensive than might appear at a first glance. Thus, as previously explained, the words "public School" in-

clude Elementary and Superior Schools. The provisions include, therefore, the making of the courses of study for all schools, and all other matters affecting their internal administration.

Regulations are approved by the Lieutenant-Governor in council, but each Committee authorizes the text books, maps, globes, etc., for its schools without this reference and when it sees fit may withdraw the authorization.

A Roman Catholic Central Board of Examiners and a Protestant Central Board of Examiners, appointed by order-in-council upon the recommendation of the respective Committees of the Council of Public Instruction, may issue, in accordance with the regulations of each Committee, teachers' diplomas. Normal schools also grant diplomas, and the Superintendent grants a diploma of qualification to any pupil of a normal school who has obtained from the principal a certificate establishing that such pupil has successfully followed a regular course of studies therein in accordance with the regulations of the Roman Catholic or Protestant Committee, as the case may be. Such diplomas, therefore, are signed both by the Superintendent and the principal of the normal school.

While each Committee examines the candidates for the office of inspector of schools, and grants their certificates of qualification for appointment, the actual appointment necessarily rests with the Government by whom their salaries and travelling allowances are paid. There

are fifty Roman Catholic inspectors and ten Protestant, and there is a Protestant inspector of Protestant Superior Schools.

The elementary schools are visited twice a year, the inspectors furnishing to the Department an "Autumn Report" in connection with the first visit and a much more extensive "Spring Bulletin" in connection with the second visit. In September each year the inspectors hold Teachers' Conferences throughout their districts, giving instructions in regard to the course of study and regulations, together with pedagogical advice.

An Inspector General of Roman Catholic schools and an Inspector General of Protestant schools are officers of the Department.

SCHOOL BOARDS. The local control of the schools rests with the school boards, the members of which are elected by the ratepayers (proprietors of real estate and husbands of proprietors), except in the cities of Montreal and Quebec, where they are appointed. In both cities certain of the members are appointed by the Lieutenant-Governor in council and others by the city council. In addition, in the case of the Roman Catholic board of school commissioners of Montreal, the Archbishop of Montreal has powers of nomination. Both in Montreal and Quebec there is a Protestant board of school commissioners as well as a Roman

Catholic Board. In Three Rivers the municipal council is the Roman Catholic school Board.

For all school boards of the Province in general the elections take place in the month of July. If for any reason an election is not held in that month the appointment to the vacancy or vacancies is made by the Lieutenant-Governor in council.

Most of the school municipalities coincide either with the civil municipality or the parish. The cases where the boundaries do not coincide are chiefly those in which school municipalities have been erected "for Catholics only" or "for Protestants only," portions of two or more municipalities being sometimes detached and thus erected. The number of school boards "for Catholics only" and "for Protestants only" is limited; in both instances they have been required usually for geographical reasons.

In other provinces the members of school boards are called simply "trustees." In Quebec the ratepayers belonging to the local religious majority (which may be either Roman Catholic or Protestant) are represented by a board of five "commissioners," while the ratepayers belonging to the "dissentient" minority are represented by a board of three "trustees." Where boards represent "Catholics only" or "Protestants only" —as well as in the case of Montreal, Quebec, and other cities with special charters—there may be two boards of commissioners in the same municipality, but in no other case. A board of

commissioners and a board of trustees in the same municipality is the normal condition.

In newly organized school municipalities two commissioners retire by lot at the end of the first year; two by lot at the end of the second year, while the fifth completes his term at the end of the third year. Thereafter each commissioner completes a full term of three years, two being elected annually during two years and one every third year. The same principle is applied in the election of trustees, except that in newly organized municipalities one only retires by lot in the first and second years, the board consisting of three members only, and therefore one retires yearly.

Male proprietors of real estate, or the husbands of proprietors, duly entered as such in the valuation roll, are eligible for election. So, also, although not qualified in respect to property, is every Roman Catholic curé and every minister of any other religious faith ministering in the school municipality. Retiring commissioners or trustees are eligible for re-election.

Persons elected are bound to accept office and cannot retire before the expiration of their term, but members of the Roman Catholic or Protestant clergy, persons over sixty years of age, and all who have been commissioners or trustees within four years, may refuse to accept office, or having accepted may afterwards resign. The right to resign is limited, therefore, to these cases.

When a vacancy occurs in case of death, lack of qualification (as, for instance, when a commissioner or trustee disposes of his real estate), refusal to accept office when the law authorizes such refusal, resignation legally given, change of domicile, or incapacity, during three consecutive months, by reason of absence or sickness, the remaining commissioners may replace the commissioner or trustee within thirty days. If this is not done within the period of delay, the appointment is made by the Lieutenant-Governor in council upon the recommendation of the Superintendent.

DISSENT. Any number of persons belonging to the religious minority in a municipality, whether Roman Catholic or Protestant, may dissent and form a dissentient school municipality. The notice of dissent is signed in triplicate. One is served on the chairman or secretary of the school commissioners, one is sent to the Superintendent, and the third is retained for the archives of the dissentient board. The notice of dissent must be given before the first of May in any year, and goes into effect on the first of July. The ratepayers who have signed elect three trustees in July.

While "any number" of ratepayers, tenants and occupants of the local religious minority may dissent, it is essential in practice that there shall be three persons qualified by law to act

as trustees. It is necessary, also that there shall be enough pupils to form a school.

When two-thirds of the minority have dissented, by giving notice, the rest become dissentient by law, without the formality of notice, except those who may be sending their children to the schools of the commissioners.

The general provisions of the School Law in respect to their powers and duties are the same for trustee boards as for boards of commissioners.

Quebec differs from most of the provinces in following the "township" or the parish plan. A rural board of commissioners may have anywhere from one to half a dozen or more schools under its control, while the board of trustees may have nearly as many. Under this system the stronger and richer "districts" into which the municipality is divided by its board are bound to assist the weaker and poorer districts, as by law the taxes are uniform throughout a municipality and must be put into a "common fund" for all districts.

Large rural school municipalities make school consolidation easier, whenever this is deemed desirable and possible.

