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For the Dominion of Canada and the Province of Alberta
A. O. Wheeler, D.L.S., B.C.L.S.
For the Province of British Columbia

Report *of the* Commission Appointed *to* Delimit *the* Boundary between *the* Provinces *of* Alberta and British Columbia

Part II

1917 to 1921

From Kicking Horse Pass to Yellowhead Pass

Office of the Surveyor General
Ottawa, 1924

OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1924

BANFF, December 12, 1923.

TO THE HON. C. STEWART, M.P., MINISTER OF THE INTERIOR, OTTAWA, THE HON. ALEXANDER ROSS, M.P.P., MINISTER OF PUBLIC WORKS, EDMONTON, THE HON. T. D. PATULLO, M.P.P., MINISTER OF LANDS, VICTORIA.

Your Commissioners, R. W. Cautley, D. and A.L.S., representing the Dominion and Alberta Governments, and A. O. Wheeler, D. and B.C.L.S., representing the Government of the Province of British Columbia, have the honour to submit herewith Part II of the Report of the Commission. Part I of the Report was published in 1917. Part II covers the operations of the Commission from Kicking Horse pass to Yellowhead pass.

Accompanying Part II of the Report is an Atlas of map sheets containing Nos. 16 to 29 inclusive, and also 16A, 18A, 24A, 27A, 28A, 29A, 27B, and 29B. A general description of the construction of the map sheets will be found following Chapter VI of Part I of the Report.

R. W. CAUTLEY
ARTHUR O. WHEELER } *Commissioners.*

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CHAPTER I

SURVEYS EXECUTED IN 1917

Description of Operations

Chapter VI of Part I concludes the report of the Commission upon the survey of the boundary between the provinces of Alberta and British Columbia from the International Boundary to the main line of the Canadian Pacific Railway through Kicking Horse Pass.

In 1917, work was commenced on the second section of the survey which comprised that portion of the Boundary between the main line of the Canadian Pacific Railway and the main line of the Grand Trunk Pacific Railway through Yellowhead Pass. The methods (see Part I, chap. II), distribution of the work, and composition of the parties were similar to those of the preceding year. Mr. R. W. Cautley, representing the Dominion and Alberta Governments, was in charge of the survey of the watershed across the passes where concrete monuments were built and Mr. A. O. Wheeler, representing the British Columbia Government, was in charge of the photo-topographical survey of the watershed between the passes surveyed by Mr. Cautley and of the placing of brass bolts and cairns at points above timber-line and also at points where concrete monuments could not be built.

In March, 1917, the Surveyor General of Dominion Lands notified the Commissioners that the demarcation of the boundary was urgently needed at Yellowhead Pass, and also in the Peace River District where considerable settlement had occurred on both sides of the boundary. The Surveyor General stated that he was making arrangements for the telegraphic determination of longitude 120° on Peace River, the 120th meridian of longitude there defining the boundary between the two provinces. Subsequent correspondence made it apparent that the longitude in question could not be determined in time to permit of the Peace River survey being made during the season of 1917, and consequently it was decided to first complete the survey of Howse Pass before proceeding to survey Yellowhead Pass, and finally, if time permitted, to survey Tonquin Pass, eleven miles southeast of Yellowhead Pass.

Howse Pass summit is the first practical crossing of the continental watershed north of Kicking Horse Pass, from which it is distant some thirty miles in a northwesterly direction. The necessary information for mapping the location of the continental watershed from Kicking Horse Pass to the north limit of the Railway Belt, including the headwaters of Bow River on the Alberta side of the boundary, and of Blaeberry River on the British Columbia side, was available from maps issued by the Department of the Interior showing photo-topograph-

ical surveys of this section by Mr. A. O. Wheeler, 1903-06. Thus, there remained to be surveyed only a portion some ten or twelve miles in length between the north limit of the railway belt and Howse Pass summit. This area was surveyed southward from Howse Pass summit and consequently the season's work may be said to have begun at that place.

Mr. Cautley's division assembled at Field, B.C., and on June 20th started for Howse Pass over the Emerald Lake road and the trail branching from it, and proceeded via Amiskwi River to its source at the summit of Amiskwi Pass on the British Columbia side of the watershed, and thence down to the Blaeberry River valley, at the head of which Howse Pass summit is situated. This is the shortest available route from railway communication, the distance being 45 miles, made up as follows: from Field to Amiskwi Pass, 29 miles; from Amiskwi Pass to Blaeberry River, 6 miles; and 10 miles up the river to Howse Pass summit.

On June 21st progress was arrested by deep snow about a mile before the summit of Amiskwi Pass was reached, and it was necessary to send the horses back for feed and to spend two days cutting and shovelling three miles of trail across the pass. On June 25th the party reached Blaeberry River and, following it, arrived at Howse Pass summit on June 26th.

The only really difficult part of the trail is that from the summit of Amiskwi Pass to Blaeberry River. The valley of the tributary of Blaeberry River which heads in Amiskwi Pass is too steep and rough for travel, and the trail leaves the pass about one and a half miles north of the actual summit and for about 600 feet ascends the steep side of the mountain to the east of the pass. It continues around the side of the mountain just below timber-line, and after crossing many ravines, in about two miles, descends at least 2500 feet to a tributary of the Blaeberry, which it crosses and follows to the river flats. The long unbroken climb is a great strain on pack-horses.

There are two other routes to Howse Pass from points on the Canadian Pacific Railway. The first is from Lake Louise station via Bow River, Bow Pass, Mistaya River and Howse River, and was the one used by Mr. Cautley in October, 1916 (see Part I, chap. vi, p. 124); the distance is approximately seventy miles. The second route is from Moberly station and follows Blaeberry River for nearly the whole distance. It is over one of the oldest trails in the region, discovered and used by David Thompson at the beginning of the last century in the days when men sought the shortest route between navigable rivers.

Work was completed by Mr. Cautley at Howse Pass on July 27th, and the following day his party left this point en route to Yellowhead Pass, via Howse River to the ford below the junction with North Saskatchewan River, thence across the ford and up the North Saskatchewan to its headwaters near Wilcox Pass, thence over Wilcox Pass to the valley of Sunwapta River and down the Sunwapta and Athabaska Rivers to Jasper on the Canadian National Railways and thence up the Miette River valley to Yellowhead Pass. Mr. Cautley thus describes the route travelled:

The first part of the trail from Howse Pass summit to Yellowhead Pass summit follows the lower portion of Conway Creek, which flows from Conway Glacier for four miles to its confluence with Howse River. Along these streams are gravel flats averaging a quarter of a mile in width, and travellers follow the flats, crossing the numerous river channels that intersect them. Six and a half miles from Howse Pass, Howse River flows through a rock cañon, and for three-quarters of a mile it is necessary to take to the right bank of the river. At twelve and a half miles the river, which flows in a northerly direction up to this point, makes a sharp bend to the east around a bold rock outpost of Mt. Sarbach. At fourteen miles, opposite a small conical island in the midst of the river flats, the trail leaves the flats and following grassy ridges for three miles, arrives at the junction of the Howse and North Saskatchewan Rivers. On July 30th there was no difficulty in fording the river just below this junction, and the water did not reach any of the packs. At the junction, the North Saskatchewan seems to carry more water than does Howse River.

For the first fourteen miles up the North Saskatchewan there is a trail along the left bank. At one mile up, or eighteen miles from Howse Pass summit, the river passes through a rock cañon and there are falls which would effectually block navigation, even for small boats. These falls furnish magnificent water-power.

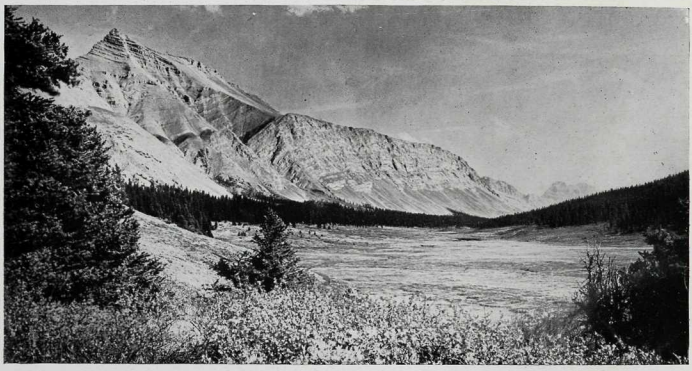
At thirty-one miles the trail again takes to the river flats and one mile farther on, Alexandra River is passed. This river appears to have greater volume than the continuation of the North Saskatchewan. At thirty-four miles the river cuts through a rocky barrier which stretches right across the valley, and the trail follows the right bank for about three-quarters of a mile, when it emerges on the river flats which it follows for one and a half miles.

At this point, which is distant from Howse Pass approximately thirty-six miles, there is another barrier across the valley, and the trail again leaves the river-bed on the right bank for two miles and three quarters and then rejoins the river flats. At about thirty-eight and a half miles the river plunges through a narrow rock cañon over falls thirty feet high. Five and a half miles farther on it forks. The west branch, which carries eighty per cent of the water, flows from an immense glacier four or five miles distant; the east branch flows from the summit over which the trail passes. Ten or fifteen chains before reaching this fork the trail leaves the river and for one thousand feet ascends a steep hill through heavy timber. It then continues around the mountain sides until at forty-seven miles it reaches the river again. At this point there is a good camping ground and excellent horse feed.

At forty-six miles a curious and beautiful cascade, which Mrs. Chas. Schäffer has named Panther Falls, leaps out from the face of a rock bluff on the west side of the river. At forty-eight miles the river, which is now no more than a creek in size, again forks and there is a pack-trail up each branch. Following the trail for four and a half miles up the west branch, through open timber over high, park-like benches, the summit between North Saskatchewan and

Sunwapta Rivers is reached. This summit is a grassy meadow, a quarter of a mile in width, extending for more than a mile to the north of the actual summit. Since timber-line is not more than four hundred feet above it, the summit probably has an altitude of 7300 feet. From the summit a great glacier may be seen about two miles away flowing from the west into the Sunwapta Valley, the toe of the glacier being several hundred feet lower than the summit.

At mile fifty-three, or half a mile beyond the summit, the trail leaves the valley at a well-marked camping ground and ascends five hundred feet to a wide expanse of alplands entirely above timber-line on the easterly side of Wilcox Mountain. From this elevation a wonderful view is obtained of the great glacier, to which reference has been made above, an unbroken mass of ice extending back to skyline. After crossing about four miles of high, rolling alplands, the trail falls steeply to Tangle Creek. Three-quarters of a mile



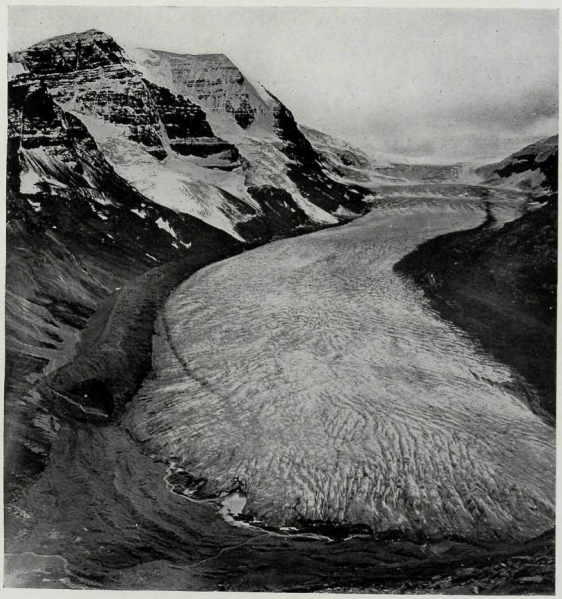
Grassy Meadow at Summit of Sunwapta Pass

beyond the head of Tangle Creek there is a well-marked camping ground beyond which the trail is very obscure. It crosses to the left bank of the creek, making a wide detour to the west in its descent to Sunwapta River.

That the course of the trail leads up and around Wilcox Peak instead of directly down the Sunwapta Valley is accounted for by the existence of a rough rock cañon about two miles below the glacier. At sixty miles Sunwapta River is reached, the trail having dropped in altitude about 1400 feet since leaving the alplands around Wilcox Peak. The headwaters of Sunwapta River proceed from immense glacial fields lying in very high mountains on the west and the river gains in volume with great rapidity.

There is a very noticeable change in the river at a point about sixty-eight miles along the trail from Howse Pass. The wide gravel beds and scattered

channels contract, the mountains close in and the stream is carried generally in one well-defined channel with low banks and narrow, timbered, muskeg flats on either side. At seventy-three miles a great rock-slide from the eastern mountain slopes has filled up the river bed to such an extent that most of the water runs through and under it. The trail at this point is to the left of the river at the foot of the mountain. One mile farther on, Poboktan Creek enters the Sunwapta from the southeast. It is a clear-water creek about twenty feet wide, proceeding from a well-defined valley between high mountains. Following the



ATHABASKA GLACIER SEEN FROM SUNWAPTA PASS

trail for two more miles, the party forded the Sunwapta from the west to the east bank, and from this point on there is a trail on the east side of the river. The southerly continuation of this trail leads up the Poboktan Valley and is more travelled than the Sunwapta route.

At eighty miles, on August 5th, 1917, the Sunwapta measured one hundred and twenty feet in width with a mean depth of three feet and a current of almost

exactly three miles an hour. At eighty-eight miles, the trail leaves the river bank for six miles and, after skirting two small lakes to the east, returns to it at the point where the Sunwapta and Chaba Rivers unite to form Athabaska River. At ninety-three miles a fairly well travelled trail leads off to the west; here a direction arrow is marked "To Athabaska Forks and Fortress Lake."

Continuing for fourteen miles, the main trail crosses Athabaska Falls cañon by a picturesque bridge immediately below the falls. At the falls the whole river plunges over a twenty-five foot lip of rock, in a drop of from fifty to sixty-five feet, into a particularly wild fissure cañon. The cañon, which is perhaps two hundred and fifty feet in length, is not more than twelve feet wide in places and is overhung by projecting masses of rock on which jackpine and spruce have managed to secure a foothold.

The trail now leaves the bank of the river, and continues for five miles to Whirlpool river which is crossed on a good bridge. Whirlpool river, at the bridge, is a clear-water stream about one hundred feet wide and perhaps two and a half feet deep. A mile and a half below the bridge it joins Athabaska River.

Five miles farther on Astoria River is crossed by a long, new trestle bridge, from which a partially constructed wagon road leads to the junction of Miette with Athabaska River. At mile one hundred and twenty-four, there is a bridge across the Miette from which a road leads to Jasper, one and a half miles distant. From this bridge the old railway tote road up the Miette Valley leads to Yellowhead Pass.

The distance by trail from Howse Pass to Yellowhead Pass is estimated to be one hundred and forty-one miles and the trip occupied ten and a half days of actual travel, the division arriving at Yellowhead Pass on August 10th. There is good horse-feed at Howse Pass and on both sides of the Saskatchewan at a point seventeen miles beyond the pass. It is also to be found at mile forty-seven and mile fifty-three along the trail and all the way up Miette River. There is also fair feed at points thirty-one, fifty-eight and sixty-six miles respectively from Howse Pass and at various places farther on.

Mr. Cautley finished his work at Yellowhead Pass on October 18th and the party arrived at Edmonton on October 20th and were then paid off.

The Topographical division under Mr. Wheeler travelled from Field by the same route as Mr. Cautley and arrived at Howse Pass on the 1st July. The summit of the pass and its vicinity were first surveyed and then the area southward to connect with previous surveys made by Mr. Wheeler of the Railway Belt on the British Columbia side of the watershed. The survey was also extended northward for about four miles beyond the summit of Howse Pass.

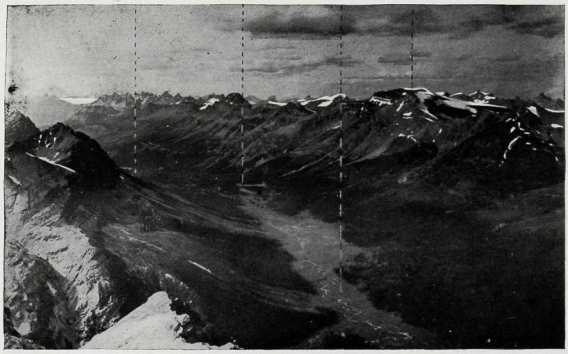
The party next moved to Mistaya River valley on the Alberta side of the watershed, and carried on the topographical survey from some distance north of the watershed to connect with Mr. Wheeler's previous surveys, which ex-

tended northward as far as Bow Pass summit. This summit is the divide separating the headwaters of Mistaya river, which flow into North Saskatchewan river, from those of Bow river which flow to the South Saskatchewan.

Work was concluded here on August 1st and the following day the party, in charge of A. J. Campbell, D.L.S., started for Jasper on the Canadian National railways, over the route taken by Mr. Cautley, described above, and arrived there on August 13th. Mr. Wheeler, who had gone round by way of Edmonton for the purpose of forwarding supplies, met them at the bridge over Astoria river about eight miles south of Jasper.

On August 14th the division proceeded up the Miette river valley and arrived at Mr. Cautley's camp at Yellowhead Pass summit on the following day. Pushing on over the summit, the party camped the same night at Yellowhead lake, directly opposite the village of Lucerne about five miles down on the British Columbia side.

Mistaya Valley Summit of Pass Bow Valley Observation Pk.



SUMMIT OF BOW PASS

A photographic survey was now made of Yellowhead Pass summit and vicinity for a distance of about nine miles southeast and the same distance northeast of the point where the Canadian National railways cross the continental divide.

Work for the season was completed on September 12th when the division returned to Jasper and on the morning of the 15th started for Lake Louise station on the Canadian Pacific Railway. As far as the junction of Howse and Saskatchewan Rivers, the return journey was made over the trail which had previously been followed to reach Yellowhead Pass. From this junction the trail up Mistaya River was taken to Bow Pass summit. In crossing this summit a necessary camera station was occupied on Observation Peak.

From Bow Pass summit the trail follows along the east side of the valley. The division arrived at Lake Louise Station on September 26th and at Banff, by rail, the same evening. The packtrain came in the next day and the members of the party were then paid off.

KICKING HORSE PASS TO HOWSE PASS

The Howse Pass crossing of the continental watershed lies nearly due northwest of Kicking Horse Pass summit. Following the sinuosities of the watershed the distance is approximately forty-one miles; in an air line it is thirty-one and a half miles.

From the summit of Kicking Horse Pass the watershed line rises in a sinuous curve north and west to the summit of Mt. Bosworth, 9093* feet above sea-level, on which brass bolt and cairn 12 A of the Kicking Horse Pass survey is set. (For survey of Kicking Horse Pass, see Part I, chap. III, pp. 27-32.)

Leaving Mt. Bosworth the watershed line lies in a general northwest direction along the crest of a deeply serrated ridge to the summit of Mt. Daly, 10,342 feet, distant five miles; at two and a quarter miles, the summit of an unnamed peak, having an altitude of 9400 feet, is passed over. To the east the ridge shows a precipitous escarpment, rising sharply above Bath Creek; to the west the slopes are more gradual.

On the Alberta side of the watershed the run-off is to the deep, forested valley of Bath Creek, a tributary of Bow River. This creek heads from two large glaciers flowing from Waputik icefield. Bath Creek Valley is bounded on its eastern side by the Waputik Range, a ridge of prominent peaks separating it from Bow River Valley.

On the British Columbia side the run-off is to the valley of Sherbrooke Lake, a very beautiful lake of exquisite blue, and to Niles Glacier and Creek, tributary to Sherbrooke Creek and Lake.

From the summit of Mt. Daly the watershed curves northward for nearly half a mile, when it turns sharply to the northeast over another half mile; it then swings back for more than a mile to northwest, thence twisting in a general direction a little south of northwest three and a half miles to the summit of Mt. Balfour, 10,741 feet in altitude. On this last course the watershed passes over the crest of Mt. Lilliput, so named on account of numerous rock pillars that, when seen from a distance, look like a swarm of little people on its surface. The total distance from Mt. Daly to Mt. Balfour, following the windings of the watershed, is approximately five and three-quarters miles.

The body of ice and snow known as Waputik icefield, with its outflowing glaciers, occupies an area of at least twenty square miles. It is divided into two parts by the crest or ridge along which the continental watershed lies, one-third of its area being on the Alberta and two-thirds on the British Columbia side. From the Alberta portion Bath and Waputik Glaciers flow southward to

*On sheet 16 A of the Interprovincial Boundary map the altitude of Mt. Bosworth is shown as 9083 feet; according to later information its altitude is 9093 feet.

the valley of Bath Creek, and Balfour Glacier flows northward to Hector Lake. In British Columbia, Niles Glacier flows south to Sherbrooke Lake Valley, Daly and Fairy Glaciers flow west to Yoho Valley, and Diableret Glacier flows north to Waves Creek. Daly Glacier is the source of the celebrated Takakkaw Falls which descend in one sheer leap of a thousand feet to the valley floor below and form one of the most spectacular sights of the Canadian Rockies.

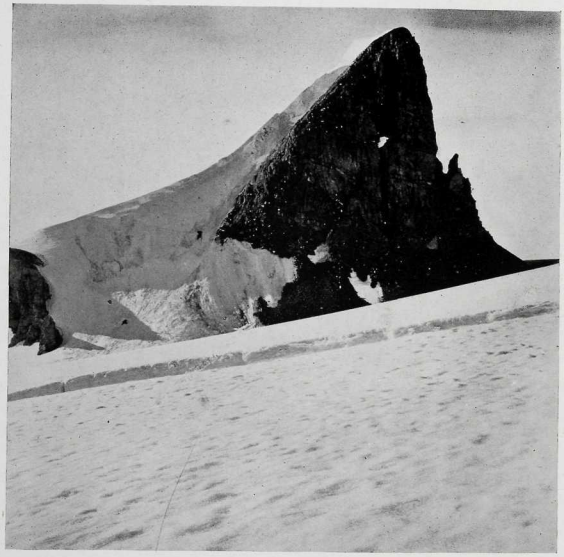
The south and east faces of Mt. Balfour are covered by an ice-cap which is shown on sheet 16 of the map as Balfour Glacier; it flows northeast in very unique form to the bed of Hector Lake. The stream from its tongue wanders in a network of channels through a shingle delta before discharging into the lake. Hector Lake is three and a half miles long with a greatest width of three-quarters of a mile. It is of a beautiful translucent, turquoise blue and discharges into Bow River by several channels, of over half a mile in length. Midway down the lake a short stream flows from Margaret Lake, a small tarn of a deep ultra-marine colour, surrounded by dense forest and well stocked with trout of good size. Half a mile away and a thousand feet above it is Turquoise Lake, of a brilliant cerulean blue, set in a rock basin above timber-line and hemmed in by rock precipices, ice and snow. The outlet from it drops sheer five hundred feet or more.

At the head of Waves Creek, directly north of Mt. Balfour is a snow pass which leads across the watershed to the basin of Hector Lake and is the line of demarcation between Waputik and Wapta icefields; it reaches an altitude of something over 8200 feet and is accessible only to mountaineers. Waves Creek, which flows from Diableret Glacier at the western extremity of the pass, presents two magnificent waterfalls. The upper, Diableret Falls, leaps sheer over a ledge for several hundred feet, and the lower, the Fall of the Waves, leaps from pocket to pocket through a series of pot-holes which the stream has carved in the sandstone formation. The stream then flows in a narrow rock cañon and finally disappears beneath the ice tongue of Yoho Glacier, from which it reappears as Yoho River. Yoho Glacier is an outlet of Wapta Icefield and is one of the most spectacular sights in the wonderful galaxy of mountain scenery known as the Yoho Valley.

Wapta Icefield is triangular in shape and has an area of from twenty-five to thirty square miles or more. It is bounded on the south or base by the head-waters of Yoho River, the snow pass directly north of Mt. Balfour, to which reference has been made above, and by the stream flowing from Balfour Glacier to Hector Lake; on the northeast by the peaks along the western borders of the Bow and Mistaya River valleys; and on the west by Mt. Baker, Ayesha Peak, Mt. Collie, Mt. Habel, and Mts. McArthur and Pollinger, forming the eastern escarpment of Amiskwi River valley and the valleys of Ensign Creek and another unnamed creek to the north of it. Many glaciers flow from this ice area, notably Habel, Yoho and Vulture Glaciers on the south, Bow and Peyto Glaciers on the northeast, Baker Glacier at the northern apex of the icefield and a number

of smaller unnamed glaciers which break through the eastern escarpment of Amiskwi Valley.

From the summit of Mt. Balfour the watershed line descends nearly due north one mile and three-quarters to the snow pass leading to Hector Lake. It then continues up Vulture Glacier in the same general direction, but curving westward, to the summit of Mt. Olive, 10,270 feet in altitude, two miles farther on. Mt. Olive is separated from the eastern extremity of the mass of Mt. Gordon by a narrow gap known as Vulture Col, so called from a curious tower in



St. Nicholas Peak

the centre of the gap which has a rock closely resembling a vulture perched upon its crest.

