

**GLACIER and
MOUNT REVELSTOKE
NATIONAL PARKS**

where rivers are born



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GLACIER and MOUNT REVELSTOKE
NATIONAL PARKS

where rivers are born

David M. Baird

MISCELLANEOUS REPORT 11

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Cover—

Rushing headlong to the distant sea the Illecillewaet River passes this point near the western entrance to Mount Revelstoke National Park. The river here is right beside the Trans-Canada Highway which is just up the bank to the left.

After a number of warm days the volume of the river increases several times and the water becomes muddy, the result of melting snow from the glaciers and snowfields at the headwaters of the many streams that feed it.

How to Use this Book

Read it from the beginning. If you haven't the time immediately, look at the illustrations and turn to the map at the back to find the numbers of the stops along the route you are travelling. Then turn to the roadlog (starting on page 41) and follow each stop carefully, for you will find that the beauty of the scene is increased for the traveller who knows something of what he is looking at and how it originated.

The first part of this guidebook describes in some detail the general aspects of the geology of Glacier and Mount Revelstoke National Parks . . . where they are, how the mountains there originated, what the rocks of the region are and where they came from, and the different shapes of mountains related to the structures of the rocks composing them. This general background is followed by detailed descriptions of selected localities of special geological interest. The last part comprises a series of notes on what is to be seen at each of the viewpoints and roadside stops along the main travel routes, with an index map to show where they are.

Most of the words used in a technical sense or which have an unusual meaning are explained carefully where they are first used. But if the meaning of a word is not immediately clear look in the index, for many of the unusual ones are listed there along with all localities and subjects.

GLACIER NATIONAL PARK and adjacent MOUNT REVELSTOKE NATIONAL PARK

are in eastern British Columbia at the same latitude as Yoho and Banff National Parks farther east. Unlike Yoho and Banff however, which lie within ranges of the Rocky Mountains, Glacier and Mount Revelstoke Parks are set among the more jagged and spiky peaks of the Selkirk Mountains, with only a strip along the eastern side of Glacier Park being part of the rounded smoother slopes of the Purcell Mountains.

Typical of the texture of the Selkirk Mountains is the array of sharp ridges and peaks in this view northward from the summit of Rogers Pass in Glacier National Park.





The mountains are sculptured from an enormous thickness of rocks that formed from sediments laid down in the seas that covered this part of North America between 450 million and 1,000 million years ago, in periods of time that geologists call 'Precambrian' for the older rocks, and 'Cambrian' and 'Ordovician' for slightly younger rocks. All of the rocks in Glacier and Mount Revelstoke National Parks have been considerably altered because of tremendous pressures, elevated temperatures and mechanical breaking during vast earth movements that resulted in the mountains themselves. In some places, notably the western and southwestern parts of Glacier Park, masses of 'igneous' rock, that is rock which at one time was molten, have been pushed into the older rocks, cutting them to pieces and changing them.

Deep erosion of this complicated mass of rocks by rivers and glaciers has resulted in the array of mountain peaks which makes Glacier and Mount Revelstoke National Parks so very beautiful today. Even now, rivers and streams are busily carving their valleys deeper and changing the shapes of the mountains. On higher levels great bowl-shaped depressions called 'cirques', often with smaller lakes in their bottoms, remind us of the glaciers that covered the whole of this area in very recent geological time. In some parts of Glacier and Mount Revelstoke Parks, where extensive snowfields and active glaciers are still present, we can see the processes by which many of the older scenic features were carved. In several places streams plunge underground into systems of caves and emerge again farther down the mountainside as full-fledged, gushing mountain streams.

Thus, for the traveller who has time to look and is given the knowledge to see, Glacier and Mount Revelstoke National Parks have, in addition to lovely scenery, many features of geological interest in the rocks and in the land forms. In this book we will talk about the scenery and how it was made from the time the rocks were first formed to the present day. We will see that the beauty of the view is the result of a billion years of geological history and that the processes that made the scenery are not unlike those we can see going on around us in different parts of the world even now. Before we look into this very long history we will examine the boundaries of Glacier and Mount Revelstoke National Parks to see exactly where they are, and, because some of the boundaries are 'divides', we should first of all find out what divides are.

DIVIDES

Any stream gradually gets smaller above the tributaries that pour water into it from its sides. Thus, even the largest rivers rise in a multitude of very small streams which make up the bulk of the main river by uniting their waters. If we travel farther and farther up a small stream we will eventually come to where it begins as a tiny trickle of water. Such a place is usually near the top of a hill, for as rain falls on the hill it will naturally flow down the slopes on all sides. Thus the crest of a ridge forms a natural divide between waters that flow down one side and waters that flow down the other. This is why, on the ground or on a map, a line drawn to separate two drainage systems is called a 'divide'.

A look at a map of the whole of North America will quickly show us that some very large rivers flow into each of the

oceans bordering this continent. If we were to follow these rivers to their very headwaters we should find a line separating the drainage to the Pacific Ocean from the drainage to the Atlantic Ocean, and other lines which divide Atlantic drainage from Arctic drainage and Arctic drainage from Pacific drainage. Thus we apply the term 'continental divides' to the imaginary lines that separate the drainage of a continent.

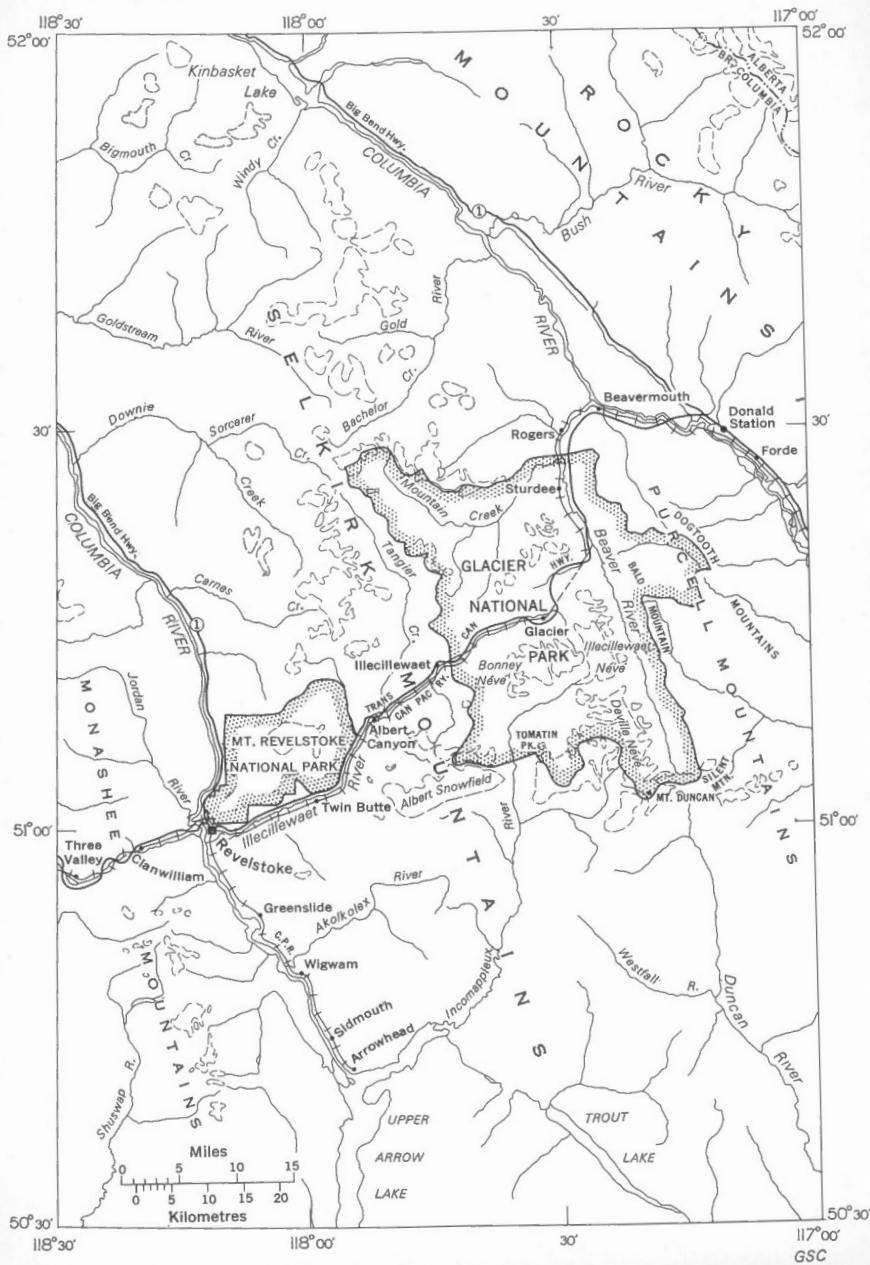
Ever since man first began to divide territories it has been convenient to do so on the basis of river drainage basins. Boundaries of countries, provinces, or even counties have commonly been defined as the divide between the water flowing to one side and water flowing to another. One such boundary is between the Province of Alberta and the Province of British Columbia. This divide, which runs right up the spine of the Rocky Mountains, separates waters that eventually end up in the rivers flowing to the Pacific Ocean from those that will flow finally into the Atlantic Ocean. This means that at any point on the part of the boundary made by the continental divide, a cup of tea spilled half on one side of the line and half on the other would eventually reach two different oceans. In fact there is one spot in North America where drainage is split among three oceans, and from this spot—in the icefields where Banff and Jasper National Parks come together—your cup of tea could be spilled into the Arctic Ocean, the Atlantic Ocean, and the Pacific Ocean.

BOUNDARIES OF THE PARKS

GLACIER NATIONAL PARK lies in eastern British Columbia with its centre near Glacier station on the Canadian



The headwaters of Mountain Creek lie in this rugged country in the northwestern corner of Glacier National Park. Sorcerer Mountain, covered with ice and snow even in mid-summer, forms a three-way divide; the water in the foreground valley goes into Mountain Creek, water over the ridge and to the left goes into Tangier River and the water over the crest and to the right of the peak flows northeastward in Bachelor Creek. Long, sharp-topped mounds of glacial debris show the position of glaciers in earlier days when they extended much farther down the valleys.



GSC

Pacific Railway at $117^{\circ}30'$ longitude and $51^{\circ}16'$ latitude. The Trans-Canada Highway enters the northeastern corner of the park by crossing a line surveyed more or less directly across the Beaver River valley. From the eastern end of this surveyed line the boundary trends irregularly southeastward along the divide between Beaver River (in the park) and various small tributaries of Columbia River to the east.

The most southerly point in the park is reached at the peak of Silent Mountain, and from there the boundary swings westward around the very headwaters of Beaver River on a low divide and up to the peak of Mount Duncan. From here it follows one of the most spectacular divides in Canada—one that separates glaciers flowing generally northward into Glacier National Park from those flowing southward and westward into the headwaters of Battle Brook and Incomappleux River. From Tomatin Peak, at the western end of this divide, a surveyed line trends directly across the valley of Incomappleux River to a high peak on the western side.

The boundary then extends northerly, again following a series of divides, to a peak overlooking the railway and highway on the floor of the valley of Illecillewaet River. Surveyed lines from this peak northward to Fidelity Mountain and northwestward from there to Corbin Peak bring the boundary to the southern end of a divide between Tangier River, outside the park to the west, and the headwaters of Mountain Creek. This divide is followed along its irregular course all the way to Sorcerer Mountain in the extreme northwestern corner of the park. Although the north-facing and northeast-facing slopes of this divide have many glaciers and snowfields, the other slopes have hardly any—a peculiarity that also applies

to the divide along the northern boundary of the park from Sorcerer Mountain eastward to Mount McNicoll. From the northeast flank of Mount McNicoll a surveyed line crosses Beaver River to where we began. In all, Glacier National Park comprises some 500 square miles, much of it consisting of superb mountain scenery.

MOUNT REVELSTOKE NATIONAL PARK lies about 10 miles west of Glacier Park. The Trans-Canada Highway follows along the northwestern bank of the Illecillewaet River from its headwaters in Glacier Park all the way to the city of Revelstoke. The southeast boundary of Mount Revelstoke National Park is the Illecillewaet River itself for about 10 miles, so the highway, somewhat straighter than the river, follows just inside the boundary for that distance. The park boundary leaves the highway at the crossing of Clachnacudainn Creek, follows up the creek for about 2 miles, and then along a series of right-angled surveyed lines across the slopes to the northwest side of Revelstoke. From the city of Revelstoke another series of surveyed lines making right-angled jogs on the map marks the park boundary all around the flanks of Mount Revelstoke itself and up the Columbia River to a point about 12 miles north of Revelstoke. From here the boundary runs along a series of dividing ridges through Mount St. Cyr to an unnamed peak about a mile northeast of it, and thence down the valley bottom of Maunder Creek to its junction with Woolsey (Silver) Creek. The boundary follows Woolsey Creek for about 5 miles to where it crosses the highway and joins the Illecillewaet River just beyond.