SCHOOL TAXES. In the larger cities and towns the school taxes are collected by the municipal authorities. In most of the places under special charter the annual rate of taxation is determined by the Legislature or rather a

maximum is fixed beyond which the board cannot go.

In general, however, throughout the Province the boards have the right to levy the rate required for the maintenance of their schools. In the great majority of cases, also, the boards collect their own taxes, although under the School law they may require the municipal authorities to do the collecting.

The valuation roll of the municipal council is that which is followed by the school board, unless the former has failed to make a valuation.

In municipalities where there is dissent each board levies its rate independently upon its own supporters, but the commissioners alone have the right to collect the school taxes due from incorporated companies. The commissioners then pay over to the trustees the annual share of the latter in these "neutral panel" taxes. This share is determined according to the enrollment of pupils in the schools of each board. Thus if the commissioners have 300 pupils, and the trustees 200, the share of the trustees is as 200 is to the total number — in this case two-fifths.

If there are two boards of commissioners (as may happen in the instances mentioned on a previous page) the division is made on a slightly different basis. The board of commissioners with the largest number of ratepayers collects the taxes on incorporated companies and then divides them with the other board of commis-

sioners not according to enrollment but according to the number of children from 5 to 16 years of age, of each religious faith, "residing" in the municipality. If the territories of the two boards of commissioners do not wholly coincide the division is made according to the number of children belonging to each residing "in the territory common to both."

Where a "special" tax is levied, as for the building of a school, either the commissioners or the trustees may tax the incorporated companies in the same way as other ratepayers under their control, to an amount equal to the amount to which the board would have been entitled if the tax had been, instead, an ordinary tax levied and apportioned by the commissioners. Thus, if the commissioners have levied a "special" tax of 50 cents on the hundred dollars, and the commissioners have 300 pupils in their schools to 200 of the trustees' pupils, the commissioners will levy the three-fifths of 50 cents on the incorporated companies. With the same proportionate number of pupils the trustees would levy the two-fifths of 50 cents (or two-fifths of whatever the rate of their special tax might be) on the companies.

In this connection it may be stated that for the building of schools in rural municipalities either the district to be served by the elementary school, or the whole municipality, is subject to the special tax, according as the one or the other plan has been followed in the municipal-

ity. The existing plan may be changed, upon the approval of the Superintendent, six months after notice to that effect has been given to the rate-payers. If the assessment is for a Superior School the district in which it is placed is first assessed for the amount that would have been necessary for an elementary school, and the additional amount required to accomodate the higher classes is levied on the whole municipality, including the district itself. The justification for this is that the Superior School provides the elementary education for the district in which it is situated as well as the higher grades for all districts.

School boards administer the properties of the school municipality. They select and purchase school sites and build and repair school houses (all subject to appeal by ratepayers within certain days after public notice has been given). If a loan has to be made for any purpose of this character "no acquisition, construction or repair" may be carried out until the school corporation has complied with the law in respect to loans. A site may be selected, and plans made for a building, but no actual purchase of the site or contract for the building may be made until the authority for the loan has been obtained from the Lieutenant-Governor in council on the recommendation of the Superintendent. The ratepayers must first be informed, by notice, that a meeting of the board is to be held to consider a resolution in this

connection. The resolution declares the purpose or purposes of the purposed loan, the particulars of the proposed issue of bonds or debentures, and declares that a special tax shall be levied yearly for the interest and sinking fund. The resolution, if adopted by the board at this public meeting, is published, and if after thirty days no opposition has been offered by ratepayers a certificate to that effect is sent to the Superintendent. It is then submitted to the Lieutenant-Governor in council for approval.

School boards engage the teachers. Engagements are for one year, but may be longer in special cases approved by the Superintendent.

If a teacher has not given notice before the first of May that he does not intend to teach the following year he is by that fact re-engaged on the same terms, unless by the first of June the board gives notice that his services are not required for the next year.

Boards may not give collective or simultaneous notices to teachers that their services are not required for the following year when the real intention may be to retain some and not others.

While engagements must be in writing, in virtue of a resolution of the school board, the essential contract binding both parties begins, of course, when verbal or written agreement has been reached.

Boards are required, under pain of losing their grants, to engage qualified teachers. When

efforts to this end have failed permission may be issued by the Superintendent to engage a teacher without diploma. The Protestant Committee requires that the application shall state that the vacant position was duly advertized in newspapers, and shall mention the salary offered. This application must be approved by the inspector before it is sent to the Department. Permissions are not issued upon the application of the teacher but of the school board.

The diplomas authorized by the Protestant Committee are Elementary, Intermediate (Model), High School (Academy) each being either first or second class; also Kindergarten Director and Kindergarten Assistant certificates. Normal school training is given at the School for Teachers, Macdonald College. First Class High School diplomas are granted only to university graduates who have taken the university course in Education.

PROTESTANT SCHOOLS. The complete course of study is in eleven grades, Grade XI being the School Leaving and matriculation year. In the Elementary Schools the first seven grades are taught; in the Intermediate (Model) Schools the first nine grades, and in the High Schools (Academies) the whole eleven grades are taught. Quebec is exceptional in having the Elementary grades in the Superior Schools. The system, however, works well. It is rendered practicable by the fact that these higher schools

are under the same local board which has charge of the elementary schools. In small towns there may be but one Protestant school and that a High School, doing all the educational work of the community from first primer to university matriculation.

In other respects secondary Protestant education is similar in Quebec to that of other provinces. The course of study is the usual 'ladder to the university'. In so far as school subjects are concerned Quebec may be regarded as conservative. The Elementary course includes Writing, English, History, Geography, Arithmetic, French, Hygiene, Nature Study and Agriculture, Drawing and Music. Simple business forms, etc., are included under the head of writing from Grade V to VII; English Grammar begins in Grade V; History of Canada in Grade VI; Geography from a text book in Grade IV; Arithmetic in all grades; French begins in Grade IV; Hygiene and Nature Study in all grades; Music in all grades; Drawing from Grade II. The additional subjects in the Superior Schools are Geometry, Algebra, Latin, Science (Physics or Chemistry or Botany). British History begins in Grade VIII, and is continued to the end of the course. Canadian History of a more advanced character is taken up again in Grades X and XI. Latin is optional and begins in Grade VIII. Greek is no longer on the course of study. English Literature begins in Grade I (child poems) and leads up to Shakespeare and Browning in Grade XI.