Continuing northwesterly the watershed descends from the crest of Mt. Olive and, at a distance of two and a quarter miles, reaches the summit of another snow pass that gives access from the Yoho Valley, by way of Yoho Glacier, to the valley of Bow Lake, by way of Bow Glacier. The route from Yoho Glacier is over the icefield around the north end of Mt. Gordon and descends the more southerly of the two icefalls of Bow Glacier; in doing so it passes close to a somewhat remarkable peak on the east side of the watershed which

owing to an outstanding gendarme of rock that closely resembles the patron saint of Christmas time, has been named St. Nicholas Peak; its altitude is 9616 feet.

The stream collecting the run-off from the two icefalls of Bow Glacier flows in a very remarkable box cañon which is so narrow that at one point a single huge boulder has spanned the chasm and formed a natural bridge across it. Below the cañon the stream flows through a shingle delta for three-quarters of a mile and discharges into Bow Lake, a sheet of vivid blue three and a half miles long and nearly a mile at its greatest width; it is extremely picturesque at the lower end, where there are narrows and timbered islands which break up the water surface and suggest the existence of separate smaller lakes.

The surface of Wapta Icefield is traversed by several outcropping ridges of rock, paralleling the direction of the range, which divide it up into troughs and basins more or less partially separated one from the other. From the summit of the snow pass around the north end of Mt. Gordon the watershed line ascends one of the outcropping rock ridges, mentioned above, to Mt. Rhondda, 10,025 feet in altitude, distant northwesterly two miles. From this point it is two miles farther along the watershed in the same direction to the summit of Mt. Baker, 10,451 feet in altitude.

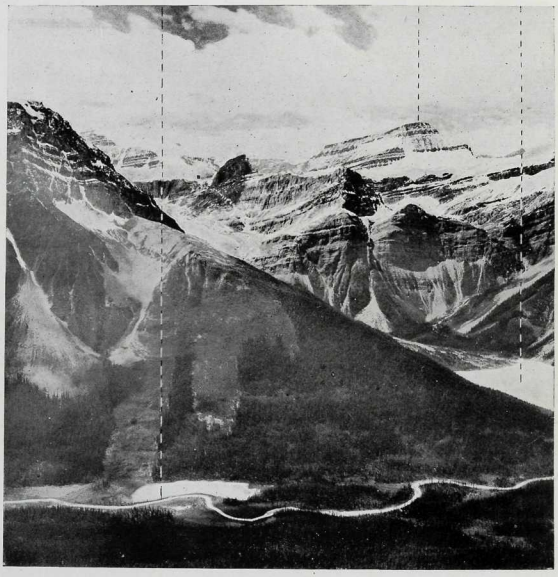
Directly northeast of Mt. Rhondda and southeast of Peyto Glacier, Mt Thompson rises to an altitude of 10,119 feet, its southern outlier, Portal Peak, 9552 feet, standing sentinel over the gap of the icefalls of Bow Glacier. Across from Mt. Thompson, directly above Peyto Glacier, is Peyto Peak, 9805 feet in altitude. Peyto Glacier is a very fine one. The stream from it flows through a morainal delta for a little over a mile and discharges into Peyto Lake, one and a half miles long with a maximum width of half a mile. The lake is hemmed in by dark green forest and its waters are of a most wonderful greenish-blue shade. The lake acts as a settling basin for the silt-laden waters discharged by the glacier and is the main source of Mistaya River. East of the watershed, directly north of Peyto Peak, high above timberline, is rock-bound Caldron Lake, three-quarters by a half mile in size.

Leaving the summit of Mt. Baker the watershed line zigzags due north for three and three-quarters miles to the summit of Mt. Mistaya, at an altitude of 10,100 feet. Many glaciers lie along the watershed on this course. On the Alberta side they drain to Mistaya River, and on the British Columbia side to Wildcat Creek, a tributary of Blaeberry River.

The watershed now swings northwest for a mile and then west for three-quarters of a mile to the highest point of Mt. Barbette, 10,080 feet. Directly below, to north and east, are the snowfields of Barbette and Delta Glaciers, the former having an outflow to Mistaya Lake and the latter by Delta Creek to Mistaya River. Mistaya Lake is another of those gem-like glacial lakes of brilliant blue that delight the eye. It is two and a half miles long with a greatest width of a third of a mile and at its northern extremity it gradually tapers down to the river channel connecting it with Upper Waterfowl (shown on sheet 17 as

Upper Wildfowl) Lake. Between Barbette and Delta Glaciers and Mistaya River the glaciated mass of Mt. Patterson rises to an elevation of 10,490 feet. On the southwest side of the watershed the drainage is to Wildcat Creek.

From Mt. Barbette the watershed line curves northward for one and three-quarters miles, then again northwest for one and a half miles to the summit of Mt. Breaker at an elevation of 10,069 feet. Just before reaching Mt. Breaker a wide snow-saddle is crossed, with Parapet Glacier falling to the southwest and



MT. BREAKER FROM MISTAYA VALLEY

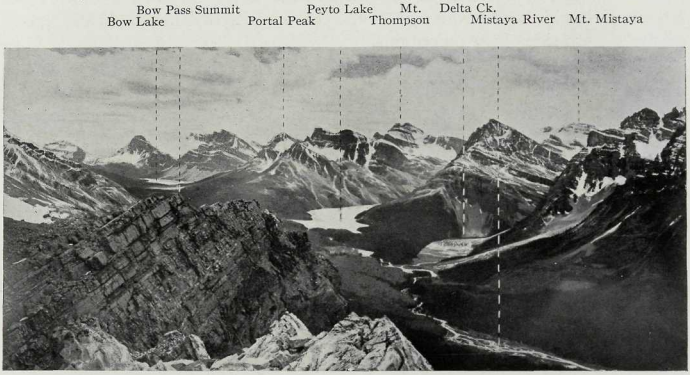
Capricorn Glacier to the northeast. The latter drains to Capricorn Lake, a small mountain tarn which in turn sends a stream to the head of Mistaya Lake.

Leaving the summit of Mt. Breaker, the watershed line lies slightly east of north over Ebon Peak, 9600 feet, in a nearly straight line for one and a half miles to the southeast corner of Aries Peak, 9900 feet; thence northwesterly about three-quarters of a mile to the summit of Stairway Peak, 9840 feet; thence northerly a little over half a mile to Midway Peak, 9570 feet; thence

northwesterly three-eighths of a mile to Mt. Synge, 9700 feet; and thence a little south of west three-eighths of a mile to Aiguille Peak, 9840 feet in altitude.

The watershed line now lies northwest for three-quarters of a mile to the summit of Howse Peak, 10,800 feet in altitude. At Howse Peak it turns southwest at right angles to its previous course, and descends the steep slopes of the peak for 2200 feet to a saddle between it and an outlying elevation of its southwestern ridge, the summit of which is distant one and a half miles. On the highest point of this outlying elevation, Brass Bolt and Cairn 13 N were placed at an altitude of 8657 feet above sea-level. It is the most easterly point to which the monumenting of the pass was carried.

The ridge of mountain peaks extending from Mt. Baker, at the northern apex of Wapta Icefield, between the valley of Mistaya River on the east and the valleys of Blaeberry River and Howse River on the west, along the crest of



MISTAYA VALLEY AND PEYTO LAKE

which the watershed line lies as far as the summit of Howse Peak, is of bold and ragged formation. Many fine and prominent peaks, with a greatest altitude of 10,800 feet in Howse Peak, rise from the general line of the crest of the ridge. The ridge extends northward beyond Howse Peak to the junction of North Saskatchewan and Mistaya Rivers, distant some 10 miles, and from this part Pyramid Peak, three unnamed peaks, Kaufmann Peak, and Mt. Sarbach rise very prominently, but none with greater altitude than Howse Peak.

The crest of the ridge holds much ice and snow in its hollows, and many glaciers, none of large size, flow from it both east and west, but far more abundantly on the east side. The east side, above Mistaya Valley, presents a precipitous escarpment with bold cliffs and rock faces rising frequently for more than two thousand feet; on the west side the slopes are less severe and in some cases present broad, flattish tops.

The valleys of Blaeberry and Mistaya Rivers are deeply indented with very steep slopes rising directly from the valley floors. The glaciers on the western side of Mistaya Valley have created a number of beautifully coloured lakes which, in conjunction with their bold rock surroundings and setting of dark green forests of pine and spruce, make the valley one of great scenic interest.

HOWSE PASS

History and Origin of Name.—Howse Pass was the southerly main route of travel of the North West Fur Trading Company across the continental watershed. It connects the headwaters of Howse River with those of Blaeberry River. The pass formed one of the two principal highways, Athabaska Pass being the other, by which trade was carried on with the Indian tribes of southern British Columbia and communication kept up with distributing headquarters on the eastern side of the mountains.

The pass was discovered and the first crossing of the divide made by David Thompson, official geographer and explorer to the North West Company, on June 22nd, 1807, from the Saskatchewan side to a rill "whose current descends to the Pacific Ocean—may God in his mercy give me to see where its waters flow into the ocean, and return in safety"; so wrote David Thompson on the above date. He was on his way to Columbia River which he then ascended to Columbia Lake, and built "Kootanae House" on the west bank of the river near the mouth of Toby Creek. Thompson returned by the same route in July, 1808. He again crossed the watershed by this pass from east to west on October 27th, 1808, and for the fourth time on June 18th, 1810, from the Columbia.

Alexander Henry, fur trader of the same company, crossed Howse Pass from the Saskatchewan on February 9th, 1811.

The above details are from Dr. Elliot Coues's "New Light on the Early History of the Greater Northwest," Henry-Thompson Journals, published in 1897.

Mr. James White, F.R.S.C., in his "Place-Names in the Rocky Mountains between the 49th Parallel and the Athabaska River" states that Howse Pass and the peak which overshadows it have been named after Joseph Howse, who, in 1810, crossed the mountains by this pass and travelled southward to near the present Kalispell, Montana, where he built a post—the only post west of the Rockies constructed by the Hudson's Bay Company prior to the union with the North West Company in 1821. Joseph Howse, according to Dr. Elliot Coues, seems to be identical with Jasper Hawes, an old clerk in charge of Jasper House on the left bank of Athabaska River immediately below Jasper Lake.

In 1871, Mr. Walter Moberly, district engineer for the Canadian Pacific Railway between Shuswap Lake and the eastern foothills of the Rocky Mountains, had explored Howse Pass and found it feasible as a route for the transcontinental line of the Canadian Pacific Railway, and had made arrangements

to conduct surveys through it with such object in view. The following spring, 1872, it was decided to adopt Yellowhead Pass for the transcontinental line and Mr. Moberly's work in Howse Pass was discontinued.

Topography and Characteristics.—The general direction of Howse Pass at the crossing of the continental watershed is northwest and southeast. The altitude of the lowest part of its summit is computed by the Topographical Division to be 5020 feet above sea-level, 319 feet lower than that of Kicking Horse Pass. From the divide, the waters flow northerly by Howse River to Saskatchewan River, which, after a long easterly course of some 1500 miles through the provinces of Alberta, Saskatchewan and Manitoba, empties into Lake Winnipeg; Lake Winnipeg discharges by way of Nelson River, flowing northeasterly to Hudson Bay. On the British Columbia side, the waters of Blaeberry River flow to the Columbia, and by that great waterway more than one thousand miles to the Pacific Ocean at Portland, Oregon.

The pass on the British Columbia side lies in a deep, trough-like valley enclosed by densely timbered mountain slopes showing precipitous rock faces and ledges at intervals. On the Alberta side it opens out in broad, gravel river-beds and the valley widens very considerably. At the summit of the pass the valley from crest to crest is about three and a third miles across.

Both from the north by the Howse, and from the south by the Blaeberry, the approaches to the summit of the pass are gradual and there is no big hill on either side. The feasibility of using the pass for a road or railway was established by Mr. Walter Moberly in 1871.

The southern approach up the Blaeberry Valley is dominated by the splendid snow and ice-covered mass of Mt. Mummery, 10,918 feet in altitude. It stands on the north side of the stream directly opposite the summit of Amiskwi Pass. Beyond the crossing of the watershed, on the Alberta side, Mt. Forbes, an immense rock cone, rises 11,902 feet above sea-level according to the computation of the Topographical division.

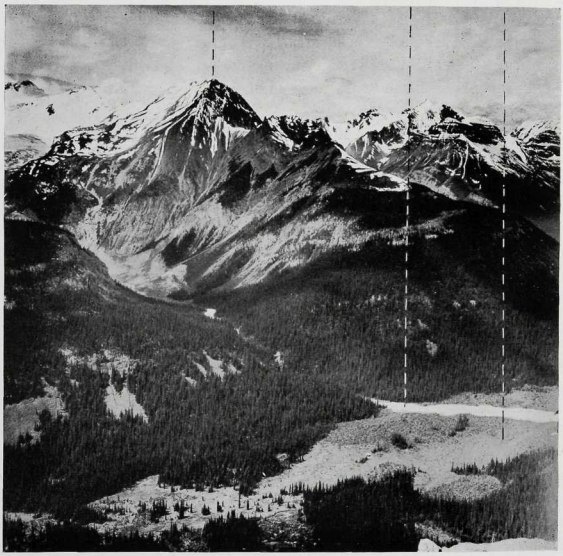
South of the summit of the pass, the watershed line ascends the northeastern ridge of Mt. Conway, 10,170 feet, in a southwesterly direction; it then descends the mountain on the opposite side, in the same direction, by a southwestern ridge and, passing over an outlying peak, arrives at a broad icefield from the centre of which rises a high pyramid peak which may or may not be a peak of the watershed, the survey not being sufficiently extended to definitely determine this point.

The summit of Howse Pass is a nearly level flat, between steep enclosing mountain sides, about a quarter to half a mile wide and three-quarters of a mile long, part of which is still covered with green timber, although most of it is covered with brûlé and brush. The northerly edge of the flat breaks off abruptly to the gravel bed of Conway Creek lying only ten feet below it.

The actual summit of the pass is within ten chains of the stream, which is of considerable volume at this point and has a number of channels intersecting a wide gravel bed. When coming up Conway Creek in a south-southeasterly

direction, Howse Pass has the appearance of being a straight continuation of the valley of the stream but, on reaching the low flat which forms the summit of the pass, the stream takes a sharp turn to south-southwest and its bed contracts to a narrow and very wild cañon, beyond which the river may be seen tumbling out from the foot of a glacier between Mt. Conway and the mountain directly to the north of it.

Howse Pass is situated on a part of the watershed forming one of the most notable cases of deviation from the general northwesterly trend of the Rocky Mountain Divide, and the watershed crosses the pass in a general southwesterly direction on its way to the north boundary of the province.



HOWSE PASS SUMMIT
Looking Northwest

The survey of Howse Pass proved to be an arduous undertaking from the point of view of Mr. Cautley's division; first, because it is very heavily timbered for 1600 feet above the floor of the valley with spruce measuring up to forty-three inches in diameter; and secondly, because the mountain sides are so steep and so broken by precipitous rock ledges that great difficulty was experienced in locating and constructing trails by which horses could pack up monument material.

Boundary Line.—The characteristic letter for the pass is N. Concrete Monument 1 N was erected at the summit of the pass in the centre of the level, open flat mentioned above, ten chains from the gravel bed of Conway Creek and only twenty feet above it. Concrete monuments 3 N, 5 N and 7 N were erected in the timber of the steep slopes enclosing the pass on the northeast. It was not found possible to convey material for monumenting beyond the location of 7 N, so it was necessary to place brass bolts and build cairns over them at 9 N and 11 N. The courses between were straight-line courses and were duly measured, partly by chaining and partly by triangulation. Beyond 11 N, the watershed is naturally well defined. In this direction a final brass bolt and cairn were placed on the outlying elevation of Howse Peak, previously referred to, and numbered 13 N.

South of 1 N, concrete monuments 2 N, 4 N and 6 N were erected. The last straight-line course extended from 6 N to 8 N, where a brass bolt was placed and a cairn built over it. The bolt is placed on the most northerly corner of the northeast ridge of Mt. Conway. Beyond 8 N the watershed is naturally well defined to the summit of Mt. Conway and no other brass bolts were placed in this direction. The total length of straight-line boundary surveyed across Howse Pass is 285·953 chains.

The following camera stations were occupied by the Topographical division in the vicinity of Howse Pass summit and southward to connect with previous surveys; Howse Pass E., 7612 feet; Howse Pass W., 9150 feet; 13 N, 8657 feet; 11 N, 7696 feet; 8 N, 8155 feet; Conway Shoulder, 8951 feet; Conway N., 9534 feet; Chimney Bluff, 8443 feet; Mount Breaker, 10,069 feet; Amiskwi Pass W., 8379 feet; Amiskwi Pass E., No. 6, 8545 feet; No. 7, 7906 feet. In Mistaya Valley the camera stations occupied were: Pyramid E., 8165 feet; Mistaya E., 7610 feet; Weed Shoulder, 8529 feet; and, at the summit of Bow Pass, on a shoulder of Observation Peak, 10,031 feet.

Views of the monuments and cairns, together with descriptions of the locations of the brass bolts, and a table of latitudes and departures referring them to the nearest concrete monuments, will be found in the appendices to this report. For the positions and altitudes of monuments and bolts and for other information see map sheets Nos. 16, 17, 18 and 18A.

Tie with Previous Surveys.—A tie was made with Timber Lot No. 8559, surveyed by J. A. Kirk, B.C.L.S., on the British Columbia side of the watershed. The connection was made between the boundary and the northwest corner of the lot; also between Mr. Cautley's control station C, which was located a short distance to the east, and the west boundary of the lot.

GENERAL REMARKS

From Kicking Horse Pass northward to Howse Pass, the continental watershed lies along the crest of the main range of the Rockies through a region of high mountains and wide icefields, and one of great scenic interest that does

and will, increasingly so, in the future attract tourists and Nature-lovers from all over the world.

Howse Pass is of lower altitude than Kicking Horse Pass, through which the Canadian Pacific Railway crosses the main watershed. It has no very steep approaches and will some day be found suitable for a trunk motor road from the Columbia Valley to the prairies, the feasibility of using the pass for such a road or for a railway having already been established.

Throughout the area referred to above, green timber—chiefly spruce and pine, and high up, balsam and Lyall's larch—is found in all the main valleys on the eastern side of the watershed. It is also found in all the tributary valleys but nowhere in large bodies of commercial size. On the western side the timber growth is much heavier and Douglas fir and cedar are found in addition to the above mentioned species. Along Blaeberry River there is considerable spruce and fir timber valuable for commercial purposes, and particularly so in the vicinity of Howse Pass Summit. Timber limits have been taken up there, but getting out the timber would be a difficult and costly process, probably requiring a railway to connect with the main stream of Blaeberry River. Singularly little burnt timber was seen and the trails travelled lay for miles and miles through green forest.

The main trails have been pretty fully dealt with above. Generally speaking, they are easily travelled and give through connection with Jasper on the transcontinental lines of the Canadian National Railways. Branch trails lead from them across divides to other main valleys, and to points of scenic interest at the heads of tributary valleys.

The distance from Lake Louise Station, on the Canadian Pacific Railway, via the valleys of Bow, North Saskatchewan, Sunwapta and Athabaska Rivers to Jasper is estimated at one hundred and sixty-five miles. The trail passes through many large tracts of timber and is gradually being improved and made passable, where obstructed by windfall, by means of work done by the Dominion Government Forestry and Parks Branches, with a view to organizing an effective fire patrol. It does not by any means seem impossible that a good road can be constructed from steel to steel when the time is ripe.

Game and Fish.—Very little game was seen in the area travelled over. Mountain goats were high up on the peaks; mountain sheep, the Bighorn, are found at the headwaters of North Saskatchewan and Athabaska Rivers, and small deer are in all the woods. The usual species of woodland grouse were met with and ptarmigan were seen above timber-line. Tracks of bear were noticed and a cougar (mountain lion) was encountered by a member of the survey party. Trappers' cabins and old dead-falls showed that the area has been worked over for fur-bearing animals, but none were seen.

Fish are scarce. There are trout of fair size in the Bow River, and in considerable quantity in Hector and Margaret Lakes, but none were noticed in Bow River above Hector Lake. Trout are also to be found in Amiskwi River to near its head. They are of smaller size and of a different species from those

on the eastern side of the watershed. There may be fish in Blaeberry River, but the muddy condition of the water prevented them from being seen and none were caught there.

YELLOWHEAD PASS

History and Origin of Name.—Yellowhead Pass is the lowest pass across the continental divide traversed at present by a railway. It was originally selected as the route of the Canadian Pacific Railway but was later abandoned; now it is crossed by two other transcontinental lines of the Canadian National Railways.

While not generally in use by the fur-trading companies as a main route of travel, it was used by their voyageurs to get from the Athabaska main route to the headwaters of Fraser River, but was abandoned owing to the difficulties and numerous casualties attending the navigation of that stream. It was also used to some extent by the Rocky Mountain Indians of the Shuswap tribe on the journey from Kamloops via Thompson River to Athabaska River at Jasper House where, presumably, they carried on trade with the fur company.

The pass was also known as Leather Pass on account of the supplies of dressed moose and caribou skins that were brought over it to outlying posts of the Hudson's Bay Company. Reference has been made to it as Jasper House Pass, and Cowdung Pass, the latter name originating likely from the fact that stragglers from the vast buffalo herds roaming the prairies in those early days worked their way up from the Athabaska valley and over the summit to the lake on the other side, which was originally known by that name.

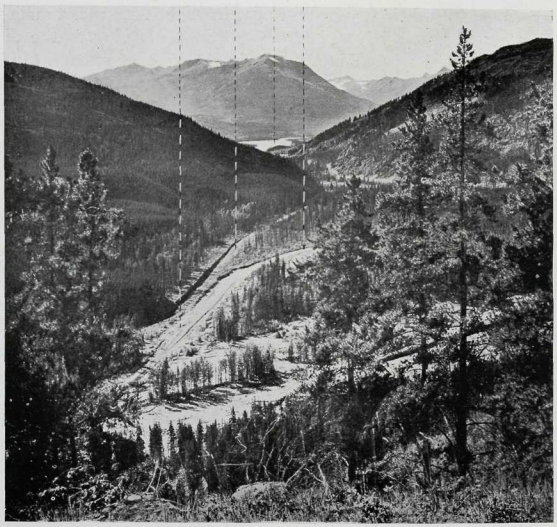
The route to Yellowhead Pass from the east lies up Miette River Valley. The Miette joins the Athabaska about a mile south of Jasper Station on the Canadian National Railways. The old trail of the fur-traders to Athabaska Pass here lay along the east side of the river and doubtless the Indian route up the Miette Valley branched from it somewhere in the vicinity.

Tête Jaune cache is some fifty miles lower down on the west side from the summit of Yellowhead Pass, not far from the junction of the North or Grand fork with the southerly branch of Fraser River. It was so named from the fact that an Iroquois trapper known as "Tête Jaune" or "Yellow Head," made this cache the receptacle for his catch of fur. He seems to have been a man of some celebrity in the neighbourhood for, presumably, the pass has been named after him.

In 1862, Viscount Milton and Dr. Cheadle traversed the pass while exploring a route across the continent to British Columbia. Their book, "The North-West Passage by Land," gives a full and delightfully interesting account of the difficulties and dangers encountered by them while en route from Edmonton to Kamloops through the almost trackless mountains and forests that encompassed the headwaters of the Fraser and Thompson Rivers; it contains references to the history and origin of the name, Yellowhead Pass, as outlined above.

In 1872, location surveys for the transcontinental line of the Canadian Pacific Railway were begun in the pass by Mr. Walter Moberly, at that time district engineer, and were continued until 1880 when the ownership of the railway was transferred to a private company known as the Canadian Pacific Railway Syndicate. The Yellowhead Pass route was then abandoned in favour of the route through the Kicking Horse Pass, some one hundred and fifty miles farther south, over which the line runs to-day.

Topography and Characteristics.—Yellowhead Pass lies in a general east and west direction and the watershed crosses it on a very erratic course from south-east to northwest.



SUMMIT OF YELLOWHEAD PASS
Showing Lines C.N.R.

Eastward of the pass summit the water drains by way of Miette River to Athabaska River. The Athabaska flows northeasterly to Athabaska Lake which discharges by way of Slave River to Great Slave Lake. From Great Slave Lake, Mackenzie River, the great waterway of the north, flows northwesterly to the Arctic Ocean.

