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THE OXFORD SURVEY
OF THE BRITISH EMPIRE

VOLUME IV



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DOMINION OF CANADA — OROGRAPHICAL AND POLITICAL.

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THE OXFORD SURVEY OF THE BRITISH EMPIRE

A M E R I C A

INCLUDING CANADA, NEWFOUNDLAND
THE BRITISH WEST INDIES, AND THE
FALKLAND ISLANDS & DEPENDENCIES

With 37 Photographs, 6 Coloured Maps, and 14 Figures in text

Edited by

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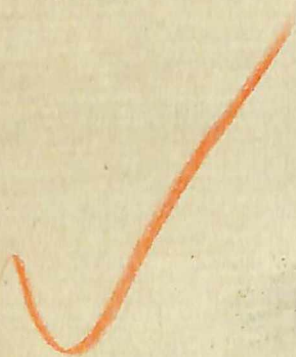
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PREFACE

THE object of this series is to furnish a survey of the British Empire and its constituent parts in their geographical and allied aspects, together with their economic, administrative, and social conditions, at the present time. History has not been included as an integral part of the scheme, except for the inclusion of a general historical summary in the General Volume; for the rest, historical references have been included only in so far as they were found desirable for the explanation of existing conditions. The history of the Empire has been brought under review elsewhere, notably in the Oxford *Historical Geography*, edited by Sir Charles Lucas.

The series is in six volumes, and the subject-matter is thus distributed :

- I. The British Isles and Mediterranean territories (Gibraltar, Malta, Cyprus).
- II. Asiatic territories.
- III. African territories (with adjacent islands, Mauritius, &c., St. Helena, Ascension, and Tristan da Cunha).
- IV. American territories (with the Falkland Islands and dependencies).
- V. Australasian territories (including islands in the Pacific Ocean and the British sector in Antarctica).
- VI. General.



AMERICA

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The Editors have been in close consultation throughout as to the general plan and details of the work. They have shared between them the arrangements with the contributors, for whose collaboration they express their thanks. Professor Herbertson has undertaken the major part of the work connected with the maps; Mr. Howarth has carried out the greater part of the editorial work in its later stages, has dealt with the illustrations (in the five topographical volumes), and has seen the volumes through the press.

It is desired to acknowledge Mrs. Howarth's collaboration in the work of indexing, and Mr. O. Brilliant's assistance in the compilation of the gazetteer references in the topographical volumes.

Notes in the text enclosed in square brackets are editorial.



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CANADA

INTRODUCTION

THE Dominion of Canada, with an area substantially exceeding three and a half million square miles, comprises the whole of the North American continent north of the United States, with the exceptions of the Atlantic seaboard of Labrador, which belongs to Newfoundland, and Alaska, which belongs to the United States. The Dominion extends through 84° of longitude, its easternmost extremity being in the province of Quebec, on the north shore of the Strait of Belle Isle, and its westernmost boundary being that between the Yukon Territory and Alaska. It is divided from east to west into the following provinces—the Atlantic Maritime Provinces of Nova Scotia, Prince Edward Island, and New Brunswick; Quebec, covering a strip south of the River St. Lawrence and the whole territory north of it to Hudson Strait; Ontario, extending from the Great Lakes northward to Hudson Bay; Manitoba, Saskatchewan, and Alberta, essentially the provinces of the interior continental plain; and British Columbia, the province of the western mountain region or cordillera. Beyond 60° N. lat., northward to the Arctic region, and, so far as concerns the mainland, westward of Hudson Bay, extend territories not organized under provincial government: these are the North-West Territories and Yukon Territory. The international boundary with the United States of America may be traced in the east as a line partly following natural features but partly artificial; it then follows the upper course of the river St. Lawrence and runs through lakes Ontario, Erie, Huron, and Superior, is demarcated mainly by rivers and lakes westward to the Lake of the Woods, and thence to the Pacific Ocean, in Boundary Bay of the Strait of Georgia, follows the line of 49° N. lat.



CHAPTER I

PHYSICAL GEOGRAPHY AND GEOLOGY

BY PROFESSOR A. P. COLEMAN

General Introduction

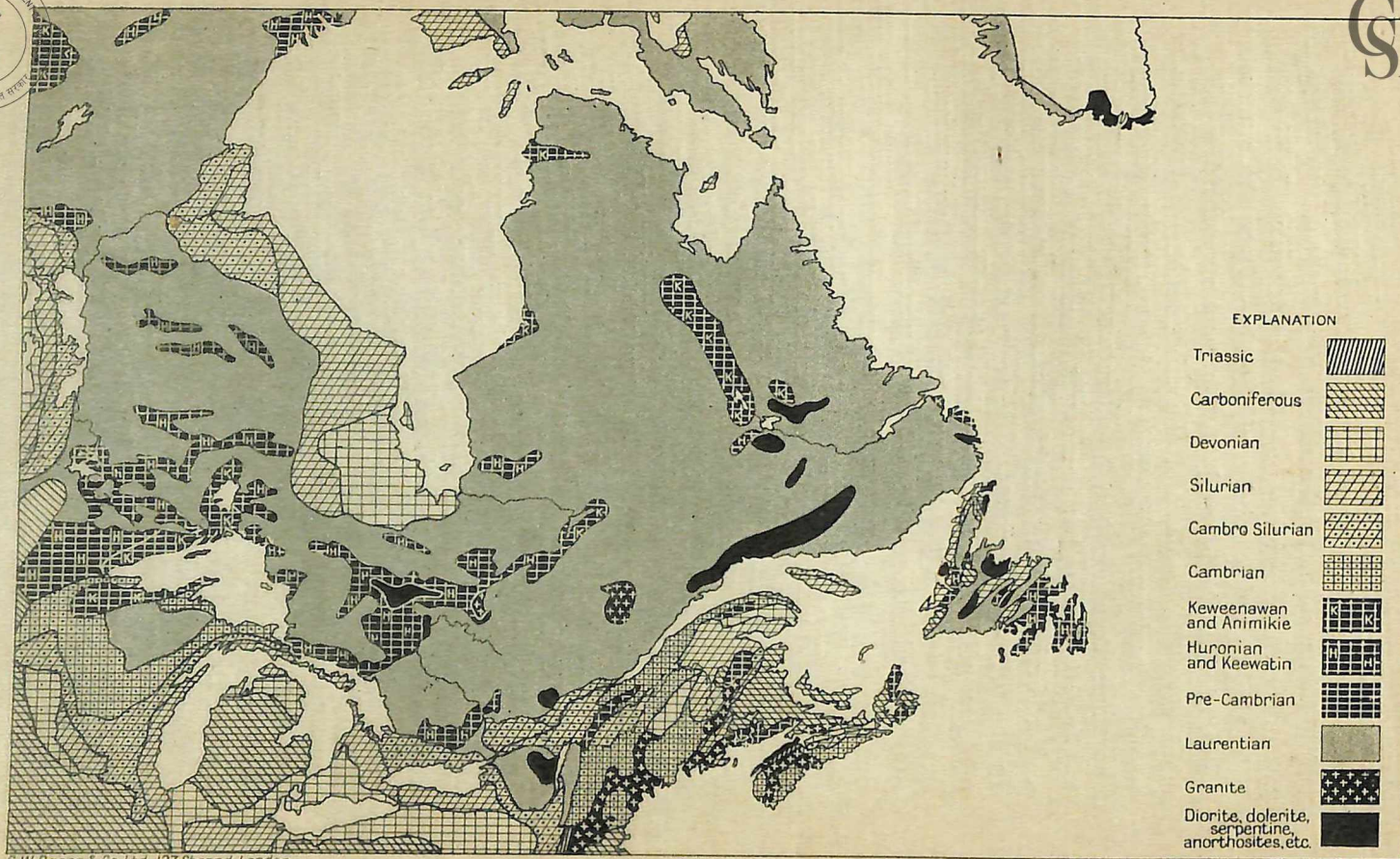
Physical
regions.

DR. GEORGE DAWSON, many years ago, when Director of the Geological Survey of Canada, divided the country into physical regions, each having certain predominant physical features resulting from the geological history sketched in the following pages. His subdivisions were as follows :

1. The Acadian region, including the Maritime Provinces, south-eastern Quebec, and Newfoundland.
2. The Lowlands of the St. Lawrence valley, including the southern part of Ontario.
3. The Laurentian Plateau.
4. The Interior Continental Plain.
5. The Cordillera.

These regions cover all the well-known parts of Canada—those which are inhabited by white men or crossed by railways—but two other somewhat distinct regions may be recognized, namely, the Lowlands of James and Hudson Bays, and the Great Northern Islands. The additional physical regions suggested are at present of little practical importance, since, except at a few trading posts, their population includes only Indians or Eskimo ; but the southern one has possibilities of settlement. Among the names employed by Dr. Dawson, the word ‘ plateau ’ used for the Laurentian area is not entirely suitable, since much of the surface included in it lies below 1,000 feet, and large portions round Hudson Bay rise little above sea-level. This greatest of all the regions may better be called the Canadian, Laurentian, or Archaean Shield, following Suess’s suggestion below.

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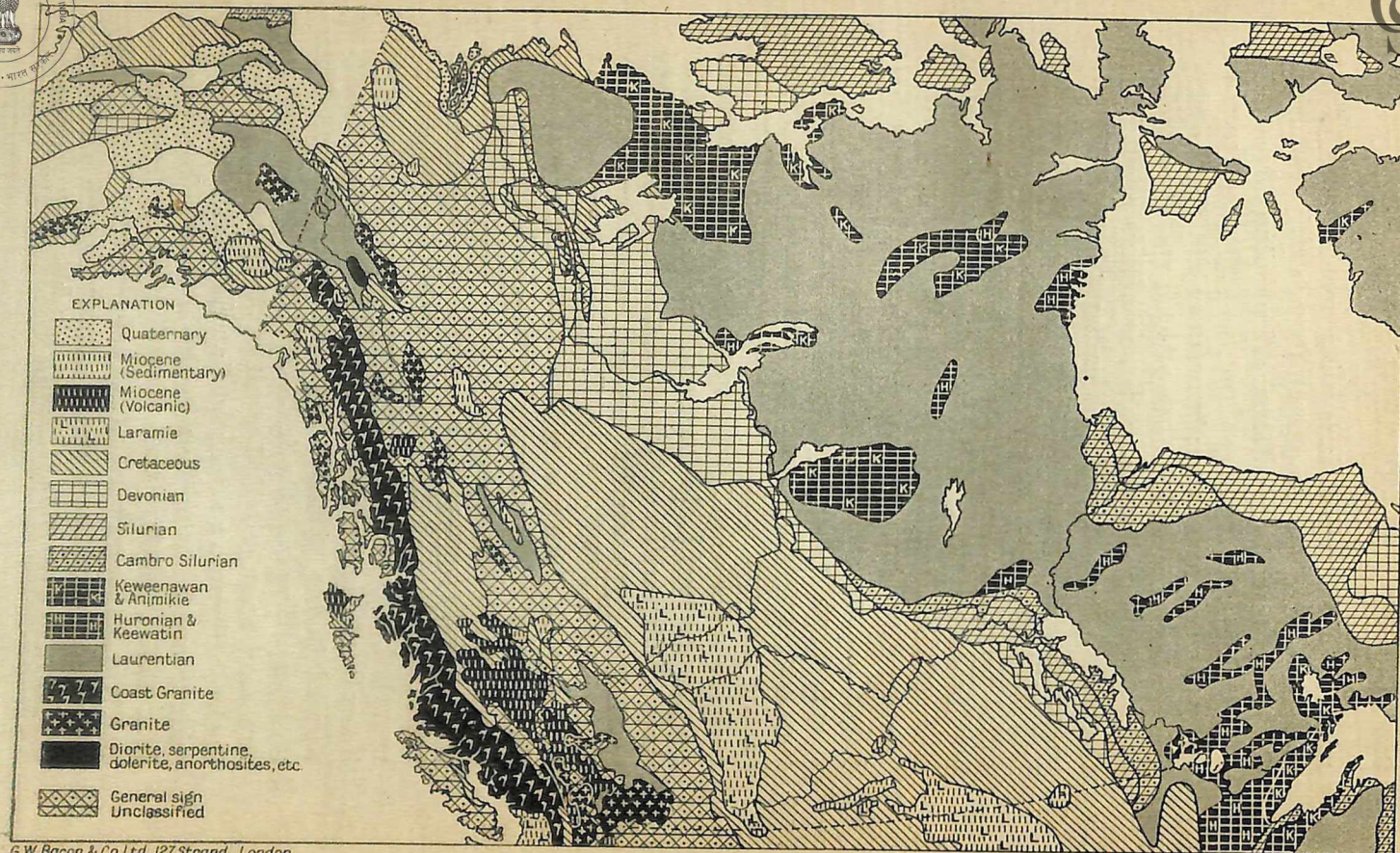
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FIG. 1. Geology of Eastern Canada.

Of the natural divisions just mentioned, the Laurentian Shield far surpasses all the others in extent, covering about 2,000,000 square miles out of the total of 3,600,000 belonging to the Dominion of Canada. From the human point of view, however, it is the least important of all, since even the smallest of the other regions is far more populous and wealthy. This is due partly to its rocky character and the forbidding climate of its northern parts ; but as railways are built across its southern end the miner and the farmer are pushing northwards successfully. In the following account of the physical geography and geology of Canada, most attention will naturally be devoted to the better known portions ; while the almost uninhabited northern territories of the Dominion, known only from track surveys along canoe routes or from winter travel with dog-trains, will be more briefly sketched. After brief notes on the geological history of the country it will be convenient to begin by describing the south-eastern parts, long known and completely explored, and then to advance to the north and the west where our knowledge is less complete. This will follow also the historical development of the provinces of the Dominion, which began with the open gateway of the Gulf of St. Lawrence and proceeded up the great river to Ontario and the other lakes in succession. As one enters the Gulf of St. Lawrence by ship, following the southern route, the folded Palaeozoic rocks of the Appalachian system show towards the south ; and not long after the high and rugged edge of the Archaean Shield rises towards the north as the steamer nears Quebec ; while the inland voyage to Montreal affords an introduction to the Lowlands of the St. Lawrence. The historic route thus opens up to the traveller three of the physiographic regions outlined by Dr. Dawson.

Historical
introduc-
tion.

The central and eastern parts of Canada are geologically of extreme old age, and form probably the largest area of Archaean or pre-Cambrian rocks in the world. While this antiquity is the most striking characteristic of the country, comparatively recent geological events have



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FIG. 2. Geology of Western Canada.



rejuvenated the region, impressing upon it many of the characters of youth. As a result Canada presents impressive contrasts in geological structure and physical features.

The
Canadian
Shield.

When Sir William Logan and his assistants began to study the geology of Canada north of the St. Lawrence and the Great Lakes, it was found that the more ancient and crystalline rocks, the nucleus or protaxis about which the rest of the continent was built up, extended north-eastwards and north-westwards on each side of James Bay and Hudson Bay; and the American geologist Dana called the Canadian Archaean with its spreading arms a V-formation. Later it became evident that the ancient rocks extended in an irregular belt along the north side of Hudson Bay also. The two ends of the V were thus joined, making a rude triangle, with blunted angles, more than 2,000 miles long from east to west, and 1,500 broad from north to south. The great Viennese geologist, Suess, named this vast area of Archaean rocks *the Canadian Shield*, and the term has been accepted by later writers. Instead of a boss projecting from the centre of the Shield, there is a depression of very old standing, which has long been filled by a shallow sea and is now occupied by Hudson Bay.

Archaean
protaxis
of the
west.

Though this was the main nucleus of the continent, North America did not grow up symmetrically around it as might have been expected, since another Archaean protaxis exists 500 miles south-west of the edge of the Shield, that of the Selkirk and the Gold Range Mountains near the Pacific coast. This is long, narrow, and somewhat interrupted, and runs from south-east to north-west parallel to the western margin of the continent. The débris resulting from the destruction of these mountainous Archaean areas provided much of the material piled up in the shallow sea around; and on their flanks and in the wide trough between them marine Palaeozoic rocks were laid down. Later there were Mesozoic sediments, partly marine and partly freshwater or land formations, deposited upon them, almost completing the outline of Canada and extending far south into the United States.



The growth of the continent appears to have been one-sided and not as a uniform aureole about the Shield and the south-western protaxis, since the Palaeozoic and the Mesozoic sediments are entirely lacking along the north-east side on the coast of Labrador. It may be, however, that the slipping down of blocks of the Earth's crust between America and Europe has hidden beneath the Atlantic the evidence of a symmetrical outgrowth from the Shield on this side.

Growth of the continent about the Shield.

With the growth in area went the upheaval of mountains, first in Archaean times, when apparently the whole surface of the Shield was covered with great mountain chains, next at the end of the Palaeozoic along the south-eastern and south-western sides, and finally at the end of the Mesozoic, when the Rocky Mountains were elevated on the margin of a shallow interior sea.

Outside this area of mountain-building the rocks are surprisingly level and undisturbed even when of great antiquity, and the continent seems to have been very stable, though there have been comparatively gentle risings and sinkings in various parts of its surface.

The physical geography of Canada is rooted in these far-off events, and the structures which they produced, modified and partly covered up during more recent ages, giving the blending of ancient and modern features referred to before as characteristic of the country.

In Great Britain a few hours of travel carry one across an astonishingly complete series of geological formations, so that England provides a compact edition of the history of the world. America is constructed in general on a simpler and broader plan than Europe, so that in Canada it is necessary to cross almost the whole width of the continent to find a fairly complete series of geological formations. Though nearly all the important divisions of geological time have a record in some part of Canada, comparatively few of them have left a marked impression on its geography, and only those of importance in this way need be referred to here.

Outline of Canadian geology.



Archaean
rocks :
Lauren-
tian.

As the Archaean or pre-Cambrian of the Canadian Shield covers more than half the Dominion, the rocks formed in this most distant and obscure of the geological ages are of prime importance and their history should be briefly outlined. The lowest rocks of all are the Laurentian granites and gneisses. The latter, with their banded colours and well-marked cleavage, were once believed to be sedimentary rocks, sandstones and shales laid down on a sea-bottom and afterwards highly metamorphosed. We now know that they are deep-seated eruptive rocks, molten materials that pushed upwards into the cold rocks above, lifting them as domes by their sluggish movement and solidifying slowly at great depths below the surface. These great domes of gneiss and granite are called batholiths, and they form the commonest structure of the Archaean region.

Keewatin. Though the Laurentian rocks underlie all others, they are not the oldest of all, since the Keewatin rocks, which they heaved on their shoulders and into which they sent dikes of granite, must have been cold and solid at that time. The Keewatin¹ also consists chiefly of eruptive rocks, but mainly lava flows and volcanic ash (tuff) now metamorphosed into greenstones and schists. In many places thick deposits of ordinary sediments are associated with them, now changed to gneiss or mica-schist, and also the banded jasper and iron ore of the iron formation.

Grenville
series.

The Grenville series of the southern Archaean, probably of the same age, contains also much marble or crystalline limestone. During Keewatin times many thousands of feet of lava, ashes, and mud and sand were laid down on a sea-bottom that has utterly vanished. Then came the eruption of the domes of gneiss, lifting the earlier rocks into great mountain ranges. Afterwards these earliest mountains were worn down to stumps, disclosing the foundations of granite and gneiss enclosed in a rude network of Keewatin schist. The process of destruction must have been enormously long and was so complete that only a hilly plain remained when the next formation,

¹ [The middle syllable is sounded as 'way'.]



the Huronian, began. Many parts of the Shield still have surface-forms outlining these ancient mountains.

The Huronian begins remarkably with a great sheet of Huronian boulder clay (tillite) formed by wide-spread glaciers, indicating at that early time a climate colder than at the present. Upon the boulder conglomerate water-formed sediments were laid down, now slate or quartzite or limestone. In many places these Huronian rocks still lie nearly flat on the worn surfaces of the older rocks, but in others they too were caught in mountain-building operations and were squeezed and rolled out into schists. Both varieties have left their impress on the scenery.

The Animikie (or uppermost Huronian) is also made up of sediments, very modern in appearance, since they have entirely escaped mountain-building forces.

The Canadian Archaean ends with another outburst of Keweenaw volcanic activity in the Keweenawan, when thousands of feet of lava, as well as ash rocks and coarse sandstones and conglomerates, were piled up on various parts of the old continent. These lavas not only influence the surface features greatly, but are important as the source of the ores of silver, nickel, and copper mined on a large scale in northern Ontario.

More than half of Canada owes its arrangement of hills and valleys and watercourses to forms shaped in the Archaean rocks, which have been more or less worked over, however, and sometimes obscured, by later activities.

The Palaeozoic formations are all well represented in Palaeozoic Canada, and limestones, shales, and sandstones of its various ages (Cambrian, Ordovician, Silurian, Devonian, and Carboniferous) play important parts in shaping the country, but need no special reference here. In many cases they still lie almost as undisturbed as when they formed the sea-bottom, but in far eastern Canada the Palaeozoic ended with the Appalachian mountain-building period, during which they were crumpled into great folds or torn asunder with profound faults. The Carboniferous of the Atlantic coast is valuable for its



important beds of coal, but is barren in the western mountains.

Mesozoic. The earlier parts of the Mesozoic (Triassic, Jurassic) are poorly represented in Canada, but the later part, the Cretaceous, is of extreme importance not only for its extent but also for its economic features. It contains no chalk, but its crumbling sandstones and shales underlie the prairies of western Canada. The climate, when they were formed, was so mild and moist that forests of leafy trees, like those of the present southern United States, covered what are now the bare plains. There were widespread marshes in which the plant tissues were stored, furnishing the beds of coal now mined at many places. The Laramie period, which includes the upper part of the Cretaceous and the lower part of the Eocene, bridges the gap between the Mesozoic or Secondary and the Tertiary, and is of interest especially because the Rocky mountains were elevated then, the latest, and therefore the highest, of the great ranges of Canada.

Tertiary. The continent was now complete so far as its main features were concerned; but during the Tertiary sediments were deposited in several small western basins, and in southern British Columbia there were volcanic eruptions covering thousands of square miles with lava or ashes.

Glacial Period. Towards the end of the Tertiary fossil plants show that the climate was growing colder, and with the Pleistocene or Quaternary began the Glacial Period. It lasted long and was interrupted by at least one inter-glacial period characterized by a warm climate. At its close the surface conditions of the northern part of the continent had been profoundly modified. The vast accumulations of loose materials, due to ages of weathering, were scoured away from the central parts of the glaciated areas, leaving bare rounded surfaces of fresh rock, while nearer the edges of the ice-sheets boulder clay was spread out or long loops of moraine were heaped up, blocking the valleys and transforming the whole system of drainage.

During the thawing of the ice-sheets, another type of



work was accomplished modifying the modelling of the surface in many places. The larger Canadian rivers flow north or north-eastward, and when the ice melted from the upper parts of their valleys the lower parts remained blocked. In the resulting glacial lakes sheets of silt or sand were deposited, and now form many thousands of square miles of the most fertile soil in the Dominion.

Under the load of ice, which was in some places two miles in thickness, the land sank some hundreds of feet, leaving thousands of square miles beneath the sea when the ice-sheets began to thaw. The removal of the load allowed the sunken portions of the continent to rise again, exposing wide belts of marine clay on the coastal plains. A large part of Canada owes its rich soil to recent water action in the two ways just mentioned, and all the flattest plains received their final smoothing from the silt thus deposited.

The geologically recent episode of the Ice Age has thus modified the old topography and hydrography of Canada, giving to one of the oldest lands under the sun its singularly youthful aspect.

Regional Description

The Acadian Region includes not only Nova Scotia, The New Brunswick, and Prince Edward Island, the original Acadian Region. Acadia, but also the mountainous south-eastern side of the province of Quebec. It is essentially maritime, almost all the towns and cities having grown up on harbours, which are numerous and excellent along the greatly indented coasts.

Nova Scotia is the most maritime of all, projecting Nova Scotia. like a great wharf into the Atlantic, the nearest part of the mainland to Europe except the inhospitable coast of Labrador to the north. As its name suggests, it may be compared to Scotland in various ways, including its geology and physical features. It has Archaean rocks like those of the Scottish Highlands, much folded and pierced by granite masses, and then levelled so that Palaeozoic sediments could be deposited on their truncated

edges. Then come anticlines of quartzite and slate of uncertain age, perhaps Cambrian, the gold-bearing rocks of the south-eastern coast. Most important are the Carboniferous sandstones and shales, as in the Lowlands of Scotland, forming shallow basins that dip gently beneath the sea in several places, especially on the north-east coast of Cape Breton Island, where the Sydney mines, the most productive coal-mines of Canada, are worked in places for miles beneath the sea. It is probable that the measures extend beneath the Gulf to Newfoundland where small areas of coal are found. The coal mined in this submarine field is used to smelt the haematite of Bell Island in Newfoundland, likewise mined below the sea, giving rise to the great steel industry of Sydney. A less important coal-field, that of the Joggins along the Bay of Fundy, is classic ground to the geologist through the early works of Lyell and Dawson.

Further to the south-west on the same side of the peninsula are the latest rocks of eastern Canada, a band of red Triassic sandstones flanked by a ridge of basaltic lava. Cape Blomidon, on the basin of the Minas at the north-east end of the basaltic hills, is well known for its fine agates and zeolites.

As in Scotland, much of the surface is rugged and hilly, especially where the disordered mountain structures of the Archaean project, but the hills are nowhere lofty, the highest scarcely reaching 1,400 feet. The coal-measures and other soft rocks make the bottoms of the valleys and are powerfully attacked by the Atlantic storms, so that the coal basins often have a bay eaten into their heart.

The long strip of Triassic sandstone on the Bay of Fundy side has been hollowed into the beautiful Annapolis valley, almost a continuous orchard under the protection of the North Mountain, the basaltic ridge mentioned above. There are several such smiling valleys eroded from the softer rocks by glacier ice and running water, locally called 'intervalles', contrasting strongly with the rough hills on each side. In some cases the carving has gone below the present sea-level, forming 'guts'

Valleys
and
fiords.



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PLATE I. SUSSEX VALLEY, NEW BRUNSWICK
(Office of the High Commissioner for Canada)

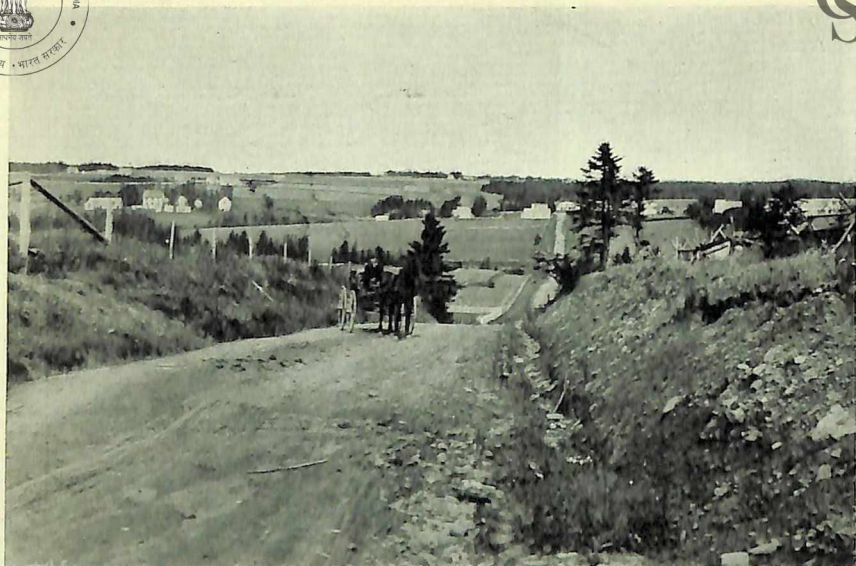


PLATE II (a). VIEW IN PRINCE EDWARD ISLAND



PLATE II (b). ST. FRANCIS RIVER, SOUTHERN QUEBEC
(Office of the High Commissioner for Canada)



or fiords, like the Gut of Canso separating Cape Breton Island from the mainland. The beautiful land-locked basin of salt water, Bras d'Or, in the centre of Cape Breton Island, is an expansion of such fiords. The tattered south-eastern fringe of fiordlets and islands is very characteristic of an area of ancient folded rocks broken by eruptive masses and then worked over by ice and the waves of a stormy sea. Though not high, this coast is rugged as compared with the smoother outlines of the more sheltered north-west side.

It has been suggested by Dr. Daly that the southern plateau of Nova Scotia, the higher parts of Cape Breton Island, and the Cobequid Hills running east and west in the narrow stem of the peninsula, are parts of a peneplain formed in Cretaceous times and then elevated and dissected. Fragments of a lower plain mainly of Carboniferous rocks are left along the Northumberland Strait and the Bay of Fundy, in the latter case scoured by the most powerful tides in the world. On the basin of the Minas and at other places these tides sweep vast quantities of red mud into the marshes, which have been diked, holding the mud to make rich hay meadows.

New Brunswick on the other side of the Bay of Fundy presents similar rocks and surface features, but rising to somewhat greater heights. In the northernmost part of the province Palaeozoic beds cut by felsites and other eruptive rocks were caught in the Appalachian revolution and form mountains often of more than 2,000 feet high, Mount Carlton reaching 2,716 feet. Their summits are rounded and densely wooded.

A triangular area of Carboniferous and Permian shales and sandstones between the hills to the south-east and those to the north-west escaped the mountain-building forces, however, and still lies flat and unfolded along the Gulf of St. Lawrence. This, with Prince Edward Island a few miles away across the Strait of Northumberland and Anticosti Island where the gulf narrows to the St. Lawrence, formed a block of the earth's crust which rested undisturbed through all the turmoil around, although



Newfoundland on the other side was powerfully affected by the Appalachian folding and faulting. New Brunswick has a large area of Carboniferous rocks in this lowland portion, far more than Nova Scotia, but only poorly supplied with coal; for the thin seams that are mined scarcely supply the local needs.

Prince
Edward
and other
islands.

The province of Prince Edward Island, the smallest in the Dominion, is also the least varied in its physical features. Its red Permian beds rise as gently rounded hills of rich soil bounded by low shore cliffs facing a somewhat sheltered sea. Along its concave northern shore the waves of the gulf have built long sand-bars across the mouths of bays and inlets, smoothing out the gentle crescent of the island. There are similar bars along the coast of New Brunswick to the west, and still more perfect spits and sand-bars tie together the remnants of crumbling Carboniferous rocks of the tiny Magdalen Islands out in mid-gulf fifty miles north of the east end of Prince Edward Island. These islands are unique in eastern Canada in having escaped the work of glaciers during the Ice Age. The continental ice-sheets failed to reach them. Sable Island, 'the graveyard of ships,' a mere sand-bar a hundred miles out in the Atlantic south-east of Nova Scotia, should be mentioned also. It presents no solid rock of any kind and is constantly in process of being destroyed and rebuilt by the waves.

South-
eastern
Quebec.

The mountainous north-western part of New Brunswick joins the Shickshock or Nôtre Dame Mountains of south-eastern Quebec, which are continuous with the Green and White Mountains of New England, parts of the Appalachian Chain. This portion of the Acadian region is of old Palaeozoic rocks greatly crumpled and folded, and in many places penetrated by eruptives. Once parts of a great range, the Notre Dame Mountains, are now comparatively low and have rounded summits, seldom attaining more than 3,000 feet, though Mount Logan near Matane reaches 3,708 feet. This mountainous belt extends for five hundred miles from the Vermont boundary to Gaspé, and there are no undisturbed areas of flat sedi-



mentary rocks like those of the maritime provinces ; but Anticosti Island, only forty miles from Gaspé, though formed of the same Ordovician and Silurian rocks and directly in line of strike of the mountains, has remained unaffected. Its low and flat surface is often hidden by the fogs of the gulf.

Gaspé Peninsula, between the St. Lawrence and Chaleur Bay, is a bold promontory rising with steep shores picturesquely carved by the waves towards the east where the island of Roche Percé, pierced by a tunnel at sea-level, rises near the village of Gaspé. On the St. Lawrence side the shore is almost without indentations, and the little fishing villages are built on small alluvial fans at the mouths of rivers. There is so little soil that the central parts are almost uninhabited except towards the New England end, where beautiful lakes and wooded mountains make attractive holiday resorts. The south-western part includes a belt of serpentine containing the asbestos deposits for which the province of Quebec is celebrated, supplying more than three-quarters of the world's demand for this mineral textile.

The Lowlands of the St. Lawrence valley begin near the historic city of Quebec and extend south-west to the Detroit River, a distance of 660 miles. From Quebec to Montreal they lie between the mountains just described on the south-east and the Laurentian Highlands on the north-west. Beyond this the St. Lawrence River and the Great Lakes are the southern boundary so far as Canada is concerned, but the plain of nearly horizontal Palaeozoic strata extends hundreds of miles south-west in the United States. The northern boundary here is partly the irregular edge of the Palaeozoic against the Archaean and partly the waters of Georgian Bay and Lake Huron.

Lowlands
of the St.
Lawrence:
Quebec-
Ontario.

In the Thousand Islands region, where the St. Lawrence widens out into Lake Ontario, the belt of Palaeozoic rocks is interrupted for a short distance by outcrops of the Laurentian, joining the main Archaean shield with the large outlier of the Adirondack Mountains in the State of New York.



The area of the Lowlands of the St. Lawrence valley is estimated at about 35,000 square miles, of which 11,400 belong to the north-eastern division between Quebec and the Thousand Islands ; 9,700 to the lowlands between Kingston and the Niagara escarpment, and 14,200 to the triangular area between the escarpment and the lakes Erie and Huron.

The rocks of these lowlands are mainly shales and limestones, providing soils of good quality. In Quebec they end abruptly against a wall of Archaean to the north, the Palaeozoic floor having slipped down along a great fault plane ; but in Ontario the ancient hilly surface of the Laurentian dipped gently southwards, and some of the higher hills, which rose as islands through the encroaching Palaeozoic sea, still project island-like through the thin edge of Ordovician limestone. Generally, however, these lowlands have been so buried under Pleistocene drift that bed-rock is hard to find except along the lakes and rivers.

Volcanic
hills :
Pleisto-
cene
water-
levels.

The Silurian limestones at Montreal were pierced by an old volcano whose neck of nepheline syenite rises as Mount Royal 700 feet above the plain, giving a magnificent view of the city and the lowlands cut by the St. Lawrence and the Ottawa rivers. From Mount Royal half a dozen other volcanic hills may be seen at different distances towards the east. These Monteregian hills, as they have been named by Dr. Adams, represent the last volcanic activity known in central Canada, and vary most picturesquely the gentle scenery of the lowlands. From the top of Mount Royal the mountainous edge of the Laurentian plateau, bounding the level plain, can be seen in the distance towards the north-east. The mountain serves also as an excellent nilometer for the Pleistocene water-levels, whose terraces on its flanks range from 50 to 600 feet above the sea. Similar terraces with marine shells may be observed all the way up the St. Lawrence, affording evidence that the sea occupied the low flat valley before the land began to rise at the close of the Ice Age ; and the plain of marine sand and clay, charged with shells



and bones of whales and porpoises, extends south-west into Ontario as far as the Thousand Islands, though the shore lines become lower and less distinct. In the Thousand Islands the highest marine level is only 350 feet above the sea, sufficient, however, to flood the Ontario basin, with its elevation of 246 feet. Some thousands of years ago what is now Lake Ontario was an extension of the Gulf of St. Lawrence, and it is possible that Indian canoes voyaged from Quebec to Niagara Falls without a portage.

After a short interruption of low Archaean hills at the Thousand Islands, flat limestones and shales of Ordovician age extend from Kingston at the outlet of Lake Ontario to the Niagara escarpment near the west end of the lake; but the rolling surface of boulder clay left by the Labrador ice-sheet completely hides the solid rock, except where cut away by river action or by waves on the shores of lakes. Occasionally the till-covered plain is varied by tumultuous morainic hills with a stony surface or by sandy and gravelly kames rising 700 feet or more above Lake Ontario. Round the Ontario basin the shore of glacial Lake Iroquois forms a prominent feature. Its wave-cut cliffs and gravel bars can be followed almost as plainly as those of the present lake. The old shore has been deformed, like the marine beaches, by unequal elevation. At Hamilton towards the west it stands 115 feet above Lake Ontario, while at the north-eastern end it is 500 feet above it. This difference of nearly 400 feet makes it clear why Lake Ontario, once below sea-level, was cut off from the St. Lawrence by the warping of its outlet at the Thousand Islands. The Iroquois shore plays an important rôle in the life of Ontario, supplying convenient routes for roads and railways, sites for cities such as Toronto and Hamilton, and the loamy and silty soil needed for one of the best fruit-growing regions of Canada, well known for its apples, grapes, and peaches.