ROMAN CATHOLIC SCHOOLS. The Roman Catholic Academies do not take up all the advanced subjects taught in the higher grades of the Protestant High Schools, but Catholic secondary education is not neglected. It is pursued in many independent institutions; in the case of boys, in the twenty Classical Colleges scattered through the Province. These institutions are exceptional in their organization. The pupils enter at an early age and not only do high school work but proceed through the Arts course, the degrees being given by the Université de Montréal and the Université Laval, Quebec. The high literary culture of French Canadian statesmen and professional men generally is largely due to the influence of these colleges. Leading teaching convents in Montreal, Quebec, and other centres render the same service in literary culture for the French Canadian women of the Province.

To outsiders, whether of other provinces or of the United States, nothing is more striking in regard to the Quebec system than the fact that the public schools, elementary and superior, are "religious" in their control and distinctively either Roman Catholic or Protestant—the Jews belonging to the Protestant schools.

The Quebec "anomaly" is viewed favourably or unfavourably according to the theory held in regard to the function of public education. The purely secularist theory is upheld not only by pronounced secularists but also by many re-

ligious men who hold that religious teaching belongs to the home, the Sunday School and the Church. They point to the cementing influence of the "common school" in building up a common national sentiment, and doubt the possibility of introducing religious instruction to suit all members of the community. At the same time there has been a movement in recent years among leading educationists in the United States towards some measure of religious instruction in the schools as a means of inculcating moral principles among the many who are deprived of ideal home and church religious influences. There is also the classic case of Professor Huxley, who, over forty years ago, after becoming a member of the London School Board, surprised his secularist friends by advocating the introduction of Bible readings in the board schools as the best means of moral instruction.

Fortunately we are not called upon in this chapter to decide upon the merits of this disputed question. It is enough to point out that during the French régime in Canada (1608-1759) education was in the hands of the clergy; that from 1760 onward the Roman Catholic church has held to the principle that public education should be religious, and that the great majority of the laity are of the same conviction. Education being a provincial matter the existing system is inevitable.

From the time, however, that public education was organized in the Province the majority

have consistently accorded to the Protestant minority the same rights in regard to their schools, and it is certain that the Protestant Committee has always regarded this as a privilege in respect to moral and religious instruction. The course in this subject in the Protestant schools is defined by the Protestant Committee, composed of members of the different denominations. No trouble has ever arisen from the work of the Committee in this connection.

Religious instruction is not obligatory upon pupils of an opposite faith in any school.

This freedom extends to the matter of language. In French Roman Catholic schools French is the language of instruction, with English as a second language subject. In English Roman Catholic schools English is the language of instruction, with French as a second language subject. The same rule is followed in English and French Protestant schools. The freedom as to the language of instruction is a matter of unwritten law. There is nothing in the School Law nor in the Regulations of the Roman Catholic or the Protestant Committee on the subject, except that in the Roman Catholic Committee's Regulations there is a general heading over such subjects as Reading as "French for French Schools, or English for English Schools."

In mixed communities where there are both English and French Catholic pupils the Depart-

ment requires that the teacher shall be bilingual.

In the course of study authorized by the Protestant Committee the teaching of French begins in Grade IV and is continued to the end of Grade XI. The Oral Method is used throughout. It is taught during four years in all elementary schools, during six years in intermediate schools, and during eight years in high schools. In order to render the teaching of the language more effective, specialists in French are trained for the high schools. Each board engaging a specialist receives a special grant from Government. A Supervisor of French teaching in English Schools is provided also by Government.

UNIVERSITIES. The four universities of the Province—Laval, Quebec, and the Université de Montréal, Montreal, (both Roman Catholic), McGill University, Montreal, (non-sectarian) and Bishop's College University, Lennoxville, (Anglican) — while all receiving Government grants are wholly independent in their control. There is no "provincial" university, but Laval, the Université de Montréal and McGill each recently received a special grant of one million dollars from the Government of the Province.

There is co-operation between the Protestant Committee and the two English universities. Both conduct courses for the training of High School teachers. The training of teachers for Elementary and Intermediate Schools is con-

ducted at Macdonald College, now forming a part of McGill University. Teacher training, however, is a matter under the control of the Protestant Committee.

The Classical Colleges, affiliated with the two French universities, are also independent. The Polytechnical School and the School of Commercial Higher Studies, Montreal, are now under the control of the Université de Montréal.

ROMAN CATHOLIC NORMAL SCHOOLS. There are fourteen normal schools for the training of Roman Catholic teachers. There is also a Domestic Science teacher-training school, giving a thorough four year course.

TECHNICAL SCHOOLS. The Montreal and Quebec Technical Schools are the two largest institutions of this character, and were founded and are largely maintained by the Government of the Province. They are under the control of the Secretary of the Province. Other technical schools aided by Government are those at Sherbrooke, Shawinigan Falls, and Beauceville. The Protestant Board of School Commissioners of Montreal conducts a Commercial and Technical High School, which holds night classes under the name of the Technical Institute.

GOVERNMENT GRANTS. The share of each board in the principal Public School Fund is determined by the number of pupils enrolled in the previous year. This fund is distributed to

all school boards, city, town and country. The deductions for the Teachers' Pension Fund are made from the grants, the present rate of the stoppages being two and a half percent.

There is another Public School Fund ($225,000.00) distributed on the same basis of enrollment but only to village and rural boards. These boards must have maintained certain minimum salary standards during the previous year. The grants from this fund have accomplished much in raising the salaries of rural teachers.

The Legislative votes for Superior Education and for Poor Municipalities are divided into two portions, according to the respective numbers of Roman Catholics and Protestants in the Province as given in the preceding federal census. All non-Roman Catholic persons are counted as Protestants in determining the basis of division.