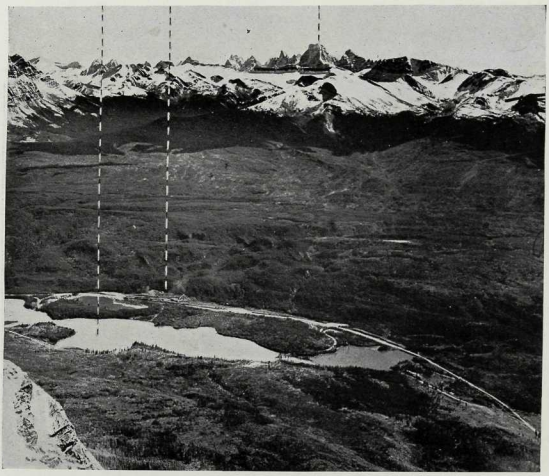
Westward, the water from Yellowhead Pass divide is tributary to Fraser River, the south fork of which flows northwesterly for some two hundred and

fifty miles, when it describes a swift curve and, flowing south some five hundred miles farther, enters the Pacific Ocean not far from the city of New Westminster.

Yellowhead Pass Summit at its lowest part, the road-bed of the Canadian National Railways, has an altitude above sea-level of 3711 feet. At the summit the Canadian National Railways, which are on opposite sides of the approaching valleys in each direction, converge to within 110 feet of one another, the north road-bed being ten feet higher than that to the south.

Yellowhead Pass, at the crossing of the watershed, is not of striking appearance, because it is a wide, low pass and the hills in the immediate vicinity are of a very secondary character, whereas the really fine mountains on either side

Yellowhead Lake Lucerne Mt. Geikie



THE VILLAGE OF LUCERNE

On C.N.R.

are at such a considerable distance as to be invisible from it. In the same way that Howse Creek approaches Howse Pass, as a large stream, which turns sharply at the pass and drains an extensive watershed area beyond it, so Miette River, approaching from the northwest through a deep cañon, passes within ten chains of the Yellowhead Summit and turns to the east-southeast as a somewhat sluggish stream fifty feet wide and from one and a half to four feet deep.

The total length of the watershed between the limestone peaks that form the terminal points of the straight-line survey of Yellowhead Pass is eleven

miles, practically all of which is below timber-line and most of it through a dense growth of small pine and spruce timber.

East of the summit Miette River winds in a serpentine manner through the somewhat marshy bottom of a narrow valley, between enclosing hills of no great altitude, for a direct distance of eighteen miles to its junction with Athabaska River, a mile south of Jasper.

West of the summit the water flows, likewise through marshy land, two and a half miles to Yellowhead Lake. The lake is three and a half miles long by half a mile at its greatest width. It is of irregular shape and a dark sap green in colour; two narrows in its shore line are spanned by bridges. The road-beds of the Canadian National Railways traverse the north and the south

South Branch Fraser River

Entering Valley of Yellowhead Pass directly below Lucerne

shores. The bridge at the first narrows connects with the railway village of Lucerne, a divisional point of the Canadian National Railways. During the war a large quantity of steel rails was taken from both road-beds and sent to France for military use, leaving the straightest alignment of each road as a single way for traffic. From Yellowhead Lake a small stream, about a mile in length, flows to the south branch of Fraser River.

The course of the watershed across the pass is very irregular. From limestone crest to limestone crest the valley is six and a half miles wide, while the actual floor is less than a quarter of a mile. Northward from the summit the

watershed line rises steeply for about two miles through much burned timber. It then ascends a steep, green-timbered hill for close on 2000 feet in a mile of distance, to the crest of an undulating plateau-like ridge, which is followed for about two miles, when the watershed line rises abruptly to the summit of Tête Roche, the western terminal of the straight-line survey.

Southward from the summit the watershed winds for three miles up the steep side slopes of the valley, over very uneven terrain and for the most part through small-sized pine and spruce timber, to the crest of a high, rocky ridge of roughly undulating character between the Miette Valley and the valley of Fitzwilliam Creek. It then follows along the crest of the ridge, eventually rising to the summit of Miette Hill, the eastern terminal of the straight-line survey.

Boundary Line.—The characteristic letter for the pass is S. Concrete monument S is placed on the straight-line course between 1 S and 2 S, at a distance of 5·75 chains northwest of the former. It is erected on the level floor of the valley about 150 feet northwest of the road-bed of the Canadian National Railways. Monument 1 S is erected at the crest of a point of rock rising directly above the road-bed of the Canadian National Railways, from which it is distant eastward about eighty feet; part of this rock point has been blasted out to permit of the passage of the railway.

Thirty-two concrete monuments were built to mark the survey in Yellowhead Pass. Of this number, no less than fifteen are more than 2400 feet above the valley floor at the summit, from which all cement and gravel had to be packed on horses over roughly made trails cut out by Mr. Cautley's division.

North of S, concrete monuments 2 S, 4 S, 6 S, etc., to 30 S, were erected, and brass bolts 32 S and 34 S were placed and cairns built over them on Tête Roche. South of S, concrete monuments 1 S , 3 S, 5 S , etc., to 31 S were erected, and brass bolts 33 S, 35 S, and 37 S were placed and cairns built over them, the last on the summit of Miette Hill. The total length of straight-line boundary surveyed between brass bolt and cairn 33 S and brass bolt and cairn 32 S was 875·838 chains.

In order to obtain data for mapping the survey of the pass in the vicinity of the summit, the following camera stations were occupied by the Topographical division: Lucerne N., 7915 feet; 34 S, 7932 feet; Marcus Hill, 6121 feet; Yellowhead Pass E., 4261 feet; 31 S, 6490 feet; 33 S, 6844 feet; 37 S, 7799 feet; and Mount Fitzwilliam, 9538 feet.

Views of monuments and cairns, together with descriptions of the locations of brass bolts and a table of latitudes and departures referring them to the nearest concrete monuments, will be found in an appendix to this report. For the positions and altitudes of monuments and bolts and for other information see map sheets, Nos. 29, 29A, and 29B.

Tie with Dominion Land Surveys.—The north boundary of section 13, township 45, range 4, west of the Sixth Meridian, intersects the course between monuments 5 S and 7 S at a point 1·41 chains southerly from 5 S. An iron post, marked "XIII, XLV, IV" was found at the northeast corner of section 13; it is distant 57·09 chains from the above-mentioned point of intersection.

YELLOWHEAD PASS TO TONQUIN PASS

The summit of Tonquin Pass lies nearly due southeast of the summit of Yellowhead Pass and is twelve miles from it in a direct line; by way of the watershed the distance is about fifteen miles. From the summit of Miette Hill the watershed line doubles back on its previous course and, describing a deep curve to the south, arrives at the summit of Mt. Kataka, 8700 feet in altitude, distant one and three-quarters miles by way of the watershed. On the east lies the valley of Clairvaux Creek, a tributary of Miette River. On the west are the headwaters of Fitzwilliam Creek, which heads from two tributary streams in a deep, pocketed valley, encircled on the west by the cliffs of Mt. Fitzwilliam, on the south by Bucephalus Peak and Frontier Peak, and on the east by Mt. Kataka. Mt. Fitzwilliam is the dominating peak south of the pass summit and may be seen rising as a rock-terraced cone from the approaches up the pass both east and west. There are a number of picturesque mountain tarns at the head of Fitzwilliam Creek to which several small glaciers drain.

Leaving Mt. Kataka the watershed line lies south-southeast two miles to the summit of Mt. Clairvaux, 8800 feet in altitude. It then makes a long curve, on a southerly course, three and a half miles to the summit of Vista Peak, 9169 feet. West of Vista Peak lies Vista Glacier, directly behind which is Glacis Ridge, forming the northern wall of Tonquin Pass. From Vista Glacier flows Rockingham Creek, fed by sources from small lakes below Mts. Waddington and Rockingham. Eastward from the watershed below Vista Peak are two other small glaciers, one of which feeds Clairvaux Creek and the other a tributary of Meadow Creek.

From Vista Peak the direction is southeasterly to the summit of Tonquin Pass, distant about three miles by the watershed, to which the southern slopes of Glacis Ridge and Vista Peak descend in comparatively easy gradients. The altitude of the lower summit of Tonquin Pass is about 6393 feet above sea-level; beyond, the southern wall of the pass rises in a precipitous, ice-bound escarpment of which Mt. Geikie, 10,854 feet in altitude, is the dominating massif.

An old trapper's trail, rising over fairly easy valley slopes and for the most part through green timber, leads from the village of Lucerne to a conspicuous marsh a mile above the junction of Rockingham and Fitzwilliam Creeks; from the marsh the trail, which is barely discernible, follows Rockingham Creek to where the stream forks, one branch flowing from Vista Glacier and a lake below Mt. Rockingham, and the other from Vista Glacier below Vista Peak. The trail such as it is, chiefly a line of trappers' blazes, follows the latter branch and

then a tributary of it to a narrow pass across the continental divide midway between Mt. Clairvaux and Vista Peak, and over it to the valley of Clairvaux Creek; the altitude of the summit of the little pass is slightly over 7000 feet.

The following camera stations: Bucephalus, 9089 feet; Glacis Ridge W., 8455 feet; and Vista Peak, 9169 feet, were used to map this portion of the watershed. (See map sheet No. 29.)

NORTHWARD FROM YELLOWHEAD PASS

Brass bolt and cairn No. 34 S is on the summit of Tête Roche at the northwestern extremity of the straight-line survey of Yellowhead Pass. From the monument the watershed line curves southwesterly one and a half miles to Lucerne Peak, 8000 feet in altitude. Continuing in a more westerly direction, the line travels for nearly another mile and a half to the peak on which Yellowhead Divide Camera Station is set at 8064 feet, en route passing over Leather Peak, 8000 feet.

Yellowhead Mountain is in reality a long serrated ridge with a number of peaks rising above the outline of its crest. It extends in the shape of a shallow bow between Miette River and Grant Brook and forms the northern wall of the valley of Yellowhead Lake and Fraser River. From Yellowhead Divide Station, at the centre of the bow, the watershed turns abruptly at right angles to its previous course and winds in sinuous curves for some fifteen miles in a general northwesterly direction. At one mile it passes over the elevation on which Quinze Lacs Camera Station is set. A mile and a half farther on, it reaches the summit of Mt. O'Beirne at an altitude of 8600 feet. The extent of the season's survey permitted the location of the watershed for only a mile beyond this point.

On the west side of the divide the water drains to the deep valley of a tributary of Grant Brook, flowing to the Fraser. On the east side lies a wide, plateau-like amphitheatre of alpine parkland, broken by rock ridges and interspersed with groves of spruce trees. Many small and picturesque lakelets lie within this area, which is enclosed by Yellowhead Mountain, the ridge of the watershed, and the elevations on which the Miette Camera Stations are set. The outflow from this area is to Rink Lake, which lies some six hundred feet below the eastern wall of the amphitheatre and discharges to Miette River.

The following camera stations were occupied: Lucerne N., 7915 feet; Yellowhead Divide, 8064 feet; Quinze Lacs, 8075 feet; Miette W. No. 37, 8050 feet; No. 38, 7857 feet; No. 39, 8191 feet; No. 41, 8076 feet; and Tête Roche, 7932 feet. (See map sheet No. 29.)

GENERAL REMARKS

Through Yellowhead Pass, there are scattered areas of timber suitable for commercial purposes. The species noted are spruce, pine (Pinus Murryana), and Douglas fir. The fir seems to have found its way across the summit of the pass and is seen in groups of trees scattered along the northern slopes of the Miette Valley. With the exception of that found near the summit of the pass, where the slopes are thickly grown with small-sized pine and, higher up, with mixed spruce and pine, nearly all the timber on the southern side of the valley has been destroyed by fire. In addition to the varieties mentioned, large cottonwood trees and smaller poplar are seen in the valley bottoms along Miette River. At the summit of the pass and west of it, there are, on the south side of the valley, areas of fair-sized timber of similar varieties, to which cedar may be added. Small pine grows extensively on the lower slopes, merging into spruce, fir and larger pine as greater elevation is reached in the tributary valleys. It is interesting to note that no larch was seen in either Howse or Yellowhead Passes, whereas this species is found near timber-line in Kicking Horse Pass, and in all the passes south of it.

Almost the entire area below Yellowhead Mountain, on the north side of the pass, has been burned over and there are burned tracts at the summit. The slopes in this area are covered by a network of windfall and are thickly grown with second growth poplar, birch, pine, and spruce. Most of the timber along the lines of the railways has been used for construction purposes.

Since the advent of the railways, the trails leading through the valleys of the pass have fallen into disuse and are difficult to travel, on account of windfall and washouts. The marshy nature of the Miette Valley creates meadow areas of wide extent, and excellent horse-feed is found throughout its length. The old construction tote road of the Grand Trunk Pacific Railway, miles of which were built of corduroy, lies along the marshy bottom in many places. It is now in a ruined condition and impassable for wagon traffic. The constant hauling of loads of fodder over this road during construction days has resulted in a heavy growth along its route of fine timothy and clover that proves very acceptable horse-feed. The growth of wild fruits along the road on both sides of the summit is remarkable, and raspberries, gooseberries, currants, cranberries, and on the higher ground, strawberries and huckleberries, are to be had in great abundance.

Game and Fish.—Curiously little wild animal life was seen. Moose, brown bears, small deer and mountain goats were occasionally seen and also signs of caribou. The bears are evidently attracted by the berries which abound in the brûlé sections of the pass. Colonies of beaver are to be found on either side of the summit in marshy ponds and bank beaver along the streams, but they are not plentiful. The usual kinds of grouse were in the woods and ptarmigan on the rocks above timber-line; ducks, also, were seen on Yellowhead Lake in considerable numbers.

Fish are to be caught in Yellowhead Lake but not in any great quantity. There seem to be three or more different kinds; a species of char, a species resembling the whitefish family, and fish of the sucker tribe.

MAPS

The location of the watershed from Kicking Horse Pass to Howse Pass, together with a considerable extent of country on either side of it, is shown on map sheets Nos. 16, 16A, 17, and 18, accompanying the report. The information for the portion south of the north limit of the railway belt of British Columbia and of Bow Pass is from photographic surveys for the Department of the Interior by A. O. Wheeler during the years 1903 to 1906, and the remainder from surveys by the Commission in 1913 and 1917.

Sheet 16 gives the altitude of Kicking Horse Pass and a number of other altitudes as slightly different from corresponding altitudes on sheet 16A for the reason that sheet 16A is the result of surveys made in 1913, while later information, obtained from precise levels along the Canadian Pacific Railway by the Geodetic Survey has enabled corrections to be made on sheet 16 which was drawn in 1918.

Map sheet No. 18A shows the survey of the watershed across Howse Pass vicinity.

The information shown on the map sheets of Yellowhead Pass and vicinity, east of the watershed south of Miette River, and north of Miette River east of Derr Creek, is from a photographic survey of Jasper Jark by M. P. Bridgland, D.L.S., in 1915. The Commissioners desire to express their appreciation of Mr. Bridgland's excellent work, which has fitted in very closely, both in contour and altitudes, with the work done by the Boundary Commission.

CHAPTER II

TOPOGRAPHICAL SURVEYS EXECUTED IN 1918

Description of Operations

The topographical division under Mr. Wheeler organized at Banff, Alberta, and with a pack-train left for Field, B.C., on the 25th June. From Field the party travelled to Howse Pass by the Emerald Lake road and Amiskwi and Blaeberry Valley pony trails, arriving at the previous year's camp-ground on the 4th July.

During 1917 the survey of Howse Pass was carried northward to its summit, where Mr. Cautley surveyed the watershed and built seven concrete monuments at the intersections of the various courses established along the watershed to define the boundary. At four prominent points beyond these monuments brass bolts were cemented in the rock, and stone cairns erected over them, the most easterly bolt and cairn being placed on the summit of an outlying elevation of Howse Peak and the most southerly on the northern extremity of an outlying shoulder of Mt. Conway. Further southwest along the same shoulder a photographic station, Conway Shoulder, was occupied and later the occupation of another, Chimney Bluff, north of the pass summit, terminated the survey for the time being.

After crossing the summit of Howse Pass the watershed ascends the above-mentioned shoulder of Mt. Conway to the highest point of the mountain and then descending traverses the crest of a number of peaks, enclosing Conway Icefield on the southeast, to a sharp-pointed peak named Mt. Lambe. Here the direction of its further course turns southeast, and so travels around the southern extremity of the Freshfield Icefield to the crests of the peaks bordering the western extremity. (See map sheet No. 18.)

It was now first necessary to locate this portion of the watershed and in order to do so, a fly camp was taken to timber-line on the northern edge of Conway Glacier, from whence flows Conway Creek. As the nature of the route prohibited the use of horses all outfit had to be packed on the backs of the party. This was an arduous and difficult proceeding, for to reach the Conway Icefield the packs had to be carried up a precipitous rock wall which terminates the trough of Conway Glacier, and the only men it was possible to procure for the survey were absolutely new at mountain climbing, consequently their troubles were greatly increased by having to carry heavy loads over such a dangerous place.

From the camp at timber-line, two stations at the head of Conway Icefield were occupied, namely, Mt. Lambe and Mt. Bergne. To reach them necessitated tramps of several miles across the treacherous, snow-covered surface of the icefield. On one occasion the leader of the party broke through the snow and dis-

appeared into a crevasse. Fortunately the members of the party were roped together and he was hauled out without other mishap than a drop into space at the end of a rope. No other stations could be reached from the fly-camp, so on the 9th of July the party returned to the main camp at Howse Pass.

On July 10th Mr. Wheeler with his assistant, Mr. A. J. Campbell, looked up the route leading to Bush Pass, travelling from Howse Pass camp down the bed of Conway Creek to that of Howse River. The bed of Conway Creek is here confined between narrow hillsides and the only practical method of travel is from gravel bar to gravel bar, most of the time in the rushing muddy torrent, for a distance of about two miles. They then ascended the wide gravel and boulder flats of Howse River to the valley of Forbes Brook which flows from Bush Pass. The gravel flats extend for a mile or more up this latter valley. Howse River, formerly known as Middle Fork of North Saskatchewan River is formed by the union of two strong flowing streams, Forbes Brook from the northwest and Freshfield Brook from the southwest. It was found that a trail had been cut out and blazed along the north side of Forbes Brook to an old camping ground some three miles from the junction with Howse River. About a mile above where the trail leaves the gravel flats Forbes Brook flows in a deep cañon. The day following was spent in cutting out the windfall and making the trail passable for the pack-train.

On July 12th camp was moved along the trail to about three-quarters of a mile from the point where Forbes Brook is joined by a large tributary stream flowing from a glacier on the east face of Mt. Forbes. At the junction both streams appear to contain nearly the same volume of water and for some distance above the junction both flow in narrow, rock cañons.

On July 13th an exploration was made of the portion of Forbes Brook between the junction of the two streams and Bush Pass, and a trail was cut out along its southern border for a part of the distance from the junction to where the brook opens out into gravel flats a mile or more from its head. The hillsides along which the trail lay are very rough and the trail a bad one where the stream lies in cañon.

A subsidiary camp was taken up Forbes Brook on July 15th to a point near its head, about a mile and a half below the summit of Bush Pass. While camp was being moved Mr. Wheeler further examined the pass and found that it was quite impracticable for horses. In order, therefore, to secure the required information for mapping the area contiguous to the watershed on the western or British Columbia side, it was necessary to pack a camp and outfit on the backs of the party over the pass by way of the stream flowing on the west side to Bush River, a very difficult route. This was done and a fly-camp established at the foot of the icefall of Campbell Glacier, which flows northward from the icefield lying directly southwest of the Barnard-Dent group of mountains. Work was carried on here from the 16th July until the 30th and six stations were occupied. During this period weather conditions were very bad, rain and clouds predominating, and the work was much hindered thereby.

While the survey was in progress on the west side of Bush Pass Mr. Wheeler had left the party to make a trip to Banff for supplies, to attend to official business, and to get another packer, one of the two with the party having decided to leave. On reaching the Forbes Brook subsidiary camp it was found that the head packer had cut his foot badly with an axe, which fact coupled with the withdrawal of the second packer, seriously handicapped the work.

The party at Campbell Glacier returned to the camp at the head of Forbes Brook and on the 1st August made the ascent of Coronation mountain, when there occurred a very serious mishap resulting in the absolute loss of a book of field notes of the work from the commencement of the season. The climbing party in charge of the chief assistant, Mr. A. J. Campbell, made the ascent of the peak by a route both difficult and dangerous and completed work at the summit. When descending by another route it became necessary at one place to lower the other two members of the party—both of whom were novices and in their first season at mountaineering—down a bad piece of cliffs; the survey instruments, camera, transit, and a rucksack containing a satchel with the field book in it, sweaters, etc., then had to be lowered separately. Untying the rucksack from the rope, one of the assistants placed it upon a too narrow ledge and the moment he removed his hand it fell off, struck the ledge on which he was standing and bounded over the edge out of sight. Climbing down it was nowhere to be seen. For two days, in pouring rain, every possible spot in the vicinity was searched and only one conclusion was probable. On bounding over the ledge the rucksack must have fallen into a narrow rock gully with a steep incline to its mouth, across which flowed a mass of glacier ice. Directly opposite the mouth of the gully there was a large hole in the ice, doubtless carved by water flowing down the gully, which furnished a run-off channel for the melting snows from above. The incline of the gully continued steeply under the ice and the only conclusion possible was that the rucksack had continued its course down the gully and under the ice. Mr. Campbell lowered a weighted rope for one hundred and fifty feet down through the hole in the ice and found that the steep incline continued beyond that distance. There was no possible way of ascertaining where the rucksack had gone.

This serious loss necessitated the re-occupation of a number of stations on the west side of Bush Pass, and Mr. Campbell, who in my absence was at his wits' end to know just what to do in the circumstances, took the only commonsense action possible by re-occupying them immediately. All the photographic views previously taken, were safe at the camp, but the transit readings for azimuths and orientations of the views, without which the views themselves were of little value, had to be done again.

On August 4th the party once more packed over the pass and were engaged until August 8th in reoccupying five of the six stations established in that vicinity. Rain fell heavily during the three days following but on August 12th a peak forming the southern boundary of Bush Pass was occupied. When, on that date, Mr. Wheeler returned with supplies and a new packer to the upper

Forbes Brook camp, the survey was again well in hand. Work in the vicinity of Bush Pass was completed on August 14th and on the following day camp was moved to a meadow at the junction of Conway Creek with Howse River.

From this camp a mountain directly opposite, on the west side of Howse River, was occupied. Two ascents had to be made owing to the clouds settling down over the mountain after the summit had been reached upon the first occasion, and so preventing the possibility of obtaining the required photographic views. The station was named Mt. David, with reference to David Thompson of the North West Fur Trading Company, who first traversed Howse Pass in 1807. It stands, a high, isolated peak directly opposite the valley of Conway Creek which gives access to Howse Pass Summit. The first ascent was made on August 16th and wet weather prevented another being made until the 19th. On the 16th, however, Mr. Campbell succeeded in re-occupying the station previously referred to as Chimney Bluff, and made connection with the cairns on the stations surrounding Howse Pass and Bush Pass by a series of angular readings, catching his points between the rolling masses of cloud.

During the wet spell the greater part of the camp outfit was moved down Howse River Valley, the floor of which is a broad shingle flat traversed by a network of water channels, and a camp site was selected on the east side of the stream. On August 20th the camp itself was moved and Mr. Wheeler made an exploration up the valley of the stream flowing from Glacier Lake to Howse River, as it was necessary to use this valley as a means of access to the watershed in the vicinity of the eastern side of Mt. Lyell.

Glacier Lake is about two miles long and about half a mile wide. A pony trail has been cut for more than a mile between Howse River Valley and the lower extremity of the lake, where the trail swings northward to a camping ground for hunting parties high up on the mountain side. The trail is much used by wild goats and a quarter of a mile from the outlet of the lake there is a log jam across the creek, a wide, swift flowing stream, that is used by the goats as a bridge from one side to the other. There is also a faint pony track along the lower half of the north side of the lake, but it is difficult to follow and for the remainder of the distance up the lake is practically obliterated by overgrowth. Above the lake, wide meadows and shingle flats, with numerous water channels and timbered islands, lead to a morainal cirque surrounded by glaciers from Mt. Forbes and the Mons and Lyell icefields.

On August 22nd a fly camp was taken to the end of timber in the valley, a party going ahead and cutting out the old trail and a path around the lake sufficiently to allow of pack-animals moving along it. The next two days wet weather prevented survey operations, but a route was explored across the tongue of the glacier from the Lyell Icefield to reach the broad Mons Icefield at the western extremity of which lay the line of the watershed.

Between August 25th and September 2nd, of which four days were lost through rain and clouds, five stations in the vicinity were occupied. Two of these, Mons Peak and Glacier Lake, are on the watershed. It took three separate

attempts to reach the summit of Mons Peak, all arduous climbing. On September 3rd the party returned to the main camp on Howse River and on the following day occupied a station on Mt. Sarbach.