The somewhat varied plain just described, lying around Lake Ontario and towards Georgian Bay, ends towards the west and south at the foot of an escarpment of Silurian



rocks consisting of soft shale at the bottom and more resistant limestone on the top. The shale has been eaten back along a base of limestone dipping gently south-west or on the old Archaean land-surface, so that a cliff faces the lowlands. The escarpment rises commonly 200 to 400 feet above the plain at its foot, and 600 or 800 feet above the sea. The highest point of the triangular scarp- or table-land reaches 1,700 feet, and since the cliff is capped with Niagara limestone it is naturally called the Niagara escarpment. It may be followed westwards from the Niagara gorge to Hamilton and then north to the western side of Georgian Bay, beyond which the Manitoulin Islands of northern Lake Huron represent a continuation towards the north-west. Locally the cliff is called the 'mountain'.

Niagara Falls.

The escarpment is the occasion for many waterfalls, the most famous being the Niagara Falls, which have a clear plunge of 160 feet and a total descent, including rapids above and below the falls, of 326 feet in the 26 miles between Lake Erie and Lake Ontario. This great fall supplies electric power for Toronto, 90 miles away round the head of Lake Ontario, and for several other cities within a radius of 160 miles.

Westward from the Niagara escarpment the Silurian and Devonian rocks are generally covered with boulder clay and moraines, or with the silts of the ice-dammed Lake Algonquin, which included the combined areas of lakes Superior, Huron, and Michigan, and lasted or thousands of years. The basins of the upper lakes once drained through Georgian Bay into Lake Ontario, but this outlet was blocked by hundreds of feet of boulder clay and morainic materials during the Ice Age, sending the outflow around by Niagara and thus inaugurating the present chain of inland seas connected by short stretches of river.

Physical conditions and human settlement.

The human history of eastern Canada was largely determined by these comparatively recent geological events, which provided drift-covered plains for the farmer and fruit-grower, easy gradients for the railways, great

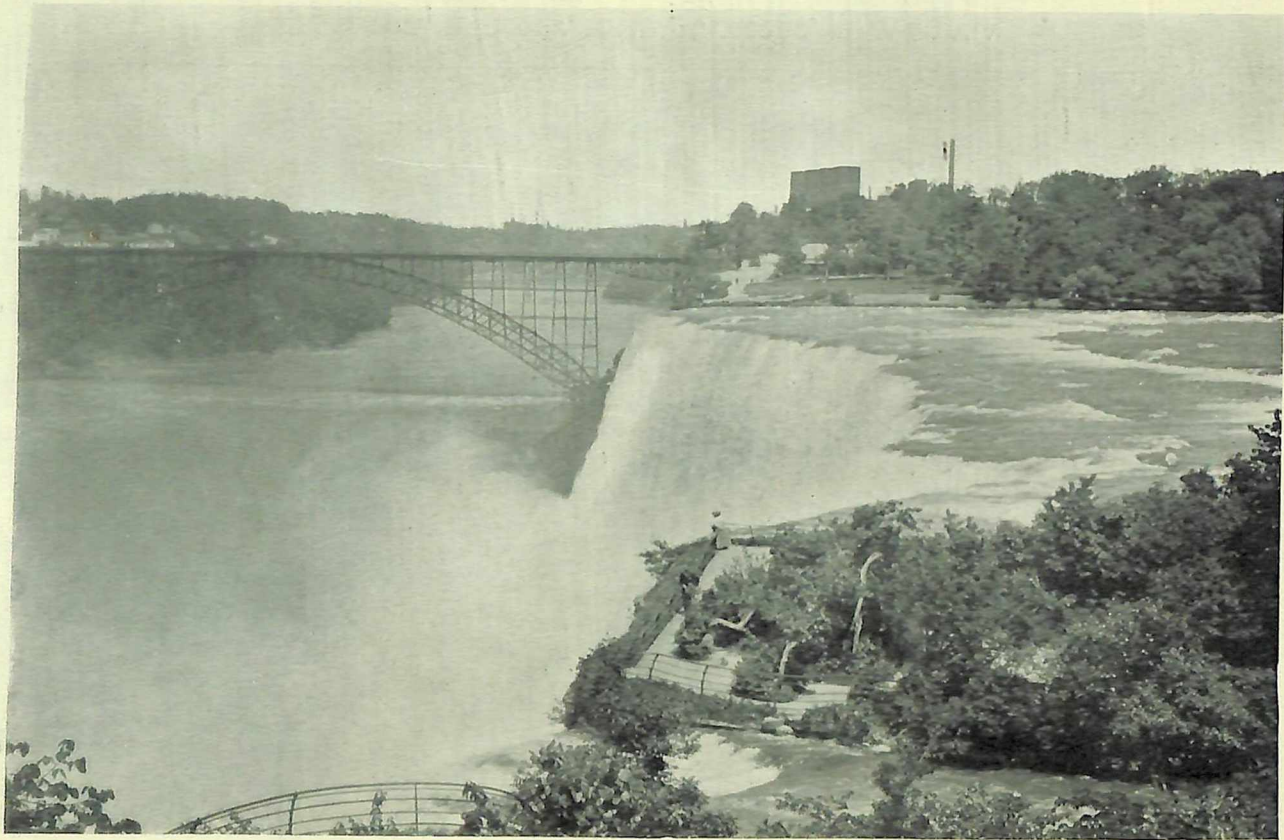


PLATE III. NIAGARA FALLS
(Office of the High Commissioner for Canada)



batholiths, forming curved bands of much the same kind. The arrangement discloses the ground-plan of great mountain ranges created, and also destroyed, before the early Huronian glaciers laid down their boulder clay and the Huronian sea deposited the sand and clay, now turned to quartzite and slate. The Huronian rocks were in turn folded into mountain chains, which have vanished, and in places all of these older rocks were covered with Animikie sediments and Keweenawan lavas, which have since undergone little change.

Surface forms.

Each of these formations presents characteristic surface-forms in the wide peneplain to which the mountain chains have been reduced. There are rounded domes, long ridges, irregularly shaped hills and valleys, even vertical cliffs, but none of the elevations rises far above the general level, and from a hill-top it can be seen that all the other hills, no matter what their shapes, reach about the same height, so that the horizon line is strikingly uniform. The original peneplain, however, has been raised to different heights in different parts, with slight tilts in more than one direction, inaugurating a new cycle of erosion which is now actively cutting down valleys and increasing the relief of this monotonous territory. Though there is a constant succession of hill and valley, the down-cutting of streams has seldom made a difference of level amounting to more than a few hundred feet, and actual mountains are confined to a few marginal portions of the great Shield. The structural forms of the different rocks as modified by erosion may often be recognized from a distance. Hard eruptives, such as granite, diabase, or greenstone, rise as domes, commonly making the highest summits. The various schists generally have a strike of 60° or 80° east of north with a steep dip, and where they predominate all the physical features stretch out in that direction, ranges of hills, river valleys, and lakes all taking their shape from the cleavage. In some places the jasper iron ranges stand up as long ridges, and usually slates and limestones have been worn down to valleys or lake basins. In Huronian districts massive



beds of quartzite may form prominent features, since they are more resistant than other rocks, and rise as white, greenish, or brownish hills like the Cloche Mountains, which stand 800 or 900 feet above Lake Huron and extend 30 miles. So great an elevation, however, is quite exceptional. There are districts where the joints of the rocks have determined the forms of hills and valleys.

After the complex of ancient rocks became exposed as a dry land-surface during the early Palaeozoic, there must have been enormous decay, but the accumulations thus made were swept away so completely in the Ice Age that over many thousand square miles the rock surfaces are fresh. The ice-sheets left their impression on the region in other interesting ways. Where the bed-rocks were unequally hard the surface was scoured and planed into *moutonnées* forms, the hills having rounded sides facing the direction from which the ice came, and more rugged shapes or piles of loose blocks on the lee side. With these significant forms, often helped out by grooves or striae, directions for travel can be determined without a compass in cloudy weather. From the two great radiant centres of the Labrador and Keewatin ice-sheets east and west of Hudson Bay, the drift materials were swept outwards, leaving bare surfaces of rock with boulder clay behind the hills or in the deeper valleys; but towards the margins of glacial action more and more boulder clay was deposited, covering the rock over extensive areas, and moraines were heaped up, greatly modifying the Archaean topography.

Effects
of the
Glacial
period.

During the final retreat of the ice as the milder climate became effective, similar moraines were left here and there over the previously scoured surface of rock, and perched blocks, sometimes as large as a cottage, were dropped on hill-tops to vary the sky-line. Here and there, near the moraines, but on their inner side, long narrow esker ridges of sand and gravel show where rivers once wound their way, carrying off the drainage from beneath the ice. Towards the later stages of the waning ice-sheets lakes followed up the ice-front in many places,



often quite ephemeral bodies of water, by no means as long-lived or efficient as Lakes Iroquois or Algonquin farther south; though one of them, Lake Ojibway, between the watershed of the Great Lakes and the stagnant ice of James Bay, was as large as Lake Superior. On its bed were spread out the great deposits of stratified sand and clay of the 'clay belt', now being opened up to settlement by two transcontinental railways. The work of these lakes during the retreat of the ice has provided almost the only extensive tracts of level soil which cover the rocks of the Archaean Shield, and is of great importance from the human point of view.

Lakes
of the
Archaean
Shield.

It is probable that the pre-glacial mantle of residual materials was well drained by long-established rivers, and that lakes were rare or absent; but the work of the ice completely changed these conditions by blocking all the valleys with drift. What had been a well-drained surface of soil was left as bald hills of rock with innumerable basins between. The result was the formation of the most extensive lake region in the world, like that of Scotland, Scandinavia, and Finland in Europe, but on an immensely larger scale as to size and number of the bodies of water. The complicated surface-forms resulting from the wearing down of the unequally resisting rocks of the Archaean mountain-systems have combined with the damming of tens of thousands of depressions to produce the numberless lakes of northern Canada. Except where covered with marine silts or those of glacial lakes like Ojibway, the whole region consists of rocky hills separated by sheets of water of every size, from ponds in the woods to inland seas fifty or a hundred or several hundred miles in length. As might be expected from their origin, these lakes have an endless variety of shapes. They are simply parts of an old irregular surface flooded to a given depth, and they present all the complications of outline due to the wearing away of steeply tilted schists cut by dikes and bosses of eruptive rocks. Islands and bays and inlets and narrows often form a labyrinth of waters most puzzling to the explorer. Some of the larger



sheets of water, like Lake-of-the-Woods, contain thousands of islands separated by wide or narrow channels, the larger islands having lakelets with islets of their own. These irregular basins often spill over some barrier of solid rock or of boulders into other basins, with no definite river as a connecting link, and the drainage follows the most devious channels, here with the thunder of falls, there with the roar and white water of rapids, but in many places through the still and deep passages between walls or slopes of rock. Usually the rivers have scarcely made a beginning of cutting away obstacles and grading their accidental beds.

Water-ways and scenery.

As might be expected from their haphazard formation, the lakes vary greatly in depth, some having hundreds of feet of clear water, while others are muddy shallows largely silted up by some inflowing stream. The smaller and shallower lakes present every stage from clean open rock-walled waters to marshes or 'muskegs'; beginning with reedy margins, going on to broad rims of peat bog round a dark pool in the centre, and ending in a wide flat of quaking green sphagnum covering many feet of black muck. With so undeveloped a drainage system there are naturally in places hundreds of square miles of muskeg or peat bog, especially in the more gently sloping and stagnant parts round James and Hudson Bays. Canoe routes can be followed in almost any direction for hundreds of miles across the 'rocky lake' type of country so prevalent on the Archaean Shield. A canoe may be launched on the north shore of Lakes Huron or Superior, or from some little railway station beyond Lake Superior, and worked north or west to Hudson Bay or Lake Winnipeg, with few portages of more than a mile or two, often for many miles with nothing more than a 'drop over' from one water-level to another. Most of the map of northern Canada has been constructed from surveys made from such canoe routes, and summer travel over thousands of miles to the north of the railways is still carried on by the methods devised by the Indian. The scenery is pretty on the small scale, the combinations



of woods, rocks, and water having infinite variety, and occasionally on the larger lakes there are fine cliffs and distant views ; but after days of travel, when all varieties of the landscape have become familiar, the constant succession of low cliffs of granite or green schist crowned with evergreen trees and reflected in calm waters may grow monotonous, while tracts that have been swept by the too frequent forest fires may be distinctly ugly. As one goes northwards the tree-growth diminishes until the timber-line is reached at the 'barren grounds', including the north-west part of Ungava and the north-east part of Keewatin, near the northern shores of Hudson Bay. From this to the Arctic Ocean rock is more continuously exposed, though in many places the term 'barren grounds' is not appropriate, and there is good soil with a rich growth of shrubby and herbaceous plants, pasture for great herds of caribou and musk oxen.

Margins
of the
Shield.

As described above, the 2,000,000 square miles of the Archaean Shield have in general the character of a somewhat accidented plain, with few residual summits rising above the general level and no striking mountains. Not far from a fourth of the surface is covered with water, draining in most cases towards the central basin of Hudson and James Bays, following the usual slight inward tilt of the plain. Its outward margin is often considerably elevated, and towards the north-east and the south-east there is a rugged descent of 2,000 or 3,000 feet, with nearly vertical cliffs towards the Atlantic and the St. Lawrence valley. The margin along the Labrador coast is strikingly abrupt, as if an eastern continuation of the Shield had disappeared by the slipping down of vast blocks now forming the sea-bottom ; and the same is true in almost an equal degree along the north-west shore of the Gulf of St. Lawrence. Nearly the whole Palaeozoic margin has been faulted down along this coast, only a remnant of it remaining near the Strait of Belle Isle. At the city of Quebec the fault-plane is clearly seen between the lower and the upper town, the Ordovician slates having slipped down along the face of the cliff.



PLATE V. QUEBEC: ST. LAWRENCE RIVER
(Office of the High Commissioner for Canada)

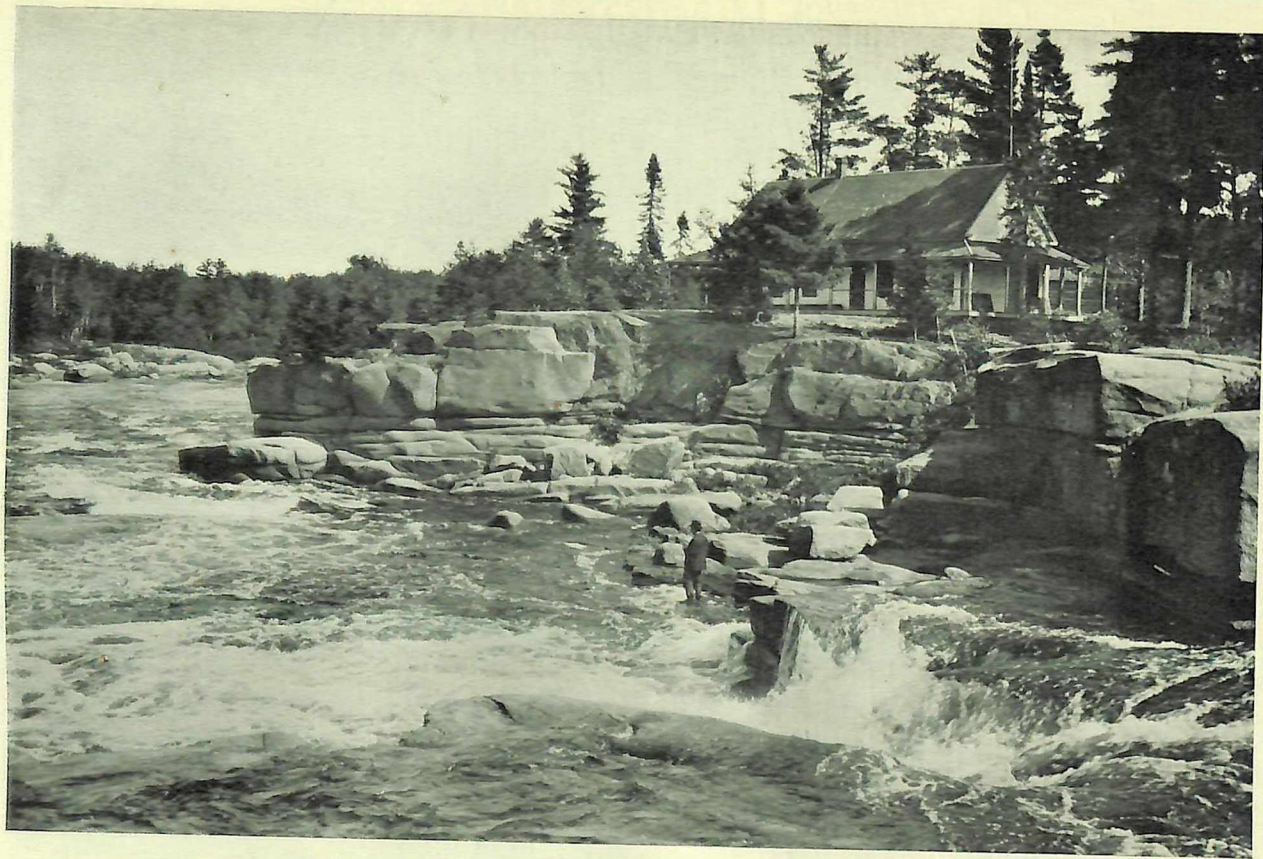


PLATE VI. PAPINEAU FALLS, BATHURST, NEW BRUNSWICK
(Office of the High Commissioner for Canada)



The splendid cliffs of Archaean rock rising from 500 to 1,000 feet along the north shore of Lake Superior suggest similar faulting, but in most parts of Ontario, and also in Manitoba and northwards, the margin is much lower and dips gently eastwards beneath the Palaeozoic sediments, the slope being from 25 or 50 feet to the mile.

The greater part of the Archaean Shield is less than 1,000 feet above sea-level, though there are considerable areas reaching from 1,500 to 2,000 feet, and at a few points along the south-eastern and north-eastern margins there are respectable mountains, which will be mentioned later.

Thus far the description of the central territory of Canada has been general; but in an area so vast there is, of course, more or less local variation, and a more special account of its main divisions is desirable.

The best known part of the Archaean Shield is naturally that which adjoins the populous lowlands to the south, and the discovery of mines in the Archaean of Ontario has directed special attention to that region, some parts of which have been carefully mapped. The band of Archaean between Ottawa and Georgian Bay, studied by our earliest geologists, differs from most other parts in the prevalence of limestones and marbles of the Grenville series, which run as long synclinal bands between batholiths of granite and gneiss, and have left a marked impression on the physical features of the region. These easily crumbling rocks naturally occupy the river valleys and lake basins, and form the fertile land occupied by farms, while the more resistant rocks rise as hills. In some places the marble is associated with graphite, mica, and talc, which are mined; and also with nepheline and other syenites so rich in corundum as to be the chief source of that abrasive in America.

Further north a broad belt of Huronian rocks extends north-east of Lake Huron, with a length of 200 miles, consisting of greywacke conglomerate, slate, and quartzite, which largely determine the physical features of the country. These rocks are sometimes steeply tilted, the



harder layers making sharp ridges, while at others they are only slightly inclined and give gentler land-forms.

The curiously straight direction of the rivers and lakes in this part of Canada immediately strikes the eye on the map, but it is often hard to account for, since the original rock structures run with a good deal of uniformity towards the north-east. The straight lines of depression crossing the general strike have been rather doubtfully explained by the weathering out of dykes or the arrangement of fault-planes or of jointage.

In places the Huronian sediments have been disturbed by sheets of basic eruptive rocks, such as norite and diabase, which have brought with them various metals, thus giving rise to great mining industries. The basin-shaped sheet of norite near Sudbury, 37 miles long and 16 wide, is surrounded by large and small nickel deposits which settled into the hollows beneath while the rock was still molten. This sheet of rock (micropegmatite above and norite below) supplies two-thirds of the world's nickel. From the geographical aspect it has produced very interesting surface forms. Outside the basin is found the hummocky country characteristic of most Archaean regions, but the easily weathered outer edge of the nickel eruptive has been carved into valleys often filled with a narrow lake, while its inner edge of granite forms an oval ring of rough hills. The soft Upper Huronian tuff and slate thus enclosed have been levelled to a flat valley occupied by farms. The contrast is notable where the main line of the Canadian Pacific Railway laboriously climbs the outer wall of hills, speeds across the level valley, and then climbs out again between the cliffs near Onaping river.

Cobalt
mineral
region.

In the Cobalt region, 90 miles north-east of Sudbury, a few square miles of Huronian conglomerate, resting discordantly on Keewatin greenstones and penetrated by a great sill of diabase, supply the richest silver ores in the world, and more than meet the world's demand for cobalt. The hilly streets of the picturesquely ugly town of Cobalt show the cliffs and ridges resulting from the slow stripping of the Lower Huronian boulder clay from



the ancient land surface of the Keewatin. Not far to the east is the remarkable trough of Lake Temiskaming, like an inland fiord, straight, deep, and of great age, as shown by the Silurian limestone still filling its upper end, but unknown elsewhere in this part of northern Ontario.

A hundred miles north-west of Cobalt are the important gold deposits of Porcupine, situated mostly in Keewatin rocks forming the usual bare hummocky hills, while the lower ground is largely covered with lake deposits.

Cobalt is south of the watershed between the St. Lawrence waters and Hudson Bay, while Porcupine is on the northward slope. In both districts there are wide areas of lake deposits, formed in bays of Lake Algonquin to the south and in the shallower waters of Lake Ojibway to the north. In the latter case the silts and stratified sand and clay are estimated to provide 16,000,000 acres of soil rendered fertile by the erosion of the shales and limestone of James Bay. The National Transcontinental and Canadian Northern railway lines follow this belt of level land for hundreds of miles.

Turning westwards from the Georgian Bay with its 30,000 islands of Archaean rock facing the Silurian escarpment of south-western Ontario and of Manitoulin Islands, the Sault Ste Marie is reached, and beyond it Lake Superior, which lies almost wholly in the pre-Cambrian rocks. Its immediate shore often consists of the latest rocks of this age, the Animikie and Keweenawan, which dip inwards from all sides, forming a synclinal basin with a greater axis more than 400 miles long, bent obtusely northward in the middle. As the Keweenawan rocks on its edge are predominantly lavas, the basin may have been formed by collapse when the molten material ascended from beneath the bottom of the lake. Its waters stand 601 feet above the sea, and its greatest depth is about 1,000 feet ; so that its bottom goes about 400 feet below sea-level, although the lake is 600 miles from tide water. Why so ancient a basin was not long ago filled is not easily explained, but its watershed is very small, the divide towards Hudson Bay being at one point only



21 miles from its shore, so that rivers entering Lake Superior are short and carry little detritus. Keweenaw diabase sheets, sometimes 300 feet thick and lying with only a gentle dip, cap nearly all the hills towards the north-west of the lake near Port Arthur and Fort William. The resulting table mountains sometimes rise 1,000 or 1,300 feet above the lake, as at Thunder Cape and Mount McKay, and the cliffs of vertical columns make striking scenery.

The Keweenaw is lacking, however, for some distance on the north-east shore of Lake Superior, which consists mainly of Laurentian gneiss and Keewatin rocks containing valuable iron mines. This part of the shore rises from 800 to 1,200 feet within the first two or three miles, so that all the rivers flowing towards the lake tumble over in fine waterfalls; and the highest point in Ontario, Tip Top Hill, reaches 2,100 feet above the sea a few miles inland. This wild coast is uninhabited except for a mining camp and a few little fishing stations, and is seldom visited by the tourist.

Lake Nipigon, 30 miles north of Lake Superior and 250 feet higher, may probably be called the first of the Great Lakes, though it is only 70 miles by 50 in dimensions. Keweenaw diabase forms much of the shore and occurs in islands, so that this basin probably had a similar origin to that of Lake Superior.

Formation of the Great Lakes.

The chain of Great Lakes seems very accidental. The two upper basins are due to synclinal depressions; the combined Lakes Huron and Michigan owe most of their depth to filling in, during the Ice Age, of a former channel between Georgian Bay and Lake Ontario; while Lakes Erie and Ontario have been formed in post-glacial times mainly by the upward tilt of the land towards the north-east, which is known to amount to at least 700 feet. If the tilting process should continue for another 50 feet, the Upper Lakes would flow south past Chicago into the Mississippi. Considering such recent tippings and dammings of the basins the equilibrium of the system seems far from stable.



To the north-west of Lake Superior the Archaean rocky lake country continues with the usual features into Manitoba and to the shore of Lake Winnipeg.

The geology and physical features of the Archaean of Quebec are very like those of northern Ontario. Crossing the Ottawa River, the batholiths of gneiss enclosed by bands of Grenville limestone so characteristic of eastern Ontario are repeated along Gatineau river and north of Montreal, but the mountainous and rugged edge of the Shield overlooking the lowlands of the St. Lawrence is loftier and more inhospitable than any portion of Ontario except part of the shore of Lake Superior. Many summits rise more than 3,000 feet above the gulf. All the larger rivers flowing towards the St. Lawrence have many waterfalls and rapids in their headlong descent from the interior, often valuable sources of power for saw-mills or paper-mills, and their lower end sometimes occupies a canyon-like valley of great age, perhaps pre-Palaeozoic. The best known and the most impressive is the fiord of the Saguenay, floored with salt water and with walls reaching in places 1,700 or 1,800 feet. Its waters are deeper than those of the St. Lawrence at its outlet.

The ore deposits so important in Ontario seem to be lacking in Quebec, and there are fewer old lake deposits to furnish farm-lands, though round Lake St. John at the head of the Saguenay a settlement has grown up. The larger Lake Mistassini, 140 miles to the north-west, presents no civilization except a Hudson's Bay post. It is 1,200 feet above the sea, is surrounded with late pre-Cambrian limestones, and is walled in on each side by ridges of older rocks rising 300 to 500 feet above it.

The northern part of the great peninsula of Ungava or Labrador has been little explored, though it has been crossed in a few places by survey parties. For nearly 300 miles through its centre, according to Mr. Low of the Canadian Geological Survey, there extends a band of late pre-Cambrian rocks like the Lake Superior Animikie, which may be important in the future because of large deposits of rather low-grade iron-ore.

The
Archaean
of Quebec.

Ungava
(northern
Quebec.)



The
coasts.

Round the coasts this part of the Shield is better known. Along the Atlantic the shore generally rises steeply and has been greatly dissected, forming a fringe of rocky peninsulas and islands separated by narrow channels or 'tickles'. There are many fiords running in among the hills, the greatest being Hamilton Inlet, which recalls the Saguenay, though on a larger scale. It runs for 150 miles inland and is followed by a definite river valley sunk from 500 to 800 feet below the general level for another hundred miles. This valley ends up-stream in a wild canyon, where the river descends from 1,660 feet to 900 feet above the sea in a succession of rapids and falls, including one sheer descent of 302 feet. Above this the river has no definite channel, but consists merely of spillways between sprawling lakes of the interior tableland. The contrast is described by Mr. Low as striking. There are many other river valleys and fiords of a similar kind on the Atlantic coast, but on a smaller scale. At some points along the shore great sheets of diabase, somewhat like the Keweenawan sills near Lake Superior, but larger, provide vertical cliffs and tabular mountain tops, while at the foot of the cliffs the ancient surface of the contorted gneiss may be seen.

The
interior
tableland.

The interior tableland loses its peneplain character and rises into the Torngat Mountains in the Nakvak Peninsula between Ungava Bay and the Atlantic. According to Dr. Daly, they present rugged peaks of schist and gneiss instead of the usual rounded forms of the residual hills in the rest of the Archaean Shield. Their lower parts are glaciated, but their summits seem to have risen as nunataks above the continental ice-sheet. The highest point ascended reached 4,400 feet, but others to the south were estimated at 6,000 or even 7,500 feet, making them the highest peaks in eastern North America.

North-west of the central tableland of Labrador the surface retains the 'rocky lake' character, though it sinks greatly. The Koksoak River and its tributaries, which interlock with those of Hamilton River, wander from lake to lake on the tableland and then descend to the



lower levels before entering Ungava Bay. Summit lake, according to Low, divides its waters between Koksoak River flowing into Ungava Bay and Manicouagan River, which reaches the Gulf of St. Lawrence, illustrating the youthful and accidental character of the hydrography. Though the interior of Labrador has a quarter of its surface covered with lakes, there is a low-lying belt 100 miles wide nearly devoid of lakes on its westward side towards James Bay. This is due to the marine sands and clays which reach inland to a height of 400 feet above the sea. There are marine terraces at similar levels along the Atlantic and gulf coasts also. North of James Bay along the coast of Hudson Bay the shores become steeper and are fringed with late pre-Cambrian iron-bearing rocks and sheets of diabase, which dip seawards much as rocks of the same age dip into Lake Superior.

North-west of Lake Superior, while retaining the same general character, the Archaean surface slowly sinks, till at the outlet of Lake Winnipeg it is only 710 feet above the sea. It forms the whole north-east shore of Lake Winnipeg and is faced by low cliffs of Ordovician limestone on the opposite side.

North-western part of the Shield.

The widening area of ancient rocks to the north has been described by Mr. J. B. Tyrrell, who has explored much of it, as having a low and unpronounced relief, nowhere reaching a height of more than 1,700 feet, and usually under 1,000. He divides it into an interior upland and a coastal plain, the former having a mean elevation of from 900 to 1,000 feet with a surface of sandy till and rounded boulders or broken fragments of rock with sandy ridges or eskers stretching across country. The coastal plain includes the part below the highest marine beach, 500 or 600 feet above sea-level. Much of it is covered with till like that of the upland, but other parts are sandy plains or terraces left by the sea. The coastal plain is about 50 miles across near Fort Churchill, but widens towards the north to about 300 miles, and probably joins the coastal plain along the Arctic Ocean. Most of the rock exposed is granitoid gneiss, but there are some areas

of Huronian quartzite and large tracts of late pre-Cambrian conglomerates and sandstones like the Keweenawan of Lake Superior, associated with the usual eruptive dykes and sheets. In many places the gentle seaward slope of the coastal plain continues below water, so that the space between the high and low tide may be miles in width, and even canoes with but a few inches of draught must keep miles from shore when following the coast to find depth enough of muddy water for navigation. There are parts of the coast, however, as near Fort Churchill, where the rocks rise from deep water and vessels can come close to the shore. This prevalent shallowness of the southwestern side of Hudson Bay is of practical consequence in choosing a terminus for the Hudson Bay railroad, since Fort Nelson, the natural port for the prairies, would require a large amount of dredging to be of service.

Chesterfield Inlet, towards the north-east corner of Hudson Bay, is a fiord-like arm of the sea somewhat suggesting Hamilton Inlet on the Atlantic coast. It extends a hundred miles westward, where a chain of lakes and rivers joins it from the interior.

The Archaean area west of Hudson Bay has been shown by Tyrrell to have been the centre from which the Keewatin ice-sheet spread in all directions, transporting boulders and leaving striae on the rounded rock-surfaces, thus recording the direction of its motion.

On the other side of the Keewatin area pre-Cambrian rocks extend north-west from Lake Winnipeg, completely enclosing Lake Athabasca, striking the middle of Great Slave Lake, and touching the shore of Great Bear Lake, a series of basins falling a little short of the Great Lakes in magnitude. All along this boundary the Archaean surface sinks gently towards the plains beneath the usual fringe of older Palaeozoic rocks, which nearly always intervenes between the ancient Shield and the Cretaceous beds of the prairies. Still further towards the north-west, Dr. J. M. Bell has shown that the Archaean includes Laurentian gneisses and also rocks like the Keweenawan, known to the natives for generations as a source of copper



along the Coppermine River. The metal occurs native in amygdaloids, as in the copper mines of Michigan. The country near Great Bear Lake is described as generally flat, but with some hills reaching 1,000 feet.

The part of the Shield stretching eastwards along the Arctic shore and extending into several of the great Arctic islands has been little studied ; but in Baffin Land and to the north of Hudson Strait Dr. Robert Bell has found wide bands of crystalline limestone associated with gneiss, suggesting the Grenville series of the Thousand Islands. The surface has the usual hummocky character, with many lakes, including Nettelung and Amajuak, bodies of water 120 or 140 miles in length. It is interesting to note that glaciation has left its marks on these treeless wastes, as on the more temperate parts of the Shield further south, but that scarcely any land ice remains on the Archaean surface.

The Archaean of the Arctic Islands.

As described above, the east and also the north-west shores of Hudson Bay are of early or late pre-Cambrian rocks, but to the south and west of James Bay and Hudson Bay they are hidden by 100,000 square miles of flat shales and limestones of Palaeozoic age, giving a surface of very different character from the 'rocky lake' country. Most of this area is within the province of Ontario, but these deposits occupy also about 40,000 square miles on the north of Hudson Bay, including most of Mansfield, Coats, and Southampton islands. As these beds usually dip gently beneath the sea it is probable that a large part of the floor of Hudson Bay consists of them. The Ordovician, Silurian, and Devonian shales and limestones nowhere rise as much as 500 feet above sea-level, and are very largely buried under the Pleistocene marine clay and sand, or else are covered by widespread muskegs, making a flat and dreary surface very imperfectly drained except immediately along the rivers. Almost the only outcrops of rock are along the watercourses, especially where the rapids are cutting downwards ; and upstream from the main area there are many remnants of the same rocks left in hollows of the Archaean, showing that these

The Palaeozoic Lowlands of Hudson Bay.



soft sediments are being rapidly stripped from the harder surface beneath. It is not unlikely that the Ordovician of Churchill River once joined that of Lake Winnipeg less than 170 miles to the west, and that the Silurian of James Bay reached that of Lake Temiskaming and of southern Ontario. Their partial destruction by glacial action provided lime for the fertile soils of the clay belt to the south. When the region stood 500 feet lower at the close of the Ice Age, probably the whole of this Palaeozoic area was under water, and it may be that the Hudson Bay region is still slowly rising, so that a wider stretch may be exposed in the future.

It is interesting to note that Hudson Bay is so shallow that an elevation of 500 feet more would turn it all into boggy land like its present southern shores. There is a gradual deepening of the water towards Hudson Strait, however, where depths of 200 and occasionally more than 300 fathoms are found, suggesting an ancient system of rivers with well-graded channels emptying into the Atlantic when the north-eastern side of the continent stood higher. The basin is very ancient, however, and must have existed before the Ordovician and probably before the late Pre-Cambrian (Animikie), since iron-bearing rocks of that age dip seaward around many parts of its shores.

The
Northern
Archi-
pelago.

Baffin Land mainly consists of Archaean granite and gneiss, and the eastern parts of Devon Island and of Ellesmere Land are formed largely of bare, rolling surfaces of Archaean rocks ; but most of the islands to the west of this line are covered with later formations, including in some places a very complete series from the Cambrian to the Carboniferous, while Triassic areas occur, as well as scattered patches of unconsolidated Tertiary deposits. The most widely spread sedimentary rocks are hard Silurian limestones, which are often slightly inclined and may rise as great escarpments 1,000 or even 3,000 feet in height. They resemble the Niagara escarpment of Ontario on a gigantic scale ; and mariners report far-stretching cliffs with the level stratification standing out



very distinctly. The overlying Devonian and Carboniferous rocks are generally crumbling sandstones easily weathered to form soils covered with rich pasture for the musk oxen. An east-and-west belt of islands, including Grinnel, Bathurst, Melville, and Prince Patrick islands, consists mainly of Carboniferous rocks known to contain coal seams of excellent quality at several points, but too inaccessible to be of value under present climatic conditions. The Mesozoic rocks, mostly soft sandstones and shales, form a group of islands more to the north and east. The scattered Tertiary areas of sand and clay contain many plant remains suggesting a warm temperate climate in geologically recent times. They enclose outcrops of fair lignite which are accessible from a relatively ice-free sea, unlike the Carboniferous coal further west, and may in the future have a commercial value. The whole association of Kainozoic plants and coal recalls Spitsbergen, where coal deposits of this age are mined.