The Protestant Committee adds to its share of both funds certain other Protestant moneys, collected or given by Government, such as marriage license fees, etc. The Committee's grants to its Superior Schools are apportioned according to the results of the June Examinations and the general report of the Protestant Inspector of Superior Schools. The Poor Fund is apportioned by the Committee on the basis of the local effort of the boards concerned, as determined by the departmental reports from the inspectors and the secretary-treasurers.

TEACHERS' PENSIONS. All lay teachers with diploma are entitled to a pension after 20 years of service in the Province and at the age of 56. A teacher may retire at 50 but cannot receive the pension until 56. When accident, ill health, etc., prevents a teacher from continuing service, he may receive a pension at any age if he has taught 20 years, and if he has taught over 10 years and less than 20 years he is entitled to receive back all stoppages paid in. Upon restoration to health he may restore his pension rights by paying again the stoppages returned, if teaching is resumed.

Married male teachers may contribute for a half pension to be paid to their widows. The contributions must begin at the time of marriage, but an amendment to Art. 3004 passed in 1921 enabled husbands who had neglected to pay these extra stoppages to do so before the 30th of June, 1922.

The pension of a male teacher is two percent of the average salary for each year of service up to 35 years. The pension of a female teacher is three percent of the average salary for each year of service up to 35 years, provided that it does not exceed ninety percent of the average salary during the ten years when the salary was highest. In both cases, where the service is over 25 years the average salary may be determined by the 25 years in which the salary was highest.

The Pension Fund is maintained by the

"stoppages" and annual grants from the Legislature.

Public education, elementary and superior, has made great progress in Quebec during the last twenty-five years. This is manifested not merely in the largely increased contributions of Government and the ratepayers but in many other ways. In all parts of the Province there is a strongly awakened consciousness to the value and importance of education in commercial, manufacturing and agricultural progress. Quebec, it is true, is conservative. Its educational system has had an historical development of its own, and public opinion does not favour adaptation to the spirit and methods of other systems different from its own. This makes it difficult, perhaps, for outsiders to measure progress and results in the familiar and ordinary terms of comparative statistics. Thus a somewhat uniform four-year high school course is general throughout the rest of Canada and in the United States. The last four grades of the Quebec Protestant high schools correspond to this system, but for Roman Catholic education the last two grades at any rate are conducted in independent institutions of high literary standards. But the statistics of what would be regarded as high school work only in these various institutions are not readily available in a form that would make the high school statistics of the Province directly comparable with those of other provinces and states. The

fact of widespread secondary education, however, remains.

Quebec is conservative also in the absence of a compulsory education act. Nevertheless, legislation passed in 1919 forbids the employment of boys and girls under sixteen years of age unless they can read and write, and this act bids fair to be well enforced. (Statutes of Quebec, 9 George V., chap. 50.)

One conservative aspect of Quebec education is appreciated by all unprejudiced observers. The emphasis placed upon moral and religious instruction both in Protestant and Roman Catholic schools has its undoubted influence upon the manners, morals and character of the people. A considerable portion of that general respect for law and custom, and the rights of others, which marks the Province can be attributed to that instruction in the schools.

It should be evident from the statements in this chapter that the English Protestant minority in the Province have complete educational freedom — Protestant schools maintained by Protestant taxation; Protestant inspectors; teachers trained in a Protestant School for Teachers; courses of study and all Regulations concerning the schools authorized by the Protestant Committee, and departmental administration represented by the English Secretary of the Department of Public Instruction.

Nevertheless, as some of these features of the Quebec systems are far from being well under-

stood outside the Province, it may be advisable to summarize them here briefly. After long experience the present writer is convinced that the chief difficulty outsiders have in interpreting Quebec educational conditions lies in the fact that all interpretations of other systems of government, law and education are likely to be mixed in the mind with the conceptions peculiar to the system with which one is most familiar. Most people in the United States, including even distinguished writers, suppose the Canadian phrase "Lieutenant-Governor in council" to mean that the executive acts attributed to the Lieutenant Governor in council are those of the Lieutenant Governor personally rather than of his responsible advisers. Similarly, no doubt, many Canadians are puzzled when they see, in the "movies," a State Governor signing a pardon for a criminal of his own free will without waiting for the 'advice and consent' of a cabinet.

Having been born and educated in Ontario, the present writer has the advantage of familiarity with two very different school systems, and is therefore perhaps qualified on that account to realize where misinterpretation, even with the best intentions, is most likely to originate.

The following points should make clear to all who are familiar with the systems of the other provinces that under the Quebec system the Protestant minority enjoy complete educational autonomy in all things relating to the schools.

1. Protestants and Roman Catholics have equality under the School Law of the Province. The provisions of the general law apply to both.

2. Dissent is a personal right. It applies to every person, proprietor or tenant, of the local religious minority whether Roman Catholic or Protestant. The majority of the Protestant schools are under the control of Protestant "commissioners" and therefore not dissentient or "separate."

3. Every school — Elementary, Intermediate or Model, and High School or Academy — is either Roman Catholic or Protestant, that is, in every school under control either the course of study of the Roman Catholic Committee or that of the Protestant Committee is followed.

4. In the Eastern Townships there are still some Protestant boards of commissioners in mixed rural municipalities where "dissent" has not taken place. In these municipalities the Protestant board engages Protestant teachers for the Protestant districts and Roman Catholic teachers for the Roman Catholic districts. The Protestant inspector visits the Protestant schools, and the Roman Catholic inspector the Roman Catholic schools.

5. Protestant taxes support Protestant Elementary, Intermediate and High Schools. For the support of each kind of school, also, Protestant boards receive their share of the school taxes paid by the incorporated companies.

6. Protestant boards share in all Govern-

ment grants to Elementary and Superior Education, as well as in the Poor Municipality grants.

7. There are no Departmental Regulations; the Regulations administered by the Department are those of the Roman Catholic and Protestant Committees for Roman Catholic and Protestant schools respectively.

8. Protestant normal school training is conducted under the authority of the Protestant Committee.

9. All examinations and examination standards in connection with Protestant education are conducted under the authority of the Protestant Committee. This includes not only the school examinations, but also those for teaching diplomas and for the office of Protestant Inspector.

10. The English Secretary of the Department, who is a deputy minister, is the responsible adviser of the Superintendent in all departmental matters concerning Protestant education.