Camp was moved on September 5th to the junction of Howse and Saskatchewan Rivers and up the latter stream as far as a full day's travel permitted. Next day the route was continued to the junction of the Saskatchewan and Alexandra Rivers (formerly known as the West Branch), and up the latter to a camp for the night. September 7th the party continued up Alexandra River along wide shingle flats, which with broad meadow flats at its mouth are a characteristic of the valley, as also of the Saskatchewan Valley within several miles of the junction. The shingle flats of Alexandra River end at a great wall where numerous glaciers fall down from the heights of Mts. Lyell, Alexandra and Spring Rice, which mighty mountains rise directly above the flats in a grandly spectacular cirque.

At this point Alexandra Valley is joined almost at right angles by the valley of Castleguard River, which leads to Columbia Icefield, and to Thompson Pass. Castleguard River flows for its lower part in a cañon between steep timbered slopes. A trail has been cut from the Alexandra shingle flats along the eastern side of the stream to within two miles or so of its head, when the bed of the river is followed. This trail was in places much obstructed by windfall and had to be cut out. The river has its source in glaciers flowing from Columbia Icefield. About five miles from the Alexandra flats, the trail, now a mere track, crosses the stream and leads westerly up steep slopes and across benches three miles farther to the summit of Thompson Pass.

September 8th to the 18th was spent in occupying seven stations in the vicinity of the pass summit. A path for pack ponies was cut out for a distance of about four miles down the valley of the stream flowing southwesterly from the pass summit to the headwaters of Bush River, a very rough and difficult route, and two stations were occupied on the British Columbia side of the pass.

On September 16th, having done all that was possible in the vicinity and provisions being nearly exhausted, the party broke camp and returned to the previous camp by the Alexandra River shingle flats. From here a station, Mt. Saskatchewan, S., was occupied, covering the northern face of Mt. Lyell and the eastern face of Mt. Alexandra, as well as the valley of Alexandra River and the contiguous country. On the 18th, camp was moved down-stream to near the mouth of the river and a station, Mt. Saskatchewan East, occupied close by.

The next day, being nearly out of food, the party broke camp and started via Saskatchewan River, Mistaya River and Bow Pass and Valley, for Lake Louise Station on the Canadian Pacific Railway. Bow Pass Summit was reached on the 22nd of September and an attempt made to ascend Observation Peak, immediately to the east of it, but clouds came down with rain and sleet, and frustrated the attempt.

That night snow fell, the first of the season, and next day clouds obscured the landscape. It was very necessary that azimuth readings should be obtained from the station on Observation Peak, in order to tie in the work of the summer with that of the previous year and of previous surveys to the south, but the supply of food would not permit of the party awaiting a clearance of the weather, so Mr. Campbell and one assistant were left at the summit camp to obtain this data as soon as the weather cleared, and the rest of the party pushed on. Lake Louise Station was reached on the 24th September and some of the members of the party arrived at Banff the same night.

The pack-train returned to Banff by trail, arriving there on the 26th. Mr. Campbell and his man arrived at Banff by trail on the 28th, having succeeded in obtaining the desired azimuths from the station on Observation Peak. The party was paid off on the 30th September and on October 1st the survey cameras were tested for levels at the usual place on the golf links at Banff and that closed field operations for the season.

HOWSE PASS TO BUSH PASS

It is stated in Chapter I, Part II of the Report, with reference to the surveys made in 1917, that the watershed line on leaving the summit of Mt. Conway "descends the mountain on the opposite side, in the same direction, by a southwestern ridge and, passing over an outlying peak, arrives at a broad icefield from the centre of which rises a high pyramid peak which may or may not be a peak of the watershed, the survey not being sufficiently extended to definitely determine this point."

The surveys of 1918 show that the watershed travels southwest in a zigzag fashion from the summit of Mt. Conway for a distance of approximately four and a half miles to the summit of Mt. Lambe 10,438 feet above sea-level. In its course it passes over three other summits of close to ten thousand feet in altitude, which border Conway Icefield at its southeastern extremity and rise as a dividing ridge between that icefield and one lying immediately to the southeast of it.

The high pyramidal peak referred to above as one that may or may not be a peak of the watershed, was seen to rise from the southwestern border of Conway Icefield and to project well towards the middle of it, dividing it into two separate heads of nearly equal dimensions. Owing to its isolated appearance and solitary aspect it was given the name, Mt. Solitaire. It is more than a mile from the watershed, which at Mt. Lambe changes its course from southwest to southeast. Conway Icefield has an area of approximately five square miles and the icefield southeast of it an area of approximately three and a half square miles. Conway Creek has its source in the outflow from the tongue of Conway Glacier. It flows, a strong stream, first over a shingle bed for one mile and then through a short rock cañon, from which it emerges again to a shingle bed and passes within ten chains of the actual summit of Howse Pass, and lies only ten feet below it.

At Mt. Lambe, as previously stated, the watershed line turns at right angles to its previous course and runs southeast for a little over a mile and a quarter to Mt. Whiteaves, 10,300 feet in altitude. It then turns again to the southwest for nearly a mile and a half to the summit of an elongated snow-clad mountain of 10,320 feet, shown on map sheet No. 18 of the atlas as Mt. Barlow, passing en route over Mt. Low, a rock peak of 10,075 feet.

For a little over four miles the watershed now takes a course nearly due west. In this course, which is somewhat erratic, it passes over a number of snow-covered elevations showing precipitous rock faces, and culminates in Mt. Nanga Parbat, 10,780 feet, and Mt. Trutch, 10,690 feet, as shown on sheet No. 18.

In the foregoing courses from Mt. Lambe the watershed is the southern boundary of Freshfield Icefield. On the opposite, or British Columbia side, the

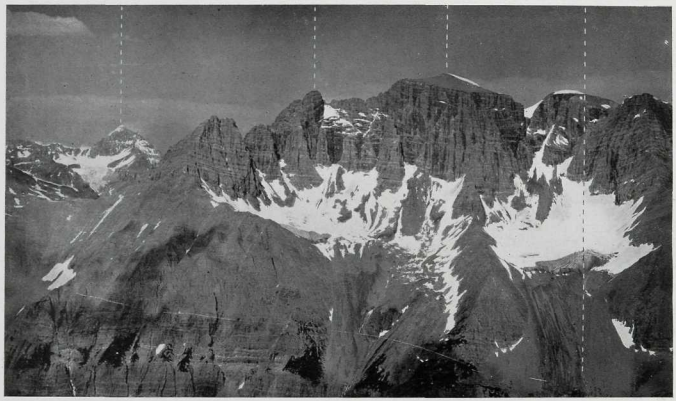
FRESHFIELD GLACIER AND BARNARD-DENT GROUP

glaciers of Mt. Mummery descend in magnificent broken icefalls to the Blaeberry River Valley. Directly north of Mt. Mummery and west of the glaciers there heads a deep valley which may well be the source of Waitabit Creek, a stream joining Columbia River near Donald on the Canadian Pacific Railway, although it is not definitely known that such is the case.

From the western extremity of the above mentioned four-mile course, the watershed travels northwesterly for one mile to the summit of Mt. Barnard, 10,955 feet, and then northerly for three-quarters of a mile to the summit of Mt. Bulyea, 10,900 feet. Directly northeast lies Mt. Walker, 10,835 feet. From Mt. Bulyea the line continues northwesterly and northerly for three-quarters of a mile to the summit of Mt. Pilkington, 10,830 feet, en route passing over Prior Peak, 10,750 feet. It then proceeds north along the ridge of Mt. Pilkington for three-eighths of a mile to an unnamed peak having an elevation 10,610 feet,

whence it curves northwesterly for nearly a mile and a half to the summit of Mt. Freshfield, 10,945 feet. This mountain has given the name to the icefield and its principal glacier lying east and north of it. Continuing in a general northwesterly direction the watershed now follows the ridge another mile and a half to the summit of Mt. Dent, 10,720 feet, and a half mile farther in the same direction to the summit of Pangman Peak, 10,420 feet. Leaving Pangman Peak, it follows the ridge around a series of snow deposits for three miles to Bush Pass S. camera station, and along its route passes over four minor peaks, with a maximum elevation of 9500 feet.

Less than an eighth of a mile beyond Bush Pass S. camera station the watershed leaves the ridge and, turning to the northwest, descends directly to



SHOWING PRECIPITOUS SOUTHWEST FACE OF BARNARD-DENT GROUP

the summit of Bush Pass which it crosses, and ascends the slope on the opposite side in the same direction. The ridge continues east for two miles and then north and northeasterly between the valleys of Forbes Brook and Freshfield Glacier and Brook. It is a rough and ragged mass of rock culminating in Coronation Mountain, 10,420 feet, and holding a number of glaciers in deeply eroded cirques on both its sides which send their run-off respectively to the streams mentioned.

All this portion of the watershed, from Mt. Lambe to Bush Pass S. station, as well as the ridge extending from Mt. Lambe northwest and northeast around Conway Glacier, and Coronation Mountain Ridge, forms a main basin which contains the wide tract of ice and snow shown on the map as Freshfield Icefield

and Glacier. With its many confluent smaller glaciers and their minor snow basins this area of ice and snow may roughly be estimated at twenty square miles.

West of the Barnard-Dent group and north of the headwaters basin of Waitabit Creek lies Campbell Icefield, the run-off from which feeds a tributary of the south branch of Bush River flowing north and a branch of Waitabit Creek flowing south. This icefield contains an approximate area of six square miles. On this side, the rock escarpment of the Barnard-Dent group is boldly precipitous.

BUSH PASS

History and Origin of Name.—Bush Pass seems to have derived its name from the fact that it offers a fairly easy passage for foot travel from the Saskatchewan River headwaters, via Howse River and Forbes Brook, across the main divide of the Rockies to the Columbia River Valley by way of the south and main branches of Bush River. As it now stands, the pass summit is not a feasible crossing for pack animals, but no very great amount of work would be required to make it so and it could be crossed provided the snow lying on the crest of the pass was in a sufficiently hard condition for horses to travel over.

The first recorded exploration of the pass was made in 1902 by Dr. Norman Collie, Sir James Outram, and G. M. Weed, members of a party who had that year made the first ascents of Mt. Freshfield, Mt. Forbes, and other peaks. Of the party, Dr. Collie, H. E. M. Stutfield, and H. Woolley were well known members of the Alpine Club, England, and G. M. Weed was a member of the Appalachian Mountain Club of Boston, Mass., U.S.A. They were accompanied by two famous professional Swiss guides, Christian and Hans Kaufmann of Grindelwald. Dr. Collie is responsible for the first detailed map of the region, published in the Geographical Journal in 1903, than which no better map has been made up to the present date of issue.

It had been a moot question for some years whether or not a serviceable pass over the Great Divide existed between Howse Pass and Thompson Pass, some fifty miles to the north. The exploration, referred to above, settled the question and also established the fact that pack animals could not be taken over it.

Topography and Characteristics.—Bush Pass summit lies in a northwest and southeast direction. The altitude of the lowest part of the summit is 7860 feet above sea-level. The eastern approach is by way of the valley of Forbes Brook, a tributary of Howse River, and the western approach by a tributary of the south branch of Bush River.

The pass is, strictly speaking, a mountaineer's pass, the passage from the east being barred by a wall of rock and steep snow slopes rising sharply about five hundred feet above the general slopes at the end of the valley. The north end of the wall is of broken rock slopes and it might be possible to construct a causeway that would enable pack animals to reach the summit of the pass.

For a mile from its junction with Howse River, Forbes Brook winds in numerous channels over a shingle bed. It then flows between thickly timbered slopes, partly in cañon, for two and a half miles from its junction with Alpland Creek, a strong flowing stream fed by glaciers on the east side of Mt. Forbes. Beyond the junction, Forbes Creek continues between steep timbered slopes, for the most part in cañon, for another two and a half miles. The bed then widens and the stream is again divided into channels flowing over a shingle flat. In the last mile and a half of its course, the stream is fed by numerous torrents rushing down the mountain sides from surrounding glaciers and the way lies up the old morainal bed of the glacier that in bygone days filled the head of the valley, now largely covered by grassy alplands and scattered groups of small spruce trees, to the base of the summit ridge, referred to above. Forbes Brook and the swift torrential stream flowing from Freshfield Icefield form the two principal sources of Howse River.

Midway of the valley of Forbes Brook and two miles north of the stream rise the towering heights of Mt. Forbes, 11,902 feet, in a magnificent snow-clad cone, probably the most striking peak of this portion of the Main Range. It was so named by Dr. Hector (Sir James), geologist to the Palliser expedition, after Prof. James David Forbes (1809-68), a Scottish scientist, sometime principal of the United College of St. Andrews. (see White's Place Names, 1916) On this side several beautiful glaciers with spectacularly broken icefalls send their torrents to swell the volume of Forbes Brook.

Almost directly south of Mt. Forbes, on the opposite side of the stream, rises another fine rock mass, Coronation Mountain, so named by the party who made the first ascent of Mt. Forbes, above referred to, and who conferred the name in honour of the anniversary of the coronation of their majesties King Edward and Queen Alexandra. (See "Climbs and Exploration in the Canadian Rockies," p. 276—Stutfield and Collie, 1903; also "In the Heart of the Canadian Rockies," p. 346—James Outram, 1905).

The summit of Bush Pass is the crest of the rock ridge. It is about half a mile wide between the steep slopes which contain it and is composed of gently sloping rock elevations with snow lying in the hollows. The rocks have been highly glaciated and are rounded and smoothed by the action of the ice. The extent of the summit of the ridge is about a quarter of a mile, when it falls southwesterly in steep, rocky, and grass-covered slopes for about 1700 feet to a tributary of the south branch of Bush River. This tributary collects the flow from the pass and from numerous glaciers lying in deep basins carved in the rugged mountain masses enclosing the valley, and particularly from a great ice-filled cirque directly below the pass summit on the north side, which provides the main source of the stream.

Two and three-quarters miles down, this tributary joins the main stream of the south branch, which has its chief source from Campbell Glacier and Icefield, lying a mile and three-quarters above the junction in a southeasterly

direction. The icefield, as previously stated, lies on the southwest side of the Barnard-Dent group and is approximately six square miles in area. Southward it drains to the headwaters of Waitabit Creek.

Beyond the rock ridge bounding Campbell Icefield on the southwest is a wide valley in which flows a stream that appears to be one of the sources of Waitabit Creek, but may possibly be a tributary of the south branch of Bush River. According to Dr. Collie's map the first supposition holds good, but the survey was not extended far enough westerly to establish with certainty the ultimate direction of its flow.

Below the junction, the south branch of Bush River flows for several miles, spread over a shingle flat, in a deep trench-like valley and then in a narrow channel through cañon; farther on the bed again opens out in a shingle flat.

Boundary Line.—The direction and character of the watershed from Howse Pass to Bush Pass have already been described above. Owing to the inaccessibility of Bush Pass from the eastern (Alberta) side and the unlikelihood of its being used for general travel in the near future, if at all, it is not considered necessary to make a monument survey of the summit.

The following camera and transit stations were occupied during the past season to obtain data to map the country adjacent to the watershed between Howse Pass and Bush Pass viz.:— on the watershed, Mt. Lambe, 10,438 feet; Bush Pass S., 9247 feet, and Bush Pass Summit, 7860 feet; east of the watershed, Mt. Bergne, 10,420 feet and Coronation Mountain, 10,380 feet; west of the watershed, Barnard Shoulder, 9113 feet, Campbell Glacier W., 8740 feet, Freshfield W., 9090 feet, and Bush River Fork, 8179 feet.

BUSH PASS TO THOMPSON PASS

From the summit of Bush Pass the watershed lies northwest for one mile to Bush Pass N. Station No. 1. From that point the general course winds a little east of north for one and seven-eighths miles to Forbes W. Station, passing close to the right of a striking peak, Mt. Valenciennes, 10,160 feet in altitude. In its course along the ridge it crosses two snow-covered saddles from which glaciers descend southeasterly to Forbes Brook valley and northwesterly to the valley of Mons Creek, flowing to Icefall Brook, a tributary of the south branch of Bush River; they form the chief source of Mons Creek.

Continuing the same course for half a mile farther, the watershed passes over the highest point of the ridge, Mt. Cambrai, 10,380 feet, and then turns abruptly to a little north of west for one and a quarter miles, passing over two ragged rock elevations, Mts. Messines and St. Julien, 10,290 feet and 10,140 feet, respectively, which lie at the southern border of Mons Icefield. From the latter of these the course is northwesterly, gradually circling northward around Mons Icefield for two miles to the summit of Mons Peak, 10,114 feet in altitude.

From the north and east Mons Peak shows as an isolated snow cone, situated at the western extremity of the icefield. On the map accompanying his book, "In the Heart of the Canadian Rockies," Sir James Outram shows this peak as Mt. Kaufmann, but the name had previously been conferred by Collie and Stutfield on the two peaks situated directly south of Mt. Sarbach on the ridge between the valleys of Howse River and Mistaya River and, consequently, the change to Mons Peak was made. The view from Mons Peak is very impressive. To the north and west it covers much of the wide snow-clad area of the Lyell Icefield and the many glaciers flowing therefrom on the south side; east of Mons Icefield, Mt. Forbes rises, a magnificent snow-covered pyramid outtopping all other peaks in the vicinity, sending down its north and west glaciers as tributaries to the icefield. The icefield is about ten square miles of area.

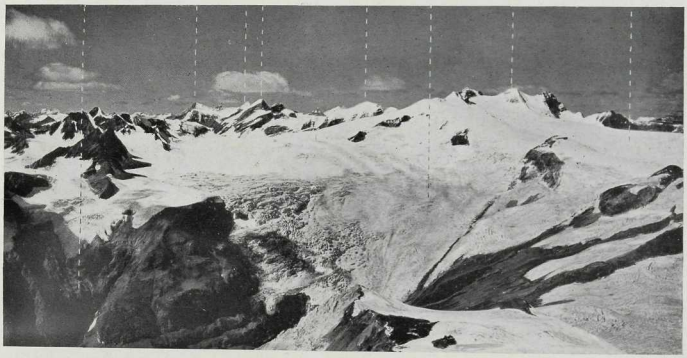
Directly northwest of Mons Peak the southwestern glaciers of the Lyell Icefield collect their outflow in Icefall Brook, a large tributary of the south branch of Bush River, which flows by the eastern base of the Bush Peak of Collie's map (1903). It is a fine isolated mass composed of three separate peaks; the southern or highest, Rostrum Peak, rising 10,770 feet, and the northern, Icefall Peak, 10,420 feet above sea-level; the centre one is a little sharp peak of 10,080 feet.

On map sheet No. 19 this very striking massif is shown as Bush Mountain. It supports two fine glaciers on its eastern flank and stands out prominently as a landmark of the region. Another fine glacier-hung peak named Mt. Kemmel, altitude 10,160 feet, rises two and three-quarters miles north of Bush Mt., and sends a strong tributary to Icefall Brook. On the east side of the same stream still another prominent, isolated peak of 10,180 feet, hung with glaciers, is shown on Collie's map as Snow Peak. It is four miles southwest of Mons Peak and has been named Mt. Arras.

Leaving the summit of Mons Peak the watershed line descends the northeast ridge of the mountain and crosses the icefield near its northwestern extremity; then, ascending a glacier on the opposite side, it arrives at Glacier Lake Station, 9843 feet, at the crest of a high rock ridge between Mons and Lyell Icefields. The distance is two and three-eighths miles and the general direction north-northeast. From Glacier Lake Station the watershed turns northwest and follows the ridge, which is soon submerged in the Lyell Icefield, to the most southern peak of Mt. Lyell, No. 5, 11,150 feet, a distance of five and three-quarters miles.

Mt. Lyell stands at the northern extremity of a wide icefield which is split into two nearly equal parts by the watershed. The mass of the mountain is composed of five distinct peaks of which No. 1 stands at the extreme northeastern edge. Nos. 2 and 3 are of equal altitude, 11,495 feet, No. 2 is snowcovered and dome-shaped; the others are for the most part bare rock peaks rising from the snow. Lyell Icefield is a tremendous body of ice and snow, lying at a great elevation, which overflows to the south by many glaciers showing exceptionally fine icefalls. On the Alberta side a large southeastern glacier

with very spectacular icefalls supplies the main initial source of Glacier River, a tributary of Howse River. Close to the termination of the glacier the ice breaks over a bold rock precipice and throughout the warm summer days great masses of ice fall over this precipice with a thunderous roar, creating huge piles of broken ice and powdered snow at its foot. On the British Columbia side there is one large, much-broken icefall and many smaller ones, which send their run-off to make Icefall Brook, flowing southwesterly. This stream, together with that flowing from Campbell Icefield and Glacier, forms the main south branch of Bush River. Westward the Lyell Icefield sends out a large glacier, or series of glaciers, which are the source of Lyell Creek, another strong tributary of Bush River, flowing at the southern base of Mt. Alexandra. Lyell Creek joins the north branch of Bush River some three miles above the junction of the north and south branches. The area of the Lyell Icefield, with its outflowing glaciers is approximately twenty square miles.

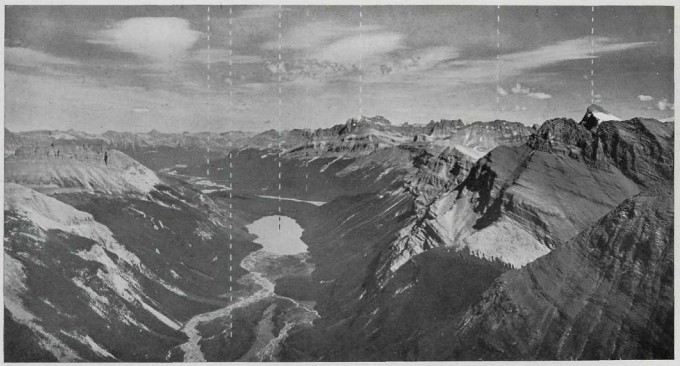


Mt. Lyell and Lyell Icefield Showing Southwest Glaciers

Glacier River receives its main supply from the most easterly of the glaciers of the Lyell Icefield and from the outflow of Mons Glacier, which joins the outflow from Lyell Glacier where it leaves the ice. Below the icefall of these two glaciers is a widespread morainal delta, through which the stream wanders in many channels over a shingle bed and between bunches of spruce trees like islands for a distance of three and a half miles, when it empties into Glacier Lake. The lake is a fine sheet of water of that exquisite blue colour that is only seen in mountain lakes, fed by glacial run-off, that lie close to their source of

supply. It is two and a quarter miles long with an average width of about half a mile. The stream flowing from the lower end joins Howse River after about a mile and a half run over a swift course.

Eastward from Lyell Icefield and directly southeast of the main snow dome of the mountain, a glacier has broken through the rock wall and descends in a shattered icefall to the Valley of the Lakes. It is a narrow valley lying between strikingly precipitous mountain sides, those of the north face of Mt. Sullivan being truly wonderful in the immensity of their sheer heights, which rise thousands of feet in unbroken precipices. The stream flowing from the glacier is split into various channels over a shingle bed and the many little



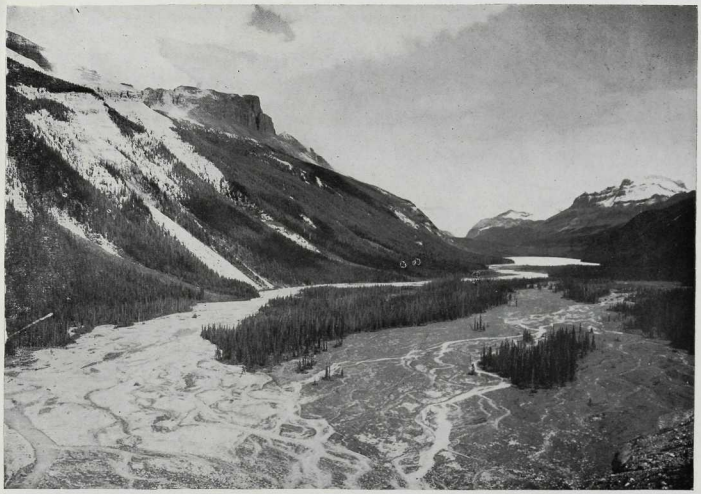
GLACIER RIVER AND LAKE

lakes that are scattered through the valley bottom have given it the name. After a northwesterly run of about eight miles, the stream joins Saskatchewan River directly opposite the southwest face of Mt. Wilson and about three and a half miles above the junction with Howse River.

As already stated, the mass of Mt. Lyell comprises five distinct peaks. Three, Nos. 5, 4 and 3, lying in a nearly due north and south direction, are crossed by the watershed. The most northerly of the three is the highest, 11,495 feet. From it, in a line northeasterly, lie two others of which the centre one, peak No. 2, is an immense snow dome, also 11,495 feet in altitude; peak No. 1, the most northeasterly, is 11,370 feet. From peak No. 5, 11,150 feet, the

watershed line travels a little west of north to peak No. 4, 11,260 feet, and then in the same direction to peak No. 3, the distance between the outlying peaks of the three being practically one mile.