These far northern islands might be expected to be largely ice-capped, and perhaps even completely buried under great sheets like those of southern Canada a few thousand years ago ; but this is far from being the case. The known areas of inland ice are comparatively small, and are confined to plateaux or mountains not far from the seashore, while the lower inland parts seem to be well covered with vegetation during the short summer. There is little evidence of a wider glaciation during the Ice Age except near Hudson Bay and Strait.

Ice-conditions and elevation of northern islands.

The Arctic Islands do not often rise to actual mountains, though tablelands seem frequent. Ellesmere Land in the far north is said to have Archaean ranges 4,000 or 5,000 feet in height, and Dr. Boas reports mountains 8,000 feet high in the central parts of Baffin Land. If this is correct, the far northern mountains may surpass the Torngats of Labrador in altitude. The coasts of the great northern islands are usually rugged, with fiords and promontories and smaller islands, as in most Arctic regions.

*The Interior Continental Plain*

The prairies :
Manitoba,
Saskatchewan,
Alberta.

In a former section the Archaean Shield was described as dipping gently towards the south-west beneath Palaeozoic sedimentary rocks as the plains are approached, while a succession of great lakes follows the margin. Going west from Lake Superior by the Canadian Pacific Railway, one traverses for 360 miles typical rocky lake country reaching its climax at Lake-of-the-Woods. At length the more rugged hills of gneiss grow less frequent, and only softly rounded surfaces of the ancient rocks rise above the soil, which spreads flatly westwards with a small covering of trees. The trees cease and the bare prairie begins some time before Winnipeg is reached.

The horizontal sedimentary rocks overlapping upon the Archaean mark the beginning of the prairie from the geological side. The fringe of Lower Palaeozoic rocks is not wide, and the Carboniferous is wanting or completely hidden by later rocks. The gap in time is so great that soft shales and sandstones of the Cretaceous rest upon hard Silurian or Devonian limestones. The flat and undisturbed Cretaceous beds contain no chalk nor flints, and crumble so easily in the weather that unchanged rock is seldom seen on the plains except where rivers are cutting their channels downward. The contrast between the endless rocky hills of granite or greenstone to the east, and the soft loam or clay of the prairie with its thick black soil, is most striking. There are reminders, however, of the rocks of the east, since the Keewatin ice-sheet expanding towards the south and west spread its boulder-clay far and wide, and the pink granites and gneisses of its gathering-ground are here and there scattered over the black prairie-soil. The richest and most level of these soils dates from a somewhat later time, however, when the Keewatin glacier still joined hands with the Labrador sheet, but was on the wane. The surface freed from ice sloped gently northwards and formed a basin for the waters, which escaped southwards through the valley of the present Red River into a tributary of the Mississippi,

The
glacial
Lake
Agassiz.



and thus the great glacial lake named after Agassiz arose. Most of Manitoba and Saskatchewan was flooded, and an arm reached eastward to Rainy Lake in Ontario. Beyond the international boundary it invaded Minnesota and North Dakota, and its total area, probably never all occupied at one time, was about 100,000 square miles.

The flatness of Winnipeg prairie is largely due to the even coat of mud and silt which settled to the floor of this shallow lake. When the two ice-sheets parted company an outlet was opened towards Hudson Bay, Nelson River found its devious way to the sea, and Lake Agassiz was drained, leaving as remnants Lake Winnipeg and the other Manitoban lakes. There were similar ice-dammed lakes further west and north, hitherto unnamed, providing level prairie near Calgary and Edmonton ; but much of the surface elsewhere is rolling rather than flat.

In latitude 49° at the United States boundary the plains extend for 800 miles westward to the foothills of the Rocky Mountains, but as the Rockies trend north-westward and the Archaean boundary somewhat more to the west, the plains narrow gradually up to latitude 62° , after which they expand again to a width of nearly 300 miles at the Arctic Ocean.

Extent of
the plains.

Cretaceous rocks underlie only part of the plains as thus defined, since later rocks, such as the Laramie, a transition from the Cretaceous to the Eocene, cover much space to the west, and Palaeozoic beds extend widely in the northern part. Everywhere, however, the underlying rocks are nearly horizontal. The plains are far from level, nevertheless. At Winnipeg the prairie is only 760 feet above the sea, forming almost the lowest part, while Calgary in the vicinity of the foothills is 3,400 feet above the sea, so that in latitude 57° there is an average ascent westwards of three and a third feet per mile. The rise is not uniform, since two parallel lines of escarpment or of more abrupt slope are found in the southern parts of the plains. Further north these can no longer be distinguished with certainty.

On this basis Dr. Dawson divided the southern plains of Canada into three parts : (1) the Red River valley, at about 800 feet above the sea, with an area of 55,000 square miles, including many lakes ; (2) the Missouri Côteau, with an elevation of about 1,600 feet and an area of 105,000 square miles ; (3) 134,000 square miles of less regular plain having an average elevation of 3,000 feet. Towards the north there is in general a slow descent, so that, for example, Edmonton, 175 miles north of Calgary and 2,190 feet above sea-level, lies 1,200 feet lower, showing an average gradient of nearly 7 feet per mile.

Eleva-
tions.

This great triangular area, while on the whole a plain, has numerous elevations and even some ' mountains ', in the local phraseology, rising with easy slopes hundreds of feet above the general level. As they are more or less cut by ravines along the rivers and are commonly wooded, they make striking features in contrast with the monotony of the prairie. In northern Manitoba, the Duck, Riding, and Porcupine mountains reach from 2,000 to 2,600 feet above sea-level ; and on the southern boundary Turtle Mountain is reputed to be 2,300 feet high. Further west, morainic hills are seen near Brandon and at the rise of Missouri Côteau, and broader elevations occur in the Cypress and Sweet Grass hills which reach 4,500 feet. Often these tablelands are capped with resistant conglomerates later in age than the Cretaceous, e.g. of the Upper Laramie (Eocene), or in southern Saskatchewan the Oligocene. In most parts of the prairie country, however, the deep valleys cut by the rivers and their larger tributaries provide the most notable physiographic features. Rows of trees on the moist slopes of the valley may mark the watercourse from afar in a treeless country, but often one comes without any warning upon one of these wide chasms in the vast plain and looks with astonishment on the muddy river meandering at a low level.

Dry
valleys
and saline
lakes.

In the south-western part of the plain there are dry valleys, locally termed ' coulees ', typical results of the work of flowing water, but now showing moisture only by a more luxuriant growth of plants as compared with the



shallow stretches of yellowish grass, sage-bush, wormwood, and cactus around them. The 'coulees' are evidences of the moister climate which ruled towards the close of the Ice Age. The change of climate has advanced so far in some parts of southern Saskatchewan and Alberta that many ponds and small lakes completely dry up towards the end of summer, leaving a shallow basin frost-white in the middle and bordered with red samphire [p. 86]. Larger lakes without outlets are permanent bodies of saline water, generally spoken of as alkaline, containing sodium sulphate and other salts as well as sodium chloride. The contrast between the rank, luxuriant growth of plants round many Manitoban lakes of fresh water and the arid shores of these western basins is strongly marked. The largest examples of the kind are the Quill Lakes near the centre of Saskatchewan, and the Old Wives Lakes (Chaplin and Johnston), west of Medicine Hat in the same province.

Since the prairie region is formed of horizontal beds, Minerals. outcrops of economic minerals are only to be expected along river cuttings or on the flanks of the so-called mountains. In the two eastern provinces the Laramie formation is of some importance for its lignite beds, which occur at Turtle Mountain, the Souris region near Estevan, and elsewhere in southern Saskatchewan. This lignite is black and coal-like in appearance, but contains 15 or more per cent. of moisture, which dries out on exposure to the air, when the coal falls to small pieces. It cannot be stored for any length of time, and is useful mainly for local purposes. In Alberta, rocks of nearly the same age contain beds of better lignite, making a serviceable fuel. The city of Edmonton is on such a coal-field, and the black seams are easily seen in the deep valleys of the Saskatchewan and Pembina rivers. Near Lethbridge in south-western Alberta there is coal of much better quality, mined in large quantities and widely used as fuel on the prairies. It occurs in flat seams like the other deposits mentioned, but is of greater age, belonging to an older group of Cretaceous rocks, the Belly River series.

The prairie or treeless part of the plains does not end at a definite point, but north of latitude 54° becomes mixed with 'bluffs' or groves of poplars or evergreens, and so blends into the northern forest region. Beyond this along the river valleys there may be open spaces, but woods predominate though the soil remains much the same. As suggested in an earlier paragraph, the western plains sink gently from their highest level in south-west Alberta to sea-level in the delta of Mackenzie and Peel rivers at the Arctic Ocean. They become treeless again in the far north because of the cold climate and assume the character of tundra.

Erratics.

One very curious problem of ice action is worthy of attention here. It has been mentioned that boulders of Archaean rocks are scattered over the prairies, evidently derived from the Keewatin region, a starting-point averaging about 1,000 feet above the sea. These erratics may be seen from the railway as far west as Calgary or Edmonton, and have been found at elevations of 4,500 feet or more in the southern foothills. It appears that the Keewatin ice-sheet had climbed 3,000 feet in its advance across the 800 miles of prairie. It is possible, however, that the western part of the plains stood lower at that time. Dr. Dawson believed that they were then below sea-level, so that the blocks were transported by icebergs. There is no direct proof, however, that the sea covered the prairies at so late a period as the Pleistocene, and it is probable that the plains were more nearly level then than now, and that ice-floes on the great glacial lakes, whose old beaches are in evidence at the foot of the mountains, may have helped to transport the boulders.

The foot-hills.

The plains do not cease abruptly at the foot of the first range of the Cordillera, but pass more or less gradually into the foothills, a belt of disturbed country sometimes 20 or 30 miles wide, formed of the same Cretaceous or Laramie shales and sandstones, but no longer horizontal. The thrust which pushed the mountains into place crumpled the soft beds beyond, tilting and folding them in similar ways, but on a smaller scale. Rock is seldom



PLATE VII. BOW RIVER BELOW BANFF, ALBERTA
(Office of the High Commissioner for Canada)



CSL



PLATE VIII. BOW RIVER FALLS, NEAR BANFF, ALBERTA
(Office of the High Commissioner for Canada)



seen on the prairie except along watercourses, but it is strongly in evidence in the foothills, which are often topped with some harder ridge of sandstone or conglomerate. Some of the foothills rise 1,000 or 2,000 feet above the plains and reach elevations of more than 5,000 feet above the sea, so that they are hills only by contrast with the mountains beside them. Usually they are crested with spruce or pine forest, and seen from a neighbouring peak of the Rockies the effect is of a sea of pale green prairie dashing in waves with dark green crests against the shore of mountains. On the prairies the rivers usually have a uniform flow seldom quickening to a rapid, but among the foothills they often plunge as beautiful falls over some harder ledge of the upturned strata. An example may be seen in the Kananaskis Falls, near the Canadian Pacific Railway between Morley and the Rockies.

The Cordillera

As the Rockies are approached from the plains, they are seen first from more than a hundred miles away as a delicately blue serrated rim on the south-western horizon. Advancing, they rise and become more solid, till beyond the foothills the frontal range stands out as bare cliffs, reaching 3,000 or 4,000 feet above the plains and stretching with varied sky-line as far as the eye can reach in each direction. This wall of rock justifies the popular name, and is broken only by a few gaps, like Bow Valley, where a river escapes from the mountain world beyond. The term Rocky Mountains is often applied in a general way to the whole sea of mountains between the plains and the Pacific coast, covering a width of 400 miles, and extending, so far as Canada is concerned, from the International Boundary for 1,100 miles to the north-west. If the Mackenzie Mountains between the Mackenzie and the Yukon rivers are considered as continuing the Rockies to the Arctic Ocean, the whole length is 1,600 miles. It is better, however, to limit the name of Rocky Mountains to the eastern chain, and call the broad belt of mountainous

British Columbia:
general description.



country along the Pacific coast the Cordillera. As usually defined, the Cordillera extends south through the western United States and includes also the Andes of South America. There is, however, little unity of age or structure among the ranges covered by this term, the only common bond being their relation to the settling seabottom of the Pacific.

The four
mountain
chains.

There are really four chains of mountains in the Canadian Cordillera, the Rocky Mountains proper bordering the great plains, the Selkirks and the Gold Ranges coming next, then the Coast Ranges, and finally an outer fringe of mountainous islands, belonging to a chain partly submerged in British Columbia, but more continuous in the 'pan handle' of Alaska towards the north-west. These four chains were elevated at very different times and present very different features as to rocky structure, but all of them have peaks of Alpine character rising well above snow-line and serving as the gathering-ground for glaciers.

Following the Canadian Pacific Railway westward from the prairies, one enters the Rockies by the 'Gap' of Bow Valley, travelling sixty miles through the highest set of ranges, ending with a rapid descent to the deep Columbia valley. Then come the Selkirk and the Gold Ranges with a breadth of about 100 miles, ending in a somewhat ill-defined interior plateau. The Coast Ranges are scarcely touched by the railway, since they end towards the south at Burrard Inlet; but the southern summits, a mass of mountains belonging to the outer chain, make a striking part of the scenery at the city of Vancouver. Authorities vary as to the names of these chains, but the customary ones are those used above. The sharply defined eastern chain is almost always called the Rockies or Rocky Mountains, though Dr. Dawson suggested the name Laramides, because they were raised in Laramie times. The second belt of mountains is not so definitely bounded, and parts of it have received separate names, such as the Purcell Range to the south-east, the Selkirks to the north and west, the Columbia Mountains still further west and north,



and the Cariboo Mountains in northern British Columbia. For these ranges, as a whole, the name Selkirks is often used, but sometimes the general term Gold Ranges is applied to them. This is a suitable name, since all of them are gold-bearing, but has not come into wide use. The Gold Ranges are separated by a vaguely bounded interior plateau from the Coast Ranges, which are separated from the outer ranges of the islands by the narrow channels of the sea followed by coastwise steamers from Vancouver to Alaska.

The distinctions made in previous paragraphs apply with certainty only to the southern part of the Cordillera, but the Mackenzie Mountains probably represent the northward extensions of the Rockies and Gold Ranges.

The Rockies rise abruptly from the plains towards the north-east and are almost as abruptly cut off from the Gold Ranges towards the south-west by a remarkable valley, thousands of feet deep and very straight and continuous for 450 miles, with a probable extension for 400 miles further towards the north-west. Almost all the great rivers of British Columbia have their beginning in this valley. North of the 850 miles thus defined, mountains of a similar age and character extend to the Arctic Ocean.

The
Rocky
Moun-
tains.

The bold cliffs of the frontal range of the Rockies near Bow River represent the upturned ends of great tilted blocks of Palaeozoic limestone, quartzite, and slate, their south-westward slope corresponding to the amount of tilt; and there may be several of these tilted blocks in succession. As shown by Mr. McConnell, of the Canadian Geological Survey, the outer block was pushed miles out over the plains, and the others ride upon one another, so that if all were slipped back into their places the width would be increased by twenty-five miles. This 'writing-desk' type of mountain, so characteristic near Bow Pass, is replaced along Athabasca Valley west of Edmonton by mountains formed by folding, and this is generally true of the central parts of the range, where broad anticlines and synclines have been carved by rivers and glaciers into castles and



cathedrals. Often the top of such mountains is formed of the bottom of a synclinal fold, while the neighbouring valleys have been cut deeply into the shattered anticlines.

It is likely that in the beginning the soft shales and sandstones of the Cretaceous formed the upper layers of the mountains, but they were long ago removed from the exposed parts and are now found only where protected at the bottoms of the longitudinal valleys. These narrow basins are of great practical importance on account of the coal they contain. The strains and pressure of mountain building have greatly improved its quality as compared with the coal of the prairies, so that the lignite has been turned to excellent bituminous coal, or in some cases into anthracite. The largest and best supplies of coal in western America are contained by these coal-fields enclosed in the Rockies.

Elevation
of the
Rockies.

The Rockies are the highest of the four chains of the Cordillera in the southern part of Canada, but are greatly surpassed by a few peaks near the Arctic Circle. The north-eastern range is generally from 7,000 to 9,000 feet in height, and each successive range grows a little higher until the central parts rise from 10,000 to 12,500 feet above the sea. There are probably hundreds of peaks above 10,000 feet, but perhaps not more than half a dozen reach 12,000 feet, and only one attains 13,000. What there may be in the little explored northern part of the Rockies must be left to the future to determine. Though none of the Rockies can be compared in height with the Himalayas or Andes, the depth of the valleys and low snow-line due to their northern latitude give them distinctly the high Alpine character, and they far surpass in this respect the higher mountains of the United States and Mexico.

Glaciers.

In the central and western parts glaciers are very numerous, though not usually large, and sometimes fifty may be counted from a single summit. Naturally they are more numerous on the side towards the Pacific where the snowfall is greatest. The largest known *nevé* in the Canadian Rockies is the Columbia snow-field, estimated



PLATE IX. LAKE MINNEWANKA, ROCKY MOUNTAINS (ALBERTA)
(Office of the High Commissioner for Canada)



PLATE X. MOUNT ASSINIBOINE, ROCKY MOUNTAINS
(Office of the High Commissioner for Canada)



to cover nearly 200 square miles. This is about 60 miles north-west of Laggan on the Canadian Pacific Railway, and lies to the east of Mount Columbia (12,500 feet), one of the highest peaks. Nearly a dozen glaciers radiate from it into different valleys, and its drainage goes to three oceans, the Pacific, the Atlantic (Hudson Bay), and the Arctic.

Mount Columbia and several of the surrounding peaks have been explored and climbed by British mountaineers, and a delightful book by Stuttfeld and Collie gives an account of the work and provides the best map of the region. The most striking peak south of the Canadian Pacific Railway is Mount Assiniboine, 11,860 feet high, a fine pyramid often compared to the Matterhorn. Though not of as difficult ascent as the Swiss mountain it is by no means an easy climb. It was first ascended by the Rev. James Outram in 1900. Many years ago heights of 16,000 or 17,000 feet were assigned to Mounts Brown and Hooker, one on each side of Athabasca Pass to the north of the Columbia group of mountains; and they were long supposed to be the highest mountains in Canada. When climbed by Stewart and Coleman, Mount Brown proved to be only 9,050 feet high and Mount Hooker was still lower, so that they are surpassed by hundreds of other peaks. Less than fifty miles north-west of Athabasca Pass stands Mount Robson (13,000 feet), the highest known point in the Canadian Rockies. It is on the western side of the range, and only six miles from the low valley between the Rockies and Gold Ranges. It towers 10,000 feet above Fraser River as a magnificent pyramid with walls of precipices too steep for snow to lie; while its opposite side with gentler slopes is covered with snow-fields and hanging glaciers. Several attempts have been made to climb Mount Robson, but only one party has succeeded, that of Messrs. Kinney and Phillips, who took very serious risks in both the ascent and the descent.

Mountaineering.

Though the Canadian Rockies present no very high peaks, they include a variety of mountain types providing both easy and difficult climbs amid fresh and beautiful



surroundings. The valleys are often park-like and charming, with waterfalls and lakes of gem-like colour, in the latter respect surpassing the Alps; and there are still numberless valleys and mountains unvisited and unnamed.

Railway
passes.

The Canadian Rockies are crossed at three points by railways with comparatively low passes, the most southern, close to the International Boundary, being the Crow's Nest Pass at 4,449 feet; the second, the Kicking Horse Pass (5,329 feet) used by the main line of the Canadian Pacific; and the third, the Yellow Head Pass (3,738 feet) followed by the Grand Trunk and Canadian Northern Railways. There are two or three other possible routes, but they are usually not met by a suitable pass through the Gold Ranges. The easier of the two southern passes through the Rockies, the Crow's Nest, loses much of its value because no outlet has been found to the Pacific.

Mackenzie
Moun-
tains.

The eastern part of the Mackenzie Mountains is related in structure and geology to the Rockies, and may be looked on as their northward continuation. They have been crossed at only three points and are comparatively little known. Their summits are reported to reach 7,000 or 8,000 feet, and to be rugged and Alpine in character, with snow-fields, but no actual glaciers, owing to the small snowfall in that interior region, barred from the moisture of the Pacific by the much loftier Coast Ranges.

The
Selkirks
and the
Gold
Ranges.

The Selkirks are cut off from the Rockies by the strange valley mentioned before as being occupied by the headwaters or tributaries of the largest British Columbian rivers. The cause of this long, straight valley, longer, wider, and more profound than the Grand Canyon of the Colorado, is not certainly known, but its position between the youngest and the oldest of the Cordilleran chains implies some significant tectonic origin. The Kootenay River flows south-eastward through it, and the Columbia north-westwards almost from the same point and at the same level. Years ago Mr. Baillie Grohman cut a channel between them and so turned the Selkirk Range into an island. It is a curious example of the vagaries of western



watercourses to find these two rivers setting out 2,600 feet above the sea, in opposite directions, and meeting again at a point 1,200 feet lower, after completely surrounding a range of mountains 200 miles long and 80 miles wide, with summits above 11,000 feet in height. The Selkirks, as thus defined, make a fairly compact and uniform group of mountain ranges, but the term is often widened to include part or all of the other Gold Ranges, in which case the unity is lost.

The south-western part of the Selkirks and the Gold Ranges consists largely of ancient granite and gneiss, the protaxis of the Cordillera, probably equivalent in age to the Laurentian of eastern Canada, but on the side towards the Rockies there are steeply tilted and folded sedimentary rocks, thought by Dawson to be Cambrian, but considered by Walcott and Daly to be late pre-Cambrian or 'Beltian'. These sediments have been metamorphosed into slates, schists, and quartzites, resistant rocks that give bold mountain forms quite as imposing as those of the Rockies, and withal sounder rocks, a matter of some interest to the climber. Though somewhat lower than the Rockies, there are many points above 10,000 feet, and Mount Sir Sandford, twenty-seven miles north of the railway, attains 11,634 feet as determined by triangulation. It was climbed in 1912 after one or two unsuccessful attempts.

The Selkirks, especially on the west side, have an enormous snowfall, more than forty feet per annum, and as a result have large snow-fields and many glaciers at the higher levels. The Asulkan glacier and the surrounding mountains have been well described by the Rev. Spotswood Green, the first to do much climbing and exploration in that part of the range. The timber line, at 7,500 feet, is not far below snow-line, and the rainy slopes of the valleys have a growth of trees and shrubs as luxuriant as in a tropical forest. Cedars reach a diameter of fifteen or twenty feet, with a corresponding height, and the lower thickets of devil's clubs and ferns of man's height are almost impenetrable without an axe. With rugged peaks

Snow-fields,
glaciers,
and
forests.



and pinnacles rising through deep snows above valleys covered with rank forest, the Selkirks present more vivid contrasts, as well as more difficulties, than the Rockies, and their grandeur is enhanced by the fact that the Columbia valley on their western side is only 1,430 feet above the sea, while mountains a few miles to the east are 9,000 feet higher.

Towards the United States boundary the mountains are lower, and in the Kootenay region, where the climate is drier than along the main line of the Canadian Pacific Railway, there is far less snow, and the range grows more commonplace. Even here, however, the long narrow lakes between the mountains are notable. The Arrow lakes on Columbia River and the Kootenay and Slocan lakes may fairly be described as inland fiords.

The Gold Ranges, so far as known, are lower than the Selkirks, but of the same snowy and alpine character. They pass towards the west without any well-marked boundary into the Interior Plateau.

Relief.

As the Selkirks and Gold Ranges were the earliest formed of the Cordillera mountains, in a climate implying enormous erosion, it is evident that their present elevation and bold relief must be due to an important recent uplift, setting the rivers at work carving the present canyons. Though their rocks are so aged the mountains themselves present many features of youth.

Minerals.

Except coal in some of their valleys, the more modern Rockies contain scarcely anything of economic value, while the ancient Selkirks and Gold Ranges (though devoid of coal) are widely charged with metals. The silver-lead mines of the Kootenay region and the gold-copper deposits of Rossland and the Boundary are examples of this, the coal and coke of the Crow's Nest moving westward to smelt the ores of the Selkirks. As the name of Gold Ranges suggests, these mountains were famous for their placer gold in early days, when miners worked in almost every river and creek. The placers are worked out in the southern parts, but the Cariboo Mountains and Cassiar, in northern British



Columbia, still furnish 'dust' and nuggets to the placer miner.

Whether the Gold Ranges should be considered to extend north to Yukon Territory is uncertain, but the granites found in the western part of the Mackenzie Mountains suggest that after a gap the old protaxis continued towards the Arctic Ocean.

As defined by Dawson the Interior Plateau is a belt of comparatively level country 100 miles wide and 500 miles long between the Gold and the Coast Ranges. Near the parallel of 49° it is over 4,000 feet above the sea, but it gradually sinks to less than 3,000 feet towards the north, where it ends in scattered mountains. Four degrees of latitude beyond this, the upper Yukon basin presents similar features and may be considered an extension of the plateau. The Interior Plateau.

Geologically the Interior Plateau is very complex, including large amounts of volcanic rocks, ash, and lava flows, as well as Palaeozoic and Mesozoic sediments. In the Nicola district a Tertiary basin with good seams of coal rests flatly on the upturned edges of the older formations. The region is an old peneplain recently unequally elevated. Since the elevation, which affected the adjoining mountains also, there has been time for powerful creeks and rivers, fed from the heavy precipitation of the Gold Ranges, to cut deep canyons. The wild valley of Thompson River near Kamloops, with the raging muddy torrent at its bottom, is a characteristic example, and it is evident the plateau is in process of destruction, and in time will become a region of low rounded mountains separated by deep valleys.

The Coast Ranges form a very definite geological unit, since they consist mainly of a long stretch of batholithic eruptives varying from granite to diorite, with some metamorphosed Palaeozoic sediments along their flanks or included in the complex. With a breadth of about 100 miles they extend along almost the whole coast of British Columbia, and then continue towards the north-west, reaching a total length of 900 miles, the latter part, The Coast Ranges.



however, being separated from the Pacific by a band of sedimentary rocks in Alaska.

The Coast Ranges appear to have been elevated not long after the Triassic, but they have undergone various changes of level since that time. The fiords of the coast were once, no doubt, land valleys, implying a greater elevation than at present. The later depression may have been connected with the accumulation of the great Cordilleran glaciers with which the Ice Age began.

Fiords
of the
Pacific
coast.

This chain shows no parallel ranges of mountains like those of the Rockies, but consists of irregular blocks separated by deep valleys, cut by rivers during the earlier more elevated stage, and widened and scoured into the typical U shape by the Pleistocene glaciers. When the ice departed the valleys were left flooded by the sea in many cases, giving the network of fiords and channels which form the present tattered fringe of the continent. Several of these fiords cut half-way or more across the mountain chain and end towards the interior as river valleys, giving access to the interior of British Columbia, thus slicing the range into nearly separate blocks. The valley of Skeena River is of this sort, providing an easy grade for the Grand Trunk Pacific Railway to reach the coast.

Though the Coast Ranges are not lofty, seldom rising above 9,000 feet, the heavy precipitation along the Pacific provides many snow-fields and glaciers, in some cases almost reaching sea-level.

Crossing the Coast Ranges by the Skeena valley one finds no sharp boundary inland, the more closely grouped mountains ending in scattered masses rising as isolated peaks from wide valleys. These low valleys consist in part of coal-bearing Cretaceous rocks whose supplies of fuel will be of great consequence in the future. The flat intermontane valleys of the interior are fertile and sometimes prairie-like, and are being taken up as farm lands, where fields of grain may be seen enclosing mountain groups 8,000 or 9,000 feet high, with small glaciers about their summits.

As one follows the Coast Ranges north-west the snow-line sinks and glaciers increase in size, and the boundary



between British Columbia and the 'pan handle' of Alaska runs from peak to peak through a wild and snowy mountain territory. The fiord scenery of the Coast Ranges may fairly be compared for beauty and interest with that of the Norwegian coast; but the lower slopes of the mountains are hidden by a tremendous growth of cedars, spruces, and other evergreen forest trees, unlike the often bare mountain flanks of Norway.

Ores of copper, silver, and gold have been found at many places in the Coast Ranges, but the side towards the Pacific is so moist and so densely carpeted with moss and bushes beneath the forest that prospecting is difficult in spite of easy access from the sea. The drier interior flank is being opened up for exploration by the construction of railways. Thus far no mines of great importance have been developed. The Atlin placer gold region just south of White Pass in northern British Columbia lies to the east of the Coast Ranges in a region of isolated mountains surrounded by wide valleys. It may, however, be considered to belong rather to the Gold than the Coast Ranges.

Minerals
of the
Coast
Ranges.

One of the most northerly fiords penetrating the coast fringe of Alaska is Lynn Canal, which reaches the Alaskan port of Skagway, the point of entry to the Atlin and Klondike gold region. From Skagway the White Pass railway climbs 2,897 feet from tide-water to the head of navigation on Lewis River, one of the chief sources of the Yukon. The head-waters of this great river of the north rise only eighteen miles from the sea at Skagway, after which they flow 2,000 miles before reaching Bering Sea, with so well graded a valley that stern-wheel steamers navigate the Yukon and the Lewis rivers for 1,800 miles out of the 2,000.

Yukon
Territory
and the
Klondike.

The broad Yukon valley, to the north of the somewhat mountainous district of Atlin, may be considered an extension of the Interior Plateau of southern British Columbia. The Klondike region and much of the less carefully explored territory around may be described as a tableland, once a plain nearly at sea-level, but later elevated and greatly carved by rivers, leaving gently

rounded ridges and domes at the watersheds. The valleys between have been cut down with rather steep slopes to depths from a few hundred to 2,000 feet below the general level. Afterwards the region sank somewhat, so that the creeks and rivers have aggraded their valleys, filling up the old bed-rock channels with gravel for a considerable thickness, followed by a bed of peat in most places.

In the Klondike itself the highest elevation is the 'Dome', 3,500 feet above the sea, while Dawson City on the Yukon stands at 1,200 feet and represents the lowest point. The bed-rocks are mostly Palaeozoic slates and schists penetrated by dikes and bosses of eruptives and greatly tilted and folded. In parts of the region, however, there are Tertiary beds of sandstone and shale containing coal, which has been mined at Tantalus and Five Fingers.

The Klondike region was the only extensive area in Canada to escape the glaciers of the Ice Age. As it is only a degree or two south of the Arctic Circle, this seems surprising, but is readily accounted for by the range of great mountains separating the comparatively low table-land from the Pacific. The St. Elias Range, with peaks above 18,000 feet, robbed the air currents of their moisture, leaving only a very moderate snowfall for the interior, which easily melted away during the short summer. That the climate was cold is shown by the hundred or more feet of frozen peat and gravel in the placers, and also by the sheets of blue ice buried under later silts and gravels, and now forming part of the banks of Klondike River. Cold alone is not sufficient to make an ice-sheet.

At their best (in 1900), the Klondike placers produced \$22,000,000 worth of gold in one year, but the output has greatly fallen as the richer ground became exhausted (\$4,580,000 in 1911). The source of the gold is not to be found in large quartz veins but in small stringers of quartz in the schist; and it is believed that thousands of feet of these rocks were weathered and destroyed to supply the extremely rich Klondike placers, which have scarcely been equalled in the world.



The outermost range of mountains towards the west is Vancouver and Queen Charlotte Islands, largely submerged along the British Columbian coast, consisting of the great island of Vancouver, 270 miles long, and the group of Queen Charlotte Islands, 170 miles to the north-west, having a length of about 150 miles. Vancouver Island resembles in some ways the Coast Ranges, being formed mainly of Palaeozoic rocks penetrated by deep-seated eruptives and greatly metamorphosed, but it has also a fringe of gently inclined Cretaceous beds along its north-east side. The coal belonging to these beds is the best on the Pacific coast of America south of Alaska, and is mined on a large scale near Nanaimo and Comox. It is interesting to find coal-mines worked beneath the sea on Vancouver Island at the extreme west of Canada, just as coal-mines are working beneath the Atlantic on Cape Breton Island at the extreme east. The coal of the two islands is of about the same quality in spite of their ages being very different.

Vancouver Island is almost an unbroken mass of mountains covered with great forests of evergreen trees below timber-line, but rising to summits 8,000 or 9,000 feet above the sea with considerable snow-fields and glaciers. This wild interior, with its moist climate and dense growth of underbush and timber, especially on the western side, is very difficult to explore, and parts of it are still scarcely known. The island is separated from the mainland at the Seymour Narrows only by half a mile of sea, which it is proposed some day to bridge; and there is reason to believe that during the Ice Age the Cordilleran glacier crossed the channel and carried erratic blocks and boulder clay across from the Coast Ranges. Vancouver Island has similar inlets, fiords, and islands to those of the mainland, with magnificent scenery, especially on its rainy and little-visited south-western coast, but the areas of available farmland are not great and the heavy timber makes the land difficult and expensive to clear.

The Queen Charlotte Islands are much smaller and less mountainous than Vancouver, no summits being reported as rising above 2,000 feet. Their southern end is of



rugged Palaeozoic rocks, but the northern part consists of gently tilted Cretaceous and early Tertiary sediments with much volcanic material. The later rocks contain beds of lignite locally transformed into bituminous or anthracite coal by neighbouring dikes of diabase. The north-westward extension of this island chain forms the narrow strip of mountainous shore and islands belonging to Alaska.

The true western boundary of the North American continent should be placed beyond the islands just described, where the edge of the continental shelf sinks rapidly towards the greater depths of the Pacific. The whole Pacific coast has undergone geologically recent changes of level, as shown by the deep fiords, once land valleys, on the one hand, and by raised beaches with marine shells on the other, reaching in places 290 or 300 feet above the sea. Whether the post-glacial rise continues slowly to the present is uncertain. These comparatively recent changes of level, however, are on a much feebler scale than those which must have accompanied the elevation of the successive mountain chains of the Cordillera, so that the bottom of the Pacific and the mountainous belt which has been thrust up beside it seem to be gradually settling down to a state of equilibrium.

The Saint
Elias
Range.

The mountains of the Cordillera proper are greatly surpassed in height by a comparatively small knob of mountains near the boundary of the Yukon Territory and Alaska beyond Lynn Canal and the White Pass. The north-western part of the international boundary follows a lofty mountain range near the Pacific coast from Mount Fairweather (15,287 feet high) to Mount St. Elias, where it turns north along the 141st meridian to the Arctic Ocean. The inland portion of this range with Mount Logan, a little to the north-east, forms much the loftiest part of Canada, since Mount St. Elias reaches 18,024 feet and Mount Logan 19,539. A little to the west in Alaska is Mount McKinley, over 20,000 feet high, the culminating point of North America. This group of lofty peaks represents, as shown by Suess, the junction of two great



mountain trends, that of the Cordillera chains, running north-west, and that of the Alaskan peninsula, trending north-east. Mr. McConnell, of the Canadian Geological Survey, describes them as follows: 'The mountains and mountain ridges of this range are characterized by extreme boldness of outline. Steep slopes, precipitous cliffs, and high broken peaks and crests prevail. The larger streams have cut deep wide valleys back into the heart of the range, while the smaller ones are usually enclosed in narrow, steep-sided, and often impassable canyons. The central portion of the range and all the higher mountains are covered with deep continuous snow-fields, and glaciers, some of the first magnitude, are present everywhere.' Mount St. Elias was climbed by the Duke of the Abruzzi, an exploring expedition as carefully planned as for Arctic work being necessary for the purpose.

Mount Logan and most of the other mountains of the range are built of Palaeozoic rocks, but the lower ground to the east consists largely of comparatively recent volcanic rocks with some early Tertiary sediments.

Mount St. Elias was once reputed to be a volcano, but this was an error, and no volcano has been active within historic times anywhere in Canada so far as known, though a well-preserved cone, with a crater breached on one side by a short lava stream, has been found in the Yukon Territory.