CHAPTER IX.

GEOGRAPHY AND HUMAN CULTURE.

We use the word culture here in its more general meaning of civilization. The influence of various geographical factors in the historical and economic development of countries is now a well recognized principle. The foundation of cities at strategic points for trade or manufacturing, or for both; the tendency towards the greater settlement of peoples in areas of low or moderate altitude, and the influence of mountain life upon the character are familiar illustrations. New York and Montreal are excellent examples of the first mentioned. Then that the greater density of population follows the lines of low or moderate elevation is well shown in the Atlas of Canada issued by the Dominion Government in 1915. One map represents the density of population in eastern Quebec and the Maritime provinces, and another the density in western Quebec and Ontario. Different shades of brown indicate the different degrees of density. The deepest shade of brown is found in the valleys and in their lowest parts. Mountain life makes for the development of the hardier virtues; that its isolation may also produce a rough or crude culture has been illustrated in recent fiction.

The area of greatest density of population in Quebec is, of course, in the Lowland Plain from Quebec City westward. East of this city the density is greater on the south shore than on the north shore, but this is partly balanced by the now considerable settlements along the Saguenay River and in the Lake St. John district, water routes being generally favorable to settlement. The population of the Gaspé peninsula is represented on the density map as a surrounding fringe some ten miles wide, with the deeper shades of brown predominating on that part of the coast which faces Chaleur bay. The central part of the peninsula is mountainous and is represented in white, that is, with less than one inhabitant per square mile. In the Eastern Townships the differing shades of brown do not coincide, as might be expected, with the different altitudes caused by the Appalachian ridges and their wide intervening valleys. The reason is that these hills are much more "worn down" in the Eastern Townships than in Gaspé, and hence are frequently cultivated to their tops. Since 1880 there has been considerable growth of population on the southern portion of the Laurentian Plateau, which railway building and the opening up of new territory like the Abitibi are destined to extend still further.

Readers of Parkman's histories can be in no doubt as to the character of the immigration from France to Canada in the seventeenth cen-

tury. As soon as the possibility of peaceful settlement on the soil was assured by the punishment of the Iroquois (1667), the Marquis de Tracy urged upon the king the necessity of starting this settlement with "good seed." Except for a small proportion of what Mother Mary of the Incarnation described as "mixed goods" (une marchandise mêlée), and which did not remain long, that immigration was in general of a good and sturdy quality. Coming mostly from northwestern France (although recent investigations have shown that the areas drawn from were more widely scattered than was long supposed) the majority were geographically suited to the Canadian climate. It is certain, at any rate, that only a hardy and sound race could have produced the intrepid and adventurous "coureurs de bois," while the men who settled on the lands of the seigneurs as farmers displayed a native spirit of independence in demanding to be called "habitants" (inhabitants or residents) rather than "paysans" (peasants) with its suggestion of the feudal conditions which still remained in France.

Geographical and political separation have largely preserved in Canada the French language of the eighteenth century. No error can be greater than that of describing Canadian French as a "patois," although the error is too constantly repeated. No spoken language stands still. Words and phrases, as well as pronunciation, are constantly undergoing change. The

English language in England is now considerably different from the same language in the United States and parts of Canada. The French language in France to-day is different from that of the eighteenth century; so also Canadian French is somewhat different from that of the eighteenth century. The essential difference between the two modern forms of the same language is that in Canada more words and phrases, and more of the pronunciation, of the eighteenth century have been preserved than in France. Considering that in addition to geographical and political separation, Canada and France were also isolated commercially, intellectually and socially for about sixty years — roughly from 1760 to 1820 — the truly remarkable fact is the substantial preservation of the language under these circumstances. In his "Antiquity of Man," Sir Charles Lyell, speaking of the rapid changes which modern languages undergo, referred to the case of a German settlement in Pennsylvania. From 1792 to 1815, a short period of only twenty-three years, this group of people was isolated from Germany by the European wars of that time. Shortly after 1815 Prince Bernhard of Saxe-Weimar visited America, and he found the group speaking an "obsolete dialect." In 1841 Sir Charles Lyell himself visited them, and found their newspapers full of English words — as "fencen," to fence, instead of umzaeunen; "flauer" for flour, instead of mehl, etc., and he expressed the

opinion that if it were not for the constant flow of immigration from Germany which began after 1815 the Germans of Pennsylvania would have developed, in the course of a few generations, a language unintelligible to Germans or to Anglo-Saxons, although containing elements from both languages.

The Germans of Pennsylvania, of course, were surrounded by, and intermingled with, English speaking people, while on the other hand, French Canadians, from 1760 to 1820, although wholly separated from France for that long period, had contact only with the comparatively limited number of English speaking people in Canada at that time. This circumstance, together with the attachment of the people to their own culture and the influence of the highly educated professional classes, largely preserved the language. Changes, however, took place, just as they have taken place in France. In Canada a number of sea-faring words became used in a new sense, such as "embarquer" for "monter"; and in time, as the English population increased, some English words were adopted, just as other English words were adopted in France. But with the resumption of intercourse with France during the last hundred years through trade and other channels, with the much wider contact with French literature which followed, with the general spread and increase of popular education, with the great development of the French news-

papers of the Province, with the creation of an extensive and important body of French Canadian literature, and, finally, by direct effort, the differences between the French language in Canada and France have been becoming steadily less marked. Such differences as do exist are of a purely philological or historical character. A French priest from France may preach to the congregation of a Quebec country parish with the certainty of being well understood. When Sir Wilfrid Laurier addressed various audiences in France some years ago it was remarked that the pronunciation of only a word or so, here and there, was 'slightly quaint', and the more learned at once recognized the quaintness as the common pronunciation of the eighteenth century. Moreover, every pupil in the English schools of Quebec who is mastering French by the Oral Method, and by the reading of modern French literature texts, is fully aware and confident that when that mastery is attained it will have afforded the practical and unquestioned command of the French language as it is written and spoken in Canada. This would not be the case if Canadian French were a 'patois'.