On its northern face Mt. Lyell sends down three distinct glaciers, which help to furnish the initial supply of Alexandra River. The two western, starting from a joint source, separate and then join again; farther on, the united flow of the ice merges with the eastern glacier from the heights of Mt. Alexandra. These two icefalls from Mts. Lyell and Alexandra, both wildly broken and extremely picturesque, are the actual source of Alexandra River.



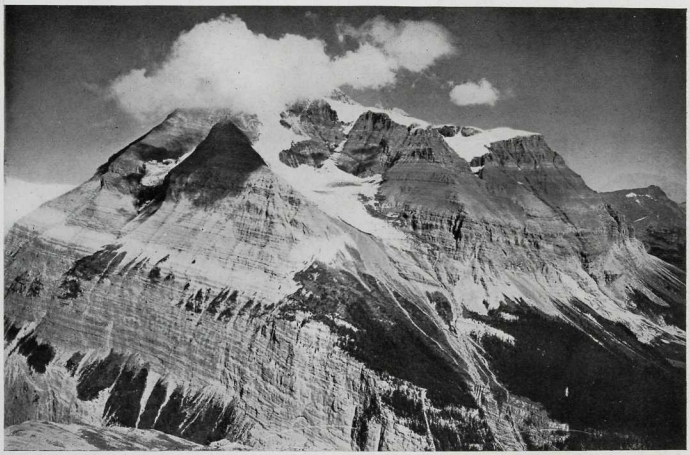
MORAINAL BED OF GLACIER RIVER AND LAKE
Showing Channels and Timber Islands

From peak No. 3 of Mt. Lyell the watershed turns west and then northwest to Mt. Farbus, 10,550 feet, describing a bow over a distance of one and a half miles. It then continues north for another mile to the summit of Mt. Oppy, 10,940 feet, and from there, swinging a little more to the south, proceeds on an erratic course for two and a half miles to the summit of Mt. Alexandra, at one and three-quarters miles passing over a peak of 10,230 feet, which has been named Mt. Douai.

From peak No. 5 of Mt. Lyell to Mt. Alexandra the watershed is the boundary of a deep, highly glaciated basin situated on the west side of the Divide, which collects the headwaters of Lyell Creek. Into this basin Lyell

Icefield sends a great icefall and glaciers descend to it from the heights of Mts. Farbus, Oppy and Douai. A glacier from Mt. Alexandra also falls into it. During the past season it was found impossible to map the basin, owing to the great difficulties of approach and the necessity of first cutting out a route from the summit of Thompson Pass through the forest to Bush River. Lyell Creek is a tributary of Bush River and can be reached only from the valley of the latter. Information required for mapping this area will be obtained next season.

From Mt. Alexandra the watershed continues straight north to a peak of 10,990 feet altitude, an outlying elevation of Mt. Alexandra. From this peak two striking glaciers send their icefalls eastward to the main Alexandra Glacier. Continuing, the watershed circles north and northwest one and a quarter miles



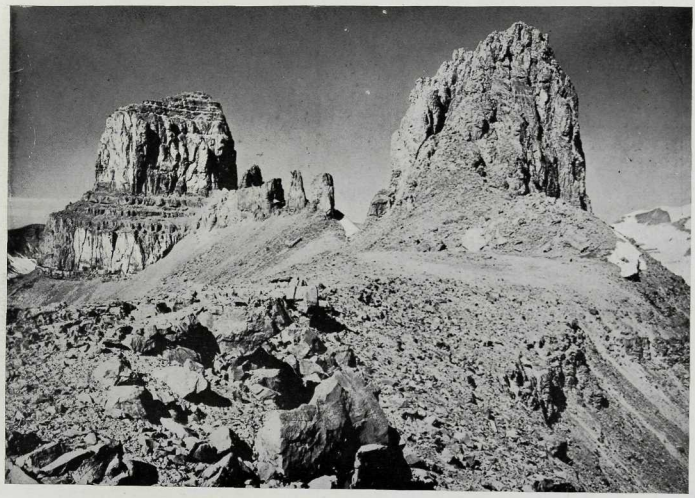
MT. BRYCE
Looking North

to the summit of Mt. Fresnoy, 10,730 feet. Between Mt. Fresnoy and Mt. Alexandra the West Alexandra Glacier gives rise to the south branch of Rice Brook.

From Mt. Fresnoy the watershed lies northwesterly for one and three-quarters miles to the summit of Mt. Spring Rice, 10,745 feet, passing to the right of Mt. Queant, 10,200 feet. Mt. Spring Rice is the southern massif dominating the gap through the crest of the range, known as Thompson Pass. South and southwest of Mt. Spring Rice two good-sized glaciers send their outflow to the south branch of Rice Brook. They are shown on map sheet No. 20 as the South Rice Glaciers. The massif has been named Mt. Spring Rice for Sir

Cecil Spring Rice, British ambassador to the United States. It occupies a position on the southeast side of Thompson Pass gap similar to that occupied by Mt. Bryce, on the northwest side, which is named for the Right Hon. Viscount Bryce, also a British ambassador to the United States.

North of Mt. Spring Rice a glacier formed in a cirque of the mountains furnishes a water supply for the north branch of Rice Brook, which joins the south branch, referred to above, about three miles southwest of Thompson Pass. Eastward Mt. Spring Rice sends a fine glacier, very picturesquely enclosed by precipices and high rock ridges, which, after a flow of some three miles, merges with Alexandra Glacier above the junction of the glacier from Mt. Lyell and is one of the main sources of Alexandra River.



THE CASTELETS NEAR MT. SASKATCHEWAN S. STATION
Map Sheet 20

Directly below the tongue of the united glaciers from Mts. Lyell, Alexandra, and Spring Rice the river begins its flow. A mile from its source it is joined by a strong flowing stream named Castleguard River, which has its course in a deep, timbered valley and receives its supply from a number of glaciers descending from the Columbia icefield on its southeastern side.

Below the junction, in fact for all of its course, Alexandra River flows in numerous channels over a wide shingle bed. After a run of about fourteen miles it joins Saskatchewan River, also flowing in a wide shingle bed. Near the

mouth are wide marshy meadows, which gradually merge into pure shingle as the stream is ascended. Up this valley a branch of the pony trail traversing the Saskatchewan Valley leads along the shingle flats, crossing very numerous channels often deep and swift, and shortly before the junction of Castleguard River is reached, turns up the valley of the latter stream for five and a half miles. It now crosses the river and leaves it, turning southwest and climbing the hillside to the gap of Thompson Pass, distant three miles farther by trail.

From the summit of Mt. Spring Rice, the watershed curves east and northeast for one and a quarter miles, en route passing over a ragged ridge of the mountain which rises in two minor high peaks over 10,000 feet in altitude to

SHOWING ALEXANDRA AND SASKATCHEWAN RIVERS AT THEIR JUNCTION

Rice E. camera station, 10,023 feet, set on an outstanding rock point overlooking the southern portion of the Columbia Icefield and the valleys of Castleguard and Alexandra Rivers.

The watershed then turns directly northwest and in a little over another mile and a quarter arrives at the summit of Watchman Peak, 9873 feet, so called owing to its strikingly isolated appearance as a solitary guardian of this gateway through the crest of the main range. From the summit of Watchman Peak the general course of the watershed is nearly due west for one and three-quarters miles to the lowest point of the summit of Thompson Pass, 6511 feet above sea-level.

THOMPSON PASS

History and origin of Name.—In the year 1900 Mr. C. S. Thompson, a member of the Appalachian Mountain club of Boston, travelled up Alexandra River (west branch of North Saskatchewan River) to the junction of Castleguard River, ascended the valley of that stream to near its source from Columbia Icefield, and striking southwest to the gap through the range, explored the pass over the watershed. On this account it has been named Thompson Pass.

In his book "In the Heart of the Canadian Rockies," page 362, Sir James Outram states that "Indians have used it in ancient times as a highway across the Divide, coming up the North Fork or by way of Pinto Pass from Cataract Valley, east of Mt. Wilson." This may have been the case and they may have travelled to the summit of the pass on their hunting expeditions, for it is a beautiful alpine spot well supplied with horse-feed and all the requisites for a protracted camp. If they did, however, it must have been in times long gone by, for no signs remain of such travel and, once the Castleguard River is left behind, there is only a faint horse track up the slopes leading to the summit of the pass. When the steep hill is climbed and the more level stretch of alplands on the east side of the pass is reached, the track becomes still more indefinite and is lost amidst the many game trails. Beyond the summit, on the west side, a possible track may be followed for a short distance but it then disappears altogether. Down the valley of the north branch of Rice Brook flowing to Bush River, no trail or horse track of any kind was found and one had to be cut out. Moreover, at the pass summit no old teepee poles were seen, such as are still found at all old Indian camp grounds, where the fallen and rotted teepee poles usually tell the tale.

The valley on the west side of the pass is narrow, dark and heavily timbered. The tracks of previous snowslides from the precipitous heights of Mt. Spring Rice on the south and Mt. Bryce on the north are grown thickly with alder bushes and offer little inducement for further travel. The distance from the pass summit to the junction of Rice Brook with the north branch of Bush River is from twelve to fifteen miles and the valley is densely timbered all the way. The valley of Bush River presents a wide shingle bed with heavy forest extending to timberline on both sides and the same forest conditions are found in all the tributary valleys to the head of the north branch.

Bush River flows into the Columbia some forty miles northwest of Donald, B.C., on the Canadian Pacific Railway, and travel in its valley is very difficult. Collie and Stutfield's party discovered this to their sorrow in their expedition of 1900, when they travelled up Bush River nearly to the mouth of Lyell Creek. The account of the expedition is very graphically set forth in Stutfield and Collie's book, "Climbs and Exploration in the Canadian Rockies," chapters 9 and 10, which are full of woe.

Topography and Characteristics.—The general trend of the pass is northeast and southwest. The summit lies in a northwest and southeast direction.

The altitude of the lowest part is 6511 feet. The eastern approach from the Saskatchewan Valley is by way of Alexandra and Castleguard Rivers, and the western approach by Bush River, Rice Brook and the north branch of the latter.

As already stated, the eastern approach is by the valley of Castleguard River for five and a half miles from its mouth, when the river is left and an ascent made up the hillside southwesterly. Midway to the pass summit, a little over a mile distant from the river by trail, is situated on a bench of land a beautiful little blue-green lake, Watchman Lake, directly below the towering heights of Watchman Peak. The trail circles its western end and then zig-zags up a steep hill and across some rolling alplands, again for slightly over a mile, to the summit of the pass.

Almost at the summit is another delightful but smaller lake, Cinema Lake, of quite as rich colouring as the first one. It also lies directly below the heights of Watchman Peak, which tower perpendicularly above it. Between the two lakes, at the top of the hill, there lies a park-like alpine tract of alternating meadowland and groves of spruce trees. Undulating timbered ridges enclose little valleys of grassy herbage and in summer time the place is one of Nature's beautiful gardens, found only at these high mountain altitudes. Excellent feed for horses is here in great abundance.

Southwest of the summit, on the British Columbia side of the pass, is a little pond surrounded by a small meadow of tall grass where the horses of the pack train congregated in luxury until it was all eaten. A steep descent on this side leads to the valley of the north branch of Rice Brook. It is a comparatively narrow valley enclosed by the towering precipices of Mt. Bryce on the north and of Mt. Spring Rice on the south. North Rice Glacier, referred to above, has flowed down into the valley and has made an awful mess of it, filling it with broken timber and debris, and making it difficult to find a pathway. Below the ice many snowslides from the heights of Mt. Bryce and Mt. Spring Rice, on opposite sides of the valley, have grown up with thick alders, through which it is very arduous work cutting a trail.

The stream descends rapidly with torrential force and at the junction of the north and south branches, three miles from the pass summit, has fallen 1750 feet. The valley of the south branch of Rice Brook is even steeper and more difficult of approach, owing to the cañon-like nature of the depression. It was a very arduous task occupying the two camera stations Bryce S. and Rice W., which are situated on the heights beyond the south branch, and entailed a climb up tremendously steep slopes for 2000 feet through thick timber, windfall and dense undergrowth.

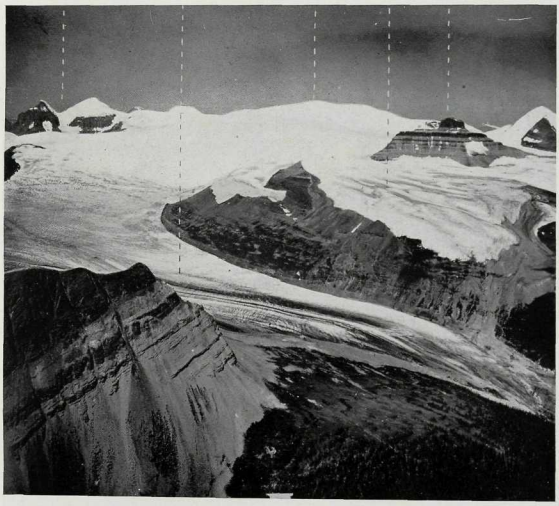
The ascent from Castleguard River to the summit of the pass on the Alberta side is fairly steep, 1000 feet in about two miles, but there is only one very steep hill—that between the two lakes, about 500 feet in a distance of a third of a mile. On the western, or British Columbia side, the descent is pretty steep, about 1750 feet in three miles but, except directly at the summit, it is more or less

gradual. If necessary, a road could be constructed without a great deal of difficulty, but it is doubtful whether one will be required in the near future, or unless some economic discovery should make it imperative.

North of Thompson Pass and Mt. Bryce lies the great Columbia Icefield, which has been reported to contain some two hundred square miles of ice and snow. This estimate appears to be very greatly exaggerated and when the survey is completed, it is expected that the estimate will be at least, cut in half.

In the centre of the southern border of the icefield is a very striking rock massif which, from its commanding position and battlemented style of architecture, has been named Mt. Castleguard. The icefield sends down three

The Twins Castleguard Gl. The Snow Dome Castleguard Glacier Mt. Castleguard



COLUMBIA ICEFIELD, LOOKING NORTH
Showing Mt. Castleguard and Glaciers

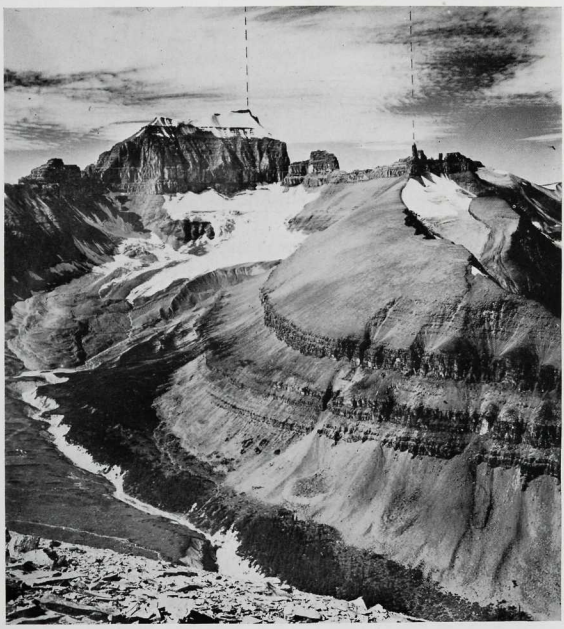
glaciers with strong ice flows, one directly in front of it and one on each side. The water supply from these three furnishes the source of the large stream joining Alexandra River a mile from its origin which, on that account, has been named Castleguard River.

Directly to the east, a low trench, between the icefield and the group of which Mt. Saskatchewan is the dominating mass, leads to Saskatchewan Glacier, a large ice-stream furnishing the main source of Saskatchewan River.

There are many other large glaciers flowing from the Columbia Icefield, noticeably: Athabaska Glacier (the source of the Sunwapta branch of Athabaska River), Dome Glacier and Columbia Glacier (the source of Bush River) and those on the north and west sides of the icefield, not yet definitely located or named.

On the east side of Castleguard River a group of mountain elevations is of remarkable appearance, owing to its brown sandstone heights with surmounting

Mt. Saskatchewan Lighthouse Tower



MT. SASKATCHEWAN

caps of grey limestone and parallel lines of horizontal strata. Mt. Saskatchewan, rising to an elevation of 10,964 feet, dominates the group. It has several glaciers and bold precipices of sheer rock. Seen from the approach up Saskatchewan River, before the junction with Alexandra River is reached, a very striking and unique feature presents itself as one travels up the pony trail: On the eastern

ridge from the main mountain mass an isolated obelisk of rock rises like a huge light house. From the valley it is the only one that can be seen, although other rock towers are near it when seen from a height. It is a long distance from the main mass and the resemblance to a lighthouse is very apparent.

At the head of Castleguard River the tributary streams from the several glaciers and from the trench-like depression referred to present some very picturesque waterfalls. The entire vicinity is one of great mountain splendour and can hardly be surpassed for its unique collection of alpine characteristics.

Boundary Line.—A detailed description of the course of the watershed from Bush Pass to Thompson Pass is given above.

The gap at the summit of the pass is a narrow one, not much exceeding half a mile in width between the rock walls enclosing it. The watershed follows a ridge of rock which clearly defines the summit and for some distance on each side of the ridge the approaches are fairly level, then fall off steeply in both directions.

Failing an economic discovery of mineral, or other such cause, it does not seem likely that there will be need for a road in the future, so it does not appear desirable therefore that the Commission should, at the present time, incur the expense of a detailed instrumental survey of the watershed across the pass and the marking of the same by concrete monuments. Owing to the difficulty of approach the expense of such a survey would be great. On the other hand the position of the pass is a central one and it may some day be valuable to connect the prairie country with the Columbia River, via the Saskatchewan and Alexandra Rivers on the eastern side and Bush River on the western side.

The following camera stations were occupied to locate the watershed and map the adjoining country between Bush and Thompson Passes:

On the watershed:—Bush Pass N., No. 1, 9312 feet; No. 2, 9043 feet; Forbes W., 10,014 feet; Mons Peak, 10,114 feet; Glacier Lake, 9843 feet; Rice E., No. 1, 10,023 feet; Watchman Peak, 9873 feet.

East of the watershed:—Mt. David, 8986 feet; Lake Moraine, 5116 feet; Arctomys Peak, 9162 feet; Lagomys Peak, 9318 feet; Mt. Sarbach, 10,153 feet; Rice E., No. 2, 9956 feet; Mt. Saskatchewan S., 9002 feet; Mt. Saskatchewan E., No. 1, 8637 feet; No. 2, 8458 feet.

West of the watershed:—Bush Pass W., 9854 feet; Rice W., 8489 feet; Bryce S., No. 1, 7962 feet; No. 2, 8060 feet.

NORTH OF THOMPSON PASS

Leaving Thompson Pass Summit, the watershed travels due northwest for seven-eighths of a mile; then, turning a little east of north, in half a mile it arrives at Thompson Pass N. camera station, 8943 feet, set on a rock point that, from the valley below, looks much like Watchman Peak, but on a smaller scale. It stands, the northern gatepost of the gap of the pass, as Watchman Peak does the south.

From Thompson Pass N. station the direction of the watershed is northwest for one and a half miles to Bryce N.E. camera station, 9577 feet, a commanding point overlooking the Columbia Icefield and giving a good view of Mt. Columbia, the Twins, the Dome, Mt. Athabaska, and Mt. Saskatchewan of Collie's map. Southwest of the ridge on which the camera station is set, the outflow from a glacier formed in a cirque of Mt. Bryce helps swell the torrent of the north branch of Rice Brook. West of the ridge and north of Mt. Bryce, a glacier from the Columbia Icefield sends a tributary stream to the north branch of Bush River.

Bryce N.E. station is the most northerly one occupied and from that point on, the watershed has not yet been definitely located.

GENERAL REMARKS

Watershed.—From Howse Pass to Thompson Pass the course of the watershed, although in general direction northwesterly, is very erratic. At Howse Pass it describes a great curve southward nearly to Mt. Mummery, then swings almost due north along the crest of the Barnard-Dent group to Bush Pass, from which the general course is slightly more westerly to Mt. Lyell. From there it lies in a general direction northwest by west to Thompson Pass and then nearly due north to the Columbia Icefield. Probably the most striking feature of this section of the watershed is the numerous great bodies of ice and snow that are accumulated along the crest of the main divide range and the large number of wonderfully broken icefalls they send down in every direction. Apparently the supreme climax of the main range is reached in the Columbia Icefield, the only other point that could possibly claim such distinction being the area centering around Mt. Robson, some one hundred and twenty miles to the northwest. Notwithstanding, the Mummery, Freshfield, Lyell and Alexandra aggregations are very remarkable and exhibit exceedingly beautiful examples of alpine scenic splendours on a smaller scale.

Trails.—On the eastern or Alberta side of the main range the facilities for travel are much easier. Owing to the less dense forest growth and the wide tracts of open grassy slopes, or alplands as they are called, trails for pack and saddle ponies can be located and cut out without very great difficulty, and many such trails are in existence along the principal routes of travel. The open tracts directly below the rock peaks furnish good ranging grounds for wild game and the Indian hunters of the past have made many paths leading up the more prominent valleys to reach them. In this section, also, the larger streams, created by the outflow from the great bodies of snow along the crest of the range, have carved out wide shingle beds at the bottoms of the valleys, through which they wind in innumerable intersecting channels. These shingle beds and the meadows along their margins afford comparatively easy facilities for travel and furnish excellent pasture lands for the transport animals in use.

On the other hand, on the British Columbia side of the divide, the valleys are deep and narrow and the forest growth is much more dense. The meadow-like alplands are not nearly so extensive and the valleys are difficult of access; consequently, travel and hunting have not been so attractive and there are few trails, those in existence having been almost obliterated by overgrowth and windfall.

There is an abundance of horse-feed along most of the routes on the eastern side and little difficulty concerning this necessity is experienced, but on the western side there are few open areas within reach and horse feed becomes a difficult problem.

Rivers and Streams.—The large accumulations of ice and snow and their overflowing glaciers send down torrents of muddy water in every direction and consequently the terrain is carved into a network of valleys, great and small. In the case of the larger streams, like the Saskatchewan, Bush, Alexandra and Howse Rivers, the wide valleys are of comparatively easy grades, and their beds have been converted into broad shingle flats through which the streams flow in many channels. Owing to the large quantities of silt held in suspension by the rapid flow, the waters are mud coloured from spring to autumn. In the smaller streams the shingle flats are not so numerous and often the torrent is restricted by a deep rock-walled cañon. As would be expected, waterfalls, some delightfully picturesque, are seen along the mountain sides in every direction. Contrary to ordinary conditions at lower altitudes the hottest part of the summer is the season of high water, and bright sunny days send down floods from the rapidly melting snows above; the hotter the day the higher the water in the streams. A stream forded easily in the early morning is often a raging, impassable torrent at night. The muddy condition of the streams frequently creates a problem with regard to drinking water and having none other for a lengthy period is the reverse of healthy, and is said to lead to the disease known as goitre.

Timber.—The timber is practically the same with slight variations, as found in the southern parts along the watershed, referred to in previous chapters. On the eastern slopes the principal species are pine, *Pinus Murrayana*, spruce, *Picea Engelmanni*, poplar, *Populus tremuloides*, and willow, at the lower altitudes; higher up are: spruce, balsam, *Abies-sub-alpina*, and larch, *Larix Lyallii*, the highest up, which is common south of Howse Pass but seems to get more scarce as one proceeds northward. On the western slopes the same species occur except that the pine becomes less frequent and the spruce and balsam more plentiful. Douglas fir, *Pseudotsuga Douglassi*, is plentiful and in some cases it has advanced over the watershed and is found at the heads of valleys draining eastward and near the summits of the passes. On the west side also, the underbrush becomes much more dense and the slopes are thickly clad with the bush huckleberry, *Vaccinium*, of the black and blue varieties, and other growths, making travel very difficult. In damp places and particularly on the paths of snow-slides from which the heavy timber has been swept, alder brush and the

poisonous devil's club are found in impenetrable thickets. Much of the timber on both sides of the watershed is of merchantable quality but the difficulties of transporting it to a manufacturing centre are prohibitive.

Game and Fish.—Rocky Mountain goat were seen high up on the peaks, and are numerous. The tracks of elk and smaller deer were plentiful in the valleys, but the animals are wild and were seldom seen. Grizzly and brown bears were occasionally seen. The woods are full of grouse, and ptarmigan frequent the alpine tracts above tree-line.

There may be trout and other kinds of fish in the Saskatchewan River but the waters were so muddy that none were seen. They do not seem to inhabit waters near the icefields for none were seen in the lakes where the water is clear, although trout are reported to have been caught in Glacier Lake, which is drained by a tributary of the Saskatchewan River. Their apparent scarcity may be due to lack of suitable food.