ORIGIN OF THE MOUNTAINS

Nearly all of Glacier and Mount Revelstoke National Parks is rugged mountainous terrain and if we want to understand the scenery we should try to find out how mountains were formed. A survey of the surface of the whole earth will show mountains of many different kinds: some stand as isolated masses on flat plains, others in groups clearly related to one another; some tower thousands of feet above their surroundings whereas others (called 'mountains' by the people who live there) may be only a few hundred feet high; some are made of jagged rocks, others have smooth rounded slopes covered with debris. The wide variety of mountains points to a wide variety of origins.

In some parts of the world great masses of liquid lava and ash pour up from the depths of the earth to accumulate around volcanic vents. These are volcanic mountains. In other places, rivers and streams have cut deeply into high plateau areas over long periods of time to leave rough, mountainous terrain. In still other parts of the world, huge wrinklings in the earth's crust are made by tremendous compressive forces, in the same way that you can wrinkle the carpet on a floor by pushing against it with your foot. These make folded mountains. Another type of mountain results in places where the earth seems to have split along enormous faults or breaks and one of the sides may be uplifted several thousands of feet. These are fault-block mountains.

When, however, we come to the great ranges of mountains—groups of clearly related mountains that extend for hundreds or even thousands of miles over the surface of the earth—

we find a much more complicated story. One of the most interesting things about the structure of the earth is that the major mountain systems all over the world seem to have the same kind of history, with at least several chapters in common. We call this type 'geosynclinal mountains' and it will help to know something about how they originate, for the mountains in the National Parks of western Canada are of this kind.

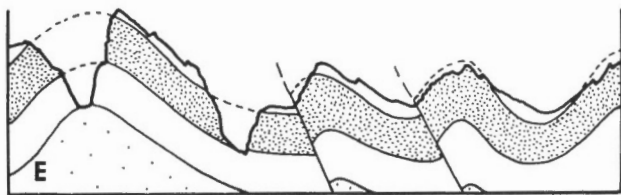
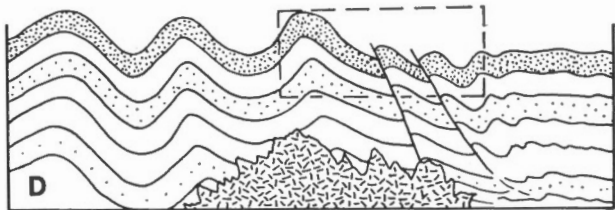
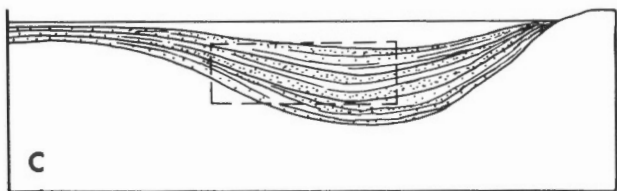
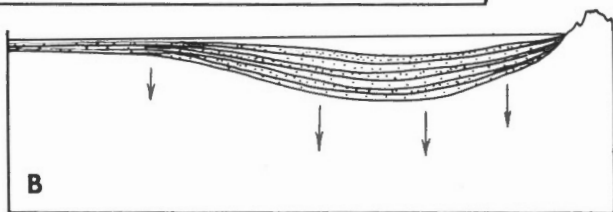
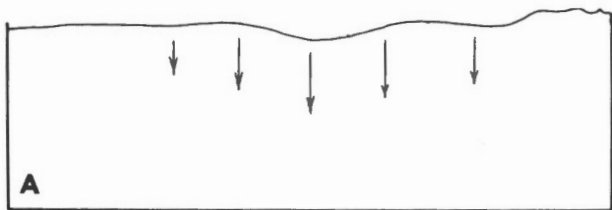
To begin the story of these mountains we must go back into geological time about 1,000 million years. North America then was very different from the land we know today. Where we now find the Rocky Mountain System from the Arctic Ocean to Mexico, there existed a great flat area which was very close to sea-level. Great forces in the interior of the earth caused the whole area to sink very slowly below sea-level. The rate of this depression was probably only a few inches in a thousand years but it continued over a long period. It meant that the sea eventually flooded the land over hundreds of thousands of square miles along the whole western margin of the continent. Into this vast shallow sea the rivers from the surrounding regions poured their loads of silt and mud, which spread evenly over the bottom. Waves along the shores of these ancient seas eroded the land, added more sediments, and made currents to distribute them over the bottom, far from shore.

As the millions of years passed, the accumulation of sedimentary materials—the mud, silt and sand from the rivers and shorelines, and limy precipitates from the sea itself—gradually filled the shallow sea. At times, vast areas must have become filled up to near sea-level. But one of the strange things about these great depressions in the earth's surface is

the way they seem to have continued to sink as the load of sedimentary material in their centres increased. By this gradual sinking and an almost equal rate of filling it was possible for thousands and thousands of feet of sand, silt and mud to accumulate, layer upon layer, and all show features of shallow-water origin.

At a time in the earth's history which geologists place at between 600 million and 500 million years ago, living things began to populate some parts of the seas fairly thickly. Some of these creatures had hard skeletons or outer coverings, and when they died these hard parts fell to the bottom and were promptly buried by the accumulating muds and silts. In some places the hard parts of the dead animals made clear impressions on the sedimentary materials on the sea bottom. When the soft sedimentary materials hardened into solid rock the remains of the long-dead organisms became fossils.

How do we know these things took place where we now find the western mountains? We read it in the rocks where the story is fairly clearly written. The rocks of which the mountains are made are distinctly of sedimentary origin—that is, they are made of ancient gravels, sands, muds and various sediments that have become hardened into solid rock. They are layered or stratified as we would expect accumulating sediments to be, because from time to time there were changes in the composition of the material being laid down. These changes may have been due to storms, changes in wave patterns, changes in drainage systems, or the changes that would take place as the land supplying the sediment was gradually being eroded away. On some of the rock



Development of geosynclinal mountains:

The spectacular peaks and valleys of the Rocky Mountains as we know them today are made of rocks which record a story that began more than 600 million years ago. At that time part of western North America began to warp downward to form an elongated trough as in A.

Rivers poured sand, silt and gravel into the lowland area. Downwarping continued until the trough was filled with a shallow sea, into which poured a steady flow of sedimentary materials, as in B.

Downsinking continued, but it seems to have been at a rate that corresponded closely to the rate of filling, so that sedimentation was always into shallow marine waters. The mass of sedimentary materials slowly changed to sedimentary rock as the load on top increased until it had a form like that in C.

For reasons we do not yet understand the trough area was then severely compressed so that the rocks in it were folded and broken. At about this time in the history of such mountains great masses of molten materials commonly appear in the cores of the folded and broken rock, eventually solidifying into granite. D is what an enlarged section of C would look like.

Uplift accompanied the folding and faulting, and as soon as the rocks emerged from the sea they were subjected to erosion. Rivers and glaciers carved the valleys and formed the peaks as shown in E, an enlarged part of D. This is the stage of development of our Rocky Mountains now.

surfaces we find ripple marks which are exactly like those found today in stream bottoms or in the shallow parts of the sea. By splitting open the rocks we can find the fossilized remains of ancient sea creatures. Some of them have modern counterparts, others are from creatures that have been extinct for millions of years; yet we can tell a great deal about them by comparing their structures with those of living creatures and noting carefully their association with creatures we know something about.

The kinds of materials the rocks are made of and all the structures found in them can be observed today in different parts of the world in the actual process of formation. We can estimate the extent of the ancient seas by looking for the rocks that were deposited in them. We can tell something of the existence of former shorelines by looking for evidence of beach deposits in the rocks. We can tell whether rocks were laid down as sediments in deep water or in shallow water by comparing what we find in the rocks with what we see being deposited in those environments now. We can conclude, by observing evidence of erosion still preserved in the rock record, that the seas withdrew temporarily from the region or that the sediments completely filled the shallow depression on the top of the continent. In short, by putting together and correlating hundreds of small pieces of scattered evidence we can unravel with some certainty the story of the rocks from which the mountains were later carved.

The next chapter in the history of the western mountains seems to have begun about 200 million years ago. The rock record tells us that a disturbance of the very shallow depres-

sion on the surface of western North America, which, as we have observed above, became filled with sedimentary materials, began to change the pattern of development. Some areas of the old trough were lifted up out of the sea and were themselves eroded to supply sediments that were poured back into the remaining sea.

As the tens of millions of years passed the crust of the earth apparently became more and more unstable in this region. From the Arctic Ocean to the Gulf of Mexico the great thickness of rocks which had been accumulating as sediments on the old sea-bottom in the previous billion years, was lifted above sea-level, broken in many places along great fractures called 'faults', and, in some places, strongly compressed. The compression or squeezing caused the great blanket of rocks to fold and buckle, and, in places, to break so that one part slid up over another part. The forces within the earth that would cause this kind of uplift and breaking are so vast that it is difficult to comprehend them at all. Yet we can go to the mountains and once again clearly see proof of these happenings, and, when they took place.

It seems certain that the folding and uplift of Canada's western mountains was an intermittent process, with the westernmost mountains being formed earlier than the ranges to the east. The Rocky Mountains along the eastern margin of the western mountain zone marked the culmination of the mountain-building period; they were pushed up about 75 million years ago. The Selkirk and Purcell Mountains in which Glacier and Mount Revelstoke Parks are situated were formed many tens of millions of years earlier.

In some mountain systems, where long-continued erosion has cut into the very cores of the mountains themselves, we can observe in some detail a third chapter in the development of geosynclinal mountains. It seems that during or just after the folding and faulting, great masses of hot molten rock appear in the cores of mountain systems. These push rocks aside or melt their way into the interiors of the belts of folded and broken sedimentary rock, where they cool down and eventually solidify. Such igneous masses occur in the Selkirk Mountains in the southwest corner of Glacier Park and they may be seen in small patches along road-cuts just west of the western boundary of Glacier Park and in Mount Revelstoke Park. Canada's Rocky Mountains have not been deeply enough eroded so we know nothing of this part of their history.

The next phase in the development of all geosynclinal mountain systems seems to be one of quiet stability, interrupted now and then by short periods of uplift. During this stage the agents of erosion—glaciers, rivers and wind—contrive to cut deeply into the uplifted complicated mass of broken and folded rocks. This has gone on now for more than half a billion years in the Selkirks.

At the present time, as we drive through the river valleys and among the mountain peaks, we can observe erosion as it proceeds. We can actually watch the glaciers pushing and scraping over the country, tearing off rock and grinding it up, some of it as fine as flour. We can see the rivers cutting into their rocky courses, wearing away the land, and carrying their loads of debris toward the ocean. We can observe great masses of gravel, sand and silt—the result of erosion of

mighty mountains through tens of thousands of years—now spread out below the foot of the mountains. Erosion has cut valleys deep into the complicated rock structures to reveal much of the story of folding, faulting and uplift.

THE ROCKS

We have already seen how most of the rocks in Glacier and Mount Revelstoke Parks were laid down as sediments in a succession of seas that covered the area in the very distant geological past. Now let's examine the rocks that resulted from the consolidation of those sediments and also find out how the masses of igneous rocks were emplaced where we now find them.

Under ordinary circumstances you would expect to find that the youngest rocks in any sequence of layered sedimentary rocks would lie on top and that the oldest ones would lie below. This is known as the 'law of superposition' and you can easily see why it would generally apply by thinking of how sedimentary rocks originate—from the accumulation of layers of sand, silt, mud and gravel on the bottom of the sea. When a road is built a layer of coarse gravel may come first, followed by fine sand, crushed stone, then coarse asphalt, and then fine asphalt on top. If you were to cut down through the road or bore a hole in it you would quickly see that the last or 'youngest' layer is the asphalt on top and that the first layer put down, the 'oldest', is the coarse gravel on the bottom.

If we could find a place in the park where a drill could penetrate the entire rock section—from the very youngest rocks on the top to the very oldest ones deep below—we

could study the whole history in one place. But because these rocks have been folded and broken along great splits or faults, this is not possible. We can attempt, however, to piece together the broken parts of the record from different areas and thus figure out almost exactly what the whole sequence of rocks looked like before it was folded and broken.

Within the rock sequence, units of various sizes with different names occur. It is the custom of geologists to give names to rock units; they are named after the place where they were first discovered and described, or after the place where they are best exposed. Where there are masses of layered rocks geologists use different names to indicate the different layers and groups of layers. An individual layer may be called a 'bed' or 'stratum'; thus we might refer to a 'limestone bed', a 'limestone layer' or a 'limestone stratum'. A group of such beds, layers, or strata that have some distinctive character in common throughout, is called a 'formation'. A still larger unit of rock layers is termed a 'group'.