The effects of geographical distribution and environment upon culture or civilization constitute one of the most important problems in the government of the world to-day. This was recognized when geographical experts were called in to assist in the re-drafting of the map

of Europe after the Great War. They were not summoned to give merely the kind of information that is obtained from survey records, but to advise in regard to those larger factors of national affinity or otherwise which have been considerably determined by geographical distribution in the past.

Nowhere does this problem require more attention than in the British Dominions, composed as they are of so many different races, creeds, and cultures, under diverse geographical conditions. It is this, indeed, which makes the facts ,the meaning and the purpose of Historical Geography so highly important. If the several commonwealths of the Empire are to hold together with the Mother Country to the best interests of world government, it is not by force but by great principles that the connection can be maintained. They cannot be united by tariff bonds which every change in the market might render irksome to one or another of the widely separated partners, but each has the magnificent task of developing those principles that experience has shown to have been the most successful, not merely in extending the sphere of British political institutions but in rendering them the instruments of sound progress and normal development for all concerned. This is idealism, it is true, but it is an idealism which accomplished much real work in the second half of the nineteenth century, after it was realized that a Greater Britain was fast growing to

maturity in different parts of the globe. It is idealism, but it is one that cannot with safety be ignored.

The Fathers of Confederation recognized that one of the chief problems in the development of national unity in Canada hinged upon a geographical factor. The Dominion is three thousand miles wide, and the general settlement of population extends across the southern fringe. In 1867 the settled areas were almost wholly in eastern Canada, but the western prairies were soon opened up for cattle-grazing and wheat-growing. To hasten that settlement, and at the same time to afford the means of inter-provincial communication, the Canadian Pacific and the Intercolonial railways were projected and built.

The transcontinental railways, and water communication during half the year through the Great Lakes, the canals, and the Great River, have been and are important and indispensable aids to the development of national unity. They have operated by creating currents of inter-provincial trade, as well as east and west intercourse generally, but at the same time the fact that the nine provinces form four distinct geographical or physiographic units has to be taken into account. These units are, 1. British Columbia, 2. Alberta, Saskatchewan and Manitoba, 3, Ontario and Quebec, 4. Nova Scotia, New Brunswick and Prince Edward Island. The differences in economic development arising from

geographical position, together with the fact that each of the four units has more or less trade intercourse with corresponding units of the United States, have naturally led to some diversity of interests east and west, although this diversity is no greater than that which is manifest in the differing economic interests of the eastern and western United States.

But it is the differences in cultural ideals, arising not merely from geographical position but also from those historical causes which are more or less of a geographical nature, that have made more than one Canadian statesman exclaim that "Canada is a difficult country to govern," and have impelled many to impatiently desire some magic "melting pot" to mould all Canadians alike from coast to coast!

The melting pot, however, implies forceful methods and has for its end uniformity rather than the truer unity which may be based upon diversity. It is just here that historical geography and British idealism suggest higher principles.

The Canadian people consist of two sound stocks, an English speaking and a French speaking, but geographical distribution having placed the majority of the one in eight provinces and the majority of the other in one province has at times rendered mutual interpretation difficult. Not difference of language only, but differences of temperament, of culture, of ideals, of institutions, and of inherited political thought, have

made it difficult for each to fully understand the other.

We have spoken of the attachment of French Canadians to their language. Not less great is their attachment to the soil of Canada. This strongest national tie is sometimes misinterpreted. It is explained, however, by some simple facts of historical geography. Most of us who belong to the English speaking majority of Canada, and at the same time are of British birth or of British descent in the first, second, third, fourth or fifth generation, retain more or less personal connection with the mother country. Widespread family relationships between the old country and the new have frequently been maintained from the days when Canada was a "colony" to the present time, and these relationships have constituted a strong factor in the maintenance of British connection.

On the other hands, the 65,000 French Canadians who remained in Canada in 1760, and who for sixty years after that date were wholly isolated from France, retained, at least so far as the great majority were concerned, no such family relationships with their mother country. Separation was almost complete; and as the English population of the country did not increase appreciably until the beginnings of the nineteenth century, the development of a French Canadian nationality, with ideals and institutions of its own, was inevitable. A culture, different in expression from that which English

Canada inherited from Great Britain or borrowed from the United States, was thus created. It is upon the growth of a deeper mutual appreciation of all that is best in these two cultures, by means of a wider practical knowledge of the two languages and a more profound study of Canadian history, that a broad and truly Canadian spirit should be based, and the development of that mutual knowledge and appreciation is one of the highest of our political duties as a people.

Fom Waltham in the county of Pontiac to Gaspé in the county of Gaspé is a distance of about nine hundred miles by railway. It is along this southern boundary of the Province that the English population is distributed chiefly. The greatest density is on the Island of Montreal, and the least density on the area between Levis and Matapedia, although along most of the St. Lawrence River between Montreal and Quebec there are but few English speaking people. The Atlas of Canada (1915) shows that the predominating element in the Eastern Townships is of French origin. In 1837 that section of the Province had 37,000 English speaking people and 4,000 French speaking. In 1887 the English element had increased to 76,000 but the French had increased to 107,000. This fact, together with the diminution of the English people in certain counties during recent years, has been described as a

"tragedy" peculiar to Quebec. The present writer lived in the Eastern Townships for thirty years and has long been convinced that the movement of the English rural population from that section to the cities and to the West has been parallel in economic origin to the similar movement of the English rural population from other eastern provinces and from such states as Massachusetts and Vermont. It is a regrettable movement, nevertheless, and so far as farming is concerned it is now being recognized that it is not justified on economic grounds in general. The climatic conditions, the soils, the markets, and the marketing facilities, are important factors which render the business of farming a certainty from year to year in the Eastern Townships, and this should tend not only to hold the prosperous English farmers in that section, but attract others.

The diminished English population in a number of the townships has rendered it more difficult to maintain the rural Protestant schools. Exactly the same conditions in this respect which prevailed in the state of Massachusetts after the close of the Civil War, and which led to the adoption of the plan of conveying pupils to a central consolidated school, prevail in the Eastern Townships and other sections of the Province. In recognition of this fact the Government of the Province has been providing for some years special annual grants in aid of consolidation of Protestant rural schools. The

system enables such townships to have schools of higher rank than elementary, every consolidated school being either an intermediate (nine year course) or a high school (eleven year course). Where such schools are established they tend to hold the English population together.