MAPS

Sheets Nos. 18, 19 and 20 accompany this chapter of the report.

CHAPTER III

TOPOGRAPHICAL SURVEYS EXECUTED IN 1919

Description of Operations

As in previous years the Topographical Division organized at Banff, Alberta, and having tested the cameras and photographic plates by the usual methods, left that place for Lake Louise Station with a pack train on June 20th. Lake Louise Station was reached on the 22nd and on the 23rd the party started for Thompson Pass, travelling via Bow River Valley and Pass, Mistaya River Valley and the valleys of the Saskatchewan, Alexandra and Castleguard Rivers.

The party arrived at Thompson Pass on June 28th, after six days of steady travel over trails much impeded by the winter's windfall that had to be cleared out in many places in order to make them passable. Taken throughout the trails are primitive and, with the exception of that from Lake Louise Station to the Saskatchewan, which is kept in a semblance of shape by the Dominion Parks Branch and the Forestry Branch for the use of rangers, are only maintained by the intermittent parties of tourists with their pack trains which pass along them from time to time during the summer months.

The trail from the Saskatchewan, where it is joined by the Mistaya, up the Saskatchewan Valley, over Wilcox Pass and down the Athabaska River Valley to Jasper, on the Canadian National Railways, is the main line of mountain travel and some improvement might be made to it with considerable advantage to travellers.

At Thompson Pass camp was pitched at the same spot as in 1918 and June 29th spent in getting ready to take a sub-camp down the north branch of Rice Brook on the west side of the pass. It was desired to get to the head of the south branch of Rice Brook and so cover the country at the head of Lyell Creek which it had been found impossible to map from the 1918 surveys. It was also desired to push on down Rice Brook from the junction of the north and south branches to the Bush River Valley and there to gather information for mapping the country adjoining the continental watershed on the British Columbia side.

A camp was made near the junction of the two branches of Rice Brook and a path cut out through the forest on the northeast side of the south branch in order to pass a deep cañon in which the stream flows close to its mouth. An attempt was made to take pack horses along it to the head of the valley, but at the first trial five of the horses fell with their loads owing to the steepness of the mountain side and the insecure footing. One horse was badly hurt and eventually had to be shot. Fortunately it was the worst horse of the bunch.

It was found impossible to get horses past the cañon, so there was nothing for it but to pack a camp outfit on the backs of the party to the head of the valley, which was done and a sufficient number of stations occupied to cover the Lyell Creek basin at its head.

An attempt was next made to get down the valley of the main stream below the junction of the two branches of Rice Brook to Bush River, but here again we were stopped by a deep rock cañon and, after an ineffectual attempt to cut a trail over the mountain slopes to the south, had to give it up owing to rock precipices that barred the way.

The party returned to Thompson Pass on July 16th and camped near the head of Castleguard River. July 17th it rained all day and July 18th was spent in cutting out a trail to get the camp to the wide, open depression lying south of the Columbia Icefield where the Saskatchewan Glacier flows from it. Here are broad, grassy alplands and belts of timber of park-like appearance. Camp was moved to a suitable location on the 19th.

On the same day a climbing party ascended to the Columbia Icefield and travelled across it towards Mt. Columbia. A station was occupied at the head of Bryce Creek Valley, which stream has its origin in a glacier flowing southerly from the icefield. It was endeavoured by this means to supply, in some measure, the lack of information at the head of Bush River.

July 20th, 21st and 22nd three high stations were occupied along the southern border of the Columbia Icefield and, on the 24th, a try was made for Collie's "Dome," now called Snow Dome, at the centre of the eastern border of the icefield. Clouds settled down before the summit was reached and rendered the attempt unsuccessful. It was a long and arduous snow tramp and was not again attempted, the more especially that the summit is covered with snow and no rock suitable for a station is to be had.

On the 25th a move was made for Wilcox Pass, connecting with the headwaters of the Athabaska River. The party arrived at the southern extremity of the pass on July 31st. In the meantime three stations had been occupied and there were two days of rainy weather.

August 1st and August 7th stations were occupied respectively on Wilcox Pass and Nigel Peak; for the other five days it rained incessantly and clouds covered the mountain tops. A move was made across Wilcox Pass and on the 9th and 10th two stations were occupied. August 12th the party camped on the Sunwapta River and on the 13th an ascent was made of Sunwapta Peak but without avail for the summit remained in clouds the whole day.

All the foregoing stations, occupied since leaving Thompson Pass, ten in number, with the exception of that at the head of Bryce Creek, were for the purpose of covering the Columbia Icefield and the country adjacent to it and to the continental watershed, which lies across it from Thompson Pass to the Dome and from the Dome to Mt. Columbia situated at the northern extremity of the icefield.

August 14th the party started down the Sunwapta Valley for Fortress Pass and Lake. On the 16th the junction of Sunwapta River, or eastern branch of the Athabaska River with the western branch was reached and camp pitched some six miles or so up the valley of the latter.

The trail up the west branch, a poor one but passable and with little cutting to do, was followed to the junction with the Chaba River where the Athabaska was crossed and the journey continued up the valley of the Chaba. Fortress Lake lies in a valley trending very nearly due west from the Athabaska-Chaba Valley. When close to Fortress Lake a wrong trail was followed, which led high up on the mountain side and then dropped steeply to the shore of the lake at a point about two miles or so from its eastern extremity. This trail is a very bad one, much overgrown with brush and impeded by windfall, necessitating a lot of cutting out. It is a hunter's trail around the north border of the lake. The night of August 17th we slept on a small beach in the open, as there was no room to pitch tents. There was no feed for the horses so they remained tied up all night. Next morning the party moved back to where the trail forked and taking the other branch soon arrived at the eastern end of the lake, travelling over a nearly level stretch of country thickly timbered with pine and spruce. Camp was pitched directly at the end of the lake in a marshy, uncomfortable spot.

It was now necessary to get to the western end of Fortress Lake, for the watershed lay along a narrow strip of timbered flat lying between the Chaba River and the east end of the lake, after which it ascended to the crest of Fortress Mountain and practically paralleled the lake at a not very great distance from it on the north side, gradually diverging from it on its western course.

The question was, how best to get to the end of the lake. We had heard that a boat belonging to the Otto Bros., outfitters at Jasper, was there but an afternoon search revealed no sign of it so, on the 19th, all hands turned to and built a four-oared raft which, under the sounding title of "The Fortress Queen" carried a party of five up and down the lake on a cruise from August 21st until September 2nd.

August 20th the climbing party occupied a station on the Great Divide at the southeast corner of the lake. Between August 21st and September 2nd only four stations could be occupied. Bush fire smoke and wet weather militated against photography, and delayed the work. An attempt was made to reach the summit of Chisel Peak, on the south side of the lake, but the dense smoke that overhung the landscape rendered photographing futile.

September 3rd the party moved to the head of the eastern branch of Chaba River. The 4th, 5th, 6th and 7th were wet, cloudy days. On the 8th two stations were occupied, one on Sundial Peak, a high sharp-pointed cone lying east of the glacier at the head of the valley. The camp was moved to the fork of the Chaba on the 9th and on the 10th a station occupied on the north side of the valley of the western branch.

On September 11th a move was made down the Chaba Valley and on the 13th a station occupied at the crest of the spur between the Chaba and the western branch of the Athabaska. A move was made up the western branch on September 14th and on the 15th a peak ascended on the eastern side of the valley, from which very good views were obtained.

September 16th the camp was moved to a point where the river finally forks, one branch heading from a glacier on the east side of Mt. Columbia and the other from a glacier on the west side of Mt. King Edward, which adjoins Mt. Columbia on the west. Two stations were occupied from this camp, one at the summit of a high terraced peak standing out prominently in the valley at the final fork of the river, which has been named Warwick Mountain. It had been sighted upon from the south side of the Columbia Icefield and is a well marked feature. The other station is on the north side of the valley and directly above the glacier from which the southwestern initial branch of the river flows.

September 18th the party moved back down the western branch of the Athabaska and on the 20th arrived at the junction of the Chaba River, the 19th being a day of rain. On the 21st one climbing party occupied a station on the north side of the Athabaska-Chaba Valley, close to Fortress Mt., and the other, which had been left behind on the 18th, made a long and difficult climb to a high peak on the east side of the western branch of the Athabaska in order to connect by angle readings with the stations occupied in the vicinity of Wilcox Pass.

There was now nothing more that could be done in this locality and the equinoctial storms and shorter daylight made it increasingly difficult to get to the summits, obtain the necessary data and get back to camp before dark, so on the 23rd the party started homewards for Banff.

Near the head of Sunwapta River a second attempt was made to occupy Sunwapta Peak. It was very necessary to get angle readings from this station to tie in the work done on the south side of Wilcox Pass with that around the western branch of the Athabaska and Fortress Lake. A start was made at daylight on a fine bright morning. About 10 o'clock, while on the way up, the clouds came down and it began to snow. We waited for a couple of hours in a sheltered spot and then pushed on to the summit, at an altitude of 10,883 feet. Here, conditions were no better and it was much colder in the exposed position. We were just about to give it up and start down when, suddenly, the clouds broke and it cleared in the west for about two hours. This was sufficient to get all the angle readings needed and most of the photographic views. We were not quite finished when quite as suddenly, the clouds closed in again and all was hidden from view. The break seemed a dispensation, for it was three days later before the weather cleared sufficiently to have made the ascent of the peak again worth while.

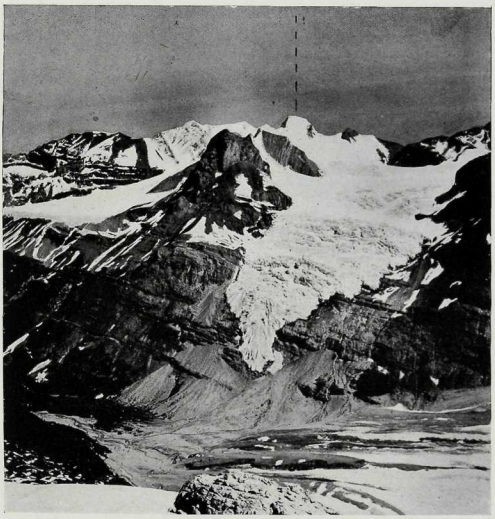
Banff was reached by the railway on October 1st, the pack train arriving on the 3rd. The cameras were finally tested and the entire party paid off by the 5th.

SOUTH BRANCH OF RICE BROOK AND HEAD OF LYELL CREEK

A description of Thompson Pass will be found in Chapter II. A description of the north branch of Rice Brook is also there given under the heading "Topography and Characteristics" of the pass. It is with the south branch of Rice Brook and the portion of the main stream flowing from the junction of the two branches to Bush River that it is now necessary to deal.

The south branch flows in a deep, narrow, precipitously walled valley of some four miles in length. For about a mile, near the junction with the north branch, the mountain sides descend very steeply and the stream is in a shallow cañon. It was in our endeavour to pass the cañon that the difficulty with the

Mt. Spring Rice



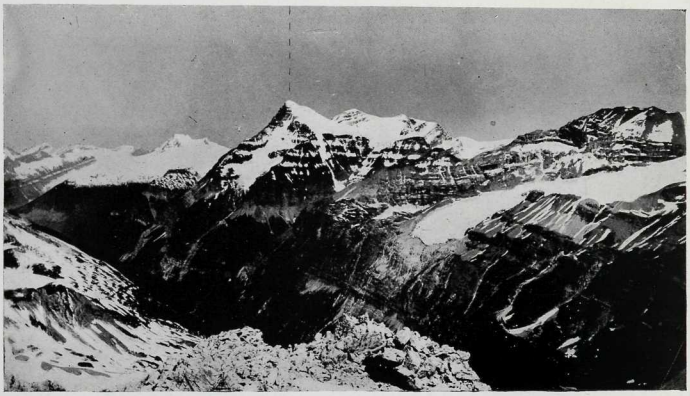
ICEFALLS AT HEAD OF SOUTH BRANCH OF RICE BROOK

pack train, referred to previously, occurred necessitating packing a camp outfit and supplies on the backs of the party to the head of the valley. This was a very laborious undertaking, owing to the much encumbered way, the dense windfall and the steady uplift of the valley at its head. A path for the pack train had been cut out before it was found impossible to use one and consequently the labours of back packing were somewhat lightened. Above the cañon the steep sides draw back a little and there is more of a flat. The greater part of the

valley is densely timbered with a heavy growth of spruce, Douglas fir and balsam. In the more level bottom the stream flows on a bed of boulders and gravel, and a way can be found along it although much impeded by debris that has been jammed against the banks.

Near the head of the valley a second cañon is encountered, the travel is still more difficult and the brush and windfall along the stream more impenetrable. The head of the valley is a strikingly picturesque amphitheatre, although the formation is rough and uneven, with a very limited amount of the usual park-like alplands. A dozen or more fine icefalls are to be seen here and along the sides of the valley, and a number of fine waterfalls dropping from great heights.

Mt. Bryce



MT. BRYCE

The mountain wall at the head of the valley is the partition between it and the head of the valley of Lyell Creek. The divide rises in several fine peaks of which the most noticeable is Mt. Whiterose, 10,060 feet, so called owing to its very obvious white, snow-covered mass when seen from the valley below. The eastern end of the dividing wall terminates in the great mass of Mt. Alexandra, rising to an altitude of 11,214 feet above sea level, crowned with snow and very impressive when seen from a close position on the northeastern ridge of Mt. Whiterose.

Three camera stations were here occupied, viz: Lyell Creek N. No. 1 (9146 feet) on a peak directly west of Mt. Whiterose; Lyell Creek N. No. 2 (9976 feet) on Mt. Whiterose; and Alexandra W. (9581 feet) on the northeast ridge of Mt. Whiterose. A fourth station was occupied at the northeastern

extremity of the valley, on a peak overlooking the north branch of Rice Creek and Thompson Pass. It has been named Thompson Pass S. (9257 feet) and was found to be a very useful station.

In 1918 three stations were occupied on the southwest side of the valley, viz: Rice W. (8489 feet); Bryce S. No. 1 (7962 feet); and Bryce S. No. 2 (8060 feet). These six stations covered the south branch of Rice Creek pretty thoroughly. Looking down the valley from its head the double peaked Mt. Bryce (11,507 feet) stands out prominently.

HEAD OF LYELL CREEK VALLEY

The three stations at the head of the south branch of Rice Brook gave good information to supply material for mapping that had not been obtained in 1918. The stream has its source in a deep circular basin and is fed by the outflow from a number of glaciers discharging the surplus accumulation of the Lyell Icefield. The information obtained defined the western limits of the icefield, which was found to have an area of approximately thirty-eight square miles and to lie at a mean altitude of 9000 feet above sea level.

The sides of the basin are very steep. The stream, which has a wide gravel bed, flows southwesterly to Bush River in a deep, narrow valley walled in by great spurs of rock which, in turn, enclose elevated hanging valleys, each containing its own accumulation of ice and snow. The frontal sides of these spurs are densely clad with forest growth.

Directly southwest of the stations occupied on the ridge dividing the Rice Brook and Lyell Creek basins, across a stream tributary to Lyell Creek, rises a fine glacier-hung peak of 10,500 feet altitude which has been named Mt. Cockscomb owing to the fancied resemblance of a rock summit forming part of its crest.

RICE BROOK BELOW THE JUNCTION

Half a mile or so below the junction of the north and south branches of Rice Brook the stream drops into a cañon and displays a spectacular fall of broken water. The distance from the junction to the confluence of the stream with Bush River is between three and four miles and for about two miles it lies in this wild and deep rock cañon of which the sides rise many hundreds of feet, at places in sheer precipices and again in very steep clay and gravel cutbanks. The forest growth along the edge of the stream is very dense and thickets of undergrowth render progress most difficult. Huge boulders and large tree trunks are piled up in wild confusion and the stream rushes downward in a swirling, muddy torrent.

As previously stated it was found impossible to make a trail for pack ponies owing to frequent rockfalls, and, although an attempt was made to get a camp and supplies to the Bush River Valley by packing on the backs of the party, a

point was reached when even this became impossible without spending more time at it than the results would warrant, so, when only a mile from the Bush River, the attempt had to be given up.

On the north side of the valley the cañon wall rises very precipitously to a great height on the southwest shoulder of Mt. Bryce. On the other side a long timbered spur breaks off precipitously to form the southern wall of the cañon. An attempt was made to cut a pack trail over this spur, and one was cut out through dense forest and windfall for several miles to its crest. Arrived there, it was found that the slopes to Bush River broke off in rock cliffs, down which it would have been impossible to take horses.

In the 1918 report of the Topographical Division it is stated that possibly a road could be constructed without much difficulty to the Bush River Valley. It was now found that such construction, on the British Columbia side of Thompson Pass, could only be accomplished with very great difficulty and at great expense; and, even if carried beyond the cañon, there would still be many serious difficulties to overcome in the Bush River Valley, provided the reports of previous explorers are to be given weight.

THE COLUMBIA ICEFIELD

During the season of 1919 the limits of the great Columbia Icefield were fairly well established. With its various ramifications it contains approximately an area of 110 square miles of ice and snow, and lies at a mean altitude of from 9500 to 10,000 feet above sea-level. It discharges some twenty or more alpine glaciers, many presenting spectacularly beautiful icefalls. Several are broad rivers of ice forming the headwaters of such large and important waterways as the Columbia, Saskatchewan and Athabaska Rivers, and tributaries of the same: Bush River from the west, Chaba River from the north, Sunwapta River from the east and Castleguard River from the south. It may be said to be the climax of the ice and snow deposits of the Main Range of the Rocky Mountains.

Mt. Columbia (12,294 feet), the second highest mountain of the Main Range, rises not far from the centre of the northern boundary of the icefield, while Mt. Bryce (11,507 feet) occupies a similar position at its southern boundary. Mt. Saskatchewan (10,964 feet) is at the southeastern extremity and Mt. Athabaska (11,452 feet) is at the eastern extremity. Mt. King Edward (11,400 feet) rises from the northern boundary not far west of Mt. Columbia.

In order to supply some of the data for mapping, deficient through inability to reach the Bush River Valley, a station was occupied on the southern border of the icefield at the head of Bryce Creek, a stream which has its source from glaciers of the icefield and flows southwesterly to Bush River along the northwestern base of Mt. Bryce. The station was named "Columbia Icefield," 8884 feet, and was found to be of much service in conjunction with stations previously occupied.

THOMPSON PASS TO MT. COLUMBIA

In Chapter II under the heading "North of Thompson Pass," a description is given of the course of the watershed from the summit of the pass to Bryce N.E. camera station, where work for the season of 1918 was discontinued. From Bryce N.E. camera station (9577 feet) the watershed lies due northwest for half a mile along an extension of the northeastern ridge of Mt. Bryce, which here terminates at the south border of the Columbia Icefield. The watershed then drops abruptly to the icefield and lies nearly due north along it for eight miles to the summit of the Snow Dome. The Snow Dome as it is shown on the map is at the northeastern border of the icefield and rises, a great snow and ice-covered mound, to an altitude of 11,340 feet above sea-level.

A peculiar feature of the watershed is that having arrived at the summit of the Snow Dome it immediately turns back again upon its previous course and travels nearly due south over the icefield, slowly diverging westward, for a distance of three and a half miles, when it assumes a general course that is nearly due west. In the two previous courses, to and from the Snow Dome, the last three miles of the one and the first three miles of the other are only separated, at their widest distance apart, by an interval of about one and a half miles, the lay of the watershed being defined by the apparent surface flow of the ice.

Along the last-mentioned westerly course the watershed travels for four and three-quarters miles to the summit of Mt. Columbia, on this side a snow-covered, cone-shaped mass readily distinguished by the black cross near its apex which is formed by rock exposure through the snow. Directly north of this course rise the two peaks shown on Collie's map as "The Twins," 'the nearest summit having an altitude of 11,675 feet and the more northerly one an altitude of 12,085 feet above sea-level. Both lie just beyond the northern border of the icefield.

SOUTHEASTERN BORDER OF COLUMBIA ICEFIELD

Along the southeastern border of the icefield, as stated in Chapter II under the heading "Thompson Pass," is a low comparatively level depression or trench lying between the icefield and the group of peaks dominated by Mt. Saskatchewan. This depression trends northeasterly from the head of Castleguard River to the valley of the Saskatchewan Glacier and is in continuity with the depression of Thompson Pass summit, glaciers from the Columbia Icefield having apparently cut the valley of Castleguard River directly across it. The valley shows a wide stretch of open alplands, with slab-like rock exposures here and there, and a fringe of scattering forest along its borders. The greater part of it is above timber line. Glaciers from the Columbia Icefield send many streams winding through the open grass lands and the whole has an attractive park-like appearance. It is an Arcadia for travellers owing to its bright sunny

aspect and the abundance of excellent feed for horses throughout its extent. The length of this trough-like depression, from the northeastern edge of Castleguard Valley to where it merges with the valley of the Saskatchewan Glacier, is approximately four miles.

The Saskatchewan Glacier, which is the largest of the glaciers flowing from the Columbia Icefield, has a length of about six and a half miles and a greatest width of about one mile. It flows northeasterly and is the main source of the Saskatchewan River, although a more distant supply comes from Sunwapta Pass. From its outflow at the icefield to its forefoot the glacier falls 2400 feet in the said distance.

Four camera stations were occupied to cover the area bordering the depression described above, the valley of the Saskatchewan Glacier and the vicinity generally, viz: Castleguard (10,096 feet); Athabaska S. (9376 feet); Saskatchewan Glacier (9366 feet); and Athabaska Shoulder (7750 feet). The first has been described in Chapter II under "Thompson Pass." It is a very prominent mountain, rising on the southern border of the icefield, and gives the name to the river which has its source from glaciers surrounding the massif. The cairn placed upon it was frequently seen from stations on the Athabaska River headwaters north of the Columbia Icefield and, on this account and the connection of the triangulation afforded thereby, it proved a very valuable station. The other three stations are named with reference to their respective proximity to the mass of Mt. Athabaska and the Saskatchewan Glacier.

SUNWAPTA AND WILCOX PASSES

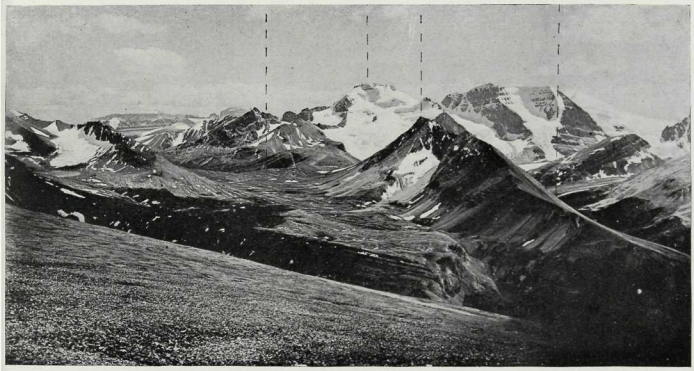
Although the main source of the Saskatchewan River is derived from the outflow of the Saskatchewan Glacier there are a number of minor sources of initial supply, noticeably from Sunwapta Pass summit, leading to the headwaters of the Athabaska River, and from Nigel Pass summit, leading to the headwaters of Brazeau River. The main line of travel to Jasper, on the Canadian National Railways, follows the Sunwapta route. A short distance above the junction of the stream from Sunwapta Pass with that from the Saskatchewan Glacier are some fine falls, known as Panther Falls, and not far above them is the junction of the Sunwapta Pass and Nigel Pass streams. The valley bottom soon opens out into grassy meadows and an imperceptible divide is crossed, only discernible by the water flowing in opposite directions.

The Pass is shown on the map as Sunwapta Pass. It leads directly, almost at a level, to the foot of the Athabaska Glacier from which the Sunwapta River, the main eastern source of the Athabaska River, is derived.

The Athabaska Glacier flows northeasterly from the Columbia Icefield. It has an approximate length of four and a half miles and a greatest width of about three-quarters of a mile. From its exit from the icefield to the forefoot it falls 2600 feet. Below the ice the Sunwapta River bed presents a wide shingle flat over which many channels of the stream flow in a complicated network.

Directly northwest of the Athabaska Glacier and separated from it by a high, rock spur is the Dome Glacier, another large body of ice directly below the Snow Dome, fed by great masses of ice falling from the Columbia Icefield, pushed over the tremendous precipices that encircle the amphitheatre in which the glacier lies. It is in sharp contrast to the Athabasca Glacier which presents a glistening white and much crevassed surface, whereas the Dome Glacier is very largely covered by rock debris fallen from the mighty cliffs that are at its head and along its sides.