This survey of the physical geography of Canada began with Nova Scotia at the south-eastern corner of the Dominion, one of its oldest and lowest parts, and ends near its north-western corner with the most recent and also the loftiest mountains within its boundaries. Conclu-
sion.

[For topography and physiography as well as geology see *Reports, Bulletins, Biblio- and Memoirs* of the Geological Survey of Canada, such as 'Geology of Canada: Report of Progress', Montreal, 1863, summarizing work down to that date and dealing especially with southern Quebec and Ontario; D. B. Dowling, 'Coal-fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia,' Ottawa, 1909; G. A. Young, 'Descriptive Sketch of the Geology and Economic Minerals of Canada,' Ottawa, 1909. Also *Reports* of various Dominion government departments, especially the Department of the Interior, and mining and other departments of provincial governments. Among other



works, see Sir J. W. Dawson, *Handbook of Canadian Geology*, Montreal, 1889; J. E. Bernier, *Report on Expedition to the Arctic Islands*, Ottawa, 1910; A. P. Coleman, *The Canadian Rockies*, London, 1911; S. E. Dawson, *The St. Lawrence Basin and its Borderlands*, London, 1905; C. E. Fay, *The Canadian Rocky Mountains*, Philadelphia, 1911; E. T. Seton, *The Arctic Prairies*, London, 1912; A. O. Wheeler, *The Selkirk Mountains*, Winnipeg, 1912; A. B. Willmott, *Mineral Wealth of Canada*, Toronto, 1897. There is a substantial bibliography of travel and observation in the remoter parts of the Dominion.

Maps.

The Department of the Interior publishes sectional maps of 1 inch = 3 miles, roughly hachured, and smaller-scale compilations (1 : 500,000, 1 : 250,000) for parts of the eastern provinces. The Militia Department is extending its survey (maps 1 inch = 1 mile, contoured) over Quebec and Ontario. Railway surveys are numerous and especially valuable in the western mountain region, where also the work of mountaineer-explorers is particularly valuable. Geological surveys or reconnaissances are extensive.]

CHAPTER II

CLIMATE

BY R. F. STUPART

General conditions.

THAT Canada, a vast territory which stretches east and west between the Atlantic and Pacific Oceans, with her most southerly point in the same latitude as Rome in Italy, and her northern boundary the Arctic Sea, should possess climates ranging from that of the warm temperate zone to that of the polar winter, is but to be expected. The great part which her topographical features, varying as they do between the widest extremes, play in placing these varying climates, in tempering or in increasing their heat or cold, is a striking consideration in the climatology of the country. Between the climates of the Pacific coast and of the western prairies is raised the lofty barrier of those mountain ranges which lie parallel to the coast. Temperatures upon the great plains of the west are influenced not a little by altitudes above the sea, varying from over 3,000 feet to less than 1,000 feet, while further to the east in Ontario, at a distance from the ocean where might be expected all the continental extremes of heat and cold, the Great Lakes temper and modify the climate. It should



be remembered that the older provinces, with the exception of the northern and as yet unsettled portions of Ontario and Quebec, are wholly further south than the British Isles, and lie between the same parallels as France. British Columbia, the most western province, spread over 11° of latitude, and with an average width of 400 miles, is of a size which would alone lead to a diversity of climate, but when in addition to area we consider that the western boundary is the Pacific Ocean, and that the whole province is traversed by three lofty mountain ranges, it will be understood why the climatic conditions are varied.

Vancouver Island in the Pacific Ocean occupies somewhat the same position in relation to the American continent that Great Britain in the Atlantic does to Europe. The annual rainfall, as in all other parts of British Columbia, varies much with the orographical features of the country. Along the exposed western coast it is very great, at many points exceeding 110 inches, but in the eastern portion it is much less, and at Victoria and some other points does not greatly exceed 30 inches. This may be compared with the west and east coasts of the south of Great Britain. The rainfall is not distributed uniformly throughout the year, the summer months being dry and the autumn and winter months wet, whereas in England it is the spring months which are driest. There are usually a few snowfalls during the winter, but the snow does not lie for any length of time at low levels. The annual temperature curve is similar to that of England, the monthly values in winter being nearly the same as in the Midland counties, and the summer temperatures somewhat lower. The percentage of bright sunshine during the colder months is no greater than in England, but during the summer is distinctly higher, and may be correlated with the drier conditions.

Across the Strait of Georgia on the mainland at low levels, and especially in the lower Fraser River valley, the climate is closely similar to that of the island, with, however, a somewhat larger range of temperature, the

British
Columbia.



summers being slightly warmer, and the winters, while mild, nevertheless liable to occasional moderate cold spells. Zero is scarcely ever recorded, and in most years the temperature does not fall lower than about 20° F. The annual precipitation is generally between 55 and 65 inches. Holly and ivy thrive here as on Vancouver Island.

The
Interior
Plateau.

The change in climate between the west and the east sides of the Coast Range is decidedly abrupt. The Pacific winds are deprived of much of their moisture in ascending the western slopes of the mountains, and the air flows eastward or is drawn down to lower levels, becoming drier and warmer. Hence the interior plateaus between the Coast and the Selkirk Ranges possess a relatively dry climate ; the summers are warmer and the winters colder than on the lower mainland. The cold of winter, however, is seldom severe, and the hottest days of summer are rendered pleasant by the fact that the air is dry and the nights are cool.

In the more southern districts the mean temperature of April corresponds very closely with that of the same month in England, while the summer is somewhat warmer than an English summer, and may well be compared with that of the southern portion of the Canadian province of Ontario, except that the air is much drier and the rainfall is scanty. There are areas within this upper country where the annual precipitation is less than 10 inches, notably in the Kamloops division, but over the greater portion of both Yale and Kootenay districts the precipitation is sufficient, and throughout the whole region irrigation, if desirable, is easily accomplished. The excellence of the climatic conditions of these interior valleys is well indicated by the success of fruit cultivation ; the grape, the peach, and the mulberry ripen early even on the higher benches, and tobacco is a profitable crop. In East Kootenay between the Selkirks and the Rocky Mountains, the winters are colder, and at times the temperature falls considerably below zero, but the spring sets in early, the summers are warm, and an annual

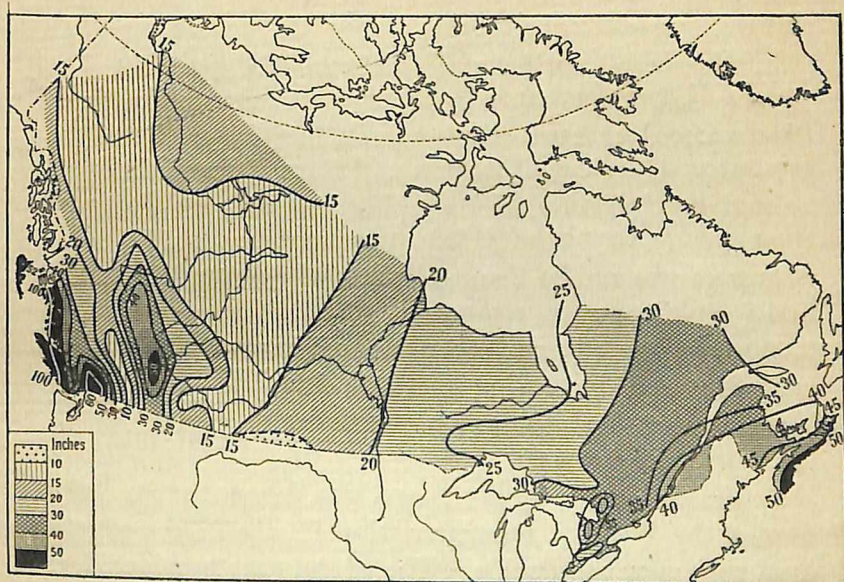


FIG. 3. Mean Annual Rainfall of Canada.

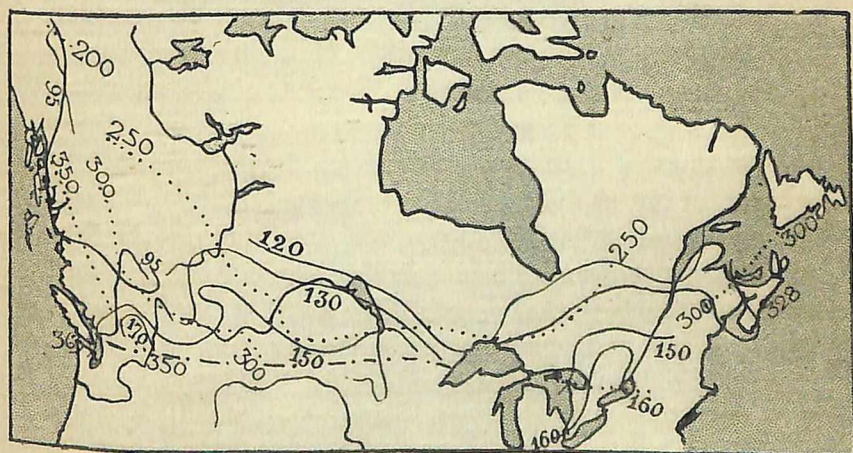


FIG. 4. Number of Days with Temperature above Freezing, dotted line; Number of Days above 60° F., continuous line.



precipitation of 18–20 inches in rain with a moderate winter snowfall affords sufficient moisture for agriculture.

Northern districts.

In the more northern districts of the province the climate near the coast is distinctly wet, but mild withal. Observations at Port Simpson, not far distant from the present meteorological station at Prince Rupert, show an annual precipitation of 74 inches, an average January temperature of 34° and July temperature of 59° , temperatures not unlike those of parts of Scotland. In the interior plateaus, very generally at an altitude exceeding 3,000 feet, the climate becomes more severe with higher latitudes and increasing distance from the coast, but large areas are suitable for mixed farming and ranching.

Western provinces:
Alberta,
Saskatchewan,
Manitoba.

To the east of the Rocky Mountains, in what are usually termed the Western Provinces, the climate differs widely from that near the Pacific. The winters are much colder. Spring usually opens a little earlier in Alberta, near the mountains, and in south-western Saskatchewan, than it does further east in Saskatchewan and in Manitoba, but early in May the more eastern districts become the warmer, and the average temperature of the three summer months in Manitoba, taking Winnipeg as typical of the province, is some 5° higher than during the same season at Calgary and Edmonton. An average daily maximum temperature in April of 53° at Calgary, 52° at Edmonton, 58° at Medicine Hat, and 50° at Winnipeg, indicates very clearly that April is truly spring, and farming operations are well under way early in that month. The rapid upward trend of the temperature curve continues during May and June. Bright hot days may be confidently looked for during July and August, and very occasionally in these months temperatures exceeding 90° , perhaps over 100° , are recorded. Average mean maxima in July of 78° at Winnipeg, 76° at Qu'Appelle, 82° at Medicine Hat, 75° at Calgary, indicate a not unpleasant warmth, while the corresponding minima show that the nights are cool. A fact of peculiar interest, in connexion with the climate



FIG. 5. General Distribution of Rain in North America.

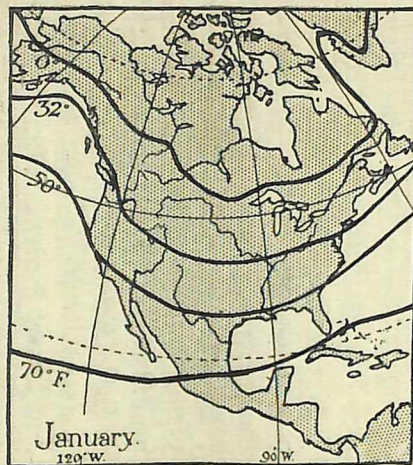


FIG. 6. January Isotherms of North America.

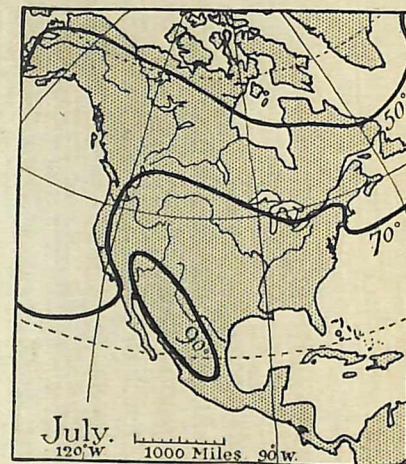


FIG. 7. July Isotherms of North America.



of the Western Provinces and territory to the north, is that the summer season in Athabasca and the basin of the great Mackenzie River is nearly as warm as in Alberta. At Edmonton and Calgary the mean summer temperature is 59° , and at Fort Simpson, in 62° N. lat., it is but 2° lower. While, however, the summers in the more northern latitudes are warm, the other seasons are not so, and a downward trend of the temperature curve is very noticeable after the middle of August.

Alberta.

Southern Alberta has a much milder winter than any other portion of the Western Provinces, and the cold becomes greater to the eastward over Saskatchewan and Manitoba and northward towards Athabasca and the Mackenzie River basin. Eastwardly from Alberta the average winter temperatures, December–March, are as follows: Calgary 15° , Medicine Hat 16° , Qu'Appelle 5° , Winnipeg 2° . Northward the change is even more marked, and in strong contrast to the small variation during the summer—Calgary 15° , Edmonton 12° , Dunvegan 1° , Fort Chipewyan -7° , Hay River at the entrance of Slave Lake -9° , Fort Simpson in latitude 62° N. -13° , and Fort Good Hope, near the Arctic Circle, -25° . Seeing that the winters are so cold in the far northern territories while the summers are warm, the time of the opening of spring becomes all-important, and the average date cannot be placed much before the end of April in the Peace River valley, and early May further north in the Mackenzie basin. All through April, however, the snow is melting fast, the temperature is frequently above 50° , and wild fowl are flying during the latter half of the month. Another feature of peculiar interest in connexion with the climate of the Western Provinces near the mountains, is the rapid changes of temperature, which in winter frequently occur in short intervals of time; also the marked variation in the mean winter temperature in different years, and the variation in rainfall during the summers of different years. The rapid changes in short intervals are accounted for and explained by the well-known Chinook or Föhn effect,

The
Chinook.



which is met with to a greater or lesser extent on the lee of mountains, on the windward side of which moisture is precipitated. When a cyclonic area from the Pacific, moving across Northern Alberta, causes a rapid south-west and westerly flow of air across the Rocky Mountains, the Chinook blows over the western prairies. Sometimes a change of wind from north and north-east to south-westerly will connote in Alberta a rise of temperature from perhaps 20° below zero to 40° above in a few hours.

The variation in successive seasons is to a great extent, though not entirely, due to the varying position of the track of storm centres in different years. The average mean track for January, deduced from many years of observation, is across British Columbia. In some winters, however, the centres persistently move further south than in others, and pass into the continent over the States of Washington or Oregon. Then the Chinook does not blow east of the mountains in the Canadian provinces, where north-east and north winds prevail, accompanied by continued low temperatures. In other years the storm centres just as persistently move across northern British Columbia, and then the Chinook is the rule rather than the exception, and the weather under the lee of the mountain keeps mild. As an example of the variation of temperature in different winters, the mean temperature of January 1886 at Edmonton was -13.7° , while in 1889 it was 21.9° —a range of 35.6° . In February 1887 it was -10.4° , and in 1889 21.9° —a range of 32.3° . In November 1896 it was zero, and in November 1890 it was 38° .

The average annual precipitation over the larger portions of both Alberta and Saskatchewan is about 17 inches, of which 11 to 12 inches fall as rain and the remainder as snow. In the southern districts of the former province, and the south-western districts of the latter, the precipitation is somewhat less, and in some localities it is even below 13 inches, and here much of the snowfall is evaporated by Chinook winds, leaving the prairies bare of snow

Rainfall
of the
western
provinces.



during a large part of the winter. Towards Manitoba the precipitation increases, and the mean annual amount for that province is about 19 inches ; the heaviest, about 21 inches, occurring in the extreme eastern portion, and the least, 17 inches, in the more southern and western districts. A feature of pronounced importance in connexion with the precipitation of the Western Provinces is that in Manitoba fully 50 per cent., and further west 62 per cent., of the total amount falls between May and the end of August, affording ample moisture for the crops during the growing season.

Ontario. Ontario, bounded on the west by Manitoba, on the north by Hudson Bay, and on the south by the Great Lakes, is spread irregularly over 15° of latitude and 20° of longitude. The climate of that portion of the province which lies north of Lakes Superior and Huron differs considerably from that of the part which lies east of Lake Huron and north of Lakes Erie and Ontario, especially in winter, when the former, in addition to lying further north, is less affected by the tempering influence of the Lakes. In the southern districts the vegetation makes rapid progress in April ; before the end of the month the trees are partially in leaf, and at times temperatures of 70° and over are recorded. May is almost invariably a delightful month, with a mean temperature ranging between 52° and 55°, and by the last week all trees are in full leaf. The summer months are decidedly warm, with much sunshine and very few rainy days, most of the precipitation which occurs falling in showers or thunderstorms which give sufficient moisture to the rapidly ripening crops. With the cool nights of September come the first indications of autumn, but it is seldom that ground frosts occur until October, which month, with its superb weather and glorious autumn tints, is one of the finest of the year. November, with the shortening days, is often wet, but snow rarely falls until December, in which month the winter sets in with blustery weather and heavy snowfalls, sometimes followed by cold spells during which the temperature may fall to zero or lower. January and



February are truly winter and the ground is usually snow-covered. With March come signs of spring. In most years all snow has disappeared by the middle of the month and by the end the trees are beginning to bud. The annual precipitation throughout this portion of Ontario is a little over 30 inches, which is pretty evenly distributed over the various months.

From the north shores of Lakes Superior and Huron to Lake Superior—Hudson Bay region. Hudson Bay the winters are distinctly severe, but as the accompanying tables for Moose Factory, Abitibi, and Haileybury indicate, the summers are warm. In January the mean temperature at Moose Factory is 25° lower and at Haileybury 15° lower than at Toronto, but as the spring advances, the differences become less, until in May they are respectively 10° and 2° lower, and by July, 6° and 2° lower.

At Moose Factory and Fort Hope, 300 miles to the westward, the average daily maximum temperatures for July and August are 74° and 70° , as against 77° and 73° at Haileybury, which latter temperatures are almost the same as those at Toronto in the same months. It will be observed, however, that in June the temperature is considerably lower in the north than at Haileybury and Toronto, and that the nights are cooler all through the summer. Temperatures of over 80° are not infrequent in Northern Ontario, and 90° or over is usually recorded once or more often in each summer. The total annual precipitation near Lakes Nipissing and Temiskaming is nearly the same as in southern Ontario, but northward this diminishes somewhat, the rainfall becoming less and the snowfall greater.

The province of Quebec comprises an enormous territory Quebec. extending from the Ottawa and St. Lawrence valleys northward into unexplored Labrador and Ungava. The summers in the south-western part of the province are as warm as in southern Ontario, but are considerably cooler further east; in July the 70° isotherm passes not far south of Montreal, the 65° line passes through Quebec city, and most of the Gaspé Peninsula has a mean temperature



something below 60° . The almost unsettled districts in the western part of the province lying north of the Ottawa River and extending to about 51° N. lat., have a summer quite as warm as that of northern Ontario and the Western Provinces, with an abundant rainfall and much bright sunshine. The winters throughout the province are cold, and between December and March the ground usually has a deep covering of snow.

Maritime
Provinces.

The general character of the seasons in the Maritime Provinces corresponds very closely with that of western Quebec and southern Ontario. The spring, however, opens just a little later, and the summer is not quite so warm, but, as in Ontario, October is usually a superb month, and it is late in November or early December before snow falls. Reference to the tables will show that the annual temperature curve at Halifax is closely similar to that of Toronto, and that of Fredericton, N.B., is almost the counterpart of Montreal. The average annual precipitation of these provinces is between 40 and 45 inches, except along the southern coast-line of Nova Scotia, where it is nearly ten inches greater.

Ice and
naviga-
tion of
Great
Lakes
and St.
Lawrence.

The Great Lakes never freeze over ; but usually most of the harbours are closed with ice by about the middle of December, and remain frozen over until the end of March or beginning of April. The average date of the closing of navigation on the St. Lawrence River at Montreal is December 16, and of the opening, April 21. Harbours in the Gulf of St. Lawrence are likewise closed by ice during the winter months, but on the Bay of Fundy and coast of Nova Scotia they are open all the year round.

CLIMATIC TABLES

The average mean highest, mean lowest, and mean temperature; the highest and lowest temperature, and mean daily range; also percentage of bright sunshine and mean annual precipitation at various stations in Canada.

TABLE I

VICTORIA, B.C.

Latitude, $48^{\circ} 24'$; Longitude, $123^{\circ} 19'$

	MEAN				ABSOLUTE		Precipitation
	Highest	Lowest	Aver. Temperature	Daily Range	Highest	Lowest	
January .	41.9	33.1	37.5	8.8	56	-1	5.28
February .	44.1	34.1	39.1	10.0	60	6	4.03
March .	48.9	36.1	42.5	12.8	68	17	2.92
April .	54.9	39.4	47.2	15.5	75	29	2.42
May .	61.6	44.2	52.9	17.4	83	31	1.44
June .	65.5	47.8	56.6	17.7	86	36	1.20
July .	70.9	49.6	60.3	21.3	90	37	0.40
August .	69.2	49.8	59.5	19.4	88	37	0.60
September .	63.8	46.1	55.0	17.7	85	30	2.16
October .	55.8	43.7	49.7	2.1	70	22	2.37
November .	48.3	38.8	43.6	9.5	63	17	6.97
December .	45.5	37.0	41.3	8.5	59	8	7.98
Year	70.9	33.1	48.8		90	-1	37.77

VANCOUVER, B.C.

Latitude, $49^{\circ} 17'$; Longitude, $123^{\circ} 5'$

January .	40.1	32.5	36.3	7.6	55	2	8.83
February .	44.7	32.6	38.7	12.1	58	11	6.79
March .	49.9	35.3	42.6	14.6	61	15	4.90
April .	56.1	38.1	47.1	18.0	79	28	3.42
May .	62.5	44.4	53.5	18.1	80	33	3.60
June .	67.7	48.6	58.2	19.0	88	36	3.28
July .	72.8	52.7	62.8	20.1	90	43	1.23
August .	72.1	51.9	62.0	20.2	92	41	1.47
September .	63.9	46.0	55.0	17.9	82	30	5.49
October .	57.6	42.3	50.0	15.3	69	23	5.48
November .	46.7	36.0	41.4	10.7	74	15	10.09
December .	44.1	35.1	39.3	9.0	58	22	7.84
Year	72.8	32.5	48.9		92	2	62.42

AGASSIZ, B.C.

Latitude, $49^{\circ} 14'$; Longitude, $121^{\circ} 31'$

	MEAN				ABSOLUTE		Precipitation
	Highest	Lowest	Aver. Ten-perature	Daily Range	Highest	Lowest	
January .	37.9	28.2	33.0	9.7	57	-13	7.29
February	43.5	31.7	37.6	11.8	64	-12	6.68
March .	52.0	35.9	44.0	16.1	74	16	5.47
April .	55.2	38.3	46.7	16.9	82	28	5.49
May .	62.9	44.8	53.9	18.1	90	30	4.85
June .	69.5	48.3	58.9	21.2	95	36	3.97
July .	76.7	51.0	63.9	25.6	95	38	1.55
August	79.0	50.5	64.7	28.5	97	38	1.62
September	67.4	46.7	57.0	20.7	90	32	5.25
October .	61.3	42.1	51.7	19.2	82	29	6.56
November	44.4	34.1	39.3	10.3	63	9	8.69
December	40.8	31.9	36.3	8.9	58	8	9.43
Year	79.0	28.2	48.9		97	-13	66.85

KAMLOOPS, B.C.

Latitude, $50^{\circ} 41'$; Longitude, $120^{\circ} 29'$

January .	29.1	17.1	23.1	12.0	56	-31	0.94
February	34.1	19.6	26.8	14.5	64	-27	0.82
March .	47.1	27.8	37.4	19.3	69	-5	0.39
April .	61.1	37.4	49.2	23.7	84	22	0.37
May .	70.1	45.9	58.0	23.2	100	26	1.01
June .	76.4	51.6	64.0	24.8	101	35	1.26
July .	83.4	55.8	69.6	27.6	102	42	1.32
August	81.7	54.6	68.1	27.1	101	38	1.01
September	69.5	46.4	57.8	23.1	93	30	1.01
October .	56.4	38.3	47.6	17.6	82	16	0.53
November	41.7	30.0	35.8	11.7	71	-22	1.10
December	34.5	24.3	29.4	10.2	56	-16	0.79
Year	83.4	17.1	47.2		102	-31	10.55

VERNON, B.C.

Latitude, $50^{\circ} 14'$; Longitude, $119^{\circ} 15'$

	MEAN				ABSOLUTE		Precipitation
	Highest	Lowest	Aver. Temperature	Daily Range	Highest	Lowest	
January .	34.3	16.6	25.4	17.7	56.0	-27.0	0.98
February	38.1	19.5	28.8	18.6	70.0	-30.0	1.09
March .	49.4	25.9	37.7	23.6	64.0	-3.0	0.76
April .	64.1	34.9	49.5	29.2	80.0	18.0	0.51
May .	73.2	41.4	57.3	31.8	91.0	24.0	1.23
June .	74.0	46.9	60.1	27.8	97.0	30.0	1.66
July .	82.1	50.1	66.1	32.0	101.0	36.0	1.30
August .	82.1	49.5	65.8	32.6	98.0	34.0	0.96
September	67.6	41.3	54.5	26.3	92.0	25.0	1.53
October .	56.5	34.1	45.3	22.4	76.0	15.0	0.66
November	40.9	25.8	33.4	15.1	65.0	-17.0	1.36
December	35.5	21.5	14.0	14.4	65.0	-4.0	1.24
Year	82.1	16.6	45.6		101.0	-30.0	13.28

NELSON, B.C.

Latitude, $49^{\circ} 29'$; Longitude, $117^{\circ} 21'$

January .	33.9	24.5	29.2	9.4	49.0	-6.0	2.89
February	32.7	21.2	27.0	11.5	54.0	-7.0	3.00
March .	40.6	25.6	33.1	15.0	62.0	9.0	1.78
April .	56.1	35.6	45.9	20.5	76.0	20.0	1.58
May .	65.3	41.4	53.4	23.9	84.0	29.0	2.49
June .	73.9	48.0	61.0	25.9	91.0	34.0	3.31
July .	81.1	51.9	66.5	29.2	94.0	41.0	1.76
August .	74.1	50.4	62.3	23.7	94.0	39.0	1.87
September	70.2	45.0	57.6	25.2	86.0	30.0	1.59
October .	54.1	34.4	44.3	19.7	75.0	20.0	2.81
November	42.2	32.1	37.2	10.1	55.0	2.0	2.88
December	38.2	34.6	36.4	3.6	49.0	8.0	3.31
Year	81.1	21.2	46.2		94.0	-7.0	29.27

CANADA

PORT SIMPSON, B.C.

Latitude, $54^{\circ} 34'$; Longitude, $130^{\circ} 26'$

	MEAN				ABSOLUTE		Precipitation
	Highest	Lowest	Aver. Temperature	Daily Range	Highest	Lowest	
January .	39.5	27.8	33.6	11.7	63	-9	9.59
February .	40.7	29.6	35.2	11.1	63	-10	7.19
March .	44.7	30.9	37.8	13.8	63	11	5.86
April .	50.4	35.2	42.8	15.2	73	18	6.78
May .	56.6	40.2	48.4	16.4	79	27	4.61
June .	60.6	45.2	52.9	15.4	88	34	4.35
July .	66.6	51.3	58.9	15.3	88	29	4.86
August .	63.9	49.5	56.7	14.4	80	31	6.78
September .	59.2	45.2	52.7	14.0	74	30	8.04
October .	53.5	40.6	47.0	12.9	65	28	12.33
November .	45.6	33.7	39.7	11.9	65	6	11.52
December .	42.6	31.2	36.9	11.4	62	5	11.17
Year	66.6	27.8	45.2		88	-10	94.08

EDMONTON, ALTA.

Latitude, $53^{\circ} 33'$; Longitude, $113^{\circ} 30'$

January .	16.2	-3.2	6.5	19.4	56	-57	0.76
February .	19.6	-1.3	9.4	20.9	62	-57	0.68
March .	33.9	10.9	22.4	23.0	72	-40	0.71
April .	52.9	28.8	40.9	24.1	84	-10	0.79
May .	64.8	39.0	51.4	26.8	90	11	1.78
June .	69.9	44.3	57.1	25.6	94	25	3.19
July .	73.7	48.3	61.0	25.4	94	33	3.39
August .	71.9	46.4	59.4	25.5	90	26	2.13
September .	62.1	37.5	49.8	24.6	86	12	1.42
October .	61.1	34.5	46.8	26.6	82	-10	0.74
November .	39.5	17.7	28.6	21.8	74	-44	0.59
December .	29.7	8.3	18.9	21.2	56	-45	0.74
Year	73.7	-3.2	36.8		94	-57	16.92

CALGARY, ALTA.

Latitude, $51^{\circ} 2'$; Longitude, $114^{\circ} 2'$

	MEAN				ABSOLUTE		Precipitation
	Highest	Lowest	Aver. Temperature	Daily Range	Highest	Lowest	
January .	23.1	1.6	14.4	21.5	58	-48	0.44
February	24.5	2.4	13.5	22.1	59	-49	0.56
March .	35.6	12.2	23.9	23.4	75	-34	0.74
April . .	53.2	26.8	40.0	26.4	78	-14	0.70
May . .	62.7	35.5	49.1	27.2	90	12	2.48
June . .	68.4	42.2	55.3	26.2	94	26	3.24
July-. .	74.7	46.5	60.6	28.2	95	29	2.56
August .	70.2	44.8	57.5	25.4	95	28	2.52
September	63.7	36.7	50.2	27.0	89	15	1.17
October .	55.1	28.7	41.9	26.5	85	-8	0.48
November	36.3	14.8	25.6	21.5	70	-31	0.70
December	30.1	10.6	20.4	19.5	60	-39	0.56
Year	74.7	1.6	37.5		95	-49	16.15

FORT CHIPEWYAN, ALTA.

Latitude, $58^{\circ} 43'$; Longitude, $111^{\circ} 10'$

January .	-1.3	-19.9	-10.6	18.6	38	-55	1.07
February	0.9	-18.5	-8.8	19.4	42	-50	0.68
March .	15.5	-5.1	5.2	20.6	46	-49	0.57
April . .	39.3	18.5	28.9	20.8	69	-32	1.38
May . .	54.8	33.8	44.3	21.0	83	-14	1.69
June . .	64.8	43.4	54.1	21.4	88	+16	2.85
July . .	70.9	50.3	60.6	20.6	93	23	2.30
August .	67.6	46.1	56.9	21.5	85	23	3.30
September	53.2	34.8	44.0	18.4	78	10	2.47
October .	42.3	26.2	34.3	16.1	63	0	1.83
November	20.5	5.9	13.2	14.6	51	-31	1.29
December	6.4	-11.3	-2.4	17.7	42	-54	0.77
Year	70.9	-19.9	26.6		93	-55	20.20

CANADA

REGINA, SASK.

Latitude, $50^{\circ} 27'$; Longitude, $104^{\circ} 37'$

	MEAN				ABSOLUTE		Precipitation
	Highest	Lowest	Aver. Tem-perature	Daily Range	Highest	Lowest	
January .	9.3	-9.9	-0.8	18.2	48	-54	0.65
February .	9.8	-9.2	+0.3	19.0	52	-56	0.96
March .	24.4	4.6	14.5	19.8	68	-44	0.98
April .	49.1	26.8	38.0	22.3	85	-20	1.11
May .	62.7	37.9	50.3	24.8	99	7	2.08
June .	71.9	46.9	59.4	25.0	102	23	3.48
July .	76.1	51.0	63.6	25.1	107	31	2.65
August .	74.5	48.6	61.6	25.9	104	23	1.68
September .	63.8	39.3	51.6	24.5	93	9	1.58
October .	50.8	29.8	40.3	21.0	87	-15	0.99
November .	29.3	12.2	20.8	17.1	73	-47	0.97
December .	17.8	-0.5	8.7	18.2	56	-55	0.61
Year	76.1	-9.9	34.0		107	-56	17.74

WINNIPEG, MAN.

Latitude, $40^{\circ} 35'$; Longitude, $97^{\circ} 7'$

January .	8.0	-13.3	-2.6	21.3	41.8	-46.1	0.96
February .	11.1	-13.4	-1.2	24.5	46.0	-46.5	0.70
March .	26.2	3.0	14.6	23.2	61.8	-36.5	1.25
April .	50.1	27.0	38.6	23.1	89.6	-12.8	1.51
May .	64.2	37.8	51.0	26.4	93.6	14.0	1.91
June .	74.2	49.9	62.1	24.3	100.5	21.0	3.62
July .	77.6	54.0	65.8	23.6	95.8	35.5	3.33
August .	75.4	50.3	62.9	25.1	97.0	30.3	2.04
September .	65.8	41.8	53.8	24.0	99.0	17.0	1.93
October .	51.8	30.9	41.3	20.9	84.8	-2.8	1.27
November .	30.5	12.4	21.4	18.1	64.8	-33.4	1.16
December .	16.8	-2.7	7.0	19.5	44.8	-39.1	0.74
Year	77.6	-13.4	34.6		100.5	-46.5	20.42



CLIMATE

73 **CSL**

HAILEYBURY, ONT.

Latitude, $47^{\circ} 29'$; Longitude, $79^{\circ} 39'$

	MEAN				ABSOLUTE		Precipitation
	Highest	Lowest	Aver. Tem-perature	Daily Range	Highest	Lowest	
January .	17.7	-4.3	6.7	22.0	48	-40	2.04
February	19.8	-2.9	8.5	22.7	47	-38	1.90
March .	32.1	8.3	11.9	23.8	71	-34	2.23
April .	48.3	26.3	37.3	22.0	79	-3	1.84
May .	61.6	39.0	50.3	22.6	93	17	3.22
June .	73.7	50.2	62.0	23.5	100	28	3.03
July .	76.7	55.4	66.0	21.3	99	36	3.91
August .	73.0	51.8	62.4	21.2	93	27	2.63
September	65.1	44.4	54.7	20.7	91	24	3.52
October .	51.2	33.9	42.5	17.3	80	13	2.71
November	35.3	20.9	28.1	14.4	63	-25	2.25
December	21.0	3.2	12.1	18.2	47	-35	2.40
Year	76.7	-4.3	37.0		100	-40	31.76

ABITIBI, P.Q.

Latitude, $48^{\circ} 43'$; Longitude, $79^{\circ} 22'$

January .	12.5	-11.3	0.6	23.8	42	-46	1.85
February	14.2	-11.0	1.6	25.2	46	-44	1.45
March .	28.2	1.6	14.9	26.6	62	-42	2.25
April .	40.3	21.0	30.6	19.3	70	-20	1.43
May .	54.6	36.4	45.5	18.2	94	8	2.86
June .	67.9	49.3	58.6	18.6	94	28	2.67
July .	72.6	55.5	64.0	17.1	94	35	2.77
August .	68.9	52.3	60.6	16.6	86	34	2.85
September	60.2	44.7	52.5	15.5	87	26	2.60
October .	47.2	32.1	39.6	15.1	76	15	2.96
November	31.1	18.2	24.6	12.9	68	-10	2.05
December	16.6	-1.4	7.6	18.0	48	-45	2.22
Year	72.6	-11.3	33.4		94	-46	27.96

MOOSE FACTORY

Latitude, $51^{\circ} 16'$; Longitude, $80^{\circ} 56'$

	MEAN				ABSOLUTE		Precipitation
	Highest	Lowest	Aver. Tem-perature	Daily Range	Highest	Lowest	
January .	8.1	-15.3	-3.6	23.4	43	-48	1.93
February	10.5	-14.8	-2.2	25.3	45	-48	1.01
March .	25.1	-3.0	11.0	28.1	57	-45	0.94
April . .	38.8	16.3	27.6	22.5	72	-29	1.33
May . .	53.0	31.8	42.4	21.3	95	-11	2.33
June . .	67.1	42.2	54.7	24.6	94	23	2.34
July . .	74.1	50.6	62.3	23.5	97	31	2.48
August .	70.3	48.3	59.3	22.0	96	32	3.24
September	61.6	41.9	51.7	19.7	91	24	2.92
October .	48.3	32.3	39.7	16.0	84	8	1.88
November	30.5	16.4	23.5	14.1	63	-27	1.19
December	13.9	-4.8	4.5	18.7	43	-41	1.47
Year	74.1	-15.3	30.9		97	-48	23.06

TORONTO, ONT.