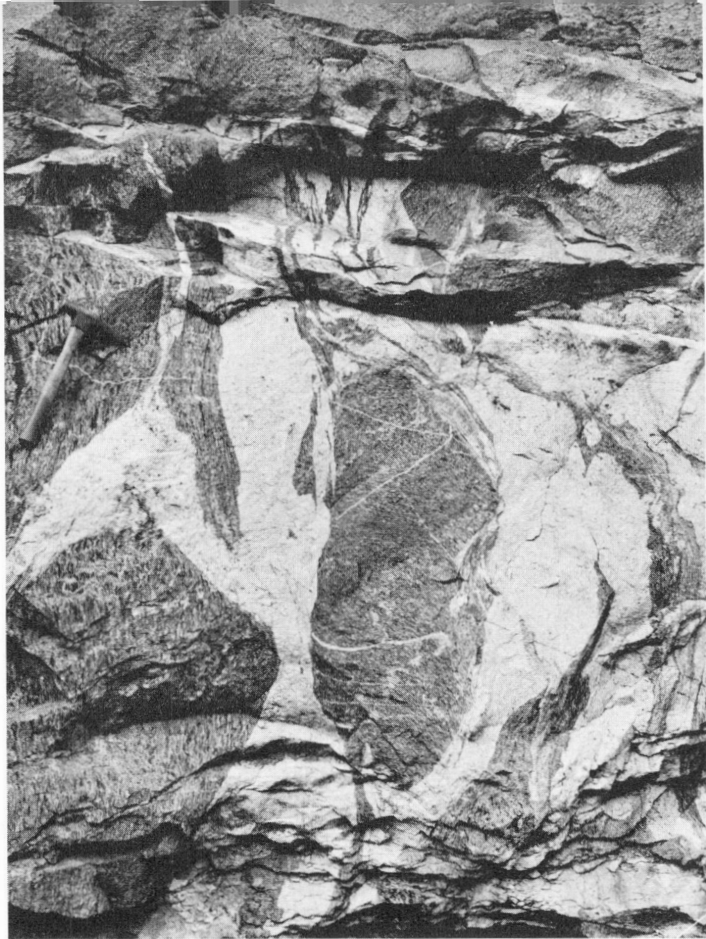
Rocks in the Selkirk and Purcell Mountains, where Glacier and Mount Revelstoke National Parks are located, have been altered from their original condition by folding, faulting and changes in their make-up and appearance—caused by intense pressures, elevated temperatures, and 'shearing' (cumulative small lateral movements resulting from pressure) which took place during the building of the mountains themselves. Thus rocks that started out as sands became recrystallized to form dense hard quartzites, and rocks that began as soft muds in the bottom of the sea turned first to shale and then to much denser and harder slate. In some of the rocks the minerals have been completely reorganized so that none of the original

material is left in its original state, and the mass may now consist of layered rocks called 'micaceous schist' and slate.

All these changes in the composition and appearance of the rocks make the unravelling of their history more difficult, much more so than where the rocks are unaltered and their regional textures and structures are still visible. Thus the rocks in Glacier and Mount Revelstoke National Parks are not as easy for the geologist to identify and subdivide into groups as the comparatively undisturbed rocks in parts of the Rocky Mountains, such as in Banff and Jasper National Parks.

Most of the rocks found in Glacier and Mount Revelstoke Parks seem to belong to two large groups. The older of these two, known as the 'Horsethief Creek Group'—named after Horsethief Creek in the Windermere area many miles to the southeast—consists of slate of various colours, dense hard quartzite, conglomerate of several kinds, thin layers of limestone, and accumulations of sharp angular material called 'breccias'. This group of rocks extends for many tens of miles along the west side of the Columbia River valley.

Rocks of the Horsethief Creek Group occupy all the mountains to the east of the Beaver River valley along the eastern border of Glacier National Park. These mountains, part of the Purcell Ranges, have generally rounded summits and many of them have a peculiar sheen because their surfaces are covered with fragments of mica schist which reflect sunlight. They are very different from the jagged peaks and very rough topography in most of the rest of Glacier Park. Other small patches of the Horsethief Creek Group are found here and there throughout the park.



Road-cuts in the western section of Glacier Park and in the area between Glacier and Mount Revelstoke Parks show spectacular displays of 'igneous intrusion'. Gneisses—the banded rocks which appear dark in this photograph—are formed when an older rock is heavily squeezed and pushed while in a semi-plastic state. These have been intruded by the light rock which was probably liquid because it was very hot at one stage of its history. As the molten rock squeezed in, fragments of the dark gneisses drifted out into it to produce the pattern shown.



Several outcrops of dark graphite-bearing slaty rocks occur along the north side of the road about a mile east of the Flat Creek Warden Station. Some of these contain abundant crystals of pyrite or fool's gold—a combination of iron and sulphur. When free to grow these crystals usually form discrete cubes, but in these outcrops most of them are elongated or flattened parallel to the slaty breaking of the rock. In this view the brassy pyrite crystals appear very light against the dark graphitic slate.

Nearly all the rest of Glacier and Mount Revelstoke National Parks is underlain by rocks of the Hamill Group, consisting mostly of pale green, pale pink, and white quartzite, here and there interspersed with zones of slate and conglomerate. The dense, hard rocks of this group form the magnificent spike of Mount Sir Donald, the tall steep-sided peaks in the Rogers Pass area, the peaks in the Mount Rogers group, the spectacular mountains in the northwest corner of Glacier Park and the sharp peaks directly south of Glacier station.

No fossils, by means of which these rocks can be dated, are found anywhere in the district. But from other considerations it appears fairly certain that the Horsethief Creek Group belongs in the vast period of time known as the 'Precambrian', when living things in this area left no traces of their passing. Rocks of the Hamill Group on the other hand are placed by some geologists in the earliest part of the 'Cambrian'—a period of time that began about 550 million years ago and saw the first rapid rise in numbers of shelled organisms. In parts of the Rocky Mountains farther to the east, rocks of this age contain numerous remains of creatures that inhabited the ancient seas of the time. If remains of such organisms were present originally in many of the rocks of the Hamill Group they would have since been obliterated because of the profound and complete changes which the rocks have undergone.

Here and there in Glacier National Park small patches of rocks belonging to the 'Lardeau Group' are found among the older rocks. These rocks are mostly grey or pale brown mica schist with patches of other schists in them that contain enough graphite to make them black or dark grey. They

occur as small patches near Deville N ev e in the southern part of Glacier Park, and along the western boundary as a strip that crosses the highway in a series of road-cuts just east of the Flat Creek Warden Station. The age of these rocks is not known but they seem to be much younger than those of the Horsethief Creek and Hamill Groups.

Rocks of an entirely different origin are found in several places in the southwestern part of Glacier National Park. Granitic rocks occur in a patch of several square miles straddling the southern boundary of the park, east of Incomappleaux River. These rocks, which pushed their way into the older rocks as enormous masses of molten or plastic material, now consist of crystals of glassy quartz, white or grey crystalline feldspar, and black shiny crystals of mica or hornblende. Small bodies of this same general kind of rock are visible along the Trans-Canada Highway in many places between the Flat Creek Warden Station and Mount Revelstoke National Park. In some places the rocks that they invaded became split and broken and drifted off into the molten matrix to form remnants in unusual patterns. Several patches of these rocks can be seen in rock-cuts along the road to the summit of Mount Revelstoke.

In early days prospectors travelled widely through the Selkirk Mountains and found here and there some evidences of mineralization that prompted them to dig pits and exploratory trenches. Some of these old workings are still visible north of the Trans-Canada Highway in the Bostock Creek area near the western boundary of Glacier Park.

THE SCULPTURING OF THE MOUNTAINS

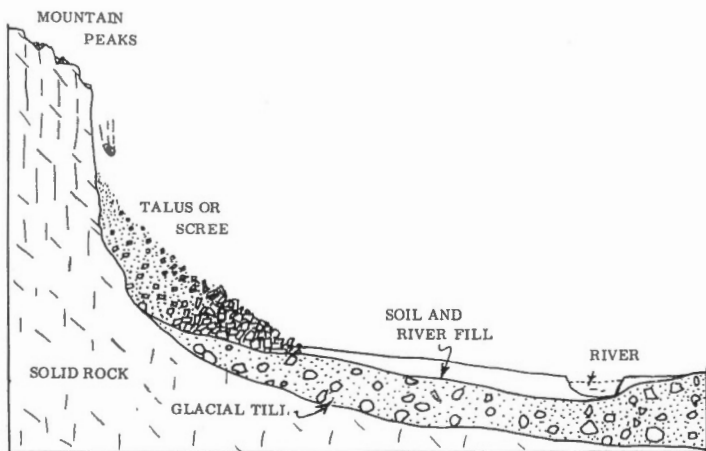
From the time the rocks were laid bare, either by the retreat of the seas in which they were laid down or by being uplifted, they have been subjected to the ever-present erosive action of rain, running water, falling snow, moving ice, frost, and chemical decay. Of all these agents of erosion, running water has been by far the most important in the carving of the mountains as we know them. For millions of years streams have carried away the debris of all the other agents of decay and erosion, and have themselves carved their valleys deep into the landscape.

The story of water erosion may begin on the highest peak. The freezing of a thin film of water under a boulder may wedge it out and tumble it over the edge of a cliff. Heavy rains may loosen rocks and boulders or may lubricate others so that they too join the downward rush. Thus, bits and pieces of rocks are torn from the solid mountains and begin their long journey to the sea.

Their first resting place may be in one of the long fan-shaped accumulations of angular blocks and pieces of rock which we can see on the sides of every steep mountain. These are called 'talus' or 'scree' slopes, and their steepness is generally the maximum angle at which the loose rubble is stable. Climbing on them may be very difficult, particularly on the lower parts which consist of very large, angular boulders and chunks of rock lying in all attitudes where they have rolled or fallen. This means that not only will the surface of the talus or scree slope be very rough and

irregular, but slight disturbances—even the passing weight of a man—may cause more sliding and adjustment of the blocks and particles in it.

Rivers may wash the bottoms of the talus slopes and carry off some of the boulders and rubble, so that angular pieces and fragments from the talus now become part of the mass of boulders, gravel and sand in the bottoms of stream valleys.



A common sequence of erosion in Rocky Mountain country begins when boulders and smaller particles of rock are wedged off the bare rocky peaks and fall to the talus or scree slopes below. Physical and chemical breakdown of the rocks in the talus produces fine-grained materials which move in the wash of rain and in streams, towards the river. A layer of glacial till made of a mixture of boulders, sand and clay commonly blankets the solid rock underneath the soil and river-fill in such valleys. In many places the glacial till is actively eroded by the river and thus contributes directly to the load of sediments on its way to the distant sea.



Deville Glacier flows northward from the Deville Névé (snowfield) in the southeastern part of Glacier National Park. You can see here how the ice falls over the cliff (near the top of the picture) and is frozen together again or 'reconstituted' to form the lower lobe of the glacier. The summer sun produces a stream of meltwater that carries with it large quantities of very finely ground-up rock flour, giving the water a milky colour.

Constant rubbing of boulders and pebbles against one another gradually wears them down and the fragments become very finely divided rock flour that looks like mud or silt in the water of the stream. Thus, over the ages, rocks in the mountains are gradually worn away by the forces of erosion and carried ultimately to the sea, where their debris rests on the bottom as mud, silt or sand.

In regions where mountains are being folded and faulted, broken and uplifted, the agents of erosion may carve a whole set of valleys and mountains at one stage of development only to have their work completely modified by further uplift, movement along fault planes, and folding of the rocks. Another cycle of erosion may reshape and completely change the outlines of the mountains and valleys of the previous cycle. Thus, after a very long period of repeated uplifts with intervening periods of erosion, great valleys were carved and the main outlines of the mountains as we know them were shaped by the action of running water.

After this general sculpturing there came a period in very recent geological times when the whole of northern North America was covered by a great ice-cap, rather like those on Antarctica and Greenland today. It is thought that this period of glaciation began about a million years ago and lasted intermittently until quite recent times, perhaps ten thousand years ago. It left its mark on the land almost everywhere we look.

Glacier erosion is of two kinds. When an area is covered by an ice-cap, more or less evenly, the movement of ice outward from the centre of accumulation of snow tends to round off

the bumps and smooth out the hollows. High in the mountains, however, the action of the glaciers is generally much more localized and accentuated. Around the margins of snowfields or icefields, tongues of ice push down the valleys, steepening them and deepening them as they go. In the areas of accumulation, great bowl-shaped depressions—called 'cirques'—are sometimes carved deep into the mountainsides. These commonly have almost vertical back walls and rounded bottoms. The cutting action caused by the movement of ice and snow toward the centres of cirques and the outlets of snowfields tends to steepen the scenery in the mountains and make it much more sharp and angular. If, for example, cirques are being cut into two opposite sides of a mountain, the two vertical back walls may happen to intersect one another, leaving a razor-sharp rock ridge. It sometimes happens that a rounded mountain-peak of considerable elevation is cut into by cirques from several sides. This process may leave semi-pyramidal towers of rock, like the world-famous Matterhorn, or Mount Assiniboine in the Canadian Rockies.