The Sunwapta Pass would be an exceptionally good and easy crossing to the Athabaska headwaters were it not for one circumstance, viz: the broad shingle flat below the ice gradually contracts and at a distance of three and a half miles the stream flows swiftly through a narrow, rock cañon which has, up to the



WILCOX PASS
Looking South

present time, prohibited travel by this route. It is thought that a trail could be made to pass the cañon by the use of some dynamite and by traversing the wooded slopes enclosing it. Certainly much facility would be given to travel if this were done, for what would then be a very easy route is now in consequence of this obstruction, a very laborious one.

In order to pass the obstruction it is now necessary to leave Sunwapta Pass at a point two miles before the Athabaska Glacier is reached and ascend the mountain side 1000 feet to an altitude of 7700 feet. Here an open depression between Wilcox Mt. and the shale covered hills lying northeast of it furnishes an elevated pass from which, after a descent of 2000 feet, the valley of Sunwapta River is reached below the cañon. The route is considerably longer and, of

necessity, much more arduous on account of the two steep hills that have to be overcome in the ascent and descent. The route on the Sunwapta side follows the line of Tangle Creek. This elevated pass and the mountain which dominates it are known as Wilcox Pass and Mountain after W. S. Wilcox, an early explorer whose party is said to have been the first white men to traverse it.

Directly south of Athabaska Glacier rises the mass of Mt. Athabaska and on the opposite side, The Snow Dome. Northward, on the west side of Sunwapta River, is a group of high peaks which either border or are adjacent to the Columbia Icefield, including Mt. Kitchener (11,500 feet); Mt. Stutfield (11,320 feet); Mt. Woolley (11,170 feet); and Diadem Peak (11,060 feet). They are the giant, upholding buttresses of the icefield and, in addition to those already mentioned, send down numerous smaller glaciers. On the opposite side of the Sunwapta Valley the formation is not so boldly massive. Long slopes lead to the summits of the peaks and their connecting ridges, broken at intervals by streams tributary to the Sunwapta River, and there is not nearly so much ice and snow in evidence.

To cover the territory five camera stations were occupied, viz: Nigel Ridge (9654 feet); Wilcox Mt. (9463 feet); Tangle Ridge No. 1 (9859 feet); Tangle Ridge No. 2 (9456 feet); and Sunwapta Peak (10,883 feet); Nigel Peak (10,535 feet) was also occupied as a transit station.

SUNWAPTA RIVER

The Sunwapta River flows in a general northwest course to its junction with the west branch of the Athabaska River headwaters. The valley is broad and, once the Columbia Icefield is passed, the sides extend upwards in long comparatively easy slopes to timber line. There is a dense growth of forest and, in places good sized tracts of brûlé and windfall.

The river bed, in its upper portion, shows frequent wide shingle flats, traversed by many and devious channels. The river margins are boggy from innumerable springs and the travelling is difficult and precarious, owing to quicksands and fallen timber. The lower portion of the river is more restricted and at one spot a gigantic rockfall from the eastern side of the valley has been carried right across and up the opposite side, the stream flowing in a narrow channel through it. Within two miles of the junction with the west branch are two cañons through which the river races in spectacular broken falls. The total length of the stream from the foot of the Athabaska Glacier to the junction is approximately between thirty-five and forty miles. Two fair sized tributaries, Jonas Creek and Poboktan Creek come in from the east. The trail follows close to the river for about two-thirds of the way down and then travels some distance back from it on the east side, following a chain of marshy valleys occupied by two small lakes, where the timber is not so dense as along the river banks. It crosses the stream close by the junction with the west branch of the Athabaska.

WEST BRANCH OF ATHABASKA RIVER

Below the junction with the Chaba River the valley of the west branch is deep and wide, and the river winds through it in great loops for the most part confined to one channel of swiftly flowing muddy water. On the west side the valley is contained by bold, steep rock sides rising to distinct peaks; on the east the sides are not so steep and long timbered slopes rise to a more or less bare, plateau-like tract of mountain land between it and the valley of the Sunwapta. The travel along the eastern river bank with a pack train is not difficult.

Beyond the Chaba junction, some eight to ten miles above the confluence with the Sunwapta, the valley is a great U-shaped trough, several miles across

ATHABASKA RIVER VALLEY
Looking Up

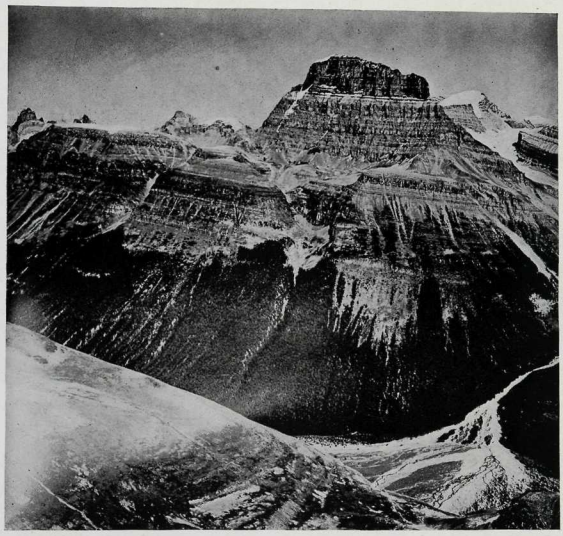
from crest to crest of the bounding ridges. The general course is a little east of south and there is more or less of a varying extent of gravel flat along the river bottom.

Not far from the junction, on the east side of the valley, a lake with water of a very peculiar shade of brownish-green is held in by the sides of a hanging valley which extends back southeast to the Sunwapta Valley. The lake is about a mile long and a quarter of a mile wide, and is fully 1500 feet above the river bottom. It has been named Gong Lake on account of its appearance.

About five or six miles up, the bed of the river widens and from then until the head of the valley is reached gravel flats, displaying a network of channels, are numerous and furnish the best place for travel with horses. The valley becomes wider and the sides more broken and abrupt. Several good sized streams from glacial amphitheatres come in on both sides of the valley, notice-

ably Habel Creek and Lynx Creek from the east and Quincy Creek and Warwick Creek from the west. All these tributary streams flow from wide amphitheatres of which the walls are hung with glaciers.

At the head of the valley Mt. Columbia is seen rising like a sharp-pointed pyramid, on this side showing a rock face patched with snow. In reality the mountain is wedge-shaped, with the flat side facing the west. Other great massifs are seen on both sides of the valley, among which may be mentioned Mt. Alberta (11,874 feet) between Habel and Lynx Creeks, and the Twins, between Lynx Creek and the Columbia Icefield; the north Twin has an altitude

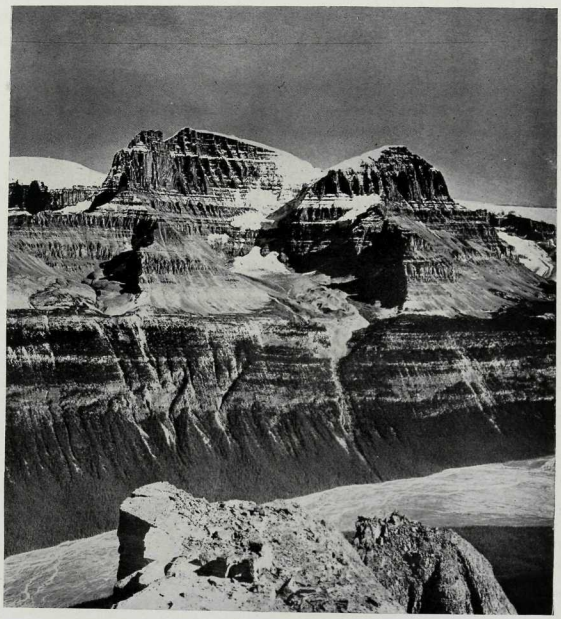


Mt. Alberta

of 12,085 feet and the south Twin of 11,675 feet. On the opposite side of the valley Dais Mt. (10,612 feet) and Mt. Quincy (10,400 feet) stand out prominently.

Near the head of the valley a strikingly castellated peak stands in an isolated position. It has a very prominent tower at its apex, which was seen from the south side of the Columbia Icefield and was noted as a point for subsequent occupation. Owing to the fact of its highly castellated appearance and its close proximity to Mt. King Edward, it was named Warwick Mt. (9535 feet) and the tributary stream flowing at its northern base, Warwick Creek.

Directly west of Mt. Columbia, some three miles, is Mt. King Edward (11,400 feet), over which the watershed passes. Below the northern apex of this mass the west branch divides, the eastern tributary having its source in Columbia Glacier flowing from the Columbia Icefield on the east side of Mt. Columbia. It presents a broad shingle flat, half a mile in width and two and a half miles in length, and the glacier at its source shows a beautiful ice stream, with a very symmetrical tongue-shaped snout, below a wildly broken icefall.



THE TWINS FROM THE NORTH

The western tributary also has a broad shingle bed and flows in a sweeping easterly curve of four miles in length from another glacier of the icefield. The glacier in which it has its source descends directly from the main watershed. The valley of the waterway is deep and hemmed in by very steep, bold and precipitous rock faces, thickly forested to timber line. Between Mt. King Edward and the glacial source of this tributary, still another glacier from the Columbia Icefield sends an outflow to it.

The following camera stations were occupied to cover the part of the area surveyed, viz: Chaba Junction S. (8479 feet); Mt. Alberta N. No. 1 (9701 feet); Columbia W. (9412 feet); Warwick Mt. (9535 feet); and Chaba Junction N. (8988 feet). Mt. Alberta N. No. 2 (10,337 feet) was occupied as a transit station only, to connect up the various stations previously occupied in other directions.

CHABA RIVER

The Chaba River, so called after the Stoney Indian word for beaver, is the most westerly branch of the Athabaska River headwaters. It flows in a north-

MT. KING EDWARD AND WEST SOURCE OF ATHABASKA RIVER, WEST BRANCH

easterly direction from glaciers at its two principal sources and has a length of thirteen miles. The valley is wide and deep and is bordered by the bold, rocky sides of mountains rising precipitously.

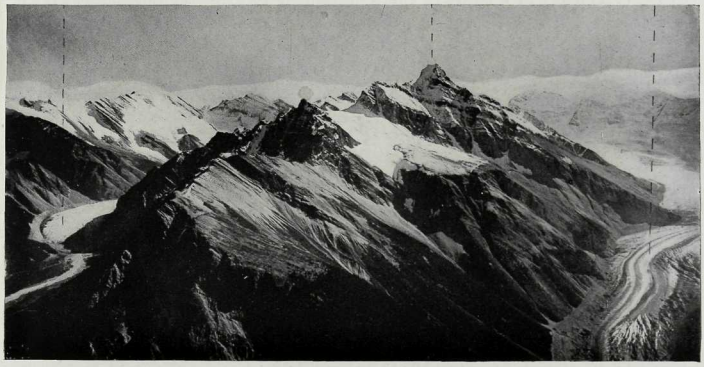
From its junction with the west branch, southward, the bed is a wide gravel flat and the flow is dispersed in many channels; at two or three places it is more restricted where timbered slopes on both sides approach each other.

Three miles up, on the west side, stands Fortress Mountain, 9908 feet in altitude, and directly beyond this natural boundary corner is a deep, narrow valley, trending nearly due west, in which lies Fortress Lake, described below.

Nine miles from the junction with the west branch of the Athabaska the river forks. One branch leads southeasterly to the Chaba Glacier in which it has its source, distant three and three-quarters miles from the forks and the other branch continues the general course of the river southwesterly for a distance of about two miles, where it heads in another glacier.

In the centre, between these two final branches of the river, is a mountain mass culminating in an outstanding wedge-shaped crest, at the corners of which two points project above the snow like ears; on this account the mass has been named Listening Mountain. Behind it lies a circular icefield, a mile to a mile

East Source Listening Mountain West Source



GLACIERS, EAST AND WEST SOURCES OF CHABA RIVER

and a half wide, which feeds respectively the glacial outflows forming the sources of the two initial branches of the Chaba River.

A short distance above the fork the eastern branch flows in a minor cañon and above that the bed opens out in a narrow gravel flat which continues to the Chaba Glacier. On the east side the primary slopes of the valley ascend steeply to near timber line and then shelve back more slowly. About the middle of the ridge between the Chaba and the west branch of the Athabaska rise the precipitous rock walls of Dais Mt., ranged in horizontal bands which, south of the massif, are twisted in serpentine folds. On the west side of the valley very steep rock slabs and precipices lead upward to the many peaked mass of Listening Mountain. Southeast of the glacier tongue, about two miles distant, is a prominent peak which was named Sundial Peak (10,438 feet) and was occupied as a

camera station. Its isolated prominence made it one of great value. Three miles southwest behind the glacier rises another noticeable peak which was named Chaba Peak (10,540 feet). The watershed passes over it.

The Chaba Glacier is a very beautiful one, not only because of the spectacular icefalls it displays and its remarkable whiteness and purity but on account of the very distinct circular dirt bands near its forefoot, which with their graceful curves and extreme regularity give the ice tongue the appearance of a gigantic white feather.

The western branch, a short way above the fork, is also confined in a minor cañon and above it the bed opens in a narrow gravel flat. The glacier which is the source of the stream is of peculiar appearance: a narrow, tongue-like formation with three or more distinct medial moraines which, reaching the full length of its outflow from the icefield above, give it a striped appearance. Six tributary glaciers in hollows of the mountain sides form the northerly confines of the valley, and send outflows to swell the torrent below. On the south side there is a glacial tributary from Listening Mt.

The continental watershed follows a circular ridge of numerous elevations enclosing the icefield of which the two main Chaba glaciers are the outlets. This great wall is banked to its crest with ice and snow, and hanging glaciers fill every hollow on this side, giving it an appearance of universal whiteness, particularly so when the sun shines upon it. What lies beyond it is, at the present time, a matter of speculation for it was not found possible to reach it from either of the Chaba branches. It is likely that information concerning the area lying beyond will be gathered next season by way of approach from the Wood River Valley.

The following camera stations were occupied, viz: Sundial Peak (10,438 feet); Dais N. No. 1 (9636 feet); Dais N. No. 2 (9450 feet); and Chaba W. (8765 feet).

FORTRESS PASS AND LAKE

History and Origin of Name.—Fortress Pass derives its name from Fortress Mountain, the massif standing at the northern portal of its summit. The mountain was named by Dr. A. P. Coleman, who explored in the vicinity in 1892. In his book "The Canadian Rockies, New and Old Trails," published in 1911, on page 148, Dr. Coleman writes as follows:

"Presently we reached a tributary coming down from nearly the right direction, so we left the main valley* for this. As there were endless beaver dams and trees cut by beaver along its course, we named it Chaba River, from the Stoney word for beaver.

"On the third night, which was frosty, we camped under a spruce, near the foot of a splendid square-based mountain built of thick courses of purple quartzite . . . . . Fortress Mountain, as we named it, proved a harder

*Valley of the west branch of Athabaska River.

proposition than we expected, and at 7700 feet we halted at the foot of a vertical wall, with the valley and its creeks and rivers spread out more than three thousand feet below, and a grand array of mountains near its head a few miles to the south, the finest of which we afterwards called Mount Quincey.

"Fortress Mountain has since been climbed by Barrett, Wilcox's partner, who determined its height at 9600 feet."

Dr. Coleman and Professor L. B. Stewart, who accompanied him, were apparently the first white men to explore the pass and lake who have left records of their explorations. In 1896 W. D. Wilcox and R. L. Barrett made an expedition to the pass and lake and it was presumably on such occasion that Barrett made the climb of Fortress Mt., referred to by Coleman.

Both parties were in search of the far-famed and much discussed Mts. Brown and Hooker of David Douglas, Mt. Brown on the north and Mt. Hooker on the south side of Athabaska Pass, said by him to have an altitude of 16,000 and 17,000 feet above sea-level. Subsequently they were reduced by Coleman, in his expedition of 1893, to an altitude of 9050 feet for Mt. Brown and the mountain which occupied the supposed position of Mt. Hooker was found to be even less exalted. The mystery has remained unsolved to the present day; possibly the surveys of the Interprovincial Boundary during the season of 1920 will shed further light upon the subject or, at any rate, will corroborate the results of Coleman's observations which appear to have been carefully made and will likely be found approximately correct.

In 1901 an expedition was made by Mr. Habel of Berlin, who visited Fortress Lake but confined his explorations chiefly to the west branch of Athabaska River and to the Chaba River. The glacier at the head of the eastern source of the Chaba he refers to as "Coleman Glacier" and to the one at the head of the western source as "Eden Glacier." The name "Coleman Glacier" has been applied elsewhere in connection with Mt. Coleman at the headwaters of the Saskatchewan River. The chief summit above the so-called Eden Glacier is referred to by Habel as "Mt. Eden." and its eastern neighbour as "Mt. Chaba." The description given is too vague to permit of the certain identification of either.

Fortress Pass and Lake are one of the beautiful scenic centres that may be visited from Jasper on the Canadian National Railways, from which place they are distant about three days by pony trail. Jasper may be styled the capital of Jasper Park as Banff is that of Rocky Mountains Park. Expeditions to this wonderful locality are frequently made during the summer months by visiting tourists and others interested in the various attractions of mountain regions.

Topography and Characteristics.—In its entirety this continental pass may be said to comprise the valley of the west branch of the Athabaska and Chaba Rivers, the valley of Fortress Lake and the valley of Wood River, the last a tributary of the Columbia River, which it enters at Boat Encampment at the head of the Big Bend. The general trend of the Athabaska-Chaba Valley,

the eastern approach, is a little east of south; of the Fortress Lake Valley nearly due west; and of the Wood River Valley, the western approach, generally southwest. At the summit the pass turns nearly at right angles to its previous course up the west branch of the Athabaska and Chaba and follows the deep trough of Fortress Lake. The summit lies at an altitude of 4387 feet above sea-level for its lowest part, and is thickly forested with small sized pine and spruce.

Here is found a most remarkable development for a pass over the continental divide: a narrow strip of sand and gravel flat, thickly timbered. as stated above, less than a mile in length and no more than a quarter of a mile in width—at one spot it is only an eighth of a mile—is all that separates the waters of the Chaba River, flowing northeast, from those of Fortress Lake, which

FORTRESS PASS AND LAKE

empties at its western extremity by Wood River. From mountain peak to mountain peak the valley of the pass, at the summit, is about four miles wide and long heavily timbered slopes extend upward on both sides from the summit flat, gaining in steepness as the bare rock above timber line is approached. The difference in elevation at the summit is inappreciable to the eye and it is difficult not to believe that at flood periods the water from the Chaba percolates through the gravel flat into the lake. When a detailed survey has been made and the pass summit monumented by Mr. Cautley's division, it will be possible to state the facts in a more definite manner. The accompanying illustration shows the close proximity of the two water basins on either side of the watershed, which discharge their flow in opposite directions.

FORTRESS LAKE

The lake is a fine sheet of water, slightly over six and a half miles long, with a greatest width of very little over half a mile. It lies in a deep, heavily timbered basin and the mountain slopes forming the sides are forest-clad almost to the water's edge. There are no beaches of any account, either of sand or of gravel, except on the south side where, two and a half miles from the upper end, the torrent of Chisel Creek has built up a delta and now sends quantities of silt in a cloud-like discharge out into the waters of the lake, and so continues the structure. At this point the lake is less than a quarter of a mile wide. The colour of the water is a bright turquoise blue, the clouded blue colour of the portion near the delta being doubtless due to the quantities of silt held in suspension.

Chisel Creek, entering the lake on the south side, drains a wide amphitheatre at its head in which lies a broad icefield and glacier, the source of the stream. A number of high snow-clad peaks wall in the amphitheatre and many incumbent glaciers fill their hollows and feed the icefield. It is at the back of this wall that the "Misty Mountain" referred to by Coleman in his book (pages 153 and 155) lies. He says: "It was now clear that the peak we had thought of as Mt. Hooker did not join the mountain we were on, Misty Mountain as we named it; but that there was a steep wall of cliff below us and a somewhat deep valley before the foot of the pyramid could be reached. Its top was probably two thousand feet above us and three or four miles away and it seemed very isolated . . . . . Misty Mountain was the highest point climbed during our tramp, and from the top of its limestone cliffs gave a marvellous survey of the region. We could look back on Fortress Lake and the mountains around it; and to the south and west in blue spaces, partly cloud-filled, on each side of the white Pyramid there were far distant peaks, probably of the Selkirks across Columbia River."

Looking up Chisel Creek from vantage points at the eastern end of the lake the white pyramid referred to by Coleman can be seen rising high above its fellows to an altitude of 12,001 feet, as computed by our angle readings upon it. It has been named Mt. Clemenceau in honour of the great Frenchman who guided the destinies of France during the world war. The valley referred to by Coleman joins the Wood River Valley six or eight miles below the western end of Fortress Lake.

The Wood River has its exit from the lake at the southwest corner, from whence it flows in a single deep channel. A wide flat, three miles or more in length extending southwesterly, which contains broad gravel flats and extensive meadow-lands, is separated from the lake by a belt of somewhat open spruce and pine forest about half a mile wide. The flat is intersected by many water channels, chiefly created by a large stream coming in from the northwest. It has a course of ten miles or so and is supplied by the outflow of several glaciers.

It is not known how far this valley extends or what it contains. The watershed, which circles around the east end of Fortress Lake lies at its head, but its exact position still remains to be located.

Below the flat at the west end of Fortress Lake the river bed contracts to a single channel and appears to lie in a narrow, densely timbered valley with every indication of a deep rock cañon. The nature of this part of the area can only be ascertained by more extended surveys, but the approaches seem to present many difficulties.

Some exceptionally high mountains are seen in this locality both north and south of Wood River and glimpses are obtained of numerous icefields hidden in their recesses, which send forth large glaciers with spectacular broken icefalls. One of the first necessities of the continuation of the survey will be the mapping of this area.

To map Fortress Lake and its immediate vicinity the following camera stations were occupied: Fortress Divide S. No. 1 (7312 feet); Fortress Divide S. No. 2 (7230 feet); Fortress Lake N. No. 1 (8945 feet); Fortress Lake N. No. 2 (8685 feet); Fortress Lake S. No. 1 (9455 feet); Fortress Lake S. No. 2 (9460 feet); and Fortress Lake Centre (7846 feet).

THE WATERSHED—MT. COLUMBIA TO FORTRESS MOUNTAIN

The course of the watershed has been described from Thompson Pass to the Columbia Icefield, across which it lies to Snow Dome; thence it was traced to the summit of Mt. Columbia and left there for a time while the general features of the country to the north and east of it were outlined and the lines of travel to again come in contact with it set forth. Its course is now described from the summit of Mt. Columbia.

As already stated, Mt. Columbia stands at the head of the west branch of the Athabaska River, directly above the final fork of that stream. Although 12,294 feet in altitude, the shape of the peak as seen from the north—a symmetrical rock pyramid—detracts greatly from its height and there is little to give it special prominence amidst the many peaks surrounding it. The effect is disappointing and it is only when seen from a point near its base that the stupendousness of the mass is realized. Seen from the opposite side, that of the Columbia Icefield, it is almost entirely snow-covered and stands out prominently as a majestic snow cone, distinguished on its southern face by the well-proportioned, black rock cross near the summit. The north and west faces are composed of very steep rock ledges of horizontal strata, with comparatively little snow lying during the summer months. Down the west face the watershed descends to a snow saddle lying at an altitude of 9100 feet; the distance is one mile and the course a little south of west. From the saddle the course is northwesterly for two and three-eighths miles up the southeast ridge of Mt. King Edward. Here it turns nearly due west for half a mile along the same ridge, ascending to a final crest of the mountain at 11,320 feet. It then follows the

crest nearly due south for another half mile to the highest point at its southern end, 11,400 feet. Seen from the southeast, Mt. King Edward has a striking, tent-like appearance and is thus easily distinguished from any easterly or westerly point of observation.

The watershed now drops southwest from the summit of the mountain very nearly one mile to another snow saddle of 8500 feet altitude and, on the opposite side, climbs one and one-eighth miles to the crest of an unnamed peak at 9840 feet, which crest it follows due south for three-eighths of a mile to its highest point at 10,000 feet. The watershed now travels a little north of west one mile to the summit of a peak 10,230 feet; thence the course is northwesterly for one and three-eighths miles to an isolated peak of 10,340 feet. A twin peak of 10,160 feet lies three-eighths of a mile away along the same ridge. From the last mentioned peak the watershed falls steeply for one and a half miles to the lowest part of the summit of the snow pass between the valley of the westernmost

SNOW PASS AT WEST SOURCE OF WEST BRANCH OF ATHABASKA RIVER

branch of the Athabaska River and the valley of a stream which may or may not flow to Bush River. This pass over the continental divide has been previously referred to under the heading "West Branch of Athabaska River." It sends a fine glacier to feed the west branch. For the last three courses described the watershed curves south and west around an icefield of considerable extent, containing roughly fifteen square miles of area. This icefield is but one of numerous others extending in many directions from the vast area of snow and ice of which the Columbia Icefield is the culminating point.