Latitude, $43^{\circ} 40'$; Longitude, $79^{\circ} 24'$

January .	28.9	14.9	21.9	14.0	58	-26	2.90
February	29.6	14.5	22.0	15.1	54	-25	2.58
March .	35.6	21.4	28.5	14.2	70	-16	2.67
April . .	48.9	32.8	40.8	16.1	90	6	2.42
May . .	61.3	42.9	52.1	18.4	93	25	3.06
June . .	72.0	52.7	62.4	19.3	93	28	2.88
July . .	77.4	57.9	67.6	19.5	103	39	2.99
August .	75.6	57.0	66.3	18.6	99	40	2.87
September	67.5	49.9	58.7	17.6	94	28	3.27
October .	54.1	38.7	46.4	15.4	81	16	2.46
November	42.0	29.9	36.0	12.1	67	-5	3.09
December	32.2	19.6	25.9	12.6	61	-21	2.92
Year	77.4	14.5	44.1		103	-26	34.11

MONTREAL, P.Q.

Latitude, $45^{\circ} 30'$; Longitude, $73^{\circ} 35'$

	MEAN				ABSOLUTE		Precipitation
	Highest	Lowest	Aver. Temperature	Daily Range	Highest	Lowest	
January .	20.7	4.4	12.5	16.3	52	-26	3.73
February	23.4	7.4	15.4	16.0	50	-24	3.07
March .	30.7	16.9	23.8	13.8	57	-15	3.99
April . .	49.0	32.8	40.9	16.2	77	8	2.24
May . .	64.0	45.8	54.9	18.2	92	25	2.95
June . .	73.7	56.4	65.0	17.3	98	38	3.53
July . .	77.4	60.8	69.1	16.6	94	40	4.29
August .	75.1	58.9	67.0	16.2	90	45	3.57
September	66.5	50.8	58.6	15.7	91	33	3.30
October .	52.9	39.0	46.0	13.9	68	22	3.13
November	38.7	26.6	32.7	12.1	78	-1	3.74
December	26.2	12.1	19.2	14.1	59	-21	3.65
Year	77.4	4.4	42.1		98	-26	40.99

QUEBEC, P.Q.

Latitude, $46^{\circ} 48'$; Longitude, $71^{\circ} 13'$

January .	17.9	3.0	10.5	14.9	51	-34	3.20
February	20.7	4.5	12.6	16.2	49	-32	3.06
March .	31.0	15.5	23.3	15.5	64	-18	3.26
April . .	45.4	29.6	37.5	15.8	80	2	2.03
May . .	62.5	41.0	51.8	21.5	88	21	3.15
June . .	70.9	51.5	61.2	19.4	90	32	4.30
July . .	75.6	56.3	66.0	19.3	96	39	4.40
August .	71.4	54.3	62.9	17.1	90	37	3.94
September	63.9	47.1	55.5	18.8	88	29	3.77
October .	50.0	36.1	43.1	13.9	77	17	3.09
November	35.7	33.9	29.8	11.8	66	-10	3.06
December	22.4	8.5	15.5	13.9	55	-27	3.16
Year	75.6	3.0	39.1		96	-34	40.46

FREDERICTON, N.B.

Latitude, $45^{\circ} 57'$; Longitude, $66^{\circ} 36'$

	MEAN				ABSOLUTE		Precipitation
	Highest	Lowest	Aver. Temperature	Daily Range	Highest	Lowest	
January .	23.3	2.8	13.0	20.5	52	-34	2.43
February .	26.3	3.9	15.1	22.4	61	-30	3.76
March .	35.2	16.0	25.6	19.2	65	-27	4.12
April .	48.9	28.1	38.5	20.8	77	-4	2.59
May .	63.2	39.9	51.6	23.3	92	24	4.23
June .	72.2	49.1	60.6	23.1	97	32	3.64
July .	75.9	54.4	65.2	21.5	96	38	3.79
August .	73.6	53.5	63.5	20.1	95	39	4.18
September	65.5	44.9	55.2	20.6	88	25	3.21
October .	52.3	34.4	43.3	17.9	82	15	3.93
November	41.7	24.9	33.3	16.8	64	-16	4.21
December	27.0	9.0	18.2	18.3	58	-31	3.62
Year	75.9	2.8	40.3		97	-34	43.71

HALIFAX, N.S.

Latitude, $44^{\circ} 39'$; Longitude, $63^{\circ} 36'$

January .	30.9	13.1	32.0	17.8	55	-16	5.63
February .	31.6	13.9	22.7	17.7	50	-17	4.94
March .	36.5	20.8	28.7	15.7	55	-9	4.15
April .	46.6	29.9	38.2	16.7	76	7	4.00
May .	58.4	38.9	48.7	19.5	88	24	4.43
June .	68.2	47.0	57.6	21.2	93	33	3.68
July .	73.9	54.4	64.2	19.5	93	41	3.43
August .	74.3	55.4	64.8	18.9	93	42	3.96
September	67.6	48.8	58.2	18.8	85	32	3.53
October .	56.2	39.8	48.0	16.4	80	23	5.21
November	44.2	32.2	38.2	12.0	65	4	5.26
December	34.3	19.7	27.0	14.6	55	-11	5.52
Year	74.3	13.1	43.2		93	-17	54.74



CLIMATE

77 **CSL**

CHARLOTTETOWN, P.E.I.

Latitude, $46^{\circ} 14'$; Longitude, $63^{\circ} 10'$

	MEAN				ABSOLUTE		Precipitation
	Highest	Lowest	Aver. Temperature	Daily Range	Highest	Lowest	
January .	24.0	6.2	15.1	17.8	50	-27	4.06
February .	25.3	7.0	16.1	18.3	47	-17	3.25
March .	31.3	16.0	23.7	15.3	53	-14	3.09
April .	41.4	27.4	34.4	14.0	68	2	2.61
May .	54.8	37.7	46.3	17.1	79	26	3.06
June .	66.4	49.0	57.7	17.4	85	36	2.60
July .	71.6	56.2	63.9	15.4	88	42	3.43
August .	72.2	57.1	64.7	15.1	88	44	5.96
September .	63.7	49.7	56.7	14.0	82	34	3.53
October .	52.8	40.2	46.5	12.6	74	26	4.65
November .	40.1	29.3	34.2	11.8	63	1	3.74
December .	29.8	15.9	22.9	13.9	52	-18	3.98
Year	72.2	6.2	40.2		88	-27	41.78

TABLE II.
PERCENTAGES OF SUNSHINE

	JAN. %	FEB. %	MAR. %	APR. %	MAY %	JUNE %	JULY %	AUG. %	SEPT. %	OCT. %	NOV. %	DEC. %	YEAR %
Victoria .	20	28	39	45	42	45	60	58	49	35	21	15	38
Agassiz .	18	23	27	30	32	33	46	44	34	31	19	15	29
Battleford .	40	49	50	52	44	47	52	54	44	44	34	31	45
Indian Head .	31	36	35	40	44	42	55	50	40	34	26	25	38
Brandon .	41	47	43	46	42	41	56	58	50	40	33	34	45
Winnipeg .	41	48	49	50	54	52	59	59	47	37	34	34	47
Haileybury .	35	40	41	46	43	55	53	54	44	34	18	20	40
Barrie .	20	29	37	45	45	53	57	53	50	37	20	16	38
Toronto .	27	37	40	47	48	56	60	60	55	44	29	24	44
Woodstock .	21	30	33	41	46	56	60	55	50	40	26	19	40
Lindsay .	25	36	41	47	46	53	55	53	50	40	25	20	41
Ottawa .	30	38	40	46	48	50	53	56	45	39	28	22	41
Montreal .	34	40	45	49	51	50	59	57	54	35	30	37	45
Quebec .	30	36	41	40	41	44	46	50	42	37	24	27	38
Fredericton .	40	43	42	45	45	46	50	51	50	45	32	36	44

The Dominion Meteorological Service publishes a *Monthly Weather Review*, Toronto, 1905 seq., and the Toronto Observatory *Annual Reports* contain results of meteorological, besides seismological and magnetic observations.



CHAPTER III

VEGETATION

BY PROFESSOR R. H. YAPP

As in other countries, the broad features of the vegetation of Canada depend primarily on climate. The lofty mountains of the west effectively intercept the rain-bearing winds from the sea ; hence follows the existence along the west coast of a narrow strip with high rainfall (up to 100 inches). In the east there is a broader belt with a fairly humid climate, for not only are the mountains lower, but the presence of large bodies of inland water (e.g., Hudson Bay and the Great Lakes) to some extent neutralizes the effect of increasing distance from the sea. Between the humid areas of the east and west the climate is more continental in character, the precipitation decreasing both towards the interior and towards the north. Over the greater part of Canada much of the precipitation is in the form of snow, which in winter generally covers the ground for months together. In severe winters, a covering of snow is beneficial to plant life, as it not only keeps the soil warmer, but protects the vegetation from the injurious effect of cold, drying winds.

Climatic
zones of
vegeta-
tion.

Southern Canada lies within the cool temperate zone, the winters for the most part being cold, though the summers are usually hot. On passing northwards the mean annual temperature gradually falls, and the length and severity of the winters increase. In the northern portions of the Dominion, temperature plays an important part in imposing a limit to the possibilities of development of vegetation. These variations of humidity and temperature are accompanied by corresponding changes in the vegetation. Thus we find in :

- (a) *The Temperate Zone*, on passing from east to west :
(i) an eastern or Atlantic forest region, extending to the

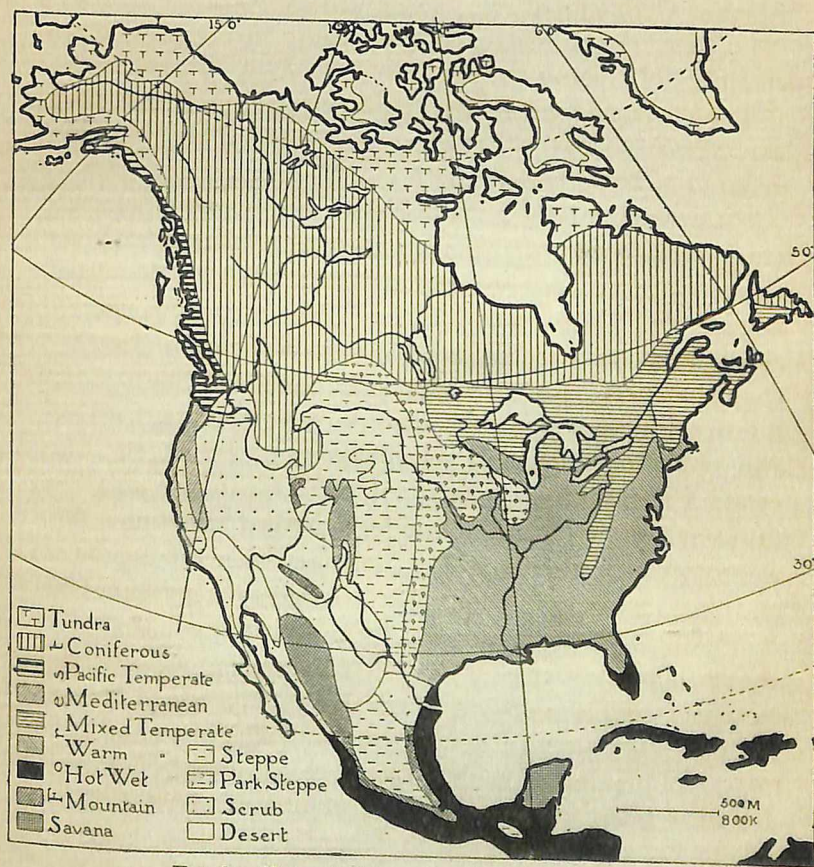


FIG. 8. Natural Vegetation of North America.

west of the Great Lakes, (ii) a central drier region of prairies, and (iii) a western or Pacific forest region.

(b) *The Sub-arctic Zone*, a vast, continuous area of coniferous forest, less luxuriant than the forests of the temperate zone. It stretches obliquely across the entire continent, from Newfoundland in the south-east, to Alaska in the north-west. North of this is—

(c) *The Arctic Zone*, occupied mainly by desolate stretches of treeless tundra.

The various forest regions may be considered first, then the prairies of the interior, and finally the 'barren grounds' of the frozen north.

Require-
ments of
forest
vegeta-
tion.

On account of their greater size and extent of surface, trees require more water than smaller plants, and are therefore more closely restricted in respect to the situations in which they can thrive. Their roots penetrate the soil to considerable depths, so it is the subsoil rather than the surface water which is important. Forests can flourish wherever the subsoil contains an abundant water-supply during the active growing season of the trees. In general, the greater the amount of water in the soil, the taller and more luxuriant the forest. But the amount of water necessary for tree-life increases with temperature, and forests are often found in colder regions where the rainfall is less than is required for the development of tree-vegetation in warmer climates. This explains in part the fact that while the prairies of southern Canada are treeless, the colder sub-arctic zone, much of which is similar in respect of precipitation and elevation, is covered by forest.

Forest trees belong either to the broad-leaved Dicotyledones, e.g. oak and other hardwood plants: or to the needle-leaved, generally evergreen Coniferae. The latter are the most generally useful timber plants, and include the pines, firs, spruces, &c., the wood of which is soft and uniform. On the whole, conifers thrive in colder climates than dicotyledonous trees, so it is not surprising that most of the Canadian forests (especially in the colder north and on the mountain sides) are of the coniferous type.



Roughly, the Atlantic temperate forest region of Canada includes those parts of Quebec and Ontario which lie to the south of lat. 50° N. : westward it extends to the Lake-of-the-Woods. Most of the area belongs to the drainage system of the St. Lawrence and the Great Lakes. In contrast to the more southerly Atlantic forests of the United States, conifers are here the dominant trees, though many deciduous broad-leaved dicotyledones also occur. The latter are most numerous in warm, sheltered spots, especially on deep, well-drained soils. Under such conditions patches of deciduous forest may occur, though there is practically always an admixture of evergreen conifers. On the other hand, coniferous forest prevails in the more exposed areas, and on shallow or partly-drained soils.

The Atlantic forests.

A striking characteristic of the forests which surround the Great Lakes and the St. Lawrence is that they form a meeting-place for northern and southern plants. They contain many northern forms which here approach their southern boundary, as well as southern plants which find here their northern limit of distribution.

Of the characteristic conifers, the white and black spruces (*Picea alba* and *P. nigra*) occur on the cold and windy Atlantic coasts and on exposed mountain sides. The white or Weymouth pine (*Pinus strobus*), commercially the most valuable tree on the continent, was formerly abundant, especially on sandy soil at low elevations. This princely tree sometimes reaches a height of 150 feet. Other conifers are the tamarack (*Larix americana*), occurring on wet soils, the red pine (*P. resinosa*), hemlock (*Tsuga canadensis*), balsam fir (*Abies balsamea*), white cedar (*Thuja occidentalis*), &c. The dicotyledonous trees include maples (e.g. the sugar maple, *Acer saccharum*), elms, beeches, birches (e.g. the canoe birch, *Betula papyrifera*, the bark of which can be peeled off in large sheets, which are used by the Indians for many purposes), poplars, and many others. The trees are always accompanied by an attendant ground flora of mosses, ferns, and other humble plants.



The forests of the Great Lake region are justly famed for the richness and diversity of their autumn colouring. In this respect they are probably unsurpassed in the whole world. As autumn approaches, the sombre greens of the conifers form a perfect foil to the endless shades of purple, red, yellow, and brown of the broad-leaved trees, or the flaming scarlet of the sumachs and the wild vines.

Westwards the temperate forests thin out and are gradually replaced by the treeless prairies, while northwards they merge into the great subarctic forest described below.

The
forests of
the Pacific
coast.

In British Columbia the complex Pacific cordillera, with its nearly parallel series of mountain chains, is some 400 miles in breadth. The high rainfall of the coast (in some parts as much as 100 inches) diminishes on passing eastwards through (consecutively) the Cascade, Gold, Selkirk, and Rocky Mountains. The abundant rainfall, together with the mildness of the climate, has resulted in the development along the coast of some of the most luxuriant forests of the continent. Trees of 200–300 feet in height often grow within a few feet of one another, while on the ground a dense carpet of mosses, ferns, and other plants luxuriate in the ever humid air and the perpetual shade cast by the forest giants. Not infrequently fallen tree-trunks may be met with piled on one another to a depth of 20–30 feet. Here they sometimes lie undisturbed and undecayed for centuries, a striking proof of the durability of certain of these western timbers. Further proof of this is afforded by the manner of growth of some of the trees. In the humid air of the forest, seedlings often establish themselves on the top of fallen trunks, sending down their roots to the soil below. Sometimes these seedlings grow into huge forest trees, which in turn may themselves perish, while the dead trunks on which they perched as seedlings, perhaps centuries before, still defy decay.

Conifers again are dominant, though broad-leaved trees, maples, cottonwoods, alders, &c., also occur, particularly in the valleys and along the river banks. In the south



PLATE XI (a). SCENE IN ALGONQUIN PARK, ONTARIO

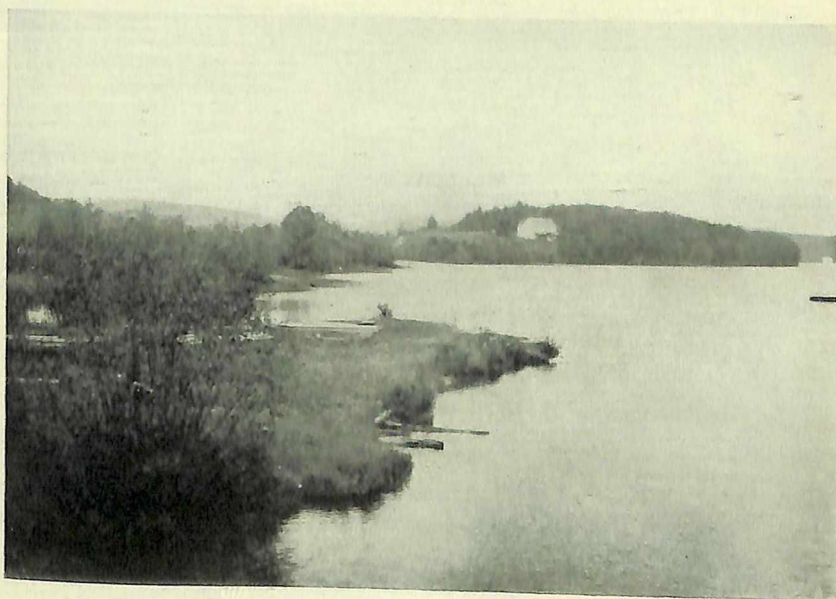


PLATE XI (b). PENINSULAR LAKE, HUNTSVILLE, ONTARIO
(Office of the High Commissioner for Canada)



PLATE XII. SCENE IN STANLEY PARK, VANCOUVER, B.C.
(Office of the High Commissioner for Canada)



the most important tree is the magnificent Douglas fir (*Pseudotsuga Douglasii*), which often reaches a height of 200–300 feet. Others are the cedar (*Thuja gigantea*), the coast hemlock (*Tsuga Mertensiana*), and the Menzies or Sitka spruce (*Picea Sitchensis*: cf. p. 176).

In other parts of the Pacific forest area the dominant species of conifers are different. Each species has its own geographical range, within which it is abundant or rare according as it is more or less perfectly adapted not only to exist, but also to compete with other species, under the prevailing local conditions of climate and soil. Thus on passing northwards along the coast, the Douglas fir, the cedar, and other species disappear, and the coast hemlock and Sitka spruce become the two dominant trees. In Alaska, still further to the north, even these give way as the Pacific forest, like the Atlantic forest of eastern Canada, encounters the vanguard of the subarctic forest belt. Similarly in the Rocky Mountains, though both the Douglas fir and the hemlock occur (the latter confined to the western slopes), the prevailing tree is *Picea Engelmanni*, *Pinus Murrayana* (lodge-pole pine) being also common. Again, as the mountains are ascended, different species are found at different altitudes. *Tsuga Pattoniana* (mountain hemlock), *Abies subalpina*, *Pinus albicaulis*, *Larix Lyallii*, &c., are among the prominent conifers at higher altitudes. Above about 4,000 feet the trees are more branched, and their trunks become dwarfed and contorted. The timber-line, or upper tree-limit, is reached in southern Canada at about 6,000–7,000 feet, but northwards it descends lower and lower, till in parts of Alaska it is only about 2,500 feet above sea-level. Between the tree-limit and the snow-line is a belt of dwarf alpine vegetation, many of the plants composing which are allied to those of the arctic regions.

The coastal valleys are frequently forest-clad like the mountains, but the valleys of the more eastern portions of the cordillera are drier, and often devoid of forest vegetation. The climax in this respect is reached in parts of the Fraser River valley, where the rainfall is small



The sub-
arctic
forest belt.

(about 10 inches), and a 'dry belt' of vegetation is found, consisting chiefly of a grey mantle of sage-brush (*Artemisia*).

From Newfoundland and Labrador in the south-east to Alaska in the north-west, the boreal forest, interspersed with innumerable lakes and swamps, stretches diagonally in a bold sweep across the northern plains of the entire continent. It embraces the southern half of Hudson Bay, and extends along the Mackenzie River nearly to the Arctic Ocean; while on the south it unites the northern extremities of the great Atlantic and Pacific forests. Over 3,000 miles long, and averaging fully 600 miles wide, it is one of the most extensive continuous forests in the world. But owing to the low temperature of the growing season,¹ and the comparatively small precipitation, the forest is thin and poor, and the timber inferior. Towards the northern tree-limit, the trees are still more dwarfed and stunted, till finally the excessive cold of winter, coupled with the intense drying effect of the biting winds, determines the boundary beyond which no trees can grow at all.

In the main the forest is composed of only eight species of trees—a contrast to the more varied forests to the south. The trees are chiefly coniferous, with the black and white spruces (*Picea nigra* and *P. alba*) dominant. They and the Banksian pine (*Pinus Banksiana*)² are best developed on the uplands. The tamarack (*Larix americana*) inhabits the swamps, and the balsam fir (*Abies balsamea*)² the margins of lakes and rivers. The broad-leaved trees are mostly confined to the valleys: the chief are the canoe birch (*Betula papyrifera*), aspen (*Populus tremuloides*), which also forms a belt along the southern edge of the forest, on the borders of the prairies, and the balsam poplar (*Populus balsamifera*). Willows also are not infrequent. The undergrowth is scanty, and towards the north includes many arctic herbs.

¹ The southern and northern boundaries of the subarctic forest lie roughly between the mean annual isotherms of 35° F. and 20° F. respectively.

² In the north-west portion of the forest belt, *Pinus Banksiana* is replaced by *P. Murrayana*, and *Abies balsamea* by *A. subalpina*.



From the point of view of the lumber industry, the Atlantic and Pacific forests are far more valuable than the subarctic. But the reckless exploitation to which they have been subjected in the past, together with the appallingly frequent forest fires, have greatly diminished their value. It is true that in time the forests regenerate themselves, but in such secondary forest the valuable conifers are largely replaced by the comparatively worthless cottonwoods, aspens, and birches.

Destruction of the forests.

The Canadian prairies are hemmed in on the east, west, and north by the three forest regions already described, while southwards they are continuous with the still more extensive American prairies. The rainfall is never great, and gradually diminishes from east to west, while summer droughts are not infrequent. The land rises from the low-lying, wheat-growing plains of Manitoba, to the dry, upland plateaux of Alberta, where stock-raising is the chief industry.

The prairies are vast, undulating, treeless steppes, covered with a dwarf grassy herbage. The general absence of trees is due, at least in part, to the inadequate water-supply. But other causes may co-operate, such as prairie-burning, which was formerly much practised by the Indians, in order to encourage pasturage for game. Grasses (family Gramineae) are the chief prairie plants, no fewer than 30 species being found. Two of the most characteristic are buffalo grass (*Buchloë dactyloides*) and grama grass (*Bouteloua oligostachya*). Mixed with the grasses are many dicotyledonous herbs, such as asters and golden-rods. On the low plains to the east, sometimes distinguished as the prairies proper, the herbage fairly completely covers the ground. But on the drier western plateaux it is more scanty, and consists largely of 'bunch grass', often with bare patches of soil between the tufts. The dry tufts persist during the winter, forming a nutritious self-cured hay, which used to constitute much of the winter food of roaming herds of bison. In the springtime the prairies are green and bright with flowers, but later the vegetation is parched by the droughts of summer



to a more or less uniform yellowish brown, broken at intervals by the deep red of the 'alkali' patches. The latter are drainage hollows, with markedly saline soil. The vegetation is red in colour, and closely resembles that of maritime salt-marshes, many of the species (e.g. the glasswort, *Salicornia herbacea*) being identical.

Arctic
tundra.

North of the subarctic forest belt are the 'barren grounds' of the arctic coastal plain. Here the scattered outposts of the dwindling forest have finally given way, to be succeeded by a desolate waste of frozen tundra, similar to that of Arctic Russia and Siberia. During the long, dark winters the ground is frozen to an unknown depth,¹ while the succeeding summers are too brief to do more than thaw out a few inches, or at most a foot or two, of the surface. Yet above this permanently frozen soil, a surface layer of dwarf vegetation maintains a precarious existence.² In the winter it is covered by a protective layer of snow, while in summer it is always wet and boggy, for natural drainage is hindered by the subterranean ice.

The vegetation is stunted, and consists mainly of mosses (e.g. *Polytrichum*) and lichens (e.g. *Cladonia rangiferina*, the reindeer 'moss'). But many flowering plants also occur, especially members of the heather family (*Ericaceae*), such as *Andromeda polifolia*, *Vaccinium Vitis-Idaea* (cowberry), &c. Other plants are the crowberry (*Empetrum nigrum*), the cloudberry (*Rubus Chamaemorus*), &c. It is interesting to notice that all the plants enumerated are European forms, and are indeed natives of the British Isles. This is true also of many other plants of the Canadian tundra. In fact the tundra plants form part of a great circumpolar flora, many of the species of which, being widely distributed in the far northern regions of both hemispheres, actually encircle the globe.

¹ In some places cliff sections have shown 150-300 feet of ice.

² In southern Alaska the lowland forest occasionally extends on to the glaciers, growing luxuriantly on the surface moraines. This is an interesting parallel to the growth of tundra on ice-bound soil.



[See S. Brown, *Alpine Flora of the Canadian Rocky Mountains*, New York, Biblio-1907; G. H. Clark and J. Fletcher, *Farm Weeds of Canada*, Ottawa, 1903; graphy J. W. Henshaw, *Mountain Wild Flowers of Canada*, Toronto, 1906; G. John-son, *Report on the Forest Wealth of Canada*, Ottawa, 1895; J. Macoun, *Catalogue of Canadian Plants*, Montreal, 1883 seqq.; 'The Forests of Canada and their Distribution' in *Trans. Royal Soc. of Canada*, 1894; J. MacSwain, *The Flora of Prince Edward Island*, Toronto, 1907; H. B. Spotton, *Elements of Structural Botany with Special Reference to the Study of Canadian Plants*, Toronto, 1907; C. P. Traile, *Studies of Plant Life in Canada*, Toronto, 1909; *Reports of the Royal Commission on Forest Reservation and National Parks*, Toronto, 1893.]

CHAPTER IV

FAUNA

BY GEOFFREY W. SMITH

CANADA forms the northern subregion of the Nearctic Zoo-Region which includes Greenland as its northernmost geographical position. limit and stretches southwards to about the level of the Gulf of Mexico. Owing to the rigour of the climate and the large tracts of barren land in the far north, there is less variety and wealth of life in Canada than in the more southern parts of North America; but an exception must be made in favour of the immense development of aquatic bird life on the northern coasts and the large inland lakes of Canada, while the occurrence of a considerable number of forms of life common to the north of Europe, such as the reindeer, Arctic fox, &c., which do not penetrate far south, adds an interesting variety to the fauna. The existence of this Arctic fauna common to Canada and northern Europe and Asia, which points to the occurrence in the past of a circumpolar continuous land area, making migration between the Old World and America possible for land animals, has led some naturalists to include Canada with the Palaearctic Region under the title Holarctic.

To some extent the distribution of the fauna in Canada corresponds to the vegetation areas; thus there are animals characteristic of the Barren Grounds or Tundra

of the extreme north with its stunted vegetation, of the Forest Regions, of the Central Prairies, and of the Rocky Mountains.

In passing in review the more important of the Mammalia we shall notice some of the characteristic animals of these areas.

Mammalia :
 reindeer.

The reindeer occurs under two well-marked varieties, the woodland caribou (*Rangifer caribou*) and the Barren Ground caribou (*R. groenlandicus*). The woodland caribou, which ranges through the forest regions from New Brunswick to British Columbia, is characterized by rather low broad antlers and elevated nasal bones, and in this respect it agrees with the Finland and Siberian variety, whereas the Barren Ground caribou, which has high antlers and flat nasal bones, agrees more with the Greenland and Scandinavian forms. The Barren Ground caribou occurs on the Arctic coasts and islands and in Labrador. There is evidence that in Pleistocene times the reindeer ranged rather further south along the Rockies into the United States, and this has been ascribed to the influence of the glacial period ; but there is no evidence that there was a deep or extensive migration of the reindeer southwards or that it has ever been entirely driven from its subarctic home. There is some dispute as to the specific distinction between the varieties of reindeer that occur in the subarctic countries, but the most commonly received opinion is that there is only one true species with local races. The low antlers of the woodland race are probably an adaptation to prevent the animal being caught and entangled while passing through undergrowth and among the boughs of trees. In autumn the Barren Ground caribou migrates into the woodlands, but its herds never mingle with those of the woodland form.

Moose.

The moose (*Alces americanus*) has representatives in Asia and Scandinavia which are there known as elks. It has a similar range to the woodland caribou, being confined to the forest regions from Nova Scotia across the continent, skirting the Rockies to British Columbia



and Alaska. As in the case of the caribou, there are records of its occurrence on the Rockies a little further south of its present range in Pleistocene times. The moose is the largest member of the deer family, and is remarkable for its immense spreading antlers, which form great laterally expanded basins. It has been greatly decreased in numbers owing to its being hunted both for sport and commerce.

The wapiti or Canadian elk (*Cervus canadensis*), which closely resembles the European red deer, has had its range very much diminished in historical times, as it used to occur all over the central and eastern parts of Canada as far south as Arizona, but now persists chiefly in the forests of the Athabaska and Peace River valleys, in Manitoba and Oregon. An interesting point in connexion with the wapiti is that it is closely related to the European deer and differs from the typical American deer, a relationship which is shown by the persistence of the lateral metacarpal bones, and in the branching of the antlers. The other Canadian deer, namely, the Virginian deer (*Cariacus virginianus*), occurring in the southern forest region, and the mule deer (*C. macrotis*) of west central Canada belong to the typical American deer which are represented by many species in North and South America, and are characterized by the antlers being either simple and prong-like, or else divided in a fork-like manner, with the anterior prong turning forwards and without a brow-tine.

Wapiti
and Vir-
ginian
deer.

An animal of very great interest is the prong-horned antelope (*Antilocapra americana*), which inhabits the prairies of central Canada. This animal represents, together with a few fossil forms, a family by itself which has apparently never ranged outside the American continent. The horns, which are short and bifurcated, have a superficial resemblance to the antlers of a deer, but instead of being solid they are hollow like those of a goat. On the other hand, the horns are shed in autumn and grow again at regular intervals, like the deer's antlers. The horn also differs in structure and formation

Prong-
horned
antelope.



from the typical bovine horn in being formed of an agglomeration of hair. It is thus seen that the animal is not so much intermediate between the Bovidae and Cervidae as peculiar in itself, standing in much the same relation to the other ruminants as the giraffes.

Bison.

Another prairie animal is the bison (*B. americanus*), now practically extinct in a wild state, though a few herds still linger in northern Canada and in the reserve of Yellowstone Park. In the sixteenth century it was extremely abundant over about one-third of the North American continent, roaming all over the prairies in vast herds covering many square miles of country. The indiscriminate slaughter of these valuable animals which followed the introduction of firearms into the country and the exploitation of its natural resources does not reflect creditably either on the intelligence or humanity of civilizing man. The American bison differs from the European which still survives in Lithuania and the Caucasus, in that the latter is a forest dweller and associates in small herds.

**Goat,
sheep,
musk ox.**

Of ruminants confined to the Rocky Mountains mention may be made of the Rocky Mountain goat (*Aplocerus montanus*) and the sheep (*Ovis montana*), while the musk ox (*Ovibos moschatus*), so called from the musky odour of its flesh, is characteristic of the Barren Grounds of Arctic North America and Greenland. The latter animal is intermediate in appearance between the sheep and ox, and represents a declining group which once ranged over northern Europe and Asia but is now extinct in these countries.

Carnivora.

Of the carnivora, the puma (*Felis concolor*) occurs in western Canada, in the Rockies, and the forests of Quebec. This animal has an extraordinarily wide range on the American continent, occurring in South Patagonia and extending through the tropics of South America into the middle of Canada. The Canadian lynx and the wild cat are found in all the forest regions. The wolf occurs under several varieties—the grey wolf in the east, the black wolf on the Pacific coasts, and the white wolf in the



Barren Grounds and the north. Other Barren Ground carnivora are the wolverine (*Gulo luscus*), the Barren Ground bear (*Ursus Richardsoni*), and the Arctic and blue foxes (*Vulpes lagopus* and *fuliginosus*). The black or silver fox, which is so valuable on account of its skin, is a varietal form of the red fox which has a wide range in eastern Canada. The silver fox, which is bred artificially for its skin in Labrador, comes from the northern districts, especially from the upper reaches of the Mississippi and Missouri. The fur of this variety is nearly black, but has a silvery sheen imparted to it by the grey rings encircling the black hairs of the hinder half of the back, the head, and the thighs. The tip of the tail is generally white, but there is much variation in this and in the general coloration. The coyote or prairie-wolf (*Canis latrans*) ranges all over North America; it lives in underground burrows. Of the smaller carnivores of general distribution mention may be made of the martens, weasels, ermine, mink, skunk, and otter. The raccoon (*Procyon lotor*) is not found in the north or on the prairies, being an inhabitant of the woodlands. It belongs to a family now confined to America with one exception, the panda of the Himalayas.

The commonest bear in Canada is the comparatively harmless fruit-eating black bear (*Ursus americanus*); the really formidable grizzly (*U. horribilis*) is now practically confined to central British Columbia and the Rockies. The polar bear is confined to the coasts of the Arctic Ocean and Labrador. Bears.

The rodents are well represented; especially characteristic of the north and the Barren Grounds are the lemmings, lemming voles, and gophers. Some of these ground rodents are peculiar to northern Canada; for instance, the lemming voles (*Synaptomys*) and the jumping mice of the genus *Zapus*, which, however, has one representative in China and is related to the jerboas. Other rodents such as the Arctic hare and the banded lemming (*Dicrostonyx torquatus*) are circumpolar in distribution, being found in Greenland, northern Europe, and Asia, Rodents.



as well as in Canada. The beaver (*Castor fiber*) is apparently the same species as the north European form, though the Canadian races are far more architectural in their habits than the almost extinct Old World races. The American beaver has been very much persecuted since the advent of the white man; at the time of the discovery of America it had an immensely wide range from Alaska and Hudson Bay to California and Arizona, but it now only survives in numbers along the Rockies, in the upper waters of the Fraser and Peace Rivers, and along the watershed between the Hudson Bay rivers and the St. Lawrence.