Long tongues of ice extending from snowfields down the valleys as valley glaciers commonly steepen the valley walls, pushing great piles of rock rubble and debris ahead of them. The position of maximum penetration of such alpine glaciers is commonly marked by great heaps of the debris they have left behind. Long 'finger lakes' are sometimes found in such dammed-up valleys, but in others the river was able to cut through the dam and drain the upper valley.

Farther back, where the valley walls were much steepened, a characteristic U-shape is impressed on the valley and the



The Witch Tower, a bold peak in the southeastern part of Glacier Park shows perfectly the nearly vertical walls at the head of a 'cirque' or glacially carved bowl. New snow contrasts with the darker, old crevassed ice. Cracks produced when the whole mass of ice pulls away from the back wall show in several places near the head of the glacial ice in the lower part of the photo. Such a crack or crevasse is called the 'bergschrund'.



Glaciers fill almost every depression around the great rocky spike of Mount Sir Donald, flanked on the right by Uto Peak and on the left by Terminal Peak. This view is from Bald Mountain westward across the Beaver River valley in the eastern edge of Glacier National Park.

When masses of glacial ice move down valleys, boulders and pebbles frozen in their bottoms abrade and polish the rock surfaces underneath to make them look like this one, recently exposed by the melting back of Grand Glacier in the southeast corner of Glacier Park.



bottom is covered with a blanket of glacial debris. Small streams, occupying shallow valleys on the shoulders of the main valleys, may now tumble over the edge in very high waterfalls. The high valleys that the streams run in are called 'hanging valleys'.

Thus we can see how glaciers tend to sharpen up the profiles of the mountains and the scenery. Bowl-shaped depressions with vertical walls (cirques), sharp ridges with nearly vertical sides, sharp angular mountain peaks, U-shaped and hanging valleys—all of these are characteristic of areas of upland glaciation. Nowadays in Canada's western mountains we can see a few remnants of the ice that covered much of the area in the not very distant geological past; these are the glaciers and snowfields still left on the heights and in protected places.

In the few thousands of years since the glaciers modified the shape of Canada's western mountains, rivers have resumed the carving and cutting of the great masses of uplifted rock. Now, however, their valleys are choked with glacial debris brought from higher places by the moving ice. In some places the cirques or bowl-shaped depressions carved by the glaciers are occupied by small lakes called 'tarns', and in other places the long valleys have filled with water and are now long finger lakes.

The glacial litter—the vast quantity of sand, gravel and ground-up rock—is in some places distributed and redistributed by flowing rivers over flat valley floors to make 'braided streams'. Steep rock walls and cliffs abound. In summer, when meltwaters from the glaciers and the snow-

fields make rivers high, you can see from the swirling muddy waters what an enormous load of rock debris is being carried to the sea each year from the wasting mountains.

Everywhere in Glacier and Mount Revelstoke National Parks, marks of the passing of the glaciers are visible. The mountains all through the parks are characterized by cirques and glacially steepened walls. Tall steep-walled spikes like Mount Sir Donald remind you of the Matterhorn. Masses of debris carried by the glaciers from the mountains are found in many valleys and along the fronts of steep mountains. Abandoned 'moraines' (drift or rock material left behind by passing glaciers) are common, as are erratic, ice-scarred boulders.

REGIONAL DIFFERENCES IN THE MOUNTAINS

The western mountains of Canada show a distinct zoning from east to west at many different places along their length. Undisturbed flat-lying rocks underlie the western plains from Manitoba to near the western boundary of Alberta. To the west this area is succeeded by the Foothills, a region of folded and faulted rocks which have not been greatly uplifted. Still farther west, the Front Ranges of the Rocky Mountains succeed the Foothills along a very sharply marked boundary line. The Front Ranges are made of a series of fault slices of folded and broken rocks thrust together so that they overlap like the shingles on a roof.

The region of the Front Ranges is fairly clearly separated from another zone of mountains to the west—the Main Ranges of the Rocky Mountains. Here the rocks at the surface are relatively undisturbed although very much up-



Smooth sloped peaks of the Dawson Range form the skyline here with the distant Illecillewaet Névé (snowfield) in the far left background. These mountains are very different in their general appearance from mountains in the Rockies because they are carved in different rocks and have a different history.

lifted and deeply eroded. This we can tell because they include some of the oldest rocks exposed in the Rocky Mountain System. Farther west again are the Western Ranges of the Rocky Mountain System, built along a belt of severe disturbance in which the rocks are broken, faulted and severely folded.

Westward, the Rocky Mountains proper end against a great flat-bottomed, elongate depression known as the 'Rocky Mountain Trench'. It extends hundreds of miles from the United States border northwestward to the Yukon and is occupied by various rivers along its length, including the Kootenay, Columbia, Fraser, Parsnip and Finlay. It is the Columbia River that wanders along the great valley in the latitude where the Trans-Canada Highway crosses it.

The origin of the Rocky Mountain Trench is not entirely clear, but this feature seems to be a great fault system for it separates the Rockies on the east from older mountains to the west. Glacier and Mount Revelstoke National Parks lie entirely within the older mountain ranges. A narrow strip of the Purcell Mountains extends along the eastern margin of Glacier Park and a much larger section of the Selkirk Mountains extends to and beyond its western border and through Mount Revelstoke Park. Because they form part of a different mountain group of different rocks with a different history the peaks and spurs in Glacier and Mount Revelstoke Parks look different from the mountains in the Rockies. In general they tend to be more spiky and jagged and do not include peaks cut into great piles of conspicuously 'bedded', horizontal rock layers.

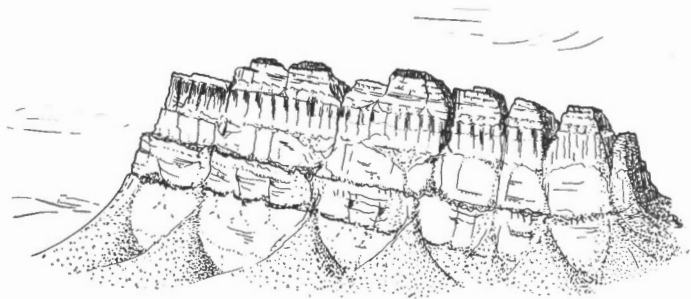
SHAPES OF MOUNTAINS

We have just mentioned that the usual peaks in Glacier and Mount Revelstoke National Parks look different from the usual peaks in the Rocky Mountains. Travellers in the mountains have long noted the distinctive shapes of individual mountains, so perhaps we had better find out what makes them different.

Shapes of mountains are due to various combinations of three things: the kinds of rocks that go to make up the mountains, the structure of the rocks in the mountains and the particular tools or agents of erosion that have carved them (in the case of the mountains of Canada's western parks, rivers and glaciers). A wide assortment of different rock types which vary in structure from flat-lying to vertical and from parallel-layered to crumpled and folded, has contributed to the many different shapes of the mountains. The hundreds of peaks and mountain masses, however, belong to only about eight kinds—the ones you see sketched and described below.

Castellate, castle, or 'layer-cake' mountains

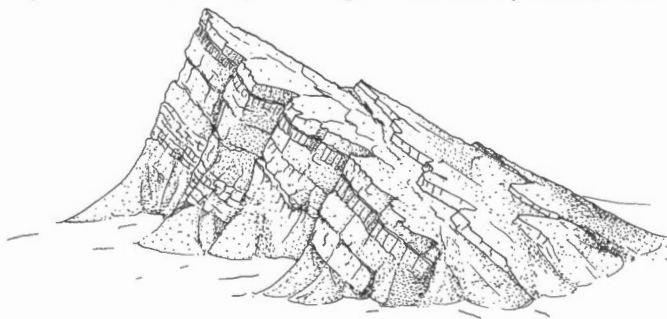
Mountains that are cut into more or less flat-lying sedimentary rocks commonly have profiles in which vertical steps alternate with flat or sloping terraces. Some such mountains look very much like ancient castles and are thus said to be 'castellate' or 'castle' mountains. Mountains of this kind are best developed in regions underlain by great thicknesses of rocks in which beds of massive limestone and sandstone or quartzite alternate with less-resistant shale or slate beds. The softer beds are eroded more rapidly, so that the harder beds



are undermined and tend to break off at right angles, forming steep slopes and cliffs. Steep-sided needles and pinnacles are sometimes left on the tops of such mountains as the uppermost massive layers are cut away. Mount Eisenhower, Pilot Mountain, the Cathedral Peaks, Mount Saskatchewan and Mount Stephen are well-known examples in the Canadian Rockies.

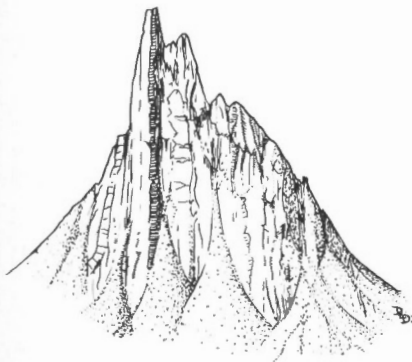
Mountains cut in dipping layered rocks

Some mountain peaks are cut into masses of layered sedimentary rocks which 'dip' or slope from nearly horizontal



to 50 or 60 degrees. Some of these, like Mount Rundle near Banff, have one smooth slope which follows the dip of a particular rock layer from its peak almost to its base, and, on the other side, a less-regular slope which breaks across the upturned edges of the layered rock units. Other mountains, like Mount Edith Cavell, are cut into dipping sedimentary rocks in such a way that neither side follows the dipping rock layers, and thus both sides are irregular.

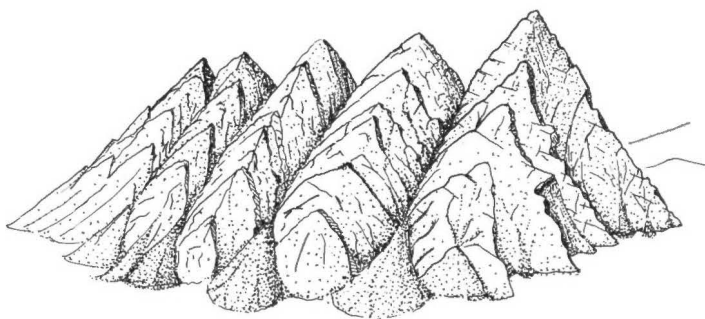
Dogtooth mountains



Sharp jagged mountains sometimes result from the erosion of masses of vertical or nearly vertical rock. The peaks may be centred on a particularly resistant bed, in which case a tall spine or rock wall may result. Some of the peaks in the Amiskwi area of Yoho Park are of this kind.

Sawtooth mountains

If the rocks in a long ridge are vertical, erosion may produce rows of angular mountains that look like the teeth in a saw. This type can be seen in the Sawback Range in Banff National Park, and in the Colin Range east of Jasper.

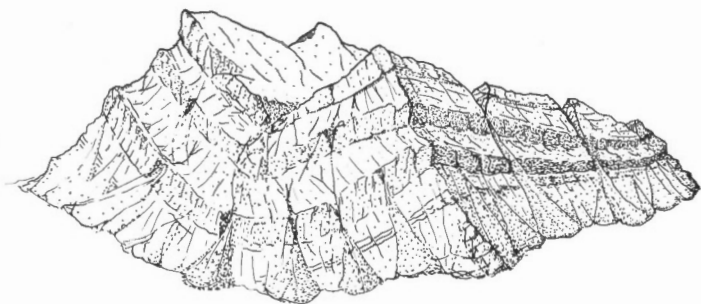


Irregular mountains

Many mountains are cut into more or less homogeneous masses of rock and, as a result, have no particularly characteristic shapes. These we may call 'irregular mountains', although individual peaks may be round, conical, pyramidal, or quite shapeless, depending on how they were cut. Ruby Ridge in Waterton Lakes Park and Mount Vermilion in Kootenay Park are examples.

Synclinal mountains

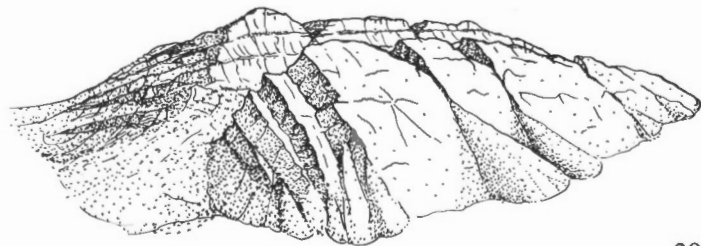
Mountains are very commonly cut by erosion into masses of rocks that have been folded into great arches and troughs. Erosion over long periods may cut away all the surrounding rocks to leave a mountain with a trough or bowl structure within it. This probably comes about because the folded rocks in the centre of the trough, which is called a 'syncline',



are more resistant to erosion than those in the surrounding parts, which tend to split and break during folding. Mount Kerkeslin in Jasper National Park is an excellent example of a synclinal mountain.