In the financial and industrial affairs not only of the Province but of the Dominion the English element of the city of Montreal has long held a commanding position. During the hundred years since James McGill made possible the beginning of the great university which bears his name a long line of broad-minded merchant princes have contributed not only to the expansion of that university but to the endowment of other institutions of immense service to the community and the country.

APPENDIX

LIST OF SOME ALTITUDES IN THE PROVINCE OF QUEBEC.

(Top of rails in front of railway station.)

Places	Above sea level (in feet)
Gaspé Village	9
New Carlisle	9
Port Daniel	15
Quebec (C.P.R.)	19
Escuminac	23
Three Rivers	51
New Richmond	53
Matapedia	54
St. Lambert	74
Hudson	91
Delson	92
St. Hyacinthe	109
Ste. Anne de Bellevue	117
St. Johns	117
Clarenceville	122
Howick	132
Ormstown	138
Lacolle	154
Valleyfield	158
Huntingdon	165
Stanbridge	169
Bedford	179

Farnham	191
Paspebiac	191
Hull	191
Joliette	201
Aylmer	216
Lachute	228
Drummondville	265
Quion	278
Wakefield	330
Shawinigan Falls	364
Cowansville	379
Richmond	390
Bristol	396
Windsor Mills	419
Rawdon	424
Sherbrooke (G.T.R.)	485
" (C.P.R.)	592
Kingsbury	550
Ayer's Cliff	558
La Tuque	563
Manawaki	570
Shawville	572
Arundel	618
Waterville	645
Foster	696
Dudswell	699
Magog	688
Cookshire	685
St. Jovite	700
Compton	733
Sawyerville	885
Bulwer	939

Coaticook	1006
Thetford	1026
Bury	1063
Scotstown	1195
Ste Agathe	1207
St. Faustin	1254
Gould	1302
Parent	1401
Milan	1645

REFERENCE. Altitudes in Canada. James White. Commission of Conservation, Ottawa. A government publication which may be consulted at most public libraries.

GLOSSARY

ANORTHOSITE. A granular igneous rock composed almost exclusively of a soda-lime feldspar.

ANTICLINE. A fold of rock strata arching upwards. In a syncline the fold is downwards, forming a trough.

ARKOSE. A sandstone derived from the disintegration of granite or gneiss, and characterised by feldspar fragments.

ASBESTOS. An alteration product in serpentine rock, occurring in long and delicate fibers, or in fibrous masses or seams. Resistant to fire and many chemicals.

BOULDER. Large or small masses of rock on surface of ground. 'Transported' boulders are those which were carried in or on the ice-sheet in the Ice Age. Many have been carried hundreds of miles. They vary in size from a foot to many feet in circumference. Sometimes they were carried but a short distance by the ice-sheet. Thus at Richmond, Que., there is a boulder of quartzite weighing over twelve tons which had been carried only half a mile by the ice-sheet from the parent quartzite ledge. The transported boulders show the results of ice-action by being more or less rounded.

'Local' boulders are usually angular. They have fallen from cliffs or ledges in the immediate vicinity, usually by the action of frost.

BOULDER CLAY. The lowest transported deposit of the Ice Age. The clay consists of scraped rock, and the included boulders are usually small and much scratched.

BRECCIA. A rock composed of angular fragments, larger than sand grains, cemented together, and often presenting a variety of colors.

CONGLOMERATE. A rock composed of rounded fragments, cemented either with carbonate of lime or silicâ.

DENUDATION. A general geological term for the wearing away of rocks; erosion.

DRUMLIN. An elongate or oval hill of glacial drift (gravel etc.) with its longer axis parallel to the direction that the ice-sheet moved.

DIKE or DYKE. Igneous rock filling cracks or fissures of varying width in other rocks.

ESKER. Like drumlins, eskers are formed of glacial drift. But while drumlins form hills, sometimes over a hundred feet in height, and are oval from end to end, the eskers are usually from four to ten feet in height and are continuous for long distances. In

Scandinavia there is an esker over sixty miles in length. The esker is believed to have been formed as a sort of river of sand and gravel under the melting ice-sheet.

FORMATION. One of the sub-divisions of a geological Period. Sedimentary strata of the same general character formed at the same time and containing similar fossils throughout large areas. Thus, the Trenton formation.

FOSSIL. The remains, impression or trace, of an animal or plant of past geological ages, which has been preserved in sedimentary rocks.

GNEISS. Granite and similar igneous rocks which, by alteration, have had their constituents arranged in a banded form.

GRANITE. An igneous (plutonic) rock consisting usually of quartz and feldspar, with either mica or hornblende.

IGNEOUS. Applied to all rocks which were formed in a molten condition.

INTERGLACIAL. The Ice Age was marked by intervening mild periods of long duration, during which the ice-sheet retreated northwards and ordinary conditions of plant and animal life were resumed.

KAINOZOIC. The last great era of geological time, from the Eocene to the present.

KAME. Like the drumlin and the esker, kames are deposits of glacial drift, but instead of having been formed under the melting ice-sheet it is more probable, from their shape, that the gravel, etc., burst forth from the base of the retreating ice-front, owing to the pressure of the streams under the ice-sheet, and deposited the materials in the oblong heaps which are less oval than the drumlins and shorter than the eskers.

MAGMA. The name applied to the soft plastic mass of igneous rocks before they have cooled and crystallised.

MESOZOIC. The great era before the Kainozoic, divided into the three Periods — the Triassic, Jurassic and Cretaceous. It was essentially the era of the "monsters of the slime". Fossils of the gigantic reptiles found in the rocks of Alberta are exhibited in the Museum of the Geological Survey, Ottawa.

METAMORPHIC. The name applied to such rocks, whether originally sedimentary or igneous, which have been altered or metamorphosed by heat, pressure and other causes.

PALEOZOIC. The first great era of the sedimentary rocks, consisting of the following periods — Cambrian, Ordovician, Silurian, Devonian, Carboniferous, Permian.

PENEPLAIN or PENEPLANE. Almost a plain.