A genus absolutely confined to America is represented by the musk-rat or musquash (*Fiber zibethicus*), which makes subterranean burrows in the banks of streams and lakes, ranging from the Mackenzie River to Labrador. There are numerous squirrels and spermophiles or gophers in Canada. The latter are typical circumpolar forms, being mostly found in the colder regions of the northern hemisphere. The so-called prairie-dogs (*Cynomys*) are a more typical American group, though they are allied to the marmots of the Old World. Their rather inappropriate name is due to the barking sound which they are said to emit. There are three species of prairie-dogs, the common (*C. ludovicianus*), found on the open plains to the east of the Rocky Mountains, the Columbian (*C. columbianus*) on the west of the Rockies and at a higher elevation than the preceding, and the Mexican form (*C. mexicanus*).

Porcupines.

There are two porcupines in Canada, *Erethizon dorsatus*, from the Atlantic coast to the Mackenzie River, and the yellow-haired porcupine (*E. epixanthus*) with a more western distribution. These porcupines differ from the Old World forms in being essentially forest-dwellers and tree-climbers, and it appears that they are a characteristic American group developed within and confined to that continent.

Birds.

There is a very rich avifauna in Canada, especially in the numbers of individuals representing some of the



species. This is notably the case in the water-fowl, such as various kinds of duck, geese, and waders of many species which breed in millions on the north coasts and on the numerous lakes of northern Canada, such as the Great Slave Lake, and migrate southwards in the autumn. Besides these, the coasts abound with sea-birds such as auks, guillemots, divers, and gulls.

The birds of prey include the golden eagle and numerous hawks ; the American vulture just reaches to the extreme south of Canada. The wild turkey, which was formerly plentiful in southern Ontario, is now practically if not quite extinct ; of other gallinaceous birds, the ptarmigan and partridge are plentiful. The woodpeckers, as is natural in a country pre-eminent for forests, are well represented, but curiously two groups of Old World birds, the true starlings and the flycatchers, are absent. Of ornamental birds, mention may be made of the tanagers, a family confined to America, the humming-birds, several species of which visit Canada, one penetrating into Alaska as far north as Mount St. Elias ; these, too, are entirely confined to America. The so-called robin, which has become semi-domesticated in Canadian towns, is really a thrush. Pigeons are restricted to the more southern parts of Canada.

Certain groups of birds are interesting as showing the route of migration by which so many Old World animals have entered America. The nutcrackers, for instance, go right across Europe and Asia ; they are then found on the other side of Bering Straits on the Pacific coasts of America, but they do not penetrate further east. The warblers, which also stretch right across northern Europe and Asia, just enter Alaska but have not spread over the American continent.

Of the reptiles and amphibia of Canada not much need be said, only three families of reptiles and eight of amphibia being represented. Rattlesnakes, the only deadly form of reptile, are confined to southern Canada, not reaching much north of the parallel drawn to Vancouver. The five other snakes and three tortoises which

Lower
verte-
brates
and in-
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brates.



are limited to Canada are principally found in the southern regions; while in the north only frogs and toads and a salamander of the genus *Plethodon* occur, as far north as Hudson Bay.

Fishes,
&c.

The marine fish, which afford the material for a very large industry on both the Atlantic and Pacific coasts, are dealt with in the special sections dealing with British Columbia, Newfoundland, &c. (pp. 174, 101, 282); the great abundance of salmon and trout and of white fish (*Coregonus*) in the lakes and rivers of Canada are also an important natural resource.

The great lakes of Canada and the United States have some of the features of so-called relict lakes, i.e. lakes which have at some time been either continuous with an arm of the sea or more probably in close connexion with the sea by means of estuaries. Thus in Lakes Michigan and Superior the shrimp *Mysis relicta* occurs, which is also found in some Scandinavian and Irish lakes, but is clearly a derived marine form, and the same is true of the Gammarid Crustacea *Pontoporeia*, and of the fish *Triglopsis thompsoni*.

The distribution of the freshwater crayfish in North America is interesting as pointing to two routes of migration; the genus *Canbarus* having spread from the southern states in a north-easterly direction into southern Canada; while the genus *Astacus* has evidently spread from Asia across a land bridge spanning Bering Straits, and is now found along the Pacific coasts west of the Rockies.

Butter-
flies.

Many genera of butterflies appear to have pursued this latter route of migration. Thus the genera *Parnassius*, *Colias*, *Coenonympha*, *Erebia*, and *Oeneis*, are all north European and Asiatic forms which have spread into North America across Bering Straits, and many of them have not penetrated right across to the east of the continent and Greenland, while all are absent from Iceland.

Origin of
fauna.

It is clear that there are at least two distinct elements in the Canadian fauna, a typical American fauna which has on the whole spread northwards from the south of the continent and is not closely related to the Palaearctic



species, and an intrusive circumpolar fauna containing many species which range in the northern countries round the pole and are still represented in the Palaearctic Region. To recapitulate the most striking genera of Holarctic distribution among the mammalia we may mention the following: *Cervus*, *Rangifer*, *Alces*, *Bison*, *Ovis*, *Gulo*, *Mustela*, *Lemmus*, *Ursus*, and *Vulpes lagopus*. An obvious connexion between the Palaearctic and Nearctic Regions is across Bering Straits, and the distribution of many species makes it clear that this bridge for migration between the two continents has existed in comparatively recent times. It has also been held that an Atlantic connexion was also established through Greenland and Iceland with Scandinavia, but though this is highly probable, it cannot be held that the advocates of this view have completely proved their case. Another disputed point is the influence which the Glacial Period has exerted upon the North American fauna, a problem which recurs with many identical features in the Palaearctic Region. Did the Glacial Period drive all the northern fauna southwards from the circumpolar countries, and have they again recently returned there, or have they always persisted in their present habitats despite the supposed rigours of the glacial epoch? The evidence in North America is rather in favour of the latter supposition, since there is no evidence that the northern types ever extended their range southwards much beyond their present distribution; while the fact that so many identical species are common to the Palaearctic and Nearctic Regions is evidence in favour of the view that these regions have been inhabitable and in direct connexion during the Pleistocene period.

R. Lydekker, *The Deer of All Lands*, London, 1898. Madison Grant, Selected 'Papers on North American Mammals' in 7th, 8th, and 9th *Annual Reports* bibliography of the New York Zoological Society, 1902-5. Thompson Seton, *Life Histories of Northern Animals*, 1910. W. T. Hornaway, 'The Extinction of the American Bison,' *Ann. Report Smithsonian Inst.*, p. 367, 1887. J. H. Allen, 'The Geographical Distribution of North American Mammals,' *Bull. Amer. Mus. Nat. Hist.*, vol. iv, p. 199, 1892; 'Birds—The Auk' (*N.S.*), vol. x, p. 97, 1893. R. F. Scharff, *The Origin and Distribution of Life in America*,

London, 1911. Outram Bangs, 'A List of the Mammals of Labrador,' *American Naturalist*, vol. xxxii, p. 489, 1898. J. W. Dawson, *The Canadian Ice Age*, 1893. Evermann, Barton, Warren, and Goldsborough, 'A Check List of the Fresh-Water Fishes of Canada,' *Proc. Biol. Soc.*, Washington, vol. xx, 1907. F. Lucas, 'Discussion of the Question on Former Land Connections between Asia and North America,' *Science (N.S.)*, vol. xiii, 1901. C. H. Merriam, 'The Geographical Distribution of Life in North America,' *Proc. Biol. Soc.*, Washington, vol. vii, 1892. H. F. Osborn, 'Faunal Relations of Europe and America during the Tertiary Period,' *Ann. N. Y. Acad. Sc.*, vol. xiii, 1900. W. Stone and W. E. Cram, *American Animals*, New York, 1905. A. E. Brown, 'Genera and Species of American Snakes,' *Proc. Ac. Philad.*, p. 10, 1901. H. G. Dyar, 'A List of North American Lepidoptera,' *Bull. U. S. Mus.*, No. 52, 1902.

CHAPTER V

ECONOMIC SURVEY

REGIONAL DIVISION—THE EASTERN REGIONS

BY PROFESSOR JAMES MAVOR

INTRODUCTION

Economic
regions.

THE Dominion of Canada may be divided into the following economic regions, each of these deriving its specific character from the predominant occupations of its people :

1. *The Eastern Fishing, Lumbering, and Mining Region*, comprising the river valley and the Gulf of the St. Lawrence, together with the Atlantic coast ; in other terms, the Maritime Provinces almost as a whole, the greater part of the province of Quebec, and a portion of northern Ontario. The boundaries of this region are approximately the Atlantic coast on the east, 46° N. lat. on the south, 95° W. long. on the west, and 52° N. lat. on the north.

2. *The Eastern Agricultural and Industrial Region*, comprising the cultivated portions of the Maritime Provinces, and of the provinces of Quebec and of Ontario. In the latter provinces the cultivated areas extend along the left bank of the St. Lawrence, and along the valleys of its tributaries within the Canadian borders.

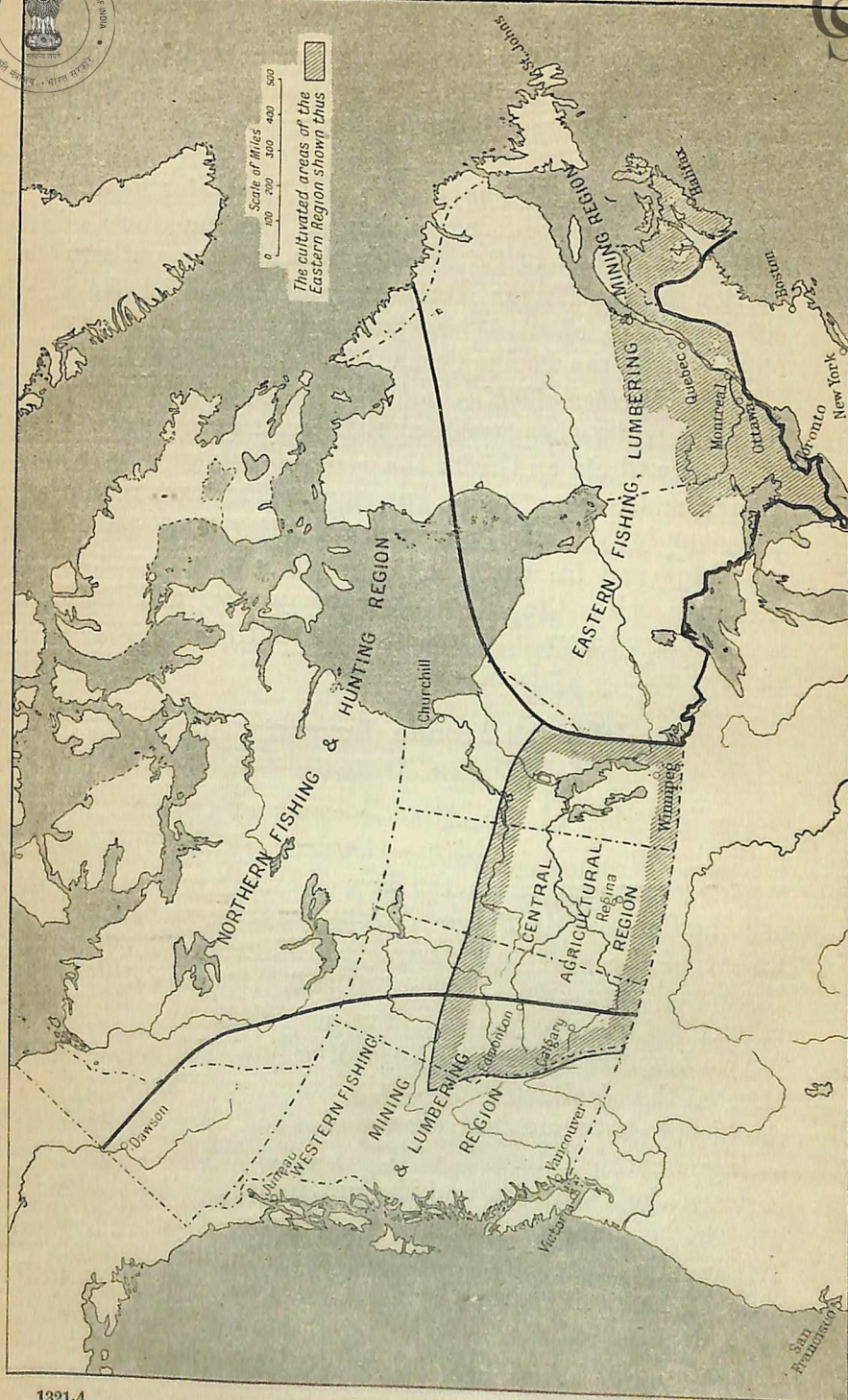


Fig. 9. Economic Regions of Canada.

3. *The Central Agricultural Region*, extending from the Red River Valley to the Rocky Mountains, and from the Canadian-United States boundary at 49° N. lat. to about 56° N. lat.

4. *The Western Fishing, Mining, and Lumbering Region*, comprising the western portion of the province of Alberta, the whole of British Columbia, and the southern portion of the Yukon Territory, and extending from 49° N. lat. to about 65° N. lat., and from the Rocky Mountains to the Pacific Coast.

5. *The Northern Fishing and Hunting Region*, extending from the regions of permanent settlement northwards to the Arctic Circle, and from the coast of Labrador to the Pacific, and to the Alaskan boundary. This vast region is sparsely inhabited by indigenous nomadic tribes engaged in fishing and hunting for their own support, and for exchange with the fur-trading companies, and with individual whalers and traders who visit some parts of the region.

THE EASTERN FISHING, LUMBERING, AND MINING REGION

Fisheries. The fisheries of the Atlantic coast of Canada fall naturally into two divisions—the deep-sea and inshore fisheries extending from the Bay of Fundy to the coast of Labrador, and the fisheries of the estuarine and inland waters of the provinces of Quebec, Nova Scotia, New Brunswick, and Prince Edward Island. These fisheries taken together are of the annual value of about £2,500,000.

Settle-
ment of
disputed
jurisdic-
tion.

Two important disputes regarding jurisdiction have affected the administration of the fisheries. These were the dispute between the United States and Great Britain acting in the interests of Canada, and the dispute between the Dominion and the provincial governments. The first dispute was settled by a decision of the Hague Tribunal on September 7, 1910, after having endured for nearly a hundred years; the second was partially settled by a decision of the Judicial Committee of the Privy Council in 1898, after having endured practically since



the confederation of the provinces in 1867. The claim of Great Britain to the right to make regulations for the control of the North Atlantic fisheries was found by the Hague Tribunal to have been established, and the claim of the provinces to the right to impose taxes upon fishery licences was found by the Privy Council to have been established.¹ The right of the Parliament of Canada to enact fishery regulations was of course not affected by the former dispute and decision; but it was affected by the latter.

In accordance with the provisions of a treaty between Great Britain and the United States signed at Washington April 11, 1908, an International Fisheries Commission was appointed for the purpose of framing a code of regulations and recommendations. Difficulty has been experienced in securing the sanction of the Senate of the United States to regulations agreed upon by the Commissioners. The existing regulations so far as Canada is concerned are contained in an Order in Council of September 12, 1907, and subsequent amending orders.

The Dominion Government maintains a fisheries protective service, while the governments of the respective provinces appoint the fishery inspectors. The Dominion

Fishery
regula-
tions and
services.

¹ On the North Atlantic fisheries dispute, see section under that title by James White, Secretary of the Commission of Conservation, Canada, in *Lands, Fisheries, and Game, Minerals*, Ottawa, 1911, p. 67, a volume issued by the Commission. See also correspondence respecting occurrences at Fortune Bay, Newfoundland, in January 1878, Parly. Paper North America No. 3 (1878), C. 2184; further correspondence respecting the same, United States No. 1 (1880), C. 2717; further correspondence ditto, E. S. No. 1 (1881), C. 2757; further correspondence ditto, U. S. No. 2 (1881), C. 3159, London (years stated). Canada-Newfoundland—correspondence relating to settlement of claims arising out of transactions at Fortune Bay and elsewhere, C. 3762, London, 1883; correspondence respecting the Newfoundland fisheries, United States No. 1 (1906), C. 3262; Message from the President of the United States (Mr. Roosevelt), December 17, 1902. See also R. McFarland, *A History of the New England Fisheries*, University of Pennsylvania, 1911, an admirable account of the North Atlantic fisheries. A copy of the award of the Hague Tribunal in the fisheries dispute is printed in the appendix. On the dispute between the Dominion and the provinces see *Correspondence, Reports of the Ministers of Justice and Orders in Council upon the subject of Dominion and Provincial Legislation 1867-95*, Ottawa, 1896, &c.; A. H. F. Lefroy, *The Law of Legislative Power*, Toronto, 1897-8; and *Canada's Federal System*, Toronto, 1913.

Government grants bounties to fishing-boats (of between 10 and 80 tons burthen), to an amount of about £30,000 annually. In 1889 a fishery intelligence bureau was established with head-quarters at Halifax, Nova Scotia; but in 1911 this bureau ceased to exist. Its functions, however, continued to be exercised by the Department of Marine and Fisheries, by which there was issued, from April 1911, a monthly bulletin of sea-fishery statistics. These statistics are collected by the fishery overseers in the several districts, and are collated by the Department. The Meteorological Department of the Dominion, with head-quarters at Toronto, receives weather reports twice daily from all stations in Canada and the United States, and issues a daily chart. It also issues telegraphic forecasts and warnings to its various stations, and answers inquiries in the same manner. Forecasts are posted on bulletin boards at the fishing ports. In 1899 a biological station was established at St. Andrews, New Brunswick, the result of co-operative effort by the Dominion Commissioner of Fisheries (Dr. Prince) and the Universities of Toronto and McGill (Montreal). Much valuable work on the fauna of the Atlantic coast has been accomplished at this station.¹

Politics
and the
fisheries.

The fisheries of Canada are among the most important assets of the country, yet their productiveness has been gravely compromised by the conflict of jurisdictions to which allusion has been made, as well as by the short-sightedness of the fishing population on the one hand, and the anxiety of the politicians to placate the fishermen on the other. This has led to the intrusion of politicians and their nominees into a field which can only be safely occupied by disinterested experts. The ruin of the lobster fishery² and the serious depletion and probable

¹ Reports of the work done at the three biological stations, St. Andrews, N.B., Nanaimo, B.C., and Georgian Bay, Ontario, have been collected and published in three volumes, Ottawa, i. 1901, ii. 1907, and iii. 1912. These volumes contain thirty-nine scientific papers. See especially the paper on 'The Chemistry of the Medusae', the result of researches during several seasons at St. Andrews by Professor A. B. Macallum, in *Journal of Physiology*, vol. xxiv, pp. 213-41.

² 'Report of Lobster Fishery Commission, Ottawa' and 'The Lobster



final extermination of the oyster beds¹ are heavy offsets against the advantages of local autonomy. The fault does not lie so much in the law as in the administration of it. So long as the fishery inspectorship is occupied or controlled by local politicians its inefficiency may be taken for granted.

The characteristic boat engaged in the Atlantic deep-sea fishing is a schooner of about 40 tons burthen. Up till about 1910 the trade was carried on by means of steamers, owned or chartered by the fish merchants, which went out to the fishing-grounds, relieved the fishing-boats of their catch, and then steamed for the market ports. Under this system the fishermen were more or less at the mercy of the merchants; and, moreover, very large quantities of fish caught by Canadian fishermen were carried direct from the fishing-grounds to the ports of the United States, and entered there. Since 1910, however, the advent of the internal combustion motor has gone far to revolutionize the fishing industry. The fishermen, by adopting the motor as an auxiliary, have become able to convey their catch themselves to the market ports, to sell it at the price of the market, and return to their fishing-grounds without material loss of time.

Fishing vessels and conveyance of fish to markets.

The economic reactions which this change produced were a diminution in the number of boats engaged in the deep-sea fishing, an increase in their size, a diminution in the number of fishermen employed at sea, and an increase in the number of persons engaged on shore in connexion with the handling, canning, and packing of fish. The fisherman has now a choice of markets, and

Fishery of Canada', by W. A. Found, Superintendent of Fisheries for Canada, in *Sea Fisheries of Eastern Canada*, Ottawa, 1912, p. 50 (report includes discussion by members of the Commission).

¹ See 'Report on Oyster Culture', by Ernest Kemp, oyster expert, in *Annual Report of the Department of Marine and Fisheries, 1911-12*, Ottawa, 1912, p. 343 seq. *Sea Fisheries of Eastern Canada*, Ottawa, 1912, p. 155; 'The Canadian Oyster Industry,' by M. T. Patton, assistant secretary of the Commission of Conservation, in *Lands, Fisheries, &c.*, Ottawa, 1911, p. 128 seq.

Principal
fish
taken.

has thus become in effect independent of the merchant, from whom he formerly purchased his supplies and to whom he was practically compelled to sell his fish. The tendency towards the debt dependence of the fisherman upon the merchant has thus been checked, probably in the long run to the advantage of both.

In the Nova Scotia fisheries cod forms the bulk of the catch, amounting to about two-thirds of the total of the chief kinds of fish. Haddock takes the next place, then herring, pollack, and hake, and then mackerel and halibut. In the New Brunswick fisheries the herring catch amounts to about three-fifths of the total, and cod to about one-seventh to one-eighth. On the coasts of Nova Scotia and in the Bay of Fundy herring are caught for bait in order to supply the American, Canadian, and Newfoundland fishermen on the Banks, and also for the sardine trade. About the end of May, the mackerel appear off the south-west coast of Nova Scotia; they go eastward along the coast to Canso, and then turn northward, entering the Gulf of St. Lawrence either through the Gut of Canso or by the east coast of Cape Breton Island. The herring make their appearance near the island of Grand Manan in July, and remain in that region until September. Late in the autumn and in the winter 'other schools of herring swarm into the mainland about Campobello Island and the waters between Point Lepreaux, New Brunswick, and Eastport, Maine'.¹ The pollack grounds lie to the north and west of Campobello Island, the mud-hake grounds lie to the east, and the wolves haddock grounds further to the north-east. These grounds are fished by fishermen from New Brunswick and also from the State of Maine. The offshore fishing grounds of the Nova Scotian fishermen lie between Sable Island and the coast of Nova Scotia. The principal deep-sea fisheries are on Banquereau, the Bank of St. Pierre, Green Bank, and the Grand Bank of Newfoundland. The season lasts from April till October, the fish moving slowly northward as the season advances.²

¹ McFarland, op. cit., p. 8.

² McFarland, op. cit., pp. 9-10.



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Prince Edward Island a large amount of capital has been sunk in the breeding of the silver fox; the high price of the fur of that animal having stimulated the production. The Prince Edward Island fox-ranchers do not breed for fur, but for exportation of foxes to other places where they are bred for the fur market. The profits of the industry seem to be large; but it has assumed a speculative phase, and there is a probability of the supply outrunning the demand unless the number of foxes in the breeding establishments is kept within the limits determined by the market, which being dependent upon fashion is peculiarly liable to fluctuation.¹ Experience of similar experiments has shown also that diseases, to which the fox may not be liable in a wild state, may have their victims when the animals are kept in close quarters.

Forest
policy and
forest
reserves
in the
Eastern
Region.

Under the British North America Act, the care of the forest lands of the Crown devolves upon the provincial governments. The Dominion Government established in 1898 a small Forestry Branch of the Department of the Interior, and the Dominion Commission of Conservation, founded in 1909, takes cognizance of forestry questions, although not in an executive capacity. The latter especially is serving a useful function in publishing scientific papers on forestry, and in giving the aid of its advice as well as in co-operating with the provincial authorities when it is invited to do so. In 1898 there does not appear to have been employed in any of the provinces a single educated forester.² Since that date the province of Quebec has established a Forestry Department; the University of Laval (Quebec) has offered courses in forestry, and a Forest Rangers' School has been established by the provincial government. The University of Toronto and Queen's University (Kingston)

¹ Cf. Conservation Commission, *Fur-Farming in Canada*, by J. Walter Jones, B.S.A., Montreal, 1913.

² Inaugural address by the Hon. Clifford Sifton at the first annual meeting of the Commission of Conservation at Ottawa, January 18, 1910. *First Annual Report of Conservation Commission*, Ottawa, 1910, p. 18.



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mingled. The hardwood forest of southern and western Ontario has almost disappeared under the axe of the woodman and the farmer. In many places the stumps still stand in the fields, or the roots form the characteristic fence of the pioneer's farm. Of the conifers, white pine abounds through the whole of the Eastern region, although there is now little good white pine timber in Ontario south of Georgian Bay.¹ Taking the region as a whole, and including the greater part of the province of Ontario which is or was in forest, the total area of the Eastern Forest region may be placed approximately at 390,000 square miles.² The proportion of the timber remaining upon this area, which is commercially valuable, has not been ascertained. Even if it were ascertained for one period, forest fires, cutting, and growth together alter the forest values continually. The loss by fire in the Eastern region is incalculable. Fires of great or small magnitude occur annually. Such fires are caused by lightning, by sparks from locomotives, and perhaps more frequently by the carelessness of hunters or other campers or of lumbermen or even of forest fire rangers, who leave their camp fires to smoulder and to be fanned into flame by wind. Measures are taken to prevent the great national loss which such fires occasion, but with qualified success. The forest area is so great and the population within it and on its margins is so scanty that the subject is one of great difficulty.³

Lumber-
ing and
transport.

In all parts of the world where timber is cut for transportation in logs to distant places, the modes of operation are very similar. In Canada the trees which are to be cut down are marked by the cutters, and then, when the ground is hardened by frost and the winter roads can readily be made from the depths of the forest to the nearest lake or river, the lumbering camps are formed

¹ Cf. B. E. Fernow, *A Brief History of Forestry in Europe, the United States, and other Countries*, Toronto, 1907, p. 355.

² Fernow, *op. cit.*, p. 350.

³ See Conservation Commission, *Forest Protection in Canada, 1912*, by Clyde Leavitt, M.Sc.F., Chief Forester of Commission, Toronto, 1913.



mingled. The hardwood forest of southern and western Ontario has almost disappeared under the axe of the woodman and the farmer. In many places the stumps still stand in the fields, or the roots form the characteristic fence of the pioneer's farm. Of the conifers, white pine abounds through the whole of the Eastern region, although there is now little good white pine timber in Ontario south of Georgian Bay.¹ Taking the region as a whole, and including the greater part of the province of Ontario which is or was in forest, the total area of the Eastern Forest region may be placed approximately at 390,000 square miles.² The proportion of the timber remaining upon this area, which is commercially valuable, has not been ascertained. Even if it were ascertained for one period, forest fires, cutting, and growth together alter the forest values continually. The loss by fire in the Eastern region is incalculable. Fires of great or small magnitude occur annually. Such fires are caused by lightning, by sparks from locomotives, and perhaps more frequently by the carelessness of hunters or other campers or of lumbermen or even of forest fire rangers, who leave their camp fires to smoulder and to be fanned into flame by wind. Measures are taken to prevent the great national loss which such fires occasion, but with qualified success. The forest area is so great and the population within it and on its margins is so scanty that the subject is one of great difficulty.³

Lumber-
ing and
transport.

In all parts of the world where timber is cut for transportation in logs to distant places, the modes of operation are very similar. In Canada the trees which are to be cut down are marked by the cutters, and then, when the ground is hardened by frost and the winter roads can readily be made from the depths of the forest to the nearest lake or river, the lumbering camps are formed

¹ Cf. B. E. Fernow, *A Brief History of Forestry in Europe, the United States, and other Countries*, Toronto, 1907, p. 355.

² Fernow, *op. cit.*, p. 350.

³ See Conservation Commission, *Forest Protection in Canada, 1912*, by Clyde Leavitt, M.Sc.F., Chief Forester of Commission, Toronto, 1913.



Mining.
Classifica-
tion of
coal de-
posits in
the Do-
minion.

mills are sometimes at a considerable distance from the 'limits' or places where the timber is cut. Sometimes the logs are exported without being cut into lumber.

The coal deposits of the Dominion of Canada may be classified as follows according to the formation in which they occur:

Lower Carboniferous or Devonian, represented by the Cannel and oil shales of the Arctic islands, and by the thin, and probably not economically exploitable, coal-seams in some parts of Nova Scotia, lying beneath the carboniferous limestone.

Carboniferous, represented by the principal coal-fields of Nova Scotia.

Lower Cretaceous, represented by the bituminous coals and anthracite of the Rocky Mountains and of the interior of British Columbia as well as by those of Queen Charlotte Islands and the Yukon Territory.

Middle and Upper Cretaceous, represented by the coals of Vancouver Island and of Lethbridge.

Upper Cretaceous, represented by deposits in Alberta and Saskatchewan.

Tertiary, represented by small areas in British Columbia, Yukon, and the Arctic Islands, and consisting of lignite and sub-bituminous coals.

Interglacial beds, represented by lignites of inferior quality and of lignitic and peat deposits, some of which are still in process of formation.¹

From an economic point of view, Canadian coals have been classified in four series, according to the proportion of carbon contained by them.

Class A. 90 to 95 per cent. Class B. 70 to 90 per cent.

„ C. about 70 per cent. „ D. 45 to 65 per cent.

¹ Cf. 'The Coal Fields and Coal Resources of Canada', by D. B. Dowling, in *The Coal Resources of the World*, Toronto, 1913, vol. ii, p. 439. These valuable volumes contain the results of an inquiry made upon the initiative of the Executive Committee of the Twelfth International Geological Congress. The reports of which the volumes are composed are official. See also *An Investigation of the Coals of Canada with reference to their Economic Qualities*: as conducted at McGill University, Montreal, under the Authority of the Dominion Government, in six volumes, Ottawa, 1912 (a valuable series of monographs).



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Class C includes those coals which, while moderately strong in carbon, yield a high percentage of volatile matter on distillation and burn with a smoky flame.¹

Extent of
Dominion
coal-fields.

The total area and quantity of actual reserves of coal, calculated upon the actual thickness and extent of the deposits in the Dominion of Canada including the Arctic islands, is stated at 26,219 sq. miles and 414,804 million metric tons. The total probable reserves are approximately calculated at one and a quarter million millions of tons. Of this quantity, about 86 per cent. is in the province of Alberta, about 5 per cent. in Saskatchewan and Manitoba, about 7 per cent. in British Columbia, about 1 per cent. in the Yukon, North West Territories, and the Arctic islands, and about 1 per cent. in Nova Scotia, New Brunswick, and Ontario.²

Eastern
mining
region :
Nova
Scotia.

The 'actual reserves' of Nova Scotia extend over 174.31 sq. miles and amount to two thousand million tons. The quantity already mined is estimated at sixty million tons. The fields are in five areas, all of which include important mines—Cumberland, Pictou, Inverness (chiefly submarine), and two areas at Cape Breton, one land and one submarine.³ The principal mines are now in the possession of the Dominion Iron and Steel Company, and of the Nova Scotia Steel Company. The other mines are worked by independent companies. In 1909 a serious strike, accompanied by riots followed by the dispatch of troops, took place at Glace Bay in connexion with the mines of the Dominion Coal Company. The strike was occasioned by a dispute in which the provincial (Nova Scotian) workmen's organization and the United Mine Workers of America (one of the international trade unions) were involved. The strike lasted for several months and then gradually collapsed, many of the strikers leaving the district.

Iron
mining.

Iron exists in the Eastern region; but owing to various causes, its exploitation has not been successful. Under

¹ *The Coal Resources, &c.*, vol. i, pp. x-xiii. Classification by the Committee.

² *The Coal Resources, &c.*, vol. ii, p. 442.

³ *Ibid.* ii, 443.



the influence of bounties and of protection many smelting plants have been established in Ontario and in Nova Scotia; but the percentage of Canadian ores treated in these furnaces has diminished. Thus in Ontario, the proportion of Ontario ores to the total quantity treated in the blast furnaces in Ontario in 1901 was 56 per cent.; while in 1911 it amounted to only 7 per cent.¹ The iron smelted at the works at Sault Ste. Marie is chiefly imported from the United States, and that smelted at Sydney, Cape Breton, is imported from Newfoundland.

Although gold has been discovered in several different and widely distant parts of the Eastern mining region, the district which has been most productive is Porcupine in northern Ontario. In this region gold-bearing veins have been discovered for the most part in the Keewatin, one of the members of the pre-Cambrian or Archaean Shield. Since the Keewatin consists largely of eruptive rocks the fissures are irregular, and thus the distribution of gold, associated as it is with quartz solutions which have circulated through these fissures, is irregular also. 'Most spectacular showings occur on many properties, but these are limited to portions of the veins.'² Warnings against excessive optimism have frequently been issued by the Bureau of Mines. In this camp as in others expensive plant has occasionally been installed without sufficient previous investigation of the local possibilities. Forest fires have been very destructive. Thus in May 1911 the surface workings and the buildings of the Hollinger mine were completely destroyed. The fire continued for nearly two months to ravage the district and to destroy the surface plant and the mining towns. During this terrible time seventy-one persons lost their lives. The opening up of the Porcupine field has led to prospecting throughout

¹ *Report, Bur. Min. (Ontario), 1912, p. 28.* On the history of the bounties upon iron see S. J. McLean, *The Tariff History of Canada*, Toronto, 1895, and E. Porritt, *Sixty Years of Protection in Canada*, London, 1908.

² A. G. Burrows, 'The Porcupine Gold Area', in *Report of Bureau of Mines, 1911*, Toronto, 1911, p. 20.



Silver
mining:
Cobalt
region.

the neighbouring regions as well as to the re-opening or renewed activity of fields which had previously been worked and abandoned.

Silver had also been discovered in several parts of the Eastern region; but although some of the deposits were very rich, their extent was limited. In the autumn of 1903, announcement was made of the discovery of silver in a new region, destined afterwards to become famous as the Cobalt mining camp. During the construction of the Temiskaming and Northern Ontario Railway, which had been undertaken by the provincial government for the development of northern Ontario, deposits of silver ores and of cobalt-nickel arsenic ores were found. The discoveries were not made by prospectors but by employes of the contractors for the railway, nor was their importance at once realized. In 1904 the district was examined by Mr. W. G. Miller, acting as geologist for the Ontario Bureau of Mines.¹ In June 1905 the rush of prospectors into the district began; and from that date the Cobalt region was subjected to rapid exploitation. Canadian, American, and English capital poured into the district. Mining towns grew up, agencies of banks were established, and a large mining population speedily collected.²

According to Mr. W. G. Miller, the Cobalt deposits 'occupy narrow, practically vertical fissures or joints, which cut through a series of usually slightly inclined metamorphosed fragmental rocks of Lower Huronian ages'.³ These rocks consist of three series, viz. 'the conglomerate and other sediments of the Cobalt series, the Nipissing diabase sill, and the Keewatin complex. But 80 per cent. of the ore has come from the Cobalt series.

¹ Report on 'Cobalt-Nickel Arsenides and Silver' in *Rep. Bur. Min.* (Ontario), 1904, pp. 96-104, and on 'The Cobalt-Nickel Arsenides and Silver Deposits of Temiskaming', by W. G. Miller, *Rep. Bur. Min.*, 1905, Part II, Toronto, 1905.

² In the sub-district of Coleman in 1901, there was not one person; in 1911 there was a population of 3,131 (2,351 males and 780 females) or 94.42 persons per sq. mile (*Census of Canada, 1911*, vol. i, p. 82). Coleman contains the town of Cobalt and most of the mines.

³ *Report of Bureau of Mines, 1905*, Toronto, 1905, p. 7.



The chief reason for this greater productiveness is due to the fact that these rocks fractured more readily than did the diabase or the Keewatin.' The slenderness of the veins is compensated¹ by their number in respect to the area. Thus, although the veins are very unequally distributed, they are sufficiently numerous to make Cobalt an exceptionally rich silver-mining region.²

The economic effects of an influx of people and of capital into a previously unoccupied country extend widely beyond the region in question. The provision of supplies for a mining camp is a profitable business, for the need of supplies is urgent. Miners' wages are high, not only because labour is scarce, but because any one may go prospecting for minerals. This counter-attraction to farming exercises influence over a wide area; thus supplies are usually brought from a distance. The local markets of Ontario were denuded of their eggs, butter, vegetables, &c., for the new mining region, and the local prices of many commodities already advancing from other and more general causes were driven upwards rapidly under the influence of the suddenly increased demand.³

Economic effects of the opening up of new mining regions.