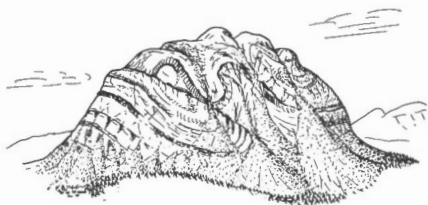
Anticlinal mountains

In some regions of folded rocks, mountains are underlain by great upbowed or arched masses of rock. Such upfolds are 'anticlines' and the mountains are called 'anticlinal mountains'. Stretching of the rocks on the outside or upper layers results in numerous fractures which in turn make the rocks very susceptible to erosion, so that true anticlinal mountains are rare. Superb anticlinal mountains are to be



seen along the west side of the valley of Rocky River in Jasper National Park.

Mountains of complex structure



Anticlines and synclines, that is upfolds and downfolds, may be seen in the flanks of some mountains that have been developed on tightly folded rocks. These we may call 'complex mountains' because of the complex structures of

the rocks within them. Magnificent examples can be seen all along the eastern edge of Jasper and Banff National Parks, and in Mount Crandell in Waterton Lakes Park.

Matterhorn mountains



When glaciers cut deeply into rocks that are more or less homogeneous they carve bowl-shaped depressions called 'cirques'. When several cirques cut into a mountain mass but are stopped by a warming of the climate and consequent melting, they sometimes leave sharp, semi-pyramidal towers

of rocks to which the general term 'matterhorn' is given. Mount Assiniboine is an outstanding example of the Canadian Rockies. Mount Sir Donald in Glacier Park is partly matterhorn in shape and origin.

ROADLOG AND POINTS OF INTEREST ALONG THE TRANS-CANADA HIGHWAY

(1) Cloverleaf at Junction of Trans-Canada Highway and Road to Summit of Mount Revelstoke

For general convenience we can use this as a starting point for a west-to-east roadlog along the Trans-Canada Highway in the parks, even though the first part is in neither Mount Revelstoke National Park nor Glacier National Park. From here, too, we can take a side trip to the summit of Mount Revelstoke itself, 6,500 feet above sea-level. This affords the only really close look we'll get at the central part of Mount Revelstoke Park as our roadlog along the Trans-Canada Highway just takes in part of the southeastern fringe.

The city of Revelstoke, British Columbia, long a railway centre on the main line of the Canadian Pacific Railway and a stopping point for river navigation, lies spread out on the river flat in an elbow of the Columbia River. Across the valley, Mount Begbie rears a double peak well up beyond the snow zone and shows patches of glacial ice. All around are the heavily wooded hills typical of the valleys of this part of British Columbia. Above Revelstoke the Columbia has little or no valley flat for many miles, running as it does in a steep-walled valley whose sloping sides extend all the way to the river itself.

The road to the top of Mount Revelstoke climbs the southwest face of the mountain in a series of switchbacks—a 16-mile drive between points that are only about 4½ miles apart in a straight line. The rocks exposed in the road-cuts consist of a variety of schists and 'gneisses' and light-coloured



The road to the summit of Mount Revelstoke climbs the southwest-facing slopes in a series of sharp switchbacks overlooking the city of Revelstoke on the river flat far below. The Columbia River, here flowing in a general southerly direction, is joined at Revelstoke by the Illecillewaet River coming in from the northeast. The mass of mountains in the background includes snow-capped Mount Begbie, 8,956 feet high.

igneous rocks to which the collective name 'granite' may be given. In some outcrops this takes the form of light-coloured pink or white 'dykes'—tabular bodies of once molten rock that has been squeezed into cracks and fissures in the consolidated rock. The dykes may be from a few inches to a few feet wide and crisscross outcrops of 'metamorphic' rocks. Closer to the top, however, the granitic rocks are much more massive and the top of Mount Revelstoke itself is mostly massive granite.

The views from the corners of the switchbacks and from the picnic area are generally to the southwest out over the wooded valley of the Columbia River and the lower Illecillewaet River. From some places the fairly steep walled valley followed by the Trans-Canada Highway to the west of Revelstoke is visible as it cuts through the mountains. South of the valley Mount McPherson, at 7,962 feet, stands high. A little south again the scenery is dominated by a mountain complex capped by Mount Begbie on which several small glaciers are visible. Directly south across the valley of the Illecillewaet River and east of the Columbia itself is Mount Mackenzie, 8,066 feet above sea-level.

The view from the top of Mount Revelstoke looks more to the west and northwest and features the tremendous valley occupied by the Columbia River north of Revelstoke. Eastward, the jagged mountains and the bare slopes of the Selkirks stretch into the distance, and from some of the trails just to the east of Heather Lodge and the summit you can look across the Illecillewaet Valley to the mountain peaks beyond.



Most people visit Canada's National Parks in summertime, but here, near the top of Mount Revelstoke, we are reminded by the 6 to 10 feet of snow that winter is a harsh but beautiful time in the mountains. Mount Mackenzie and other high mountains on the south side of the Illecillewaet River valley form the skyline in this view looking south.

Foot trails lead eastward and northeastward from the top of Mount Revelstoke and provide several beautiful walks. About 3 miles in a straight line northeast from the top of Mount Revelstoke is Mount Williamson, on whose flanks are located several very beautiful small lakes. The nearest one is Millar Lake, and a mile beyond this is Eva Lake, surely one of the gems of the western mountain country in Canada.



From the fire lookout tower on the top of Mount Revelstoke the view northward shows the Columbia River valley with a fairly well marked snow line in the high mountains on all sides. In these unusually late spring conditions in June 1962 there was still some 6 feet of snow on top of Mount Revelstoke.

Clachnacudainn Snowfield, with great tongues of glacial ice extending from its bottom into the valley of West Woolsey Creek, occupies the northeastern slopes of the Clachnacudainn Range, a little to the northeast of the centre of Mount Revelstoke National Park. This area is difficult to reach, other than from the Trans-Canada Highway up the valley of Woolsey Creek and by trails along the bottom of the valley of West Woolsey Creek. But it is an exciting place indeed, with great waterfalls, spectacular snowfields, great tongues of dark glacial ice, and all the features that make the top parts of mountains so very beautiful.



Two fingers of white 'aplite' contrast sharply with the dark speckled dioritic rock in which they occur at the head of the Clachnacudainn Snowfield in Revelstoke National Park.

For the rest, Mount Revelstoke National Park consists of mountains rising from the valley bottoms at 1,500 to 1,700 feet above sea-level to well over 8,000 feet. The uppermost parts are generally bare and rocky and the scenery tends to be very sharp and jagged as it is in most of the Selkirk

Mountains. The lower slopes, however, are rounded and covered with extensive and luxuriant forest growth; and it is interesting to note that as you travel upward from the valley bottoms the trees gradually change in shape, getting thinner and thinner in proportion to their height, apparently streamlining themselves to keep from being heavily loaded down with snow.

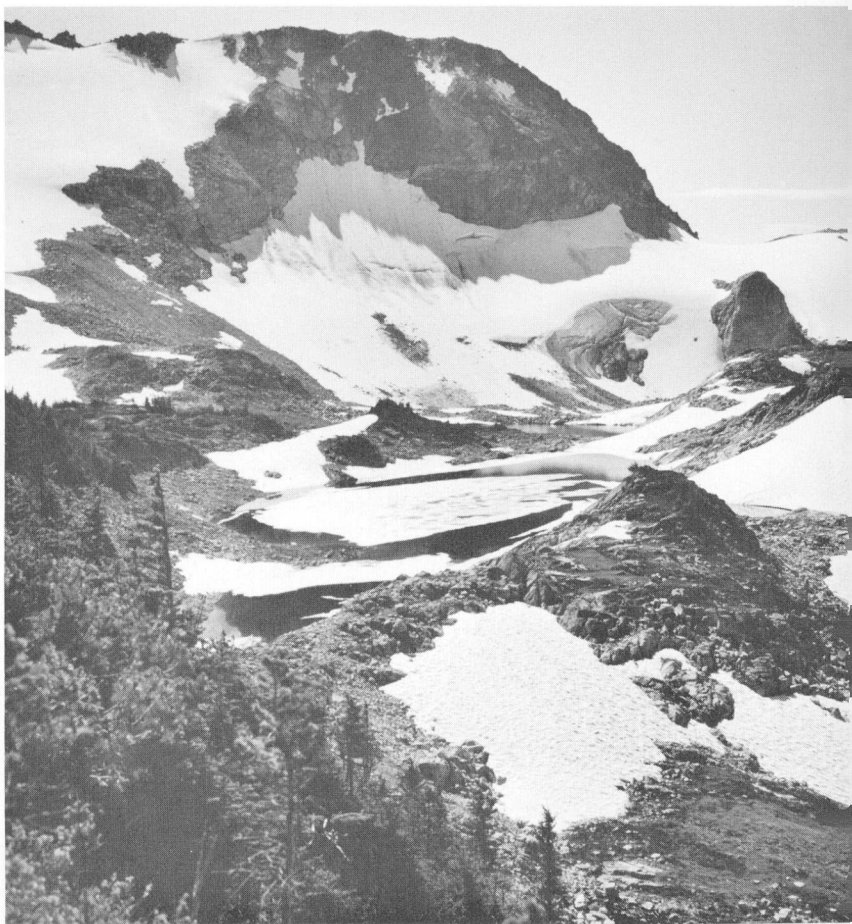
After travelling back to the road junction we head eastward along the Trans-Canada Highway, at first outside of Mount

Here and there, tucked in among the mountains, lie beautiful little lakes. This one is Eva Lake, unique because it is on top of a ridge. A few feet beyond the shore in this view, a great cliff drops hundreds of feet to the valley below.





Upper Jade Lake in Mount Revelstoke National Park lies as a turquoise gem below grey talus slopes and dazzling white snowbanks in the midst of spectacular mountain scenery.



This small lake on the southern end of the Clachnacudainn Snowfield is, even in late August, still largely covered with ice.

Revelstoke National Park and then for several miles through its very margin along the Illecillewaet River. The road then passes into an area between the Mount Revelstoke and Glacier Parks before leading through Glacier Park toward the east. Other roads extend southward and westward from Revelstoke. The 'Big Bend' Highway, long the only way to come into this area from the east, follows the 'Big Bend' of the Columbia River as it swings from one major northwest-trending valley across the mountains and into the next.

Travelling eastward on the Trans-Canada Highway from here you may note several rock-cuts along the road. Interesting features of these rock exposures are described below at Stop No. 2. You may also note off to your right and at a level slightly below the main highway a flat terrace area well above the level of the valley flat. This was probably made at a time when glaciers filled part of the valley system so that local water levels were very much higher and 'outwash' materials—sand and gravel from the glaciers—filled this space (where the terrace is now) on this side of the valley. The top level of the fill was controlled by the water level.

From road junction to Stop No. 2—2.9 miles

(2) Roadside Stop Opposite Rock-Cuts

Rock-cuts along this section of the highway expose fresh surfaces of a grey rock that shows a fine 'gneissic' banding because of the alignment of minerals and their segregation into more or less parallel layers. Cutting across this rock are numerous 'dykes' of a fine-grained, white, igneous rock which

at one time was molten and was able to squeeze up cracks and breaks before it solidified. Most of the dykes or veins are thin, of quite fine grain, and are called 'aplite'. Where the light-coloured igneous material is in thicker masses you may note that the grains tend to be coarser, in which case the veins may be called 'pegmatite'. Some of the veins are parallel to the layering in the darker rock while others distinctly cut across the structures of the rock they are in. You may notice, too, that the veins are in some places offset where they cross each other and still others show sharp bends and jogs where they have followed a crooked crack to begin with, have been partly offset when they were still in a fluid phase, or have been faulted after their emplacement.

To Stop No. 3—2.1 miles

(3) Roadside Stop on Sweeping Curve of Road

Eastward from here the mass of quartzite, schist and limestone of North Albert Peak rises high on the left, with Albert Peak just to the right across and up the valley of the Illecillewaet River. Down the valley to the southwest, snow-capped Mount Begbie rears its peak with minor related peaks to the right. Just below and all along the road here the Illecillewaet River runs swiftly toward its junction with the Columbia, carrying quantities of mud, silt and sand as its part in the ceaseless wearing away of the mountains. If you spend some time in one place on the Illecillewaet River you will note a distinct daily variation in its volume. This is because today's water is yesterday's melting snow in the snowfields and glaciers that lie at the headwaters of almost all the streams in the Illecillewaet River system. The day

Many of the rock-cuts in the first 15 miles going eastward from Revelstoke show 'granodiorite' or 'diorite' as a grey or dark rock crisscrossed by numerous dykes of lighter-coloured 'aplite' or 'pegmatite'. A geologist can study these and try to work out the sequence of events where one dyke crosses another.



These stellate or radiating patterns of fractures were made by blasting. In some a small piece of the drill-hole can still be seen at the centre.





The view directly across the valley of the Illecillewaet River from the spur below the Jade Lakes shows this spectacular skyline with deeply gullied mountain slopes leading to the river far below. This picture, taken in July 1964, shows a heavy accumulation of the previous winter's snow at about 6,000 feet above sea-level.

after an especially warm day the river rises tremendously and also changes colour as the load of sediment increases.