PLATEAU. A plain which rises visibly with some steepness on at least one side from its surroundings of land or water.

PLUTONICS. Igneous rocks which have cooled and crystallised in the depths of the earth.

PRE-CAMBRIAN. The general name applied to the vast era which preceded the Paleozoic. The oldest known rocks.

SCHIST. Any metamorphic crystalline rock having a closely foliated structure, such as gneiss. Slate has a **schistose** structure, that is, it can be readily split up into thin leaves (foliate). Most schists, however, are difficult to split in this way.

SEDIMENTARY ROCKS. All rocks which have been formed in the seas and lakes by the deposition of particles of land waste, such as shales and sandstones. The name Aqueous is also used, as being more comprehensive and including chemical (gypsum for example) and organic (coral lime-stone) deposition. In general, sedimentary rocks are Stratified (See Strata).

SERPENTINE. A hydro-silicate of magnesia. The rock has usually a dull green color. There is an extensive serpentine band in the Eastern Townships, containing the alteration product asbestos. Serpentine itself is an altered or metamorphic rock.

SHALE. Hardened mud rock, usually splitting

easily into thin leaves (foliate), like schists, but shales are not 'crystalline'.

SILICA. Oxide of silicon. Most important rock substance. Quartz, quartzite and sand are almost pure silica. Enters into many species of rock, forming silicates.

STRATA. The layers in which sedimentary rocks are formed. Layers of limestone frequently have the appearance of having been built like a wall. Sometimes igneous rocks imitate stratification, having formed, on cooling, into beds with joints and bedding planes. But when rocks are described as Stratified, sedimentary rocks are alone referred to.

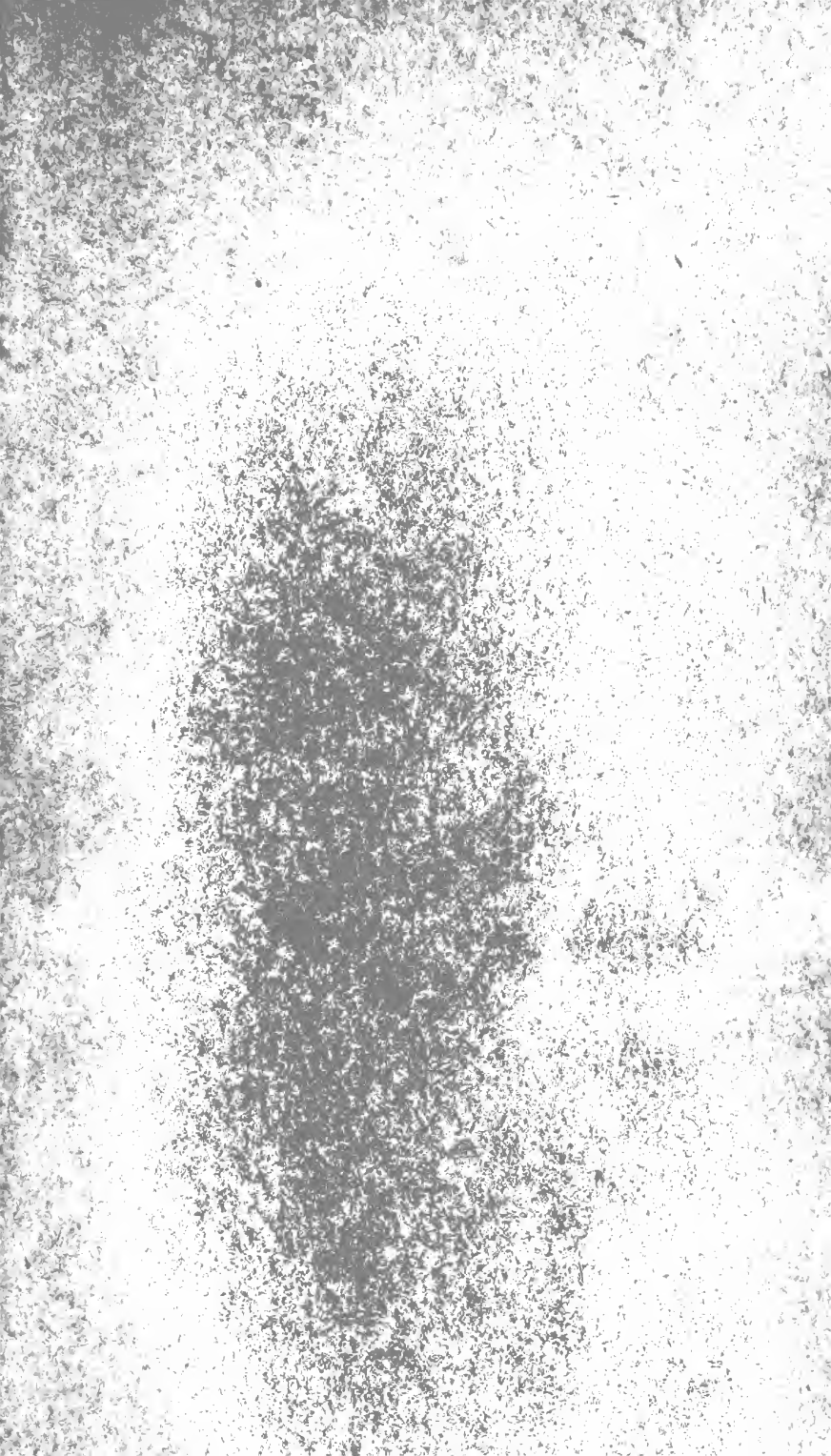
STRIAE. The scratches found on ledge rock over which the ice-sheet had passed. The under load of pebbles rather than the ice produced the striation. The striae are mostly parallel, and over large areas point uniformly in one direction — the direction from which the ice moved. Sometimes the striae become deep grooves.

SYNCLINE. The reverse of anticline, which see.

U-SHAPED VALLEYS. U-shaped valleys in mountain areas owe their origin to ice action.

V-SHAPED VALLEYS. V-shaped valleys have been cut by river action.

VOLCANICS. Igneous rocks which have cooled and crystallised at or near the surface of the ground. See Plutonics.

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