The speculative public had recovered from the disastrous experience of investment in the mines of British Columbia in 1896-7, and they plunged into the Cobalt market with energy. Mining lands were sold and leased by the government, which derived a large revenue from these payments and from mining royalties;⁴ as well as from the government railway which had been constructed into the region prior to the important mineral discoveries. Capital was thus diverted from agriculture and from industries other

¹ *Report of Bureau of Mines*, vol. xix, Part II, 4th edition, Toronto, 1913, p. 123.

² The quantity of fine silver produced in Cobalt and the adjacent areas was as follows, stated in millions of ounces—1910, 36.6; 1911, 31.5; 1912, 30.2. *Ibid.* p. 35.

³ See Statistical Tables and Diagrams in *Wholesale Prices in Canada, 1890-9. Special Report*, by R. H. Coats, Ottawa, 1910, and subsequent reports.

⁴ The Ontario government derived from these sources in 1910 about £200,000, and in 1911 about £160,000. Cf. *Rep. Bur. Min.*, 1912, p. 42.

than mining, and credit was employed to obtain capital from the United States and from Great Britain for the exploitation of the mines. Although the precarious character of mining enterprise rendered losses inevitable, and although the precise amount of capital which has been actually expended upon wages, supplies, and machinery for the development of the Cobalt region cannot be determined with precision, it is probable that the yield of the successful mines has already approximately replaced the capital outlay, taken as a whole. The number of successful mines, however, is small in proportion to the number of the prospects and mines upon which capital has been raised and in general, no doubt, expended.

Copper
mining.

Practically the whole of the copper produced from mines in the Eastern region is derived from the nickel-copper ores of the Sudbury region. The total quantity is from 7,000 to 10,000 tons annually.¹

Nickel
mining.

The nickel ores of Sudbury in Ontario appear to be situated on the edges of a single sheet of eruptive rock in a basin enclosed by rocks of Lower Huronian and Laurentian ages. Nickel-bearing ores are distributed irregularly over these edges, and they may extend beyond them.² The first important work in the region was carried on by the Canadian Copper Company in 1886. In 1902 this company was absorbed by the International Nickel Company. Nickel ore mining and smelting are now carried on not only by the pioneer company, but also by Messrs. Vivian of Swansea, by the Dominion Mining Company, by the Mond Nickel Company, by the Dominion Nickel Copper Company, and by some smaller concerns. The total amount of nickel recovered from this region up

¹ *Rep. Bur. Min.*, vol. xxi, Part I, p. 26.

² Cf. A. P. Coleman, *The Nickel Industry, with special reference to the Sudbury Region, Ontario* (Report to Dominion Department of Mines), Ottawa, 1913. See also Barlow, 'Nickel and Copper Deposits of the Sudbury Mining District,' in *Reports, Geological Survey of Canada*, Part H, vol. xiv, Ottawa, 1904; Coleman, in *Rep. Bur. Min.* (Ontario), vol. xiv, Part III, Toronto, 1905, and A. Gray, 'The Nickel-Copper Industry of Ontario,' in *Mining World*, vol. xxxii, Nos. 20-2 (1910).



till 1911 is stated by Prof. Coleman at about 133,000 tons, the total amount of ore mined being five and a half million tons.¹ The ore is smelted at the works in the region, and the resulting bessemer matte is exported for refining in the United States or in Wales.

The Huronian rocks contain a great diversity of metals. Besides those already mentioned, zinc, arsenic, and cobalt are produced to the extent of an average annual value of about £35,000 in the aggregate. In reducing the silver ores cobalt must be isolated. Since the demand for it is slender, the mine owners have been obliged to allow the metal to accumulate. Palladium and tungsten have long been known to be present in the Huronian, and the presence of mercury was determined in 1911.²

Clay for brick and tile making, stone and cement for building purposes, asbestos and mica for fireproof packing, &c., corundum for cutting and polishing, petroleum in the form of oil, and natural gas for heating and lighting purposes are among the abundant minerals in Ontario, the exploitation of which is vigorously conducted. Coal is absent. In 1896 specimens of a mineral, to which the name of anthraxolite had been given by the late Professor Chapman,³ were brought from the Sudbury district and were described by the newspapers as coal. Some time elapsed and many experiments were made before the public were convinced as to the nature of the material. It was described by the late Dr. G. M. Dawson and by Prof. Coleman as a bitumen from which most of the volatile matter had been removed by metamorphic action.⁴ Chemical analysis showed that relatively to anthracite the material had a small percentage of carbon and a large percentage of incombustible ash.

Three minerals only need be further noticed in this place. The exploitation of each of them has assumed

¹ Coleman, *The Nickel Industry*, p. 107.

² *Rep. Bur. Min.* (Ontario), 1912, pp. 6 and 50.

³ Professor E. I. Chapman, *Minerals and Geology of Ontario and Quebec*, p. 143.

⁴ A. P. Coleman, 'Anthracitic Carbon or Anthraxolite,' *Bulletin Bur. of Min.* (Ontario), Toronto, November 1896, p. 6.



considerable proportions. These are corundum, petroleum, and rock salt.

Corundum.

The corundum region of Ontario is in the central portion of the southern part of the province. It comprises the counties of Renfrew, Frontenac, Lennox, Hastings, Haliburton, and Peterborough. The occurrence of corundum in this region was first reported by Mr. W. F. Ferrier in 1896.¹ The mineral chiefly consists of aluminium oxide (Al_2O_3), but there are also usually present oxides of other metals which impart to it sometimes a striking iridescence. It crystallizes in long and narrow rhomboids; a cross section has six sides.² These crystals are found embedded in a felspathic matrix. On the surface they are slightly altered to mica. Corundum is not fusible before the blow-pipe, but it dissolves slowly in borax and phosphor salt. Next to the diamond it is the hardest known substance. Gems of corundum are of very rare occurrence; but mineral suitable for abrasive purposes is abundant. It is used together with emery powder or separately for grinding and polishing; and facets of corundum set on the periphery of iron disks are used for sawing building-stone, the disks being driven at a high speed.

Petroleum.

In spite of a bounty of $52\frac{1}{2}$ cents per barrel, the petroleum industry in Ontario has declined from nearly 800,000 barrels in 1907 to less than 290,000 barrels in 1911. There are two refineries in Ontario, but the crude oil is for the most part imported from the United States, the domestic oil being insufficient to keep the refineries going.

Salt.

The salt beds of Ontario extend from the shore of Lake Huron, near the town of Goderich, across the south-western peninsula to the Niagara River. The beds have a thickness from 300 feet in the south-east to 775 feet in the north-west. On the St. Clair River the beds are

¹ *Summary Rep. Geol. Surv. Can.* 1896, Ottawa, 1896, p. 5, although the mineral is said to have been first noticed by a child. Cf. *Rep. Bur. Min.* (Ontario), vol. vii, Part III, p. 215.

² *Rep. Bur. Min.* (Ontario), loc. cit.

found at a depth of 1,000 feet and are from 20 to 100 feet thick. The lake or river water is forced down through an outside tube, and the brine comes up through an inner one. The pressure at the bottom of the tube is about 500 lb. per square foot.¹ Operations on a considerable scale began in 1869, but the wells became much more numerous between 1881 and 1890. The annual production of salt in Ontario is about 90,000 tons. About one-half of this quantity is produced by the Canadian Salt Company, whose works are at Windsor and Sandwich. The production of salt has been of enormous benefit to the dairying industry. A demand has also arisen for it for the manufacture of caustic soda and bleaching powder.

THE EASTERN AGRICULTURAL AND INDUSTRIAL REGION

The eastern agricultural and industrial economic region is embraced (so to say) by the region of which an account has been given. The agricultural and industrial area comprises the riparian lands of the St. Lawrence Valley both in Ontario and Quebec and a portion of the Maritime Provinces. Farming and industry are practised on the coast, in the river valleys, and sporadically on the uplands throughout regions where fishing, mining, or lumbering is the predominant occupation.

The most important parts of the eastern agricultural region are the rich alluvial soils of the Niagara peninsula and the heavy clay soils of central Ontario. The eastern agricultural region may be broadly divided in an economic sense into two divisions—the self-contained, which comprises the greater part of the province of Quebec, and the commercial-agricultural division, which comprises the agricultural portions of Ontario and of the Maritime Provinces.

The French colonists of the seventeenth century formed their settlements on the banks of the St. Lawrence and its tributaries. The normal dimensions of a grant *en censive* were 4 *arpents* or 768 feet in width by 40 *arpents*

The agricultural areas.

The self-contained agricultural area.

¹ Report of the Royal Commission on the Mineral Resources of Ontario, Toronto, 1890, pp. 45 and 183.

or about $1\frac{1}{2}$ miles in depth. Owing to subdivision of the lots, there are now many farms of one *arpent* or one *arpent* and a half wide by 40 *arpents* deep. The villages are thus strung, as it were, along the river banks. On the St. Lawrence they form practically a continuous line between Quebec and Montreal, the parish church being in the centre of each village, and the houses extending on either side of it. On the tributary rivers the villages present the same aspect. Fish traps stand opposite almost every house, and from the beginning of colonization until the present time the *habitant* is as dependent upon the fish which *le bon Dieu* sends into his trap as he is upon the produce of his farm. On the St. Lawrence, especially below the city of Quebec, where fish are plentiful and various, large numbers of eels are caught in the traps by the farmers, who salt them down for winter use or for sale. The surplus products of the farm and of the fish traps are customarily sold, but not until the family requirements are satisfied. The absence of shops in the villages, though not in the small towns, discloses the predominantly self-contained character of village life.

Geo-
graphical
and allied
divisions
in the
agri-
cultural
region.

M. Léon Gérin, in his admirable studies of French Canada prepared after the manner of Frédéric le Play, has pointed out that the characteristic group of settlements is situated in a region which may be divided into three subdivisions in five series from the points of view of geography, topography, agronomy, economics, and sociology. The three geographical subdivisions are—the river bank, the intermediate plain, and the *arrière-plane* or mountain. The topographical division is into three land levels: the flat lowlands, the terrace, and the uplands. The agronomical division is according to the principal characteristics of the soil: the fertile alluvium, the clay of medium fertility, the unfertile sands, and the coarse soils. The economic division is according to production: hay, grains, and timber. The sociological division is into the three orders of inhabitants corresponding to the three distinct physical *milieux* in which they find themselves.



Passing as they did from a region where the undivided family was still the rule, the French emigrants from rural France naturally continued the patriarchal or semi-patriarchal system to which they had been habituated. The property of the family was common property, and every member of the family performed his share of the common labour. The eldest sons always, and the younger sons frequently, lived in the family house together with their parents and with their wives and children if they were married. The extent to which this primitive life has remained undisturbed has depended upon which of the three regions in the above classification the settlers have occupied. In the river region where there is much contact with the moving life of the river, the patriarchal system is disturbed by the activity and variety of the social *milieu*: in the mountain region it is disturbed by the conditions of forest life, and by the difficulty of engaging in sufficiently continuous and profitable labour for all the members of the family within the boundaries of the family property or even within its neighbourhood. It is in the intermediate region that quasi-patriarchalism thrives. The manners of the people correspond to the three sub-regions. In the riparian region the *habitant* has certain pretensions to refinement, and social distinctions make their appearance. From such *habitant* families come the lower ranks of the professional classes—the priests, the physicians, the lawyers, and the politicians of rural Canada. The upland people have rude and simple manners, while the intermediate population possesses at once simplicity and refinement. There are similarly distinct phases of intellectual culture; illiteracy in adolescents is $6\frac{1}{2}$ per cent. in the riparian region, 10 per cent. in the intermediate, and 24 per cent. in the upland region. In the uplands religious faith is intense, and the people are united; in the intermediate region, religion is more formal; it is only on the river that indifference and schism make their appearance. On the river the family property is sometimes large, but the value of it is unstable; the estimated funded property



per head is \$400, which would make about \$2,000 per family. In the intermediate region this amount is estimated at \$320 per head; in the uplands at \$150 per head. On the river, where the soil is deep and fertile, the cultivation is at once varied and specialized, hay predominating. Crops are grown for the market, for communications are easy. In the intermediate region the clay soil enables the *habitant* to cultivate grain to advantage, and to engage in *petite* culture, and he devotes himself especially in the winter to manufacture for household requirements. The *habitant* of this region is a good carpenter and a good shoemaker, and his wife is a good weaver. The life of the family is thus highly self-contained and stable. In the upland or forest region, cultivation of the land is fragmentary, and the *habitants* engage themselves chiefly in the primitive labours of forest and of forest industries.¹

Distribu-
tion of
French
popula-
tion.

The above sketch of French-Canadian life may in general terms be held to apply to the whole period which has elapsed since the English occupation, and with minor differences to the whole of the valleys of the St. Lawrence and its tributaries. In the river cities and towns, notably in Quebec, Montreal, and Three Rivers, settlers of British origin have introduced themselves into the French-Canadian mass;² but they are rare in the sub-regions described as intermediate and upland, and even in the river villages, although after 1763 the French villages absorbed many of the disbanded English soldiery. Mutations of the conditions described have been going on slowly. The rapid growth of the village population throughout the nineteenth century has disturbed the

¹ Cf. Léon Gérin, 'Trois types de l'habitant canadien-français,' in *La Science Sociale*, Paris, 1899, vol. xxviii, pp. 96 *seq.* See also *Proc. and Trans. Royal Society of Canada*, 1898-9.

² The following shows the proportions of the population of the province of Quebec as a whole, of French, British, and other origins, from the Census Returns of 1901 and 1911 respectively:

	<i>French.</i>	<i>British.</i>	<i>Other origins.</i>
1901	80%	18%	2%
1911	80%	16%	4%



quasi-patriarchalism of the three regions in diminishing influence proportionately to their distance from the great ways of communication, but all the regions have been affected by it.

Owing to the increase of the French-Canadian population, the practice of primogeniture, the inferior industrial development of Lower Canada, and the vigorous industrial growth of New England, there occurred for many years a migration of French-Canadians to the United States, where the French-Canadians form a large part of the population of many New England towns. This migration has involved certain reactions upon the life of the villages, and there has, moreover, been in progress a certain interfusion of interests and ideas between the *habitants* of the different regions. The growth of industry, notably at Montreal, Three Rivers, and Sherbrooke, has drawn the French-Canadian women into the cotton and shoe factories, and the men into the bridge works and machine shops. Even in the uplands the manufacture of paper has come to play a large rôle. Yet peasant habits of life are stable, and there remain throughout the province in effect the three subdivisions of which an account has been given, each type of *habitant* occupying a distinct *milieu*, to which his economical and social characteristics correspond.

While the agriculture of the province of Quebec is predominantly, although not exclusively, practised by self-contained family and village groups, the agriculture of Ontario is predominantly practised by individual farming families settled upon isolated farms, and is characterized by commercial economy. The Quebec farmer consumes the produce of his farm and purchases little; the Ontario farmer produces for the market, and even purchases many things which he might, if he would, produce for himself. The exploitation of the heavy clay soils of Ontario thus presents a great contrast to the exploitation of the agricultural portion of the province of Quebec. In the latter province we have seen that the agricultural resources have been exploited by a highly homogeneous and stable population, habituated to village life, quasi-patriarchal in

The agricultural areas of Ontario.



its family relations, with a tendency towards the modification of these relations in the riparian villages on the one hand, and in the pioneer farms on the other. In Ontario the alluvial and heavy clay soils have been cultivated by a heterogeneous population, distributed for the most part in isolated farms over a wide area, and characterized by slender social cohesion and the almost total absence of patriarchalism. Diversity of origins and variety of surroundings have produced a much more complex series of types than may be found in Quebec.

Social
charac-
teristics
in
Ontario.

The salient social characteristics of the Ontario population considered as a whole are diversity of race and therefore of character in an ethical and religious sense, a high degree of individualism and of individual mobility, with consequent inferior cohesion of the family and communal groups. The high degree of individual mobility leads to changes of occupation and of residence on slight occasion, and to rapid changes in the standard of comfort. Individualism leads also to variation in spheres other than economic—to dissent and sectarianism in religion and to ethical standards of varying stability.

The society of Ontario, diversified in racial origins as it is, may be regarded as being composed of some of the elements resulting from the decomposition of previously existing European societies, these elements being economically and morally perturbed by the shock of removal to new surroundings in a new continent and being under the necessity of undergoing gradual adaptation to new conditions. While the comparative culture levels of a heterogeneous, individualistic, and fluctuating society cannot be estimated with even approximate accuracy, certain provisional conclusions may be suggested.

Their asso-
ciation
with
regional
divisions.

The general characteristics which have been remarked vary in the three sub-regions into which the agricultural area of the province of Ontario may be divided, in correspondence with the similar regions into which Quebec has been found to be divisible. In the first or riparian region, the agricultural population in the immediate neighbourhood of the urban centres or on the



alluvial soils of the shore and bank lands possesses, in general, strongly individualistic characteristics. Habits of association and co-operation are not inherent and are acquired with difficulty. Although market gardening is by no means highly developed, fruit is grown on small farms especially in the Niagara district. Small farmers also supply the pork factories, dairies in the towns, and local markets. From this region the population of the towns is largely recruited. In the second or intermediate region, away from the Great Lakes and from the larger rivers, on the heavy clay soils of central Ontario, the farming people retain a few elements of quasi-patriarchalism, and possess a considerable amount of family and social stability. Their manners are simple, and their habits tend to an almost excessive frugality. Their well-being depends indeed rather upon this circumstance than upon skilful farming. The rural telephone has ameliorated the isolation of the farm, and has contributed to sociability, which was formerly lacking. Although intellectual interest is rare, there is a general belief in the efficacy of education. In this intermediate sub-region, racial character is less diversified than in the other two sub-regions. While the farming population, as also the population of the inland towns in the centre of the farming districts, is predominantly of British origin, there are a few compact settlements of Germans, and settlers from various parts of Great Britain tend to settle in definite racial groups. There are, for example, several Scottish settlements. There is thus throughout this sub-region a certain interior solidarity within the constituent groups of which the population is composed.

The third sub-region comprises the uplands of central Ontario, where the soil is thin and poor, resting upon a rocky substratum, and the probably more fertile but more remote slopes from the height of land in Northern Ontario towards James Bay—the southern extremity of the Hudson Bay waters. Among the isolated farmers in these wide regions there is to be found extraordinary

but rarely well directed industry. The farm has been obtained as a rule as a gratuitous grant or alternatively for a very small price: the farmer has little agricultural capital or none; he is far from a market, and he is at the mercy of the seasons. He is thus engaged in an unrelenting conflict with Nature, and has neither leisure nor inclination for any but material considerations. Mortgages, unless the money is obtained locally, are rare, because the security is inadequate, and since the farmer rarely possesses agricultural capital of his own, the progress even of an industrious farmer is slow. The most serious disadvantages of such a situation are experienced by the women. In the north, farms are often at a great distance from medical aid, and the women sometimes lack even assistance from others of their own sex. Nevertheless the climate is invigorating, and the farming population becomes less isolated as new farming districts are opened up. Recruits for these are not wanting, although some of them have had no previous experience of pioneer life. The proximity of mining or of railway construction camps in some cases affords a market for farm produce, and if such outlets are not merely temporary, conditions become ameliorated. Some give up the struggle in despair; but seventy years ago pioneers went with equal toil and equal discouragement into parts of Ontario which are now well occupied by a thriving population.

The clay
belt of
Ontario.

Much controversy has been excited by the opening up to agricultural exploitation of what is known as the clay belt in northern Ontario. This region is traversed by the Grand Trunk Pacific Railway and is tapped by the Ontario Government line to the north from North Bay. The successful exploitation of the region undoubtedly depends upon the prosperity of the mining districts lying to the south of it. Should the productivity of the mines be maintained or increased, the clay belt must become valuable, even although it may not uniformly be susceptible of economical cultivation.¹

¹ Cf. *Our Fertile Northland*, Toronto, n. d., and B. E. Fernow, *Report*, Ottawa, 1912.



Throughout the three sub-regions above described, Farm labour and tenure. a normal Ontario farm of 100 acres is usually cultivated by the owner of the farm and his family without the aid of hired labour. Where a hired labourer is employed, he customarily lives with the farmer's family. In the intermediate or second region and in the riparian or first region, farm mortgages are common. In the third region they are very rare. In this region also there is little mobility of farm property. If a farmer does not succeed, he may abandon his holding unless he can arrange to sell it to an incoming settler. In the second region there is a greater but still not a high degree of mobility; in the first region there is much more, especially in the neighbourhood of growing towns, where encroachment upon the agricultural area invites speculation. In the intermediate or second region it is customary for the farmer wholly to control the family finances. He provides his sons and daughters with food and clothing, but he gives them no money. On the other hand, it is a well-understood practice that the family resources in the hands of the farmer should be devoted to the purchase of a farm for the eldest son, when the family fortune is in a position to purchase and stock the farm, and thus to enable the eldest son to marry. Even after his removal from the family homestead, which customarily takes place upon marriage, the eldest son returns to assist his father during ploughing, seeding, and harvest seasons without payment, at least until the younger members of the family have grown up. This family practice does not seem to cause much friction so far as the eldest son is concerned; but it is not looked upon with favour by the younger members. The absence of money renders them practically immobile; and until their elder brother has succeeded in establishing himself, there is no chance of their owning a farm, even if they should desire to do so. If the family is prosperous, however, one or more members are sent to the university, and are thus drawn into the learned professions; if the family is not prosperous, but the younger members are ambitious, they make their

way to the towns and go into business or industry. To the absence of pocket-money and to the severity otherwise of the family discipline is attributed the dislike of the farm which drives the younger members of the farmer's family into the towns. This, however, is not the exclusive cause. The arduousness of agricultural labour—the farmer is really a driving foreman of his sons, as the farmer's wife is a driving forewoman of her daughters—the long winter and the isolation, especially in the remoter districts, are important contributory causes. Conditions vary, however, in different districts; and it is therefore impossible to give a view of farm labour in Ontario which would be uniformly accurate. The conditions described are to be found in their fully developed form in the remoter farms of the intermediate region and in less fully developed form in the neighbourhood of the interior towns; in the shore lands of Lake Ontario they are hardly observable. As in other countries where similar conditions exist, domestic crime is a consequence of severe family discipline. In the riparian and in the intermediate region, where the family is large enough to spare some of its members, the youths go to the north-west to work as harvesters, and return in early autumn when harvest is over. From these regions also there has been a steady drain of the young men to the west. All the prairie provinces have drawn heavily upon Ontario. The rural population of Ontario declined between 1901 and 1911 to the extent of 52,000, or about 5 per cent. of the rural population.¹

The
 Eastern
 industrial
 region.

The Eastern industrial region occupies a portion of the littoral of the Atlantic coast, a portion of the St. Lawrence valley, and a portion of the coasts of the Great Lakes. The most important industrial activities are necessarily devoted to the exploitation of those raw materials with which the region abounds and to the manufacture of these. In Nova Scotia the presence of

¹ *Census of Canada, 1911*, Ottawa, 1912, vol. i, p. 528. See also S. A. Cudmore, 'Rural Depopulation in Ontario,' in *Trans. Canadian Institute*, Toronto, 1912.



PLATE XIII. FRUIT ORCHARDS, WINONA, ONTARIO

(Office of the High Commissioner for Canada)



PLATE XIV (a). LOGS ON OTTAWA RIVER (ROCKLIFFE, ONTARIO)

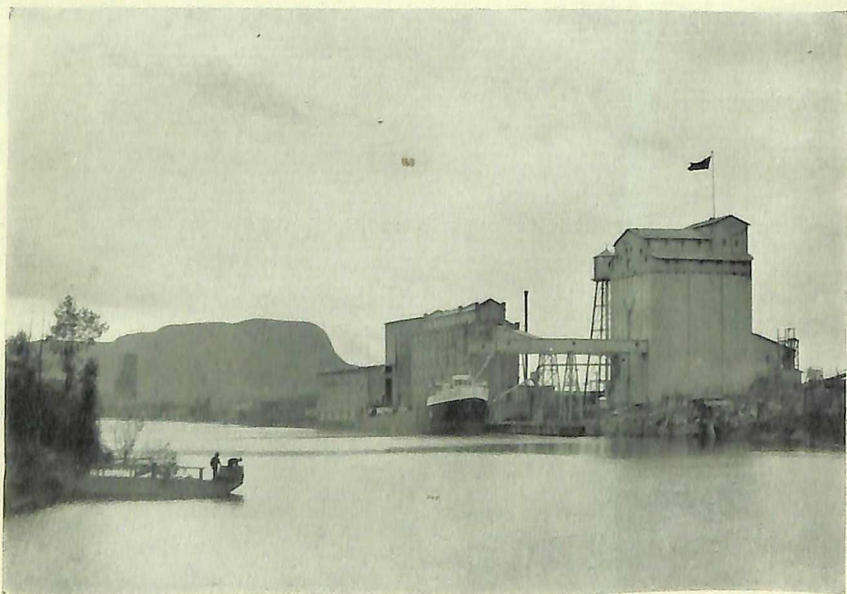


PLATE XIV (b). FORT WILLIAM, LAKE SUPERIOR, ONTARIO
(Office of the High Commissioner for Canada)



coal has rendered possible the establishment of steel works, although the absence of a local supply of iron ore is a great disadvantage. In Ontario the absence of coal has been a handicap, compensated to some extent by proximity to the Pennsylvania coal-fields, from which supplies might be drawn, and by the existence of water powers, which by means of electrical conductors might be made available at a distance. The want of coincidence of complementary natural resources in Eastern Canada might appear at first sight to render industrial progress problematical. The enterprise and energy of the people and the provision of means of communication have in a large measure diminished the inconvenience of this lack of variety in resources within the boundaries of the region; and its industrial development has reached a stage which places it beyond question.

The most important industries of the Eastern region may be regarded as the forest industries, viz. the group of industries concerned with forest products—the preparation of timber for construction purposes; the manufacture of doors and windows, which have been standardized and are now produced by machinery in great quantities; the manufacture of matches, which is a large industry at Hull in the province of Quebec; and the manufacture of wood pulp, principally for paper-making. Pulp and paper are made on a large scale at Grand'Mère in the province of Quebec, at Sault Ste Marie, and at other places. Flour milling is an important industry in Ontario, cement making in the neighbourhood of Ottawa, iron smelting and steel manufacture at Sydney, Cape Breton, and at Hamilton and Midland, Ontario. The finer metals are refined at Sudbury near the mines, and at Thorold in the Niagara peninsula. Industries subsidiary to the directly exploitative industries are chiefly concentrated in the urban centres where labour is more readily obtainable. The manufacture of agricultural machinery is carried on at Toronto and at Brantford, the manufacture of food products from cereals at Peterborough, and the manufacture of bread in practically all

Industries
associated
with
forest
and agri-
cultural
products.



the towns, but principally in the larger provincial centres of population.

Other industries.

Distilleries are established at Toronto, Waterloo, and Walkerville; breweries at Toronto and London, Ontario; and aerated water factories at Toronto. Electrical machinery is manufactured at Peterborough and Hamilton, automobiles at Toronto; general machinery is made at Toronto and Hamilton, Ontario, and at Sherbrooke, Quebec. Shipbuilding is carried on at the seaport towns and at Toronto. Throughout the eastern industrial region there are numerous industries which may be regarded under the general heading of chemical industries. Among these the more important are the manufacture of wood alcohol, soap, glycerine, fertilizers, alkalis, refined chemicals, coal-tar, corundum, graphite, asbestos, mica, beet-root sugar, and the exploitation of natural gas and petroleum at Petrolea in Ontario and calcium carbide at Ottawa.¹ Of industries engaged in the manufacture of imported raw materials, sugar refining is carried on in Montreal, tanning (the hides being imported from the Argentine) in the small towns on the edge of the forest region, where hemlock bark is readily obtainable, cotton manufacture in Montreal, carpet manufacture in Toronto, and shoemaking in Montreal. Toronto is the centre of the letter-press printing trade of the Dominion, of paper-box making, and of the jewellery trade. Toronto and Montreal are the centres of the ready-made clothing business.

Economic position of manufacturing industries.

The existence of a relatively large class of manufacturers employing a small amount of capital and a small number of men is noticed elsewhere; here it may be observed that the rise and continuance of the small manufacturers as a class have been due to the relative smallness of the domestic market, to the variety of demand, to the facilities for small credits and to the comparative restriction of large credits owing to the slender accumulation of industrial and commercial capital,

¹ See W. R. Lang, *The Chemical Industries of the Dominion. University of Toronto Studies*, Toronto, 1905.



and to the competition of numerous and approximately equally skilled and equally active *entrepreneurs*.

The urban centres of population in the eastern region exhibit the economic and social phenomena which may be expected to arise from the rapidity of their growth from small to relatively large communities. Eagerness for local autonomy and the weakness of the central government of the provinces, together with the entire absence of control over the municipalities by the Dominion Executive and Parliament have combined to prevent progress in municipal government from keeping pace with the economic progress of the country. The more active and superior minds have been drawn into the larger field of Dominion politics or have been engaged exclusively in the pursuit of fortune; and thus the task of municipal administration has fallen into the hands, for the most part, of parochial politicians and of underpaid and frequently incompetent municipal functionaries.

Economic characteristics of urban centres.

The results of these conditions, inevitable in a new country in which individualism is the dominant characteristic, appear in defective municipal services, as in Ottawa, Montreal and Toronto, where the deficient water-supply is a source of danger, in the inferior policing especially of the smaller towns, in the prevalent absence of sanitation, as shown, for example, by the reports of the medical officers of public health and of the factory inspectors, and in the insistent demands for the study of 'municipal problems' and for changes in the system of municipal government. The adoption of what is known in the United States as commission government, involving the election of a small number of persons who would be paid salaries somewhat larger than the salaries customarily paid to municipal councillors, and would be required to devote their whole time to the service of the municipality, has been urged in several of the cities. But the insecurity of the tenure of office, the exposure to social and political pressure and the inadequacy of the salaries which the municipalities are willing to pay, seem to militate against the success of the system by

Bearing of economic conditions upon public service.



preventing properly qualified persons from undertaking the duties of commissioners. The plan, moreover, inevitably compromises the democratic character of civic government, and it is exposed to the objection that it confuses the executive and legislative functions. The difficulty seems insoluble excepting by time. Sooner or later there will arise in Canada, as there is now arising in the United States, a class of disinterested, able and leisured persons who will devote themselves to civic legislative control as a public duty, and will cause the executive offices to be occupied by competent and adequately paid experts who will be required to exercise their functions without regard to local intrigues or to petty political pressure. The extension of municipal enterprises—in the operation of street railways and the like—has undoubtedly contributed to the over-burdening of the municipal councils with work for the performance of which they had no adequate or appropriate administrative machinery, and has thus helped to bring civic administration into discredit, not so much on account of corruption, although that has occasionally been exposed, as on account of incompetence, which has been evident for some years, especially in the more rapidly growing municipalities.

Local protection of industries.

The rivalry of the industrial centres has led to the policy of granting bonuses to factories and of granting them also exemption from taxation for a period of years. This practice has, on the one hand, burdened many of the cities with debt, and, on the other hand, has reduced their revenue. The exemption from municipal taxation of all property held by ecclesiastical and by educational institutions has also imposed a heavy burden upon the cities, and has compelled them to contribute to the maintenance of religion and of education in an indirect and not altogether desirable manner.

Great areas of eastern cities and expense of public services.

The large areas occupied by the eastern cities and the constant encroachment upon surrounding agricultural lands have at once induced excessive speculation in suburban areas and have compelled the cities to furnish



means of communication and other municipal services over an area out of proportion to the magnitude of the population. These conditions have not only tended to the increase of municipal indebtedness and to the increase of taxation, but have aggravated the irritation caused by the deficiencies of the municipal administration. Too great density of population is by all means to be avoided; but wide distribution of it, concurrently with demands for urban facilities of all kinds, is enormously expensive. Such demands are frequently made and public movements organized or exploited by owners of vacant property who desire to have its value increased in order that they may be able to sell it to advantage. Since the funds necessary for sufficiently speedy provision of these facilities cannot all be raised by means of taxation without unduly withdrawing from productive industry the means necessary for its support, such funds must be raised by means of loans. The rate of interest for capital is relatively high because of its scarcity in a new country, and therefore the municipalities are driven to borrow abroad. Their demands have thus swollen the aggregate demands for capital which Canada has made upon the money market.

Montreal and Toronto are the twin financial centres of the Dominion. They are indeed to a certain extent rivals, since the financial groups of one city are composed of different persons from those of the other, and since the interests of the respective groups are frequently divergent. The greater number of the chartered banks have their head offices in one or other of these cities, and here also are the head offices of the trust, loan, and insurance companies, through which, and by the aid of whose credit, funds are secured in Great Britain and elsewhere for the promotion of enterprises and for farm mortgages. Montreal, being nearer the seaboard and possessing a harbour for ocean-going vessels, has a certain advantage of position over Toronto; but its population is sharply divided into two main racial groups—one, consisting of about two-thirds of the total population, being composed of French-Canadians, and the other, consisting of about one-

Montreal
and
Toronto.



fourth of the total population, being of British origin. The absence of a common language which results from this racial diversity, as well as social disparity otherwise, has seriously retarded the economic progress of the city, although Montreal has succeeded in retaining the leadership in influence and in finance with which its age has endowed it. The population of Toronto is much more homogeneous, about 86 per cent. being of British origin.

Educational
establishments.

Montreal and Toronto may be taken together as the twin educational centres of the Dominion, although there is a larger number of students attending higher educational institutions in Toronto than in Montreal. The University of Toronto is maintained by the province of Ontario, and includes within its somewhat complicated system two federated Universities, and a large number of colleges, including University College, which is maintained by the province. The funds for the maintenance of the University and University College are derived from the share of one-half of the succession duties. The other educational institutions in the province, which are separately maintained by means of public funds, are the Agricultural College at Guelph and the Mining School at Kingston (an appanage of Queen's University there), which are maintained by the province, and the Royal Military College, also at Kingston, which is maintained by the Dominion Government.

Capital
and
industry
in eastern
Canada.

The struggle between large and small capitalists, which has become very acute in the United States, and has there long passed into the political field, giving rise to legislative attempts to limit the size of industrial and financial combinations, has not assumed so grave a character in eastern Canada. The reason appears to be that industrial development in the latter region has not proceeded so far as in the former. The method of consolidating industries by means of mergers has been imitated; but the success of the imitations has not been conspicuous, and the small capitalist still holds the field to a considerable extent. This condition has been facilitated



by the banks, which have made a practice of lending to the small manufacturers upon the parts of things as they are made. This practice has enabled manufacturers with very slender capital to carry on a relatively large business; although it involves the dependence of such manufacturers upon the banks. It has nevertheless enabled people with technical skill, but practically without capital, to build up manufacturing industries when otherwise such industries could only have been started or maintained by persons having direct control of capital. While there is an undoubted tendency in certain industries towards consolidation, the census returns suggest that the small manufacturer is able to hold his own in certain branches. In the census district of South Toronto, for example, which is the most important manufacturing district in Ontario, one-half of the number of industrial establishments employ 90 per cent. of the total capital and 93 per cent. of the total number of employees, yet the fact that so many small establishments maintain themselves in the face of the competition of the larger establishments is not without significance. It is true, however, that many of these are small workshops in the ready-made clothing trade, and that the conditions of employment in some of them are by no means desirable. According to the census returns of 1911, there were in Montreal 27,948 Jews, and in Toronto 18,237.¹ A very large number of these work in small workshops belonging to Jewish firms. The great frugality of the Jews, and their willingness to work upon a very narrow margin of profit, have enabled them to compete successfully with the large factory-owners and practically to monopolize the trade in certain branches. The Jews in eastern Canada have come chiefly from the Baltic provinces of Russia and from Poland; but many have come from Galicia in Austria and from other countries in eastern Europe. They have acquired a very large amount of property, especially in Toronto, where there are many synagogues and Jewish clubs.

¹ *Census of Canada, 1911*, vol. ii, p. 372.

Seasonal occupations and unemployment.