Here and there in its course you may note that the Illecillewaet River is split into numerous channels by islands of sand and gravel deposited by the river itself. The material in these islands began partly in the ancient glaciers that covered this area long ago and partly in very recent glaciers. At the time of the older glaciation the whole country, including the Illecillewaet River valley was filled with ice, and as it melted, great quantities of debris were washed out into the valley. This material, along with fine silts and sands being brought off the mountains by the glaciers right now and washed into the main river valley, forms the river's load, now in transit to the distant sea.

Here and there along the road are rock-cuts showing a variety of layered gneisses cut by dykes of several different kinds. Here and there, too, you can see star-shaped scars in the road-cuts. These mark the ends of drill-holes that were filled with explosive at the time the cuts were being made, and the star-shaped fractures are the direct result of the explosions themselves.

To Stop No. 4—4.7 miles

(4) Illecillewaet Lookout and Cairn

The cairn at this place is built of layered quartzites with surfaces shining with tiny mica flakes. Below, the Illecillewaet River winds along the valley flat, carrying its silt-laden waters ever westward. All around, the mountains hem in the valleys, with the mass of North Albert Peak and, to its

right, Albert Peak, dominating the view to the east. Directly opposite, a rocky 'cirque' or glacially carved bowl lies atop the forested slopes. Upstream, that is generally eastward, you can see a flat-topped terrace built of 'outwash' sands and gravels and right nearby a great wall of glacial outwash lies beyond the road, exposing a mass of bouldery sand.

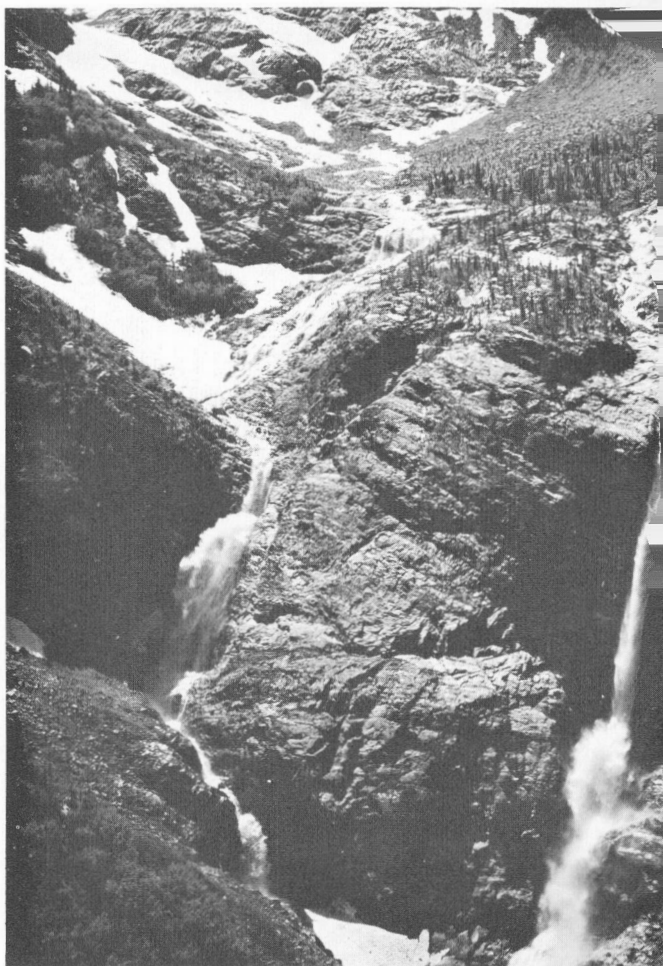
To Stop No. 5—1.0 mile

(5) Entry to Mount Revelstoke National Park

Mount Revelstoke National Park extends northwestward and northward from the Illecillewaet River. In its western section the boundary lies up the hill slopes from the river and



The meltwaters of
Clachnacudainn
Snowfield and
Glacier spill noisily
over the steep
slopes and then
plunge over these
twin waterfalls to
form the
headwaters of the
west branch of
Woolsey (Silver)
Creek. Several miles
later on these
waters flow under
the highway at the
eastern boundary
of Mount
Revelstoke
National Park.



highway. East of Clachnacudainn Creek, however, the park extends all the way down to the bank of the river, so the highway at this point actually crosses into the park. For administrative convenience this entry to Mount Revelstoke Park is used by the National Parks authorities as the western gateway to the whole section of the Trans-Canada Highway between here and the east gate of Glacier National Park.

To Stop No. 6—3.1 miles

(6) Viewpoint Opposite Long Road-Cut in Sweeping Bend of the Highway

Notable along this part of the road is a very long rock outcrop, the eastern end of which is mostly light coloured and made of highly altered rock whereas the western end is darker above and lighter below. The difference in the appearance of the rocks is, of course, from their difference in mineral composition. The rock face in many parts of the outcrop is laced with 'dykes' that crisscross one another to weave quite a complicated story when you come to try unravelling which rocks came first and why. Up the valley to the northeast is the lower spur of Mount Cotterell, while opposite, straight to the east, the wooded slopes lead upward toward the Albert Peaks. Behind them, not visible from here, are spectacular glaciers.

To Stop No. 7—3.3 miles

(7) Rock-Cuts in Black Argillite

Road-cuts here expose fresh surfaces of finely banded black 'argillite' (a rock derived from certain softer rocks, such as





The Clachnacudainn Snowfield, with the Inverness Peaks poking up at the back, gives rise to several great tongues of dark, glacial ice that push downward to where their melting equals their forward movement. Note the patterned surface of the snow in the left foreground and the pond of meltwater in the lower centre.

shale) and slate with numerous quartz veins and small patches and thin coatings of brassy pyrite or fool's gold. The pyrite weathers very rapidly to a rusty brown colour in many places. The quartz veins in many of the outcrops are parallel to the structure of the rock and give a streaky appearance to the slates and argillites which are otherwise black because of their high content of graphite. Some of the rock is so graphitic that you can easily mark your hands or a piece of paper with it.

To Stop No. 8—1.9 miles

(8) **Eastern Boundary of Mount Revelstoke National Park**
We can pause briefly here to note that for the next 11.6 miles the Trans-Canada Highway follows the valley of the Illecillewaet River in an area that lies between the two parks. The highway crosses the river twice and follows along the northwest bank through well-wooded country. You may note the occasional rock outcrops and the numerous banks of glacial debris through which the road has been cut.

To Stop No. 9—4.7 miles

(9) **Long Outcrops of Dense Black Rock**

Extensive road-cuts along this section of the highway are in dense, black, fine-grained argillite streaked with veins, lenses and sausage-shaped masses of quartz. The crossings of the Illecillewaet River mark, in this neighbourhood, a boundary between, to the east, rocks of mostly sedimentary origin—rocks that formed from materials that were once suspended in water—and, to the west, rocks of mostly igneous origin



A view straight westward from the spur east of and high above the station at Albert Canyon shows the railway and the Trans-Canada Highway far below on the river flat of the main valley. Beyond the spur at the centre of the picture is the west branch of Woolsey (Silver) Creek.

—those that have solidified from a molten state. As you look down the valley from here you can see a mass of mountains, more or less framed by the valley, that is the centre of Mount Revelstoke National Park. It comprises Mount Revelstoke on its western end, with a long high ridge leading northeastward and culminating in Mount Williamson, Mount Coursier and the Inverness Peaks. The large white patch visible during most of the summer includes part of the Clachnacudainn Snowfield on the northeastern slopes of this mass and, nearer at hand, snowfields on the eastern side of Mount Klotz and the spur that leads southward from that. All along here on the lower levels the slopes are very heavily wooded and you will see, here and there, the scars made by logging operations.

To Stop No. 10—5.2 miles

(10) Snowsheds Area

The MacDonald Snowshed is the first of a series of snowsheds you go through travelling east on the Trans-Canada Highway. All along this steep-walled valley in the Selkirk Mountains, and indeed in almost any steep mountains where there is a heavy snowfall, avalanches of snow and ice are common. In most mountain areas the avalanches take place in the same localities over and over again because snow tends to be unstable in the same places and when it begins to fall it follows the same path down the valleys. Many of these avalanche paths are crossed by the Trans-Canada Highway, but protecting the road are the reinforced concrete snowsheds you will pass through in this region and again in the steep parts of Rogers Pass in Glacier National Park.



Reinforced-concrete snowsheds like this are built into the hillside in the general vicinity of Rogers Pass and other places along the Trans-Canada Highway where avalanches are known to occur. Snowslides and avalanches rumble down the mountainsides and over the roofs of these structures, allowing the highway to be kept open.

It is interesting to note that in the design of these snowsheds the engineers are cooperating with Nature rather than trying to fight her; they mold the snowsheds into the general contours of the hills and allow the avalanches to go more or less unimpeded over the top of the road, instead of setting for themselves the almost impossible task of building a great barrier to stop the avalanches altogether. Here and there you may notice on the opposite side of the valley, particularly in the Rogers Pass section, piles of gravel and rocks that have been placed carefully in an avalanche path to help break up the flowing avalanche.

To Stop No. 11—0.6 mile

(11) Western Boundary of Glacier National Park

The Illecillewaet River flows swiftly on its way towards the Columbia many miles to the west. Eastward from here you may see the valley of Flat Creek with grey-topped, forest-fire-scarred mountains dominating the valley. All along the sides of the road and in the valley flats, masses of glacial drift are to be found along with river deposits which are largely water-washed glacial drift.

To Stop No. 12—2.4 miles

(12) Flat Creek Warden Station

The warden station lies southeast of and below the road. It was established long before the road went through the area, when the only access was by railway. Opposite, the valley of Flat Creek leads off to the southeast with Flat Creek Pass in the deep "V" at the right. Snowfields and small glaciers are visible to the left on the flank of the jagged mountain mass which leads ultimately to Slick Mountain and Mount Oliver. Eastward the jagged mountains include Cougar with the grey scar on its side. The road almost opposite the entry to the warden station leads high up the slopes of Fidelity Mountain to the avalanche study station located there. Also up this road are old mining prospects on which there was some activity about 50 years ago; the only remains now are a few tumbled-down and rotted log cabins, some bits and pieces of rusted iron and rusted dumps.

To Stop No. 13—0.5 mile



The upper end of the valley of the Illecillewaet River leads eastward to the spectacular peaks of the Sir Donald Range, dominated by the great spike of Mount Sir Donald at 10,818 feet above sea-level. This view is from the slopes of Fidelity Mountain near the western border of Glacier Park. The Trans-Canada Highway and the railway follow along the bottom of the once glacier-filled valley. Ross Peak is on the right and the slopes of Cougar Mountain are on the left.



Mountains are nowhere more beautiful than in places like this where they are covered with masses of crevassed and broken glacial ice, partly blanketed in new velvety-looking snow. Along the skyline great cornices or overhanging lips of snow show how the wind has drifted it over the top edge. Scenes like this are to be found in many parts of Glacier National Park south of the main highway.

Spectacular mountains and magnificent glaciers in all stages of development mark the southern margin of Glacier National Park. The large valley in the right foreground is occupied by the remnants of Thor Glacier with its tributary Odin Glacier to the left. On the skyline are peaks of the Purity Range which forms part of the southern boundary of the park.



(13) Road-Cuts in Dark Slates

Road-cuts in this section show fresh outcrops of pyrite-studded graphitic slate as the road swings in a wide bend. In some parts of the dark slate the pyrite occurs as fairly discrete crystals while in others it seems to be smeared along surfaces of joints. When fresh, the pyrite is a bright brassy yellow colour but it very quickly becomes coated with a layer of oxide and in a short time turns almost completely to iron rust. From this region the westernmost view of the Sir Donald Range is up the valley to the east. Showing on the skyline southwestward from here are the snow-capped peaks on the west side of Flat Creek valley, including Fortitude Mountain.

To Stop No. 14—1.6 miles

(14) Viewpoint Opposite 'Ross Peak' Sign on the Railway Eastward the jagged peaks of the Sir Donald Range dominate the skyline. If you walk to the north side of the road you will see the whole array of them—from left to right, Avalanche, Eagle, Uto and Sir Donald. Patches of glacial ice and fresher snow are clearly visible, with ridges and patches of morainal debris here and there. To the west down the valley of the Illecillewaet River the snowy peaks at the crest of Mount Revelstoke loom in the sky. The slopes northward lead to Cougar Mountain and southward to Mount Green.

To Stop No. 15—1.0 mile

(15) Viewpoint on South Side of Road

To the west Fidelity Mountain is scarred by the zig-zag road leading to the avalanche study station, which on clear days



In the high mountains of Glacier and Mount Revelstoke National Parks snow may accumulate in protected spots to depths of many tens of feet and thus stay in patches all year round. The surface of this snow is almost always patterned in peculiar concave shapes with snake-like lines going more or less down the slopes.

shows its shiny metal roofs conspicuously against the dark hillside, unless the slopes there are still covered with snow. A thousand feet or so west of this viewpoint a pile of very coarse rock rubble marks the position of what may be an ancient landslide from the adjacent peaks. To the east are the four peaks in the Sir Donald Range, with Sir Donald itself, the highest, at the right. Northward is Cougar Mountain (out of sight) and beyond that to the right or east is Cheops, with its various spurs. To the right or south we get glimpses of the snowfields up the valley leading toward Mount Green, with the woody slopes of the lower parts of Ross Peak ahead and to the right.

To Stop No. 16—1.1 miles

(16) Viewpoint

The four peaks of the Sir Donald Range loom large in the sky immediately to the east, while westward is Fidelity Mountain with the jagged mark of the road leading to the avalanche study station. Opposite this viewpoint a partial cirque with a mass of debris from snowslides is cut into the hillside. Cheops Mountain shows wooded slopes with green alpine meadows near the highest visible part to the northeast. A nearer grey peak is a limestone ridge, part of Cougar Mountain just northwestward.

To Stop No. 17—2.9 miles

(17) Viewpoint Just Beyond Eastern End of Bridge Over Bonney Creek

The four main peaks to the east include Mount Sir Donald which from here is obscured by the hillside and the trees.

The mass of Cougar Mountain with various spurs and snow and ice patches lies to the southwest along the road and above the curve. The peak on the left is a 'dip' slope of grey limestone. In the valley of Cougar Brook this limestone has been dissolved by underground waters to form the Nakimu Caves and an unusual underground drainage system. The road to the Nakimu Caves scars the snowslide areas on the mountains across the river from here.

Old piers that supported the railway in its early route up and over Rogers Pass may be seen in the woods just up Loop Brook from the bridge. They form part of a double loop in the old railway as it climbed the steep valley side here on its way to Rogers Pass just to the east. The valley of Loop Brook affords a superb view of Mount Bonney and, below its back wall, Bonney Névé (snowfield) and Glacier.

The steep slope here is an outlying spur of Ross Peak. The rock-cuts just uphill along the highway are of quartzite, that is a rock that began as a sand made up largely of grains of quartz, and later recrystallized over a long period to form dense rocks such as these. This rock is very common in the peaks of Glacier National Park and throughout this general region.

From Stop No. 17 to:

Turnoff to Glacier station—1.1 miles

Turnoff to Illecillewaet camp ground—2.0 miles

Stop No. 18—2.15 miles

(18) Roadside Stop

From this point, just to the east of the Illecillewaet camp ground turnoff on the Trans-Canada Highway, the complex



Cougar Brook here disappears abruptly as it plunges underground into one of the passages it has dissolved in the limestone. On its way to the point where it drains into Illecillewaet River, about 2 miles west of Glacier station, this brook has eaten great underground channels through the rock by leaking down cracks and openings wherever it can, eventually flowing below the surface altogether before emerging farther downstream. It does this several times in the course of a mile.



This spot is one of many near the Nakimu Caves where Cougar Brook drops out of sight to its underground course. It does so in this view just to the left of the park warden, who stands on one of the large blocks of soluble limestone.



Bonney Névé (snowfield) lies high in the mountains beyond the foreground woods and the waters of Loop Brook. The tall masonry pylon used to carry the railway when it made a loop in this area to gain height in its former route through Rogers Pass.

of Mount Rogers and adjacent peaks may be seen to the north (uphill). The dark peak to the left is Mount Sifton and the wooded slopes immediately adjacent to here lead upward to Cheops Mountain. Westward, the deep "V" of the valley of the Illecillewaet River leads off into the distance. On its left is the sharp top of Ross Peak with slabby near sides and numerous scars on its flanks marking where snow and rock slides have scoured out the trees and left fresh rock. To the left the margins of Bonney Glacier are draped over the slopes of Mount Green and the ridge leading to Mount Bonney, a little to the left out of sight.

The wooded slope above Glacier station is the end of Asulkan Ridge. A small bit of Asulkan Glacier shows in the "V" of the next valley to the left. South and southeast the valley of the Illecillewaet River shows its branching with Asulkan Brook to the south and Illecillewaet Brook to the southeast. The great scar on the rocks, marking where Illecillewaet Glacier used to extend down farther than it does now, and Glacier Crest on the skyline are spectacular from this section of the Trans-Canada Highway. Below the melting ice a spew of meltwater streams with ridges of glacier material on the sides of the scar complete the view. The rock outcropping in the road-cuts along this section is quartzite (recrystallized sandstone) with sericite-rich layers (shiny with microscopic crystals of mica).

To Stop No. 19—1.4 miles

(19) Arch at Summit

To the south the snowfields on Asulkan Ridge make a conspicuous white splash. Looking to the left, the rocky ridge of



Illecillewaet Glacier spreads from the Illecillewaet Névé (snowfield) on the skyline over an irregular rocky slope toward the valley bottom. The crevassed old ice contrasts with the patches of more recent snow left over from the previous winter. Fifty years ago the glacier extended a mile farther down the slope than it does now.



The view southeastward from the northeast spur of Cheops Mountain shows the white of Illecillewaet Névé on the skyline and Illecillewaet Glacier below it. The sharp spike at the left is Mount Sir Donald. The curve in the Trans-Canada Highway (lower centre) is just above the west portal of the Connaught Tunnel, cut in a straight line through the mountains to avoid the steep grades and dangerous snowslides of the Rogers Pass area. Part of the old railway may be seen above and to the left of the highway. The scar leading up the valley is a trail to the campsite and the site of the old Glacier station and hotel which was very fashionable about 1900.

Glacier Crest is visible and to its left again is just a little of Illecillewaet N  v   (snowfield). Below it and to the left of Glacier Crest lies Illecillewaet Glacier, almost entirely hidden from this spot. Directly east the slopes of Avalanche Mountain show abundant evidence of why it got its name. The larger and darker trees are stripped out in long lanes where snow and ice has cascaded off the upper part of the mountains and avalanched downward. In summer the avalanche paths are marked by much lighter green, low bushes, which grow quickly.

Directly opposite and to the west lies Cheops Mountain, with its sharp-pointed peak and subsidiary spurs leading in several directions. Eastward along the Trans-Canada Highway (here really due north) the great mass of mountains is climaxed by Rogers Peak high and at the back, with glaciers in the upper cirques and sharp ridges in between. The Hermit and Mount Tupper, rectangular and blocky looking, make very bold peaks in this complex to the right and from here appear to lie just over the flank of Avalanche Mountain. Grizzly Mountain completes the Mount Rogers complex well to the left.

To Stop No. 20—0.7 mile

(20) Warden's Quarters

In this tall alpine-type house the warden for this district maintains his office and living quarters. Nearby is the highway maintenance depot with workshops, equipment sheds and garages.

To Stop No. 21—0.5 mile



The Trans-Canada Highway occupies the very narrow bottom of the steep valley between Mount MacDonald to the right and Mount Tupper and The Hermit to the left. In this view from the northeast spur of Cheops Mountain the steep rugged slopes show clearly why the area is so prone to snowslides in the spring. The main line of the Canadian Pacific Railway used to go through this valley but was abandoned in favour of a tunnel underneath Mount MacDonald. The distant Purcell Mountains form the skyline through the gap made by Rogers Pass.



Standing like a great eastern pyramid among the mountains around it is Cheops Mountain, seen here from near the summit of Rogers Pass.

(21) Roadside Stop

The jagged square-set mass of The Hermit and Mount Tupper appears straight down the road to the north. The very jagged peaks of the Mount Rogers complex are cut in massive white, grey and green quartzite of the Hamill Group with their shapes being due partly to erosional history and partly to the presence of joint patterns in these massive but brittle rocks. The mountains all around here show light green paths made when the dark coniferous forests are stripped out by avalanches in the late winter and spring and their places are taken by light green, low shrubs and bushes. Cheops Mountain to the southwest is largely hidden by one of its own spurs. The valley of Connaught Creek leads off to the west.

To Stop No. 22—1.2 miles

(22) Roadside Stop

Eastward the bald-looking, light brown-grey peaks of the Purcells are visible on the skyline. This particular section of them is called the 'Prairie Hills' and is more or less continuous across the valley of Grizzly Creek with Bald Mountain to the south. Southward, a vertical cliff of Mount MacDonald grades gradually downward into the very steep lower slopes. These and the great cliffs and steep slopes in the lower part of Mount Tupper and The Hermit show why avalanches are very common in Rogers Pass and why the railroad in its

Here at the crest of Rogers Pass in Glacier National Park and surrounded by the high Selkirk Mountains a monument marks the place where the Trans-Canada Highway was officially opened in 1962.



early days had so much trouble. This route eventually became so troublesome that the railway abandoned it in favour of the Connaught Tunnel, some five miles long, right under the peak of Mount MacDonald. Here and there along the highway in this section you can see the remains of old wooden piers and bits of the right-of-way where the trains used to run on the surface when they tried to fight the elements.

Westward along the highway, Cheops Mountain is to the left of the valley of Connaught Creek with a line of high mountains along its north side.

(23) Snowsheds

Along a stretch of about a mile and a half, engineers of the Trans-Canada Highway have built very strong reinforced-concrete snowsheds into the hillsides to allow avalanches to thunder down and over the highway into the valley bottom just below. Here and there along the road, mounds of earth may be seen on the valley wall opposite, placed there to disrupt the flow of avalanche material. Sometimes avalanches in these mountains are deliberately set in motion by artillery fire so that there can be some measure of control over them. As you can well imagine this section of the Trans-Canada Highway was one of the most expensive and difficult of all to build.

Looming above the highway just east of the summit of Rogers Pass are the majestic peaks of The Hermit and the immediately adjacent Mount Tupper. Little wonder there is trouble with snowslides and avalanches with such steep bare mountains so very close to the bottom of the valley.





This masonry bridge, part of the old main line of the Canadian Pacific Railway, spans a rushing white brook near the east portal of the Connaught Tunnel. The brook is unusual in that it issues as a full-fledged stream from a cave in a thin band of limestone just above the bridge. Its source is probably much higher, perhaps in the melting snow and glacial ice on the other side of the mountain.

(24) Road to Stoney Creek Warden Station, Just Below the Easternmost Snowshed

Stoney Creek warden station was established long before the Trans-Canada Highway was built so it is located on the old Canadian Pacific Railway line. The branch road climbs steeply from this point on the highway to the old railway roadbed, abandoned when the Connaught Tunnel was put in, and follows it to the station.

An unusual phenomenon can be seen a few hundred yards above the old stone bridge, just above the top of the initial steep climb. A trail leads from the far end of the bridge up the steep slope on the left bank of the rushing brook (the right as you face it but the brook's left bank). A few hundred feet upstream from the bridge the brook emerges abruptly from a round orifice in the rock as a full-fledged stream, with the addition of surface waters only during floods or in wet seasons. The rocks here are pale grey limestone or marbled limestone of the Nakimu Formation. It seems clear that the brook originates higher up inside the mountain by the coalescing of streams of underground water, with or without the direct addition of surface streams. The Nakimu limestone is soluble so the water flows through caves and tunnels in it to emerge at last where it does as a gushing full-bodied stream that can be seen from the Trans-Canada Highway from a few hundred yards to the east of the turnoff.

To Stop No. 25—0.4 mile

(25) Viewpoint

The bald-topped wooded slopes of the Prairie Hills lie eastward across the valley of Beaver River. The eastern portal of the Connaught Tunnel is in the hollow nearby. This is where trains plunge into and through the heart of Mount MacDonald to emerge at Glacier station, thus avoiding the difficult and dangerous Rogers Pass. If you happen along just after a train has gone through you may notice clouds of pale blue smoke issuing from the orifice. The tunnel is ventilated by a huge fan at the Glacier station end. To the right a white ribbon of rushing water may be followed by the eye upward past the



The north side of Mount Rogers supports spectacular tongues of ice separated by razor-sharp ridges of rock. The freshly exposed rock surfaces all around the lower part of the ice tongue and the sharp-edged mass of glacial debris show that this glacier and the one just to the left were more extensive in the recent past than they are now.

old stone bridge to a point where it abruptly disappears from view. This is the brook described above at Stop No. 24. Westward along the Trans-Canada Highway (really south-westward) the great cliffs of Mount MacDonald form the steep south side of Rogers Pass.

To Stop No. 26—2.6 miles

(26) Viewpoint

This viewpoint on the outside of a long curve in the highway is opposite an extended series of rock-cuts in grey-green 'schist'. This rock probably began as a fine mud on the bottom of the sea over a billion years ago. After deposition the mud solidified to form a solid rock, and perhaps hundreds of millions years later was affected by the enormous pressures that make mountains. At this stage the minerals in the original rock were completely reorganized and reconstituted so that tiny crystals of mica (sericite) formed throughout the rock and some segregation into very thin layers took place. These rocks belong to the Horsethief Creek Group which occupies all of Glacier National Park to the east of the Beaver River valley and small patches in other places.