The seasonal character of so many occupations and the practice of dispensing with the services of employees, unless these services are absolutely required, render employment precarious. The Canadian is not quite so migratory as the workmen of the United States, yet there is a great amount of migration to and from the Canadian industrial centres. Each winter there is a certain amount of unemployment on account of the seasonal character of many occupations. Farm labourers who are not employed in the winter, excepting where mixed farming or early vegetable and flower culture under glass is carried on, leave the rural districts in the late autumn and with other outdoor labourers seek employment in the industrial centres. When the winter is open, as sometimes happens, they find employment as casual workers in the building trades and in other construction works. Even when the frost comes and outdoor work becomes more difficult, various devices have been adopted to prevent total suspension of operations, unless, owing to depression, the building trades are inert. Some of those who cannot find ordinary employment in the depth of winter are employed by the street cleaning department to clear snow from the streets, although a municipal ordinance, of Toronto for example, which prevents any one from being employed by the city for less than the minimum wage of two dollars per day, somewhat hampers the distribution of relief in this manner. The object of the ordinance, however, is evaded by the employment of men in different gangs on different days, so that the total amount of relief is distributed in such a way as to apply to a relatively large number of men. A heavy snowfall is thus looked upon as a benefit. The pressure of unemployment falls, however, with special severity upon men who are not accustomed to outdoor labour, and when a winter is severe and prolonged the maintenance of these falls heavily upon the charitable organizations.

Rates of wages and cost of living.

The rates of wages in the eastern industrial centres in Canada are somewhat lower than the rates of wages in similar employments in the United States; but employ-



ment in Canada is, on the whole, less fluctuating and the cost of living is, on the whole, lower. Agreements regarding the rates of wages are common, and, on the whole, the conditions of these agreements are well kept. The increase in the cost of living which has been observable in Ontario has not been so in the same degree in the Maritime Provinces and in the province of Quebec. It may therefore be inferred that the increase is due partly to general and partly to local causes. The wide general causes need not be discussed here further than to remark that the most important among them are the increase in population, the increase in consuming power, the diversion of capital and labour from agriculture into industry, and the movements of currency and capital. The effects of these general causes upon the eastern industrial region have not been uniform, nor has the development of parallel local causes been uniform throughout the region. In general, it may be said that the influx of population into the larger towns has caused the increase in them of prices of foodstuffs and house accommodation, the supply of neither of which is rapidly responsive to the demand; but that prices of clothing and of miscellaneous commodities, including many foodstuffs, especially those of foreign production, have not advanced. In the smaller towns and in the villages the population has been stagnant or declining,¹ and thus prices have advanced in these places only in respect to those supplies which had to be introduced from the centres where prices had advanced. In the mining regions, the price of supplies advanced because of the increased local demand and the absence of a local supply.

The advance in the price of house accommodation and of factory premises, which arose during the period of industrial expansion in 1900-13, induced a sharp advance in the price of land. These advances were both checked by the rise in the rate of interest first in 1907 and again in 1913.

¹ Cf. S. A. Cudmore, 'Rural Depopulation in Ontario,' *Trans. Canadian Institute*, Toronto, 1912.



Causes of
increase
in prices
of certain
foodstuffs.

The increase of prices of certain foodstuffs was due to various causes. Beef, which had formerly been produced at a low cost upon the open prairie, gradually ceased to be so produced, as the prairie came to be occupied by settlers. The reorganization of the cattle trade could not be accomplished with sufficient rapidity to maintain the supply. There was an inadequate fund of stock, there was inadequate skill in the management of cattle under the changed conditions, and there was inadequate capital in the hands even of those who might have adapted themselves to the change.

The exclusive devotion to wheat in the north-west, together with the heavy drafts of agricultural labour from the eastern region, and the consequent inferior development of the production of miscellaneous foodstuffs, induced advances in the prices of these in the industrial centres.

Difficulty was thus experienced in adjusting the rate of wages and of salaries to the advances in rent and to the prices of certain foodstuffs at a time when the profits as such of industrial enterprise, owing to the increase in the rate of interest, were not advancing because the demands for industrial and other capital were insistent enough to raise the price of it to the organizing employer. The advance of prices of foodstuffs was aggravated by the municipal ordinances, which, passed at the instance of the retail dealers, practically prevented the peddling of vegetables and other farm products, and thus limited local competition. Competition was also limited by the inadequacy of market facilities and by the inferior state of the country roads in the neighbourhood of the towns. These conditions, combined with the depopulation of the rural districts in Ontario,¹ have contributed, along with wider and more general causes, to increase the cost of subsistence.²

¹ S. A. Cudmore, 'Rural Depopulation in Ontario,' *cit.*

² On the movement of prices in Canada, see R. H. Coats, *Wholesale Prices in Canada 1890-1909*; *Special Report*, Department of Labour, Ottawa, 1910; *Wholesale Prices, Canada, 1910*, and *ibid.*, 1911; and *Comparative Prices, Canada and the United States, 1906-11*, *ibid.*, 1911.



The demand for capital in the north-west fell in the first instance upon the eastern financial centres; the rate of interest was relatively high, owing to the scarcity of capital in proportion to the demand, and thus capital and credit were both deeply engaged in supplying the means for agricultural development. So also the prospect of high gains in mining enterprises absorbed a large part of the available funds in the eastern centres. Protection to industry offered as well the opportunity of high returns to capital. There was thus relatively little inducement for investment in house building, where the returns to capital were in general less than in the forms of investment above mentioned. Under these conditions the supply of houses lagged behind the demand. There were no companies organized for the purpose of supplying workmen's houses, and there was no considerable class of house proprietors building and renting houses for the investment of their capital. The workmen in most of the centres were thus obliged to buy or to build houses for themselves. Up till 1907, the opening up of new districts in the great arc of the circle which surrounds Toronto, for example, enabled workmen to purchase land on easy terms, and lax municipal building regulations permitted them to build small wooden houses at a trifling cost. It was possible at that time to buy a lot of land 25 feet wide and 100 feet deep for about £20, payable in instalments, and to build upon this land a house at a cost of £10 to £20, so that a workman who had saved from £15 to £20 could secure a freehold lot and a house for himself free of rent.

Housing
of the
working
popula-
tion.

Large numbers of such houses were erected round the industrial towns. As they were in the rural areas, the taxes were trifling in amount, and the facilities were proportionately slender. There were no streets, no lighting, no water-supply, and no sewerage. Gradually the areas upon which these so-called 'shack-towns' grew up were embraced within the urban districts, streets were made, and other conveniences followed. The land rose in value under the pressure of increasing demand, and in

consequence of these improvements, the taxes increased until they became practically equivalent to a rent charge. The mere increase in the amounts involved the workmen who desired to build under the new conditions in financial obligations to which they were unequal, and thus gradually the housing problem emerged as an important fact. The influx of population led to the advance of rents, although even after rents had advanced the greater ease with which higher returns could be secured otherwise, and the memory of a former period of overbuilding, tended to prevent speculation, and serious overcrowding became prevalent in several towns. A small housing company promoted on philanthropic grounds was formed in Toronto in 1913, and was able to embark upon its business under conditions favourable to its pecuniary success.¹

Hydro-
electrical
develop-
ment in
the
Eastern
Region.

The volume of the rivers in eastern Canada, and the abrupt changes in level which occur in their courses, provide abundant means for the development of hydraulic power. The exploitation of the water power of Niagara Falls began on the United States side of the frontier, and extended upon the Canadian side. The power was applied on the American side chiefly to the promotion of industrial enterprise on the spot; in Canada it has been applied chiefly to the promotion of urban transport, urban street and domestic lighting, and power for industrial enterprise at a distance, the electrical power generated at the Falls being transmitted at high tension for distances of rather over one hundred miles. The hydro-electrical works at the Falls have been established exclusively by private enterprises; but a portion of the power generated by one of these on the American side is purchased by a provincial commission in Ontario, which has installed a system of conductors by means of which the power is distributed to various places within the circuit of its operations. The work of this commission is supplemented by the work of civic commissions under which the local supply of power is organized.

¹ 'Better Housing in Canada: The Ontario Plan,' *First Ann. Rep. of the Toronto Housing Company, Ltd.*, Toronto, 1913.



Similar distribution is also effected by means of conductors installed by private enterprise. In Toronto, for example, a private company possesses a plant at the Falls for the production of power, and a system of conductors from the Falls to Toronto. This company sells the whole of its power to a subsidiary company which distributes electricity for domestic lighting and for power, and to another company by which the street railway of Toronto is operated. The public commission competes in respect to domestic lighting, and in addition undertakes the lighting of the streets, and supplies the power required by an outlying system of civic street railways.

Electrical power has been utilized, within the practicable radius, by those industries in which the amount of power required is not sufficiently great, or its consumption sufficiently continuous, to justify independent installation of prime movers. The absence of coal in Ontario and Quebec, and the comparative frequency of coal famines, through strikes in the United States or otherwise, have given great importance to the development of electricity as an alternative means of procuring power. Under normal circumstances, for purposes where the form of the motive power is a matter of indifference, and where the amount of power required is large, it appears that there is, at a distance of from ninety to one hundred miles from the source of supply of electricity, a balance of advantage in favour of the steam or the gas engine for direct utilization of mechanical power. Where, however, such prime movers are utilized for the generation of electricity intended for subsequent re-conversion into mechanical energy, the advantage is on the side of electricity produced by hydraulic means at the distance supposed from the point of utilization, but not with certainty at any materially greater distance. The question is thus one of distance, and no doubt improvements in the engineering of the extensive works necessarily required, in the details of the mechanism involved, and in the method of conveyance will increase the distance over which electricity can be transported. At the same time

Effective radius of distribution of electrical power.



Water-
supply.

a progressive increase in the price of coal would tend to bring more closely together the comparative costs at greater distances than those supposed.¹

It has already been noticed that the chief towns of the Eastern Region are situated on the banks of the St. Lawrence or its tributaries, or on the shores of the lakes which form part of the St. Lawrence system. Mere abundance of water, however, does not constitute a good water-supply. The cities of Detroit, Cleveland, and Buffalo, with numerous smaller cities and towns, pollute the waters of the St. Lawrence before they reach any of the larger Canadian urban centres. Lake Ontario acts as a settling and purifying basin, but its bays are polluted by the sewage of the towns on its shores, and these towns therefore draw their water-supply from polluted sources. There can be no doubt that the practice of pumping water from lake or river below the level of the towns will eventually be abandoned, and that the utilization of natural lakes or constructed reservoirs in higher areas conserved for the purpose will be substituted. Filtration plants, chemical correctives, and sewage treatment systems have not availed to provide a pure water-supply.²

CHAPTER VI

ECONOMIC SURVEY (*continued*)

THE CENTRAL AGRICULTURAL REGION

BY PROFESSOR JAMES MAVOR

Relation
to the
Interior
Conti-
nental
Plateau.

THIS region is nearly conterminous with the Interior Continental Plateau of the geologists. The form of the plateau is a rude triangle whose base is lat. N. 49°, and whose apex is lat. N. 62°, the triangle leaning westwards,

¹ For details of water powers, see L. G. Denis and A. V. White, *Water Powers of Canada*, Ottawa, 1911, and *Water Powers of Western Canada*, by the same authors, both issued by the Conservation Commission.

² For waterworks, see L. G. Denis, *Water Works of Canada*, Ottawa, 1913.



ONTARIO, QUEBEC, &c.—POLITICAL.

CSL





ONTARIO, QUEBEC, &c.—POLITICAL.

CSL





and the length of the base being about 800 miles. This triangular plateau consists of three steppes or prairies at different levels, the lowest steppes being in the eastern part of the region. The mean level of the westerly steppe is about 2,000 feet higher than the mean level of the easterly steppe. The rivers have for this reason a rapid course, and not infrequently they flow in deep gorges which they have cut in the soft cretaceous surface of the prairie. The land surface is varied. In the south-east it is characterized by treeless level stretches, large areas of which are covered with water when the spring freshets cause the rivers to overflow their banks. In the south-west the prairie, also unwooded, is broken by frequent ravines and coulées or depressions; in the north there are similar indentations with occasional eminences and park-like timbered lands.

From a meteorological point of view the central agricultural region may be divided into two unequal portions—(a) the eastern portion, in which there is normally a rainfall sufficient in quantity and in distribution for the successful cultivation of cereals, and (b) the western portion, in which the rainfall is normally less in quantity in comparison with the eastern portion, and is in frequent seasons deficient and unequal in distribution, this portion of the region being therefore less reliable for the cultivation of cereals. The eastern portion of the region comprises the whole of the province of Manitoba and approximately one-half of the province of Saskatchewan. The western portion comprises about one-half of the province of Saskatchewan and the province of Alberta, with the exception of the more northerly parts of both provinces.

Climatic
condi-
tions.

The question of the periodicity of rainfall and of the desiccation of the western portion of the plains cannot for a long period be determined with any precision, owing to the short time (only since 1886) during which meteorological observations have been taken. Observations and inductions in respect to analogous regions in Asia and eastern Europe suggest a complicated periodicity



involving great cycles of some centuries and inferior cycles of a few years' duration. While the destruction of forests and the cultivation of the soil undoubtedly alter the distribution of moisture on the surface and for some distance beneath the surface of the soil, there is no reason to believe that either of these incidents has any effect upon climate.¹

The region
as a
whole :
plan of
survey for
settle-
ment.

The plan of survey in the prairie provinces involved the mapping of the region into square blocks, called townships, each containing 36 square miles. Each square mile is a section, containing 640 acres ; and each section contains four homesteads, or quarter sections. Each quarter section is designated by the number of the section to which it belongs, and by the point of the compass, according to its position. A postal address in outlying regions may read : NW. quarter of Section 16, Township 40, Range 10, West of 2nd Meridian. The sections on the plan are numbered from the SE. corner of the township to the SW. corner, Nos. 1-6 ; Nos. 7-12 are to the north of the first row, No. 7 being north of No. 6, No. 18 is north of No. 7, No. 19 north of No. 18, No. 30 north of No. 19, and No. 31 north of No. 30. Throughout the region Sections 8 and 26 in each township form the land grant of the Hudson's Bay Company, and Sections 11 and 29 'are set apart as an endowment for purposes of education'.² In those areas which were under grant for purposes of selection to railway companies, each alternate section is granted to such companies and is held by them for sale, while the corresponding section is held by the government for free grants to individual settlers. The railway companies have customarily raised money upon the security of their grants by means of land-grant bonds, and the local school trustees

¹ Cf. *Report to the Board of Trade on the North-West of Canada, with special reference to Wheat Production for Export*, by James Mavor, Parliamentary Paper, C. 2628, London, 1904, and *Agricultural Development in the North-West of Canada, 1905-9*, supplementary to the foregoing, printed in extenso in *Report of the British Association, Winnipeg meeting, 1909*, London, 1910, pp. 209 seq.

² *Revised Statutes (Dominion)*, chap. 54.



have similarly raised money by means of bonds upon the security of the school lands; both kinds of bonds have been in course of redemption as funds respectively accrued from the sale of lands.

The method of granting alternate sections of land to the railway companies for the purpose of enabling them to borrow the funds necessary for the construction of the lines was adopted for three reasons. Firstly, if the grants had been in solid blocks such a plan would have endowed the railway companies with practically complete territorial control over the regions so granted; and the plan of leaving in the hands of the government an amount of land equal, or nearly equal, to that granted to the railways within the area of the land grants prevented such a condition from arising. Secondly, in the event of the value of the lands being increased by the settlement induced by the railway companies, who would naturally desire to sell their lands and so relieve themselves of interest charges upon their loans or land bonds, the government would gain either through increased inducement to homestead settlement or through the sales of land at higher prices than might otherwise be obtained. Thirdly, the railway lines would inevitably pass through the railway land grants, so that unless the government undertook the construction of lines through the separate areas remaining in its hands, settlement would be forced into the railway regions and would be retarded in the government regions.

Grant of
land
sections to
railway
com-
panies.

The method of alternate settlement, however, had grave disadvantages. It produced a very uneven distribution of the population over an extremely wide area; and it resulted in isolated settlement. Isolated settlement involved undue cost of local administration as well as other ulterior social and economic consequences. Education of widely separated families is at once difficult and costly; and, therefore, the strict application of a compulsory system of primary instruction has been practically impossible. The organization of markets has been rendered unduly difficult, and thus isolated settlement has

Results of
alternate
settle-
ment.



prevented the cultivation of miscellaneous crops, and has driven the farming population to specialist production of wheat. The weariness induced by isolation has driven an undue proportion of the population into urban centres, and has also resulted in an increase of mental disease, especially among women. The same condition has rendered the organization of medical attendance a matter of grave difficulty and great cost.

Block
grant to
C.P.R.

One instance only has occurred in which the land grant of a railway company has been converted from an alternate-section-grant into a block-grant. This is the grant of 3,000,000 acres of land in one block to the Canadian Pacific Railway Company, being the balance of their original grant of 25,000,000 acres. This area has been dealt with in this manner in order to enable the company to embark in an extensive scheme of irrigation. The area in question was not regarded as otherwise susceptible of economical exploitation. The company has already constructed an irrigation system and has been selling the land to settlers at a price which includes the cost of the water for irrigating purposes. This plan appears to have worked out successfully.

Home-
stead
settle-
ment.

The method of settlement adopted by the Canadian Government in the north-west was copied from the method in use in the western states of the United States. This method involves a free grant of land (subject only to a registration fee of \$10) to any able-bodied man who is a citizen of Canada or is British born, or who is intending to take out naturalization papers. The grant is given on the conditions that the settler resides upon the grant and that he cultivates a specified proportion of it. The settler does not receive the patent for his land until he has fulfilled the required conditions. A provision exists in the homestead law, which has occasionally been taken advantage of, whereby settlers may group their houses together in a hamlet and may cultivate the surrounding area without dwelling upon their separate lots. The area of a free grant is 160 acres, or one-fourth of a square mile. If a farmer has grown-up sons, each of



them may enter for a homestead, and if they choose and if the group of homesteads are contiguous, they may reside at the paternal homestead. It is customary for a farmer who takes a homestead to purchase on instalment terms another quarter-section of 160 acres from a railway company, or from the Hudson's Bay Company or from school land areas. The government does not customarily sell lands within the areas set apart for homestead settlement. A homestead entry may be made for less than 160 acres, but such entries are very unusual.

Undoubtedly a generous land policy is, on the whole, most advantageous for the government and for the settlers alike. It induces settlement, and draws taxpayers into the country. It offers to the settler the prospect of an increase in the value of land, as the farms in his neighbourhood are taken up and as the area of desirable land available for free settlement diminishes. The eventual distribution of the land in the fertile areas may be such that the normal area of a farm will be less than 160 acres. On the other hand, there is the risk that after the good homestead land has all been taken up, prices to new-comers will rise to such a degree that they will find themselves in the pinch of land scarcity, while, side by side with them, there are old settlers who have acquired their land for nothing and are in possession of a relatively large block of it. This distinction between 'old-livers' and 'new-comers' emerges in all communities in which such land systems obtain.

The land of the Prairie Provinces has not yet been fully surveyed in any sense. The Dominion Land Survey, which is carried out under the administration of the Department of the Interior, has been at work for many years, but its task is by no means completed. This survey, reliable as it is within the limits of its intention, undertakes to survey only lands which are to be opened for settlement. After settlement takes place, excepting in cases of dispute about boundaries, the Dominion Survey is not concerned. The homestead inspectors are entrusted with the duty of seeing that homesteaders fulfil

Need for
a scientific
agri-
culture
survey.



their obligations; but they are not required to record the character of the cultivation, the area cultivated, or the quantity of the crop, unless the conditions of home-steading are not being fulfilled. The Dominion Census Department procures, through agents appointed by it, information about the areas under cultivation and the crops in the various districts; and the provincial departments of agriculture have also their correspondents and their independent sources of information. The railway companies collect some data, and so also do the banks. The result of these various inquiries, conducted on various systems, or without system, is an annual series of estimates of a discordant character. None of the authorities mentioned trusts the others. The results of the inquiries made on behalf of the banks and of the railway companies are not published in detail, but probably, as a rule, they are more reliable than the others because administrative action of an important character must depend upon the soundness of the estimates. The results of the inquiries on behalf of the government—Dominion and provincial—are not necessarily acted upon by anyone. They are not generally accepted as indisputable.

Although an agricultural survey conducted at intervals of (say) five years, accompanied by a careful agricultural census each year, would be a costly affair, the advantage of it could not be questioned. It would involve the employment of a large number of competent agronomists to whom the task of obtaining and compiling the necessary data would be entrusted. Hitherto the collection of agricultural statistics has been wholly in the hands of amateurs, and the work has been unnecessarily duplicated by different agencies, all of them more or less unequal to the task.

Speculative forecasts of wheat production.

While loose prophecies of future wheat production are prevalent in Canada, and while they serve the temporary purposes of the politician and the land speculator, they are destitute of scientific or of practical commercial importance. Unfortunately, the statistical data which are available do not command sufficient confidence to



justify conclusions as to how far the actual production corresponds with the estimated possible productivity of the land. Although no agricultural survey has been made, the whole of the settled area and a considerable portion of the area suitable for settlement have been surveyed under the Dominion Land Survey branch. The surveys made for purposes of land measurement are to a certain extent surveys of the nature of the land from the point of view of its susceptibility to cultivation. Much of the area in question has been surveyed by the railway companies with a view to the selection of their land grants; while a large part of the region has been examined with care by competent experts employed by the various loan companies. The interests of these companies lay, of course, in placing a conservative estimate upon possible productivity; but the information collected by them, so far as available, was of great value.

In 1904 the writer invited several highly competent experts, who were thoroughly familiar with the conditions of the prairie region and were in a position to avail themselves of the sources of accurate knowledge indicated above, to form estimates of the possible area of wheat production and the possible yield of wheat from that area. These estimates were to be based upon the fullest and most detailed data of a scientific character then available and upon the assumptions that the yield per acre of the land then in cultivation would not diminish, that a population sufficient to secure the production in question would in time settle in the country with adequate agricultural capital and skill, and that all of the area suitable for the cultivation of wheat would be utilized for that cultivation, the necessity of periodical fallowing being taken into account. Two estimates based upon data of the necessary precision were forthcoming. These were formed by three gentlemen who had all been professionally engaged in surveying for one or other of the purposes above indicated; they were in possession of the necessary material, and they were all exceptionally well qualified for the task which they generously undertook.

Estimates
of area
available
for wheat
growing,
and yield.

The higher of the two estimates in question placed a limit of 22,432,000 acres as the extreme acreage which could be expected to be devoted annually to wheat cultivation in the prairie region now comprising the provinces of Manitoba, Saskatchewan, and Alberta.

The total yield from the area in question was estimated at 357,445,000 bushels per annum; but the period at which this maximum yield might be expected to be produced was not estimated. The joint authors of the lower of the two estimates, particulars of which need not be given here, calculated the average annual yield at 18.5 bushels per acre, while the author of the higher estimate, particulars of which have been given above, placed this figure at 15.9 bushels per acre.

Other contemporary estimates offered a much higher maximum yield, and one of them stated that in the year 1912 the yield would reach 350,000,000 bushels. The experience of the years since 1904 has altogether falsified the predictions of the latter forecasts, and has strongly confirmed the more cautious estimates published in the Report to the Board of Trade furnished by the writer in 1904.

The crop statistics of the Dominion and of the respective provinces, which are not at all in accord, leave much to be desired in point of accuracy and consistency; but no other statistics are available, and the Dominion statistics are probably the more reliable. Between 1901 and 1911, the population increased by 315 per cent., while production of wheat increased by 307 per cent., approximately in the same proportion. The production, however, has been subject to serious fluctuations. The close approximation of the average yield for fifteen years, 1898-1912, namely, 18.69 bushels per acre, to the higher of the two estimates of yield quoted above, 18.5 bushels per acre, is noteworthy. The yields, however, fluctuate greatly, ranging from 9.11 bushels per acre in 1900 to 25.16 bushels in 1901, a figure which has never since been reached.

*Eastern portion of the Central Agricultural Region*

The soil of the Red River Valley is in general a rich black loam somewhat similar to the Black Soil zone of South Central Russia. The richest portion of the district is the floor of the ancient Lake Agassiz, which lies south of Lake Winnipeg and extends west of the Red River Valley for about a hundred miles. Manitoba has been settled largely, although not exclusively, by farmers from Ontario, who were, to begin with, wholly unaccustomed to prairie farming, and were very slenderly supplied with agricultural capital. The richness of the soil and the ease with which it may be cultivated, however, has enabled the Manitoba farmers, as a rule, to secure large profits from the cultivation of wheat. Unfortunately, these large profits have been employed to a considerable extent in the purchase of areas of land wholly beyond the productive powers of the farmer. The economic effects of excessive purchases of land have been the rapid advance in its price, the ineffective cultivation of large portions owing to the absence of sufficient agricultural capital and to the difficulty of obtaining labour, a scarcity of land in the most fertile regions, and diminished yield per acre owing to the progressive exhaustion of the soil through improvident farming. The quality of the grain has also exhibited a tendency to deteriorate owing to the prevalence of foreign grains in the samples, due to ineffective measures to prevent the growth of weeds and to indifference in the selection of seed. Notwithstanding these drawbacks, farming profits have been high in normal years, and thus, in the absence of an elevated standard of comfort, there has been little inducement towards the improvement of agriculture. This condition has been aggravated by two causes—the low standard of education throughout the province of Manitoba, an inevitable consequence of rapid and isolated settlement,¹ and the

Soil and
agri-
culture.

¹ The principal causes of the inadequacy of education in Manitoba are shown by the Reports of the Education Department of that province to be the wide distribution of the population under the system of isolated

occupation of some of the richest lands by stagnant communities like the Mennonites, who practise a largely self-contained life and whose simple habits render them indifferent to agricultural progress.

The population of Manitoba.

From a socio-economic point of view, Manitoba society may be divided into three strata: (1) the stagnant communities of which mention has been made, the Mennonites, the French-Canadians who occupy a portion of the Red River Valley, and some other foreign groups; (2) the pushing commercial farmers, chiefly of Scotch-Ontario extraction; and (3) the urban population of Winnipeg, Brandon, and other urban centres.

(1) *The stagnant groups.* These groups are very industrious, very orderly, and very prosperous within the narrow limits of their intentions. Many of them are ignorant of the English language. The Mennonites, for instance, speak a corrupt German, and the French-Canadian the patois of Quebec. Their manners are simple, and their powers alike of production and consumption comparatively small. They are, as a rule, indifferent to education, and some of them, the Mennonites again for instance, take no part in the political or social life of the province. They are scarcely at all affected by fluctuations in the prices of produce or in the price of land. When prices are high they are not so well off, and when prices are low not so much depressed as their more active neighbours.

(2) *The pushing commercial farming groups.* These constitute, from the point of view of commercial progress, the back-bone of the country. They are shrewd bargainers, although they are rarely skilful farmers. Their manners

settlement, the difficulty of procuring competent teachers (owing to the superior attraction of occupations other than teaching and to the higher salaries paid to teachers in Saskatchewan and Alberta), the short period during which teachers will consent to continue their services (especially females, who customarily marry within three years after entering the profession), the numerous languages spoken in the isolated farm-houses (German, French, Polish, Ruthenian, Swedish, Icelandic, &c.), and, above all, to the indifference of the people to the advantages of education. Cf. *Reports of the Department of Education (Manitoba)* for 1910 and 1911, Winnipeg, 1911 and 1913, e.g. pp. 46 and 134 (1910) and 55 and 165 (1911).



are simple, and their standard of comfort is customarily so far below the level of their means that they save in order to accumulate land. The scarcity of labour has driven them into the use of machinery, while their want of knowledge of mechanics and the difficulty of procuring building timber have contributed to neglect and consequent deterioration of the agricultural implements they possess. The diversion of their savings into purchases of land and machinery, and their exclusive devotion to wheat, due partly to the scarcity of labour, and partly to the absence of facilities for marketing other crops, have prevented them from improving their cattle by the introduction of good stock. They are thus not in a position to practise mixed farming to advantage. For the rest, the Scotch-Ontario farmer in Manitoba is a keen and not over-scrupulous politician. He sends his representatives into the legislature and into the provincial Cabinet with the very definite intention that what he conceives to be his interests will be fully safeguarded and promoted.

(3) *The urban groups.* The rapid growth of the towns and the large proportion which the urban population bears to the total population have been due to a series of interacting causes. Railway construction drew large numbers into the country, many of the immigrants crossing from the United States, where they had been employed as navvies. During the winters, when out-of-door work was difficult or impossible, many of the men employed on railway construction went into the towns. As this construction was completed in the several localities the disbanded railway workers, excepting when they took up homesteads, either left the country altogether, or sought employment in the urban centres. They were obliged to adopt one or other course, because specialist wheat-farming does not offer constant employment to hired labourers. Some of them took up homesteads; but many of them were reluctant to do so, because they were more accustomed to the migratory habits of railway-construction gangs than to the settled condition of home-

Causes
of the
growth of
towns.

steads. Railway construction also drew into the country a large amount of capital, a great portion of which was necessarily expended locally in wages and supplies. The small trader followed the construction camps as the land speculator preceded them. Together they established trading centres, and as immigration flowed in the farmers brought demand and supply alike to those centres. The railway gangs and the specialist farmers are good customers of the local merchants, because the first do not, as a rule, produce anything for immediate consumption, and the second produce predominantly for the market. Indeed, in a specialist wheat-farming district, the local storekeepers must import even foodstuffs from eastern Canada, because of the impossibility of obtaining from the local farmers the supplies necessary to meet the demand. The urban centres thus experienced a growth which in a sense is abnormal, because it results from the concurrence of two conditions, one temporary and the other probably not permanent—the construction of railways and the high specialization of farming.

Under these conditions, in the urban centres and in their neighbourhood there has been great mobility of property in land. Prospects of rapid advance in price from nothing (the value of a free grant) to a considerable amount per acre in the outskirts, or per lot or per foot in the urban areas proper, induce frequent sales of the same piece. The practices of lending money on mortgage for short periods and of purchasing options on land contributed to this mobility. The violent optimism of the communities in which real expansion, as well as speculative expansion, was going on, attracted immigrants who were eager to share in the active interchange of property. This high mobility of property brought into the towns banks, loan companies, lawyers, real estate dealers, shopkeepers, and others engaged in more or less parasitic occupations. The urban communities thus tended to grow to a greater extent than the surrounding farming districts seemed to justify. Yet the relatively high profits of farming and the increasing wants of the

Land
purchase
in urban
areas.



more progressive among the farming population, together with the frequent visits and occasionally prolonged residence in the winter of farming families in the towns, contributed to the stimulation of their growth.

These conditions, however, were not uniform throughout the region. The towns grew, as might be anticipated, chiefly in the wheat areas, because there little besides wheat was produced. These areas have been settled chiefly by settlers from Ontario and from the United States. There are also in Manitoba extensive settlements of Scotch farmers who adopt the same methods of agriculture. In the foreign settlements, those of the Mennonites and Galicians for example, the communities are more self-contained. They produce most of their own food and sell only the surplus; and their household economy being more frugal than that of the others, they buy less. They are indifferent about appearances, spend little upon non-essentials, and contribute little to the support of the towns.

The rivalry of the growing towns and the anxiety of the land speculators to develop the areas which they had undertaken to exploit led to enormous expenditures for paving and other municipal services. Although the towns occupied relatively large areas, the portions actually occupied by business premises were comparatively restricted, and for this reason urban communications became important. Sometimes street railways were provided by joint-stock companies working with extra-provincial or foreign capital, and sometimes street railways, electric lighting, and other services were undertaken by the municipalities. The result of these various conditions has been the growth of a very large aggregate of municipal indebtedness. Although the solvency of most of the municipalities cannot be called in question, it is obvious that uninterrupted growth is necessary to enable them to prevent the local taxes from becoming abnormally high.

The municipal tax-system of the West has been modelled in general upon the complicated system of

Municipalities
and taxation.



Ontario; but, owing to the slenderness of industrial development, taxation has principally devolved upon land. With a view to the encouragement of building, the assessments of taxes upon land have in general been greater than those upon buildings. This practice has been adopted in deference to public opinion. The reason for it is the expectation that land will be forced upon the market, and that it will not be held for speculative purposes. There is, however, no evidence as yet that any material change in the speculative land market has taken place in consequence of this practice. It is clear that, unless the tax-rate is abnormally high, the rate of interest upon loans must be a more important factor than the tax-rate in determining the period during which land may be held by speculators. There is some reason to believe, however, that the method of assessment above described is tending to concentrate buildings upon relatively small areas, to increase the height of the buildings, and to promote congestion in the centres of the towns, even though their geographical position on wide prairie levels would suggest the possibility of their expansion in all directions. Public opinion on taxation fluctuates so much that it is impossible to predict the next step which may be taken by the western municipalities, in endeavouring to meet the obligations which they have undertaken in a period of rapid growth.

Character
of the
urban
groups.

The character of the urban communities may in some measure be surmised from the above description of their constituent elements. Mere rivalry has led to a kind of civic pride; but the population of the towns fluctuates greatly. The absence of stable employment, the seasonal character of most of the occupations, and the high degree of mobility of land render this condition inevitable. The mass of the population of many of the larger towns is migratory by habit; and even the professional people change their place of residence with some frequency. A speculator in land who has realized his holding in one place moves to another to repeat the process of purchase and sale, carrying to the new field his experience of



methods of placing land on the market to the best advantage; or he retires to the East, where the climate is more to his liking.

In the towns complete illiteracy is rare; but the educational standard is probably somewhat lower than that of provincial towns in Great Britain or on the continent of Europe. Foreign immigrants for some time after their arrival customarily receive the newspapers of their native places, and in this way retain some contact with external affairs; but the Ontario settler, even in the towns, carries his parochialism with him, and he is customarily ignorant of, as he is indifferent to, the events or the politics of any but his own locality. In the latter, however, he is thoroughly expert. The settler from the United States—whether he is a native American or a returned Canadian—is of similar type, although, as a rule, he possesses more capital, and is to an even greater extent infected with land hunger. He often purchases land to such an extent as to compromise the cultivation of it by leaving too small a margin of agricultural capital if he is a farmer, or too small a commercial capital if he engages in business in the town.

The constituent elements of Saskatchewan society are approximately the same as those of the society of Manitoba. There is, however, a larger proportion of non-British and non-Canadian elements, and there is a larger number of self-contained or semi-self-contained groups. The population of Saskatchewan.

(1) The category of stagnant or self-contained groups includes the Dukhobors, a Russian dissenting sect, a large number of whose members emigrated from the Caucasus in 1899.¹ Upwards of three-fourths of this group practise a closely self-contained communism. They purchase little from the outside, and practically nothing from the neighbouring towns. Their purchases, such as they are—tea, The Dukhobors and other communities.

¹ On the Dukhobors see Mavor, *Report*, cited above, p. 15. Unfortunately, there is no reliable recent critical study of the workings of the Dukhobor system. The only book upon their economic life of real value is *To America with the Dukhobors*, by Leopold Sulerjitsky (in Russian), Moscow, 1905.

sugar, leather, cotton and woollen cloth, iron bars, salt, and a few other commodities—are nearly all raw materials which are utilized by domestic industry. The Dukhobors do not therefore take a place as members of a commercial community, and their very virtues have made them obnoxious to their neighbours. They have also, however, rendered themselves generally unpopular by their refusal to submit to the vaccination law and to other laws passed in the interests of public health, by refusal to register their births, marriages, and deaths, and by frequent, although not invariable, refusal to send their children to school. They seem to think that it is possible to form a state within the state, suspended without organic connexion, owing its existence to the state and yet rendering nothing in return. There are smaller and less stagnant groups of Mennonites in Saskatchewan, hived off from the parent stock in Manitoba, but in general less infected than the parent stock with extreme conservatism.

Valuable and stable elements in the population as these groups may eventually become, they may take at least a generation to adapt themselves to their new social surroundings, and in doing so they may lose a large part of their traditional culture without acquiring any other worthy culture to take its place. But it is probably more in the interests of civilization that the whole community should advance together than that the social elements should remain disparate through diversity of economical ideals. In other words, it is not clear that civilization is advanced by a hard social knot, whose economical system differs radically from that of the surrounding society, but whose virtues, such as they are, are not communicable, because there is no common ground of organic economical relations.

The experience of the communist and semi-communist groups in the Canadian North-West has not demonstrated that either a greater material or a greater intellectual output may be expected from such systems than from the individualist system of current society. It may be