From this viewpoint the wooded Beaver River valley extends in both directions. Along it the rounded bare-topped Prairie Hills and, farther to the south, Bald Mountain, both part of the Purcell Mountain system on the east side of the valley, contrast with the very much sharper angular peaks of the Selkirks on the west side. The large gravel pit below and on the valley flat was opened up in a mass of glacial outwash as a source of gravel and sand for construction of the Trans-Canada Highway.



The view westward from the Prairie Hills is dominated by the bulk of Mount Shaughnessy (on the right skyline), with small glaciers between the sharp radiating ridges on its flanks. Across the bottom of the valley far below the Trans-Canada Highway makes a scar below the wooded slopes. Above the highway the straight line through the woods is made by the Canadian Pacific Railway. You can just see the lighter line where the old right-of-way diverges gently to the left; this was the original route leading to Rogers Pass, by-passed at a lower level through the Connaught Tunnel in 1912.

*From Stop No. 26 to:
Beaver River Crossing—1.8 miles
Stop No. 27—2.3 miles*

(27) Roadside Stop (Opposite Screened Cliffs)

Stoney Creek on the opposite side of Beaver River brings in a great flood of sand, silt and gravel, producing what is called an 'alluvial fan' that pushes out into the bottom of the main

Sorcerer Mountain rears its snow-and-ice-covered head 10,387 feet above sea-level in the extreme northwestern corner of Glacier National Park. Smooth and polished rock surfaces and irregular mounds of debris, some with very sharp edges, are indicators of the much greater earlier extent of the glaciers which are still receding from year to year.





As little as 50 years ago most of this valley was filled with ice from the waning tongue of Grand Glacier that you see here and another that came from the Deville snowfield to the right. The whole mass of ice reached nearly two miles farther down the valley. The glacier's tongue emerges from the snowfield at the back, passes over a deeply crevassed fall area and smooths out toward its front edge where the meltwater stream issues.



A nearer view of the glacier's surface displays the spectacular deep crevasses or cracks and great ice spikes or 'seracs'. The old ice contrasts with the whiteness of last winter's remaining snow, visible here in light patches in the mountains at the left, as the blanket on the upper part of the glacier, and as a patterned strip along the edge of the rock in the foreground.

river valley. The recently killed trees indicate the shifting position of the fan as the stream has changed course in times of flood. The jagged peaks opposite are climaxed by Mount Shaughnessy and are characterized by numerous beautiful glaciers, remnants of morainal material, avalanche scars which take the form of light green patches in the darker woods in the lower sections, and here and there the threads of meltwater streams. The path of the railway is visible along the hillside where the main line of the Canadian Pacific Railway gradually climbs upward to the level of the Connaught Tunnel. Rogers Pass, followed by the Trans-Canada Highway, lies in the valley just beyond and to the left, past the long wooded slope, and before the next ridge. To the left of this again one of the great peaks of the Sir Donald Range pokes up into the sky.

To Stop No. 28—2.5 miles

(28) Viewpoint

From here the long scar in the wooded hillside across the Beaver River valley is the main line of the Canadian Pacific Railway as it climbs steadily, here heading south, to the level of the Connaught Tunnel underneath Rogers Pass. It can be seen here and there as it crosses the sharp V-shaped valleys cut into the otherwise smooth slopes of Beaver Valley by fast-flowing tributaries from the mountains to the west. The tall peaks are the northeastern outliers of the Hermit Range. Mount Shaughnessy at 10,546 feet above sea-level is the first very high one. The farthest one belongs to the Sir Donald Range.

To Stop No. 29—3.1 miles

This westward view from the north shoulder of Tomatin Peak in the southwestern part of Glacier Park shows the mountains of the Purity Range beyond the rounded masses of old ice and new snow in the foreground.





The Deville Glacier spills northward from the Deville Névé (snowfield). It once filled the valley in the centre of the picture, received a tributary glacier from the valley in the foreground and then swung directly eastward toward Beaver River, into which its meltwaters pour even now. The little lake at left centre (showing just above the treed area) has been formed by the damming off of the brook in the foreground by the glacial deposits.



(29) Eastern Boundary of Glacier National Park

The park boundary comes down the ridge opposite, between the two brooks in their conspicuous valleys. From here a view to the east shows the last glimpse of the very high mountains in Hamber Provincial Park. To the southwest are the jagged partly-snow-covered peaks of the north end of the Hermit Range, with Mount Shaughnessy the highest of the near ones looming above treed slopes on the wall of the Beaver River valley.

Looking southward you can see where the treed hillside nearby intersects the line of distant high mountains. This marks the valley of Connaught Creek and the route through Rogers Pass that is followed by the Trans-Canada Highway as it crosses the high mountains. The first tall distant peak to the right belongs to the Sir Donald group. Next closest is a long ridge leading right to a horizontally lined, open "V" peak, Mount MacDonald.

Below, Beaver River wanders on the flat with islands and bends in a course that is choked with the very heavy load of material washed out from melting glaciers long ago. A large gravel pit part-way across the valley from here was opened up to provide clean washed sand and gravel for the Trans-Canada Highway.

The road-cuts in this area expose displaced and mangled rocks that began long ago as sediments at the bottom of an ancient sea. In the thousand million years or so which have elapsed since these formations of the Horsethief Creek Group were first laid down they have been completely altered by heat and pressure during mountain building processes so that they are now largely 'schists'.

For those travelling east it may be worthwhile to note that road-cuts a few miles outside the border of Glacier National Park reveal outcrops of spectacular micaceous slate. These are very unusual in their smooth even surfaces and the patterns of wrinkles on some of them. The road-cuts are scattered along a half mile or so where the highway is straight for a long distance.

EPILOGUE

As you drive or ride or walk through the valleys and mountains of Glacier and Mount Revelstoke National Parks or stand on the highest peaks and survey the landscape below, try to think back upon the many geological events—spanning a thousand million years—that made this scenery. The layered rocks found in the highest peaks and in the deepest valleys began in ancient seas as mud, silt and sand. Where cars now are parked and picnics are spread, where mountain climbers dig in their pitons and picks, where railway tunnels pierce the mountains, waves once stirred the sea bottom and passing currents once carried mud and silt.

In some places the rocks, now under ice and snow, began as great seething molten masses deep below the surface of the earth. There they cooled slowly over thousands of years to form the granite that is exposed only after millions of years of erosion has stripped off the overlying cover. In valleys where big trees grow and squirrels play, great glaciers once ground slowly over the land, gouging out the very valleys themselves and covering their floors with debris from the surrounding mountains. Beside the rivers and creeks, where men now hear the murmur of running water, the sound of brooks went unheard for tens of millions of years while the valleys were being slowly etched into the great mass of uplifted rocks, leaving only the high peaks to remind us of the enormous volume of rocks that must have been taken away.

When you stand below the glaciers in summer, with melt-water streams gushing their milky course over the barren and scraped rocks, you can see where the ice has very recently

receded because melting has overtaken the addition of snow at the heads of the glaciers. This is the result of today's slightly warmer climate. But from the history of what has gone on before we know that glaciers have receded in the past only to expand again as the cycle of climatic change swung back.

Thus we see geological processes going on all around and realize that the short little time allotted to each of us to observe these things is but a tiny chapter in a very long story of never-ending change.

For more information on the geology of Glacier or Mount Revelstoke National Park see the following publications.

A Guide to Geology for Visitors in Canada's National Parks, by D. M. Baird. Published by the National Parks Branch, Department of Northern Affairs and National Resources. Available from the Queen's Printer, Ottawa, or from any of the National Parks. This pocket-size book describes the general principles of geology with special references to the National Parks of Canada, written in layman's language (second edition 1964, 153 pages, 48 illustrations).

Rogers Pass Map-Area, British Columbia and Alberta, by J. O. Wheeler (1963). Paper 62-32 of the Geological Survey of Canada. This is a preliminary account and map of the geology of an area that includes Glacier National Park. It is written essentially for the professional geologist.

Geology of Part of the Selkirk Mountains in the Vicinity of the Main Line of the Canadian Pacific Railway, British Columbia, by V. J. Okulich (1949). Bulletin 14 of the Geological Survey of Canada. This account of the geology along the valley followed by the Canadian Pacific Railway between Albert Canyon on the west and Stoney Creek on the east is written for the geologist but contains some information of interest to the traveller.

Geology and Economic Minerals of Canada. Economic Geology Series No. 1 of the Geological Survey of Canada. This compilation of the geology of all of Canada contains a great deal of information on the western mountains. Available from the Queen's Printer, Ottawa, or from the Geological Survey of Canada, Ottawa.

Particular questions of a geological nature concerning Glacier or Mount Revelstoke National Parks should be addressed to the Director, Geological Survey of Canada, Ottawa, or to the office of the Geological Survey in Calgary or Vancouver.

For information on all other matters concerning the parks, write to the Director, National Parks Branch, Department of Northern Affairs and National Resources, Ottawa.

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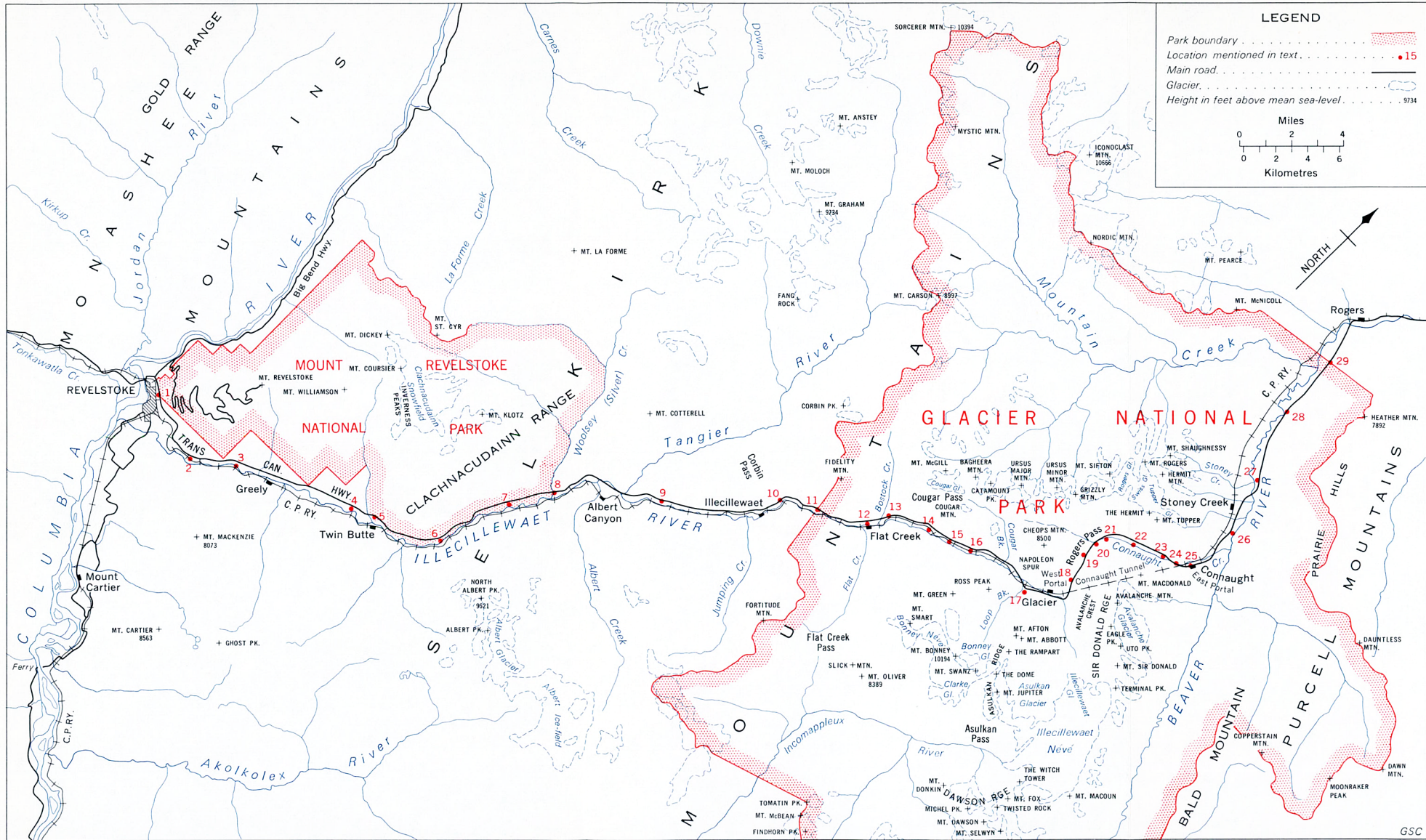
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LEGEND

- Park boundary
- Location mentioned in text 15
- Main road
- Glacier
- Height in feet above mean sea level 9134

Miles
0 2 4

Kilometres
0 2 4 6

NORTH

GSC Miscellaneous Report 11