From the summit of the snow pass the watershed lies north and northwest up the icefall of a glacier, sending an outflow on each side of the divide, and at a distance of two miles reaches the crest of the north ridge of the pass. A quarter of a mile farther it passes over the summit of a peak 10,200 feet in altitude. The same northwest course is continued for another mile, when the watershed turns

west along the ridge which separates the flow to the west branch of the Athabaska from that to the Chaba branch and to the valley lying southwest of the snow pass, and in three-eighths of a mile arrives at the summit of Chaba Peak 10,540 feet, referred to previously as being located at the southeastern extremity of the icefield from which the Chaba Glacier flows.

Leaving Chaba Peak the watershed sweeps around the southern and western limits of this icefield. From the summit it descends on a course very nearly due west seven-eighths of a mile to a snow saddle at 9190 feet where it turns southwest, slowly rising, along the edge of the icefield for one and a quarter miles. It now turns northwesterly and in a little over half a mile arrives at the summit of a peak of 10,180 feet. Continuing south of west at nearly three-eighths of a mile it reaches a summit of 10,470 feet, where it turns northwest and falls, again reaching a summit of 10,002 feet in a little over three-quarters of a mile.

From the last mentioned point the direction is northeast across a bay of the icefield, half a mile, to the summit of a peak of 10,310 feet at the crest of a continuous ridge directly behind Listening Mountain. From this corner point the watershed ridge winds in gentle curves, in a general northwest direction, for three and three-quarters miles to the crest of a prominent mass at 10,340 feet altitude. It presents in the interval a number of outstanding elevated points of which four are above 10,000 feet, the greatest altitude reached being 10,440 feet. The watershed now travels nearly north for a mile and a quarter along the crest of the mass at the head of the Eden Glacier of Habel.

Again turning west of north the watershed lies along the same ridge for two and three-eighths miles. It here crosses in a northeast direction what appears to be a snow pass leading to an icefield beyond and climbs to the crest of a mountain mass of which the summit is at an altitude 10,580 feet; the distance is a mile and a half. Below this mountain, which may be the Mt. Eden of Habel, lies another small icefield discharging a much broken icefall to feed the western branch of Chaba River above the fork by its flow.

From here the watershed curves generally east to the summit of a peak 9920 feet, distant one and five-eighths miles. It now lies along a broken ridge with outstanding peaks up to 9600 feet, rising at the end of a somewhat erratic course, generally northeast, to the southern corner of a wedge-like peak at 9820 feet. Along the crest of the peak it lies for a little over a quarter of a mile, reaching a greatest altitude of 9910 feet at the northeast corner, the total length of the course being two miles. The watershed in this last course lies at the head of three other glaciers tributary to the western branch of Chaba River.

Continuing from the summit of the wedge-like peak the watershed winds on a nearly due east general course for a little over a mile, the highest peak passed over, that nearest the wedge-like one, having an altitude of 9540 feet. The end of the course is at the head of the valley of the southern tributary of Chisel Creek. From this point the next course lies north-northeast for nearly

a mile to an altitude of 9150 feet where the ridge divides, the western arm turning northwest to the peak summits on which the camera stations, Fortress Lake S., Nos. 1 and 2 (9460 feet), are set, seven-eighths of a mile distant.

From the last high mass that may be Habel's Mt. Eden to this division of the ridges, the flow northward is to Chisel Creek basin and southward to the west branch of Chaba River. Beyond the fork of the ridge the watershed continues the same general north-northeast course for another seven-eighths of a mile to the summit on which the camera station, Fortress Divide S. (7312 feet), is set. From this summit it falls two miles in a general northeast direction to the summit of Fortress Pass (4387 feet), nearly 2925 feet.

NORTH OF FORTRESS LAKE

On the north side of the pass summit the watershed ascends directly to the summit of Fortress Mountain, 9908 feet. From the summit of Fortress Mountain the watershed travels northward along the ridge of which it is the south terminal point, around the head of a high valley sending a tributary stream to Fortress Lake, a mile and a half from its eastern end. On the opposite side of the valley divide, the waters flow to some tributary of the main stream of Athabaska River. Beyond this point the course of the watershed is still unknown except for the fact that it lies north of Fortress Lake and not many miles from it. It travels in a gradually diverging direction around the head of the large northwestern valley referred to previously as sending a good sized stream to join Wood River in the broad flat at the western end of the lake. The next season's work will define the location of the watershed through this mountain area and onward to Athabaska Pass.

GENERAL REMARKS

Watershed.—Between Thompson Pass and Fortress Pass the general trend of the watershed is north-northwest but its actual course is most erratic. In an air line the distance between the summits of the two passes is close to thirty miles. The length of the watershed for this distance is approximately sixty miles, and the distance it makes in westing is approximately fifteen miles, although it extends nearly six miles farther west between the extreme points. From the most westerly point it turns northeasterly to encircle the basin of Fortress Lake and, having accomplished that object, it again proceeds northwesterly.

The most peculiar feature of its many eccentricities is where, on the Columbia Icefield, it doubles back on its previous course to the summit of Snow Dome. The lay of the watershed is regulated by the piled up masses of ice and snow which have here accumulated. It is impossible to say how the watershed

would lie were the vast accumulation to be removed through melting. Throughout a considerable part of this high snowbound area the lay of the watershed is defined over snow-covered tracts and in consequence has a more or less fluctuating definition.

Trails.—The only trails leading to the watershed, with the exception of an old hunter's trail around the north side of Fortress Lake, are on the Alberta side of the Divide and the exception merely leads from the west end of the lake. In consequence it was found impossible to cover much ground on the western side as headway could only be made by cutting out trails for the pack train, a very tedious operation in forests of such dense growth as those encountered.

The existing trails are possible for travel but, as a whole, are very bad and during the season of high water are, in places, nearly impassable. Much of the travel is made along the wide shingle beds of the larger streams. These flats are crossed in every direction by many channels of the stream and during freshets, which occur directly after a hot sunny day, the larger ones are rushing torrents impassable for men or horses. The trails are also much encumbered by windfall of which only the fallen logs that it is actually necessary to cut in order to get by are removed by travellers, so that they do not get any better and, if anything, get worse. They are through lines of communication leading to the best of the scenery of the Canadian Rockies and are worthy of some attention by the several governments within whose jurisdiction they lie. Were they improved and kept in some state of efficiency, it is thought that a largely increased travel to the finer scenic centres would be promoted. It would be a costly matter to put in really good trails and keep them up but, if the ones most used were periodically cut out and some of the worst marshy places avoided by deviations, a distinct benefit would be conferred upon the public who travel over them.

As a rule horse feed is obtainable but in some instances, owing to the slowness with which progress can be made, it is difficult to get from one feeding ground to another in a day's travel.

Rivers and Streams.—All large streams like the Saskatchewan, Athabaska, Bush and Wood Rivers, and branches, like the Sunwapta and Chaba Rivers, have so near their sources beds composed of more or less wide shingle flats due to their waters being in a continual state of flood nearly all summer. For the same reason the waters of these streams are always muddy except during the winter months when the flow is at a minimum. Apart from the difficulty and danger of crossing the many river channels that flow in a network through the shingle flats they are the easiest lines of travel.

Timber.—The forest growth for the area surveyed during the season of 1919 is the same as for the country previously mapped (see Chapter II under "General Remarks"). Tracts of good merchantable timber are seen at the heads of nearly all the valleys. On the Pacific slopes especially, the timber is of large size and of a greater variety. Good timber is found in the valleys of Rice Brook and Castleguard River, also in the vicinity of Sunwapta Pass. The Bush River

Valley appeared to be heavily timbered along the main stream and in the numerous valleys sending tributary streams to it. Large tracts of merchantable timber, chiefly spruce, fir and cedar, were noticed surrounding Fortress Lake and in the valleys tributary to Wood River. The difficulty would be to get the timber out owing to the fact that most of the streams near their heads, where the best timber is found, are confined in deep rock cañons at some part of their course where the fall is very steep and the water rushes through in cascading torrents, rendering transport of logs an impossibility without costly artificial structures of some sort to pass such obstructions. Moreover, the wide shingle beds of the larger waterways with their shifting, comparatively shallow channels would prove a serious difficulty.

Around Fortress Lake a number of timber claims appear to have been taken up at some time, judging by the old location posts seen along the shores, but no actual lumbering has been done.

Game and Fish.—The species of game observed were the same previously noted for other seasons. A few mountain sheep were seen in the vicinity of Wilcox Pass. Moose were observed at the eastern end of Fortress Lake. Mountain goats are found high up but very few were seen. Bear and small deer are in the woods but do not appear frequently.

No fish were found in the streams or in Fortress Lake, although the lake is said to contain some and kingfishers were seen flitting around the shores of the lake. There may be fish in the larger streams but, if so, the muddy waters prevented their being seen.

MAPS

The season's surveys furnished data for Sheets Nos. 21, 22, 23 and 24 of the general map. Data to map the area at the head of Lyell Creek, which was unobtainable in 1918, were secured by the expedition to the head of the south branch of Rice Brook and the same have been added to Sheet No. 20. The later information also furnished further detail to previously mapped parts of the watershed.

The increasing difficulty of getting data on the British Columbia side of the Divide has made it impossible so far to map any part of it northwest of the Columbia Icefield until close to Fortress Lake. It is hoped to be able to gather data for such purpose during the season of 1920 by means of the snow pass at the head of the western source of the west branch of Athabaska River and of the valley of Wood River and its tributaries.

CHAPTER IV

TOPOGRAPHICAL SURVEYS EXECUTED IN 1920

Description of Operations

Mr. Cautley's division continued the survey of the 120th Meridian south from the point to which it had been run in 1919. In consequence no monument survey was made of the passes located by the Topographical division.

The Topographical division was, as usual, organized for field work at Banff and preparation made to start for Fortress Pass and Lake, where the survey had been discontinued in 1919, with the object in view of closing the gap between that point and the point where it had been discontinued south of Yellowhead Pass in 1917.

It was intended to send the horses and some of the party and outfit to Jasper by way of the Bow, Saskatchewan and Athabaska Rivers route, but it was ascertained that, owing to the heavy snowfall of the previous winter and the slow rate at which the snow was melting, it would be impossible to cross Wilcox Pass which lies at an altitude of 7660 feet. The balance of the party and outfit was to have gone by rail, via Calgary and Edmonton to Jasper, and there take over the food supplies shipped from Edmonton. In consequence of not being able to cross Wilcox Pass at that time, the entire party and outfit had to be sent round by rail at a greatly increased expense.

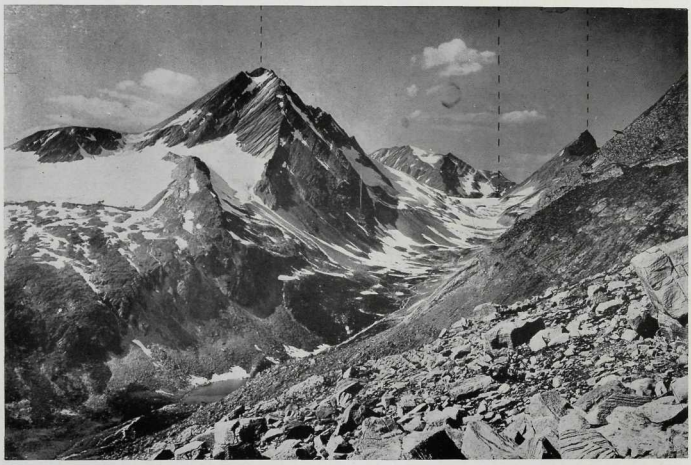
Leaving Banff on June 15th the party arrived at Jasper on the 17th, but the horses and food supplies did not arrive until the 22nd, having been delayed in transit. The day following a start was made for Fortress Lake, which was reached on the 27th. The large amount of snow, which was melting rapidly, had greatly increased the volume of water in the streams beyond normal for the time of year and, in consequence, travelling was slow.

With the party was Major E. O. Wheeler, R.E., of the Survey of India, who had been commissioned by his government to study the Canadian methods of photo-topographical surveying with the object in view of applying them to the high mountain areas of that country.

Fortress Pass and Lake had been surveyed and mapped the previous season and the watershed located as far as Fortress Mountain, situated at the northeastern extremity of the lake. It was now necessary to locate the watershed north of the lake, which it parallels in a general direction diverging slowly from it on its western course. The previous season a raft had been used to get to the lower end of the lake, but to carry the work farther it was now necessary to camp there for a considerable time and occupy stations beyond and to the

north and south, so an old hunting trail through the forest along the north shore of the lake, over a very rough mountain side, was cleared out sufficiently to enable the pack train to travel. This work was completed by July 2nd and on the 3rd camp was established at the lower end of the lake.

Directly below the lake is a flat three miles long and half a mile wide. For the most part it is meadow-land with protruding spurs of timber and gravel wash where tributary streams come in to join Wood River, the outlet of Fortress Lake, which, divided into many channels, flows through it. Below the flat the valley narrows and the stream races through a deep cañon which, some miles below, opens to another flat. It would be a difficult matter to build a road



ALNUS CREEK VALLEY

through the cañon. Close by the lake a large tributary comes in from the north which was named Alnus Creek, on account of the thick growth of alders that clothe the mountain sides of the valley for a considerable part of its course. At the western end of the flat Serenity Creek comes in from the north and Clemenceau Creek from the south. Owing to the flooding of the flat it was necessary to cut a trail around the flooded parts.

Three stations were occupied on the north side of the valley and camp was moved to the lower end of the flat on July 9th. Clemenceau Creek valley was now ascended. At the head of the valley is situated an exceptionally high snow-crowned peak of 12,004 feet altitude above sea-level. It is hung with glaciers and

a wide icefield surrounds it on three sides. It was necessary to reach the southern borders of this icefield in order to cover the country that could not be reached the previous season from the head of the west branch of the Athabaska River. To do this the climbing party had to man-pack a camp up the valley, a most strenuous undertaking, and reach stations covering the watershed by crossing the wide icefield referred to. Five camera stations were occupied in the vicinity and the party returned to the base camp on July 19th.

A station was then occupied on the south side of Wood River and on the 21st a climb made of Chisel Peak from the same camp. Chisel Peak rises directly from the shore of Fortress Lake on the south side and midway of its length.

Mt. Serenity Mt. Oates

GLACIERS, MAIN SOURCE OF ALNUS CREEK

It was now necessary to travel up Alnus Creek valley, at the head of which lies the watershed. There had evidently been a hunting party up the valley at some previous time, for an old path for pack-ponies was discernible. It was, however, practically grown out of use and had to be cut out again. First it lay through heavy woods and then through thick alders. As the head of the valley was approached the going was more open and finally camp was pitched in a little grove of spruce near timber line that stood in the open grasslands almost at its head. It is a picturesque and beautiful spot. On the way up two fine glaciers send their icefalls directly into the valley and, in one case, the path

passed directly by the foot of the ice which rises in a magnificent wall seventy to eighty feet in height. The head of the valley was reached on July 29th and six camera stations were occupied from the camp.

This having been done the party then moved back to the east end of Fortress Lake and took a fly-camp to timber line in a high, hanging valley opening directly north of it, at the head of which lay the watershed. The stream draining the valley has been named Fortress Creek. Two camera stations were occupied on the watershed, which overlooked the valley of Lick Creek, a stream draining a large basin sending its waters to the Athabaska River. The name has been given on account of a salt-lick in the vicinity.

Directly on the opposite side of the watershed is a tributary of Lick Creek which was named Catacombs Creek from the fact that it flows at the base of a broad, ridge-topped mountain with a very striking alcove formation which suggested the name Mt. Catacombs. The stream has a short run to the wide valley of Lick Creek. The two stations here occupied closed the work in the vicinity of Fortress Lake.

On August 6th the party started for Whirlpool River on the way to Athabaska Pass but, before moving up its valley, supplies had to be brought from Jasper. On August 11th a move was made for fifteen miles up the Whirlpool. It was now very smoky from forest fires and nothing could be done in the matter of photography, so camp was moved farther up the Whirlpool and a raft built to cross the river to a desirable station as soon as the weather should be sufficiently clear.

Although very smoky a climb was made on August 15th to a station on the west side of the valley and some views taken. The 17th and 18th it rained steadily and cleared the smoke away, and on the 19th it was possible to occupy a station on the east side of the valley to advantage.

Camp was again moved up the river and, on the 20th, a good station occupied at the junction of the south and middle branches.

August 23rd the party moved up the south branch of the Whirlpool to the summit of Athabaska Pass and camp was pitched close by the little tarn known as Committee Punch Bowl, from which the water flows on both sides of the Great Divide respectively to the Arctic and Pacific Oceans. This little sheet of water, a few acres in extent, is situated directly on the watershed.

Rain and cloudy weather prevented photographing until the 29th, when two stations adjacent to the pass summit were occupied. On the 30th the much talked of Mt. Brown was ascended but soon clouds settled down over the top of the mountain and the climb had to be made a second time in order to get the required photographs and angle readings. Two other stations in the vicinity were occupied and that closed the work at Athabaska Pass.

Before reaching the summit of Athabaska Pass, about three miles down on the northern side, a pass leads westerly across the watershed to a valley draining to a tributary of Canoe River. It was named Canoe Pass and, on September 2nd, the party moved camp to a charming little lake just west of

the summit. From the camp six camera stations were occupied, the most prominent being on the summit of Mallard Mt., so called from a prominent rock resembling a mallard duck, which is seen during an approach from Canoe Pass.

On September 6th the party moved down the valley to the tributary of Canoe River and up the same for several miles to a point where a high pass led over to the headwaters of Fraser River. The going was bad and much trail cutting necessary.

About three miles beyond this place, at the head of the Canoe River tributary, is the summit of a fairly low, timbered pass over the watershed, leading to the headwaters of the middle branch of Whirlpool River, to which has been given the name of "Whirlpool Pass."

A trail was cut out to the summit of the Fraser Pass, which led up the mountain side in a series of zig-zags and camp was placed near timber line about a mile below the summit. On September 8th a climbing party occupied a prominent peak on the east side, and this was the last camera station it was found possible to occupy.

September 9th rain and snow set in and continued almost without intermission until the 20th. On the 17th an exploration was made of Whirlpool Pass summit and it was ascertained that it would be advisable to make a monument survey of it, the easy approach from both sides of the watershed suggesting a suitable route over the Great Divide from the Athabaska River to the Columbia River.

An attempt was made on the 19th to make a climb and occupy a station near Fraser Pass summit, but clouds soon settled down and it began to snow again; moreover, owing to the amount of snow that had fallen, the climbing was dangerous and slow, for the spaces between the rocks were filled with snow that would not bear a man's weight.

September 20th the weather was as bad as ever, so on the 21st camp was struck and the party moved down the Fraser River valley for about two hours to a dry sheltered camp in the timber, opposite a long grass-grown slide where there was excellent horse-feed. Two miles below the summit of the pass there was no snow on the ground and the precipitation was in the form of rain, quite a pleasant change from two weeks of almost continuous snowfall at the high altitude of the previous camp.

The party stayed at the lower camp ground until the 25th in the vain hope of fine weather, but nothing could be done beyond exploring a pass of the watershed nearby, which led to the north branch of Whirlpool River by one of its tributaries. The entire summit of the pass is filled by a beautiful little lake of vivid blue, with a glacier falling into it on one side in a precipitous wall of ice and an immense rockfall blocking it on the other. As a route from the Whirlpool to the Fraser it is effectually barred.

It was now realized that nothing further could be done so on the 25th the camp was packed up and a move made down the Fraser Valley to Lucerne, a

station on the Canadian National Railways which is situated not far from the junction of the stream from Yellowhead Pass and Lake with the branch of the Fraser River that was followed. Lucerne was reached on the 28th and the same night camp was pitched at Yellowhead Pass. Next day the party arrived at Jasper by way of the Miette River.

The weather began to clear on the 27th and the 28th, 29th and 30th were very fine warm days. On the 30th the majority of the party left for Edmonton where some of the members were paid off. The two packers were sent back to Banff with the horses by way of the Athabaska, Saskatchewan and Bow River route. They only got over the Wilcox Pass in time for, in places, the snow there had drifted to a depth of six feet. The trip took fourteen days and during the whole time only two were fine.

The two assistants returned to Banff, and the usual tests of cameras at the close of a season's work were made on October 4th in rain and clouds.

It was a most exceptional season. The late melting of the snow in the spring and its early arrival in the fall, caused the failure of the division to close the gap and so finish the topographical work in the second section of the Boundary Survey, as had been intended.

WOOD RIVER VALLEY

Fortress Lake, of which a description will be found in Chapter III, is drained by Wood River, a tributary of the Columbia, which it joins close by the old site of Boat Encampment at the head of the Big Bend.

It leaves the lake at the extreme southwest corner and flows in a single channel through a belt of timber at the western extremity of the lake for a distance of half a mile or more. It then enters the open flat previously referred to and spreads out in a network of channels, winding through the swampy meadow lands of which the flat is composed and constricting again to one channel at the lower end. It so flows for a short distance and presently opens out in a gravel flat for perhaps half a mile. Beyond that the fall becomes very much steeper, and the stream for several miles flows in a deep, narrow cañon with sharply closing sides to open again to a much larger gravel flat.

As previously stated the first flat has a length of approximately three miles with an average width of half a mile. Spurs of timber, covering the lower slopes of the enclosing mountain sides, extend into it at irregular intervals and groves of spruce and pine are scattered along its bottom.

Some fifteen to twenty miles below, Wood River is joined by a stream from the north, referred to here as Jeffrey Creek. The old fur-trading route between the Columbia River and Fort Edmonton, via the Athabaska Pass, lay from Boat Encampment, now no longer in existence, up Wood River to its junction with Jeffrey Creek, then up the valley of that stream and over a high timbered ridge, referred to by David Douglas as "the Big Hill," to the valley of a stream flow-

ing from Athabaska Pass, and so to the pass. It is thought that a road by the Fortress Lake and Wood River route to connect with the Columbia River would be a very difficult and costly location.

About two and a half miles below the western end of the flat a large torrential tributary of Wood River comes in from the southeast. It drains from a wide ice-bound area surrounding on three sides a high mountain of 12,004 feet, which, seen from this side, shows as a huge snow-covered pyramid and is very conspicuous. This massif was named Mt. Clemenceau by the survey, to perpetuate the name of the famous French statesman of the Great War. A number of hanging glaciers fall from its heights on all sides and send broken streams of ice to the main glaciers below.

Mt. Clemenceau Mt. Bras Croche

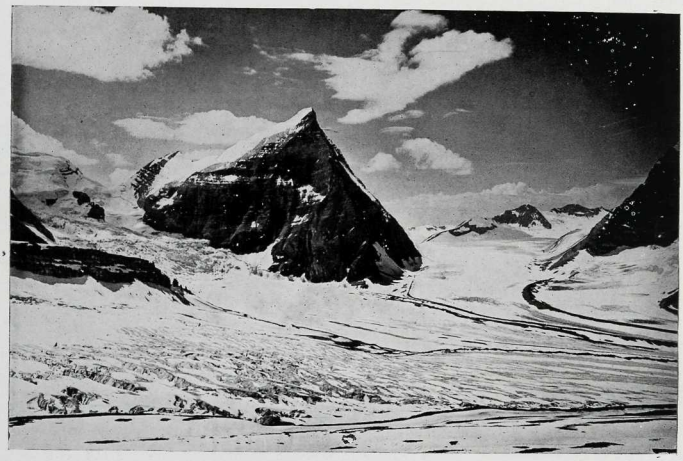
MT. CLEMENCEAU

Beyond the southeastern margin of the Clemenceau Icefield is seen the deep valley of a large stream which, judging by its general direction and source, may be the Sullivan River shown on the official map of British Columbia as joining the Columbia River a short distance above Kinbasket Lake. A tributary of this stream, Tsar Creek, heads from the snow-covered pass where the most western source of the main Athabaska River has its rise, referred to in Chapter III. The main source of the stream lies farther afield, south of Mt. Clemenceau.

At the head of this deep valley and separated from the Clemenceau Icefield by a glacier pass a few miles away, rises the sharp pyramidal cone of Mt. Tsar (11,232 feet), which shows a fine isolated massif with a distinctive glacier on its northern slope. The name Tsar was given by the Boundary Survey.

Directly at the junction of Clemenceau Creek with Wood River, on the south side, rises a precipitous block mass to an altitude of 10,871 feet. Its sheer walls form one of the sides of the cañon of Wood River. The name Mt. Bras Croche has been given to it.

On the eastern side of Clemenceau Creek is another fine mountain completely clad with ice and snow on its northwest face. This robe of white gives it a spectral appearance and it has been named "Ghost Mountain." Below it is an ice-filled basin from which the drainage flows to Wood River at the lower end of the flat. On the same side still another torrent comes into the flat from a glacier on the south side of the western ridge of Chisel Peak.



CLEMENCEAU ICEFIELD AND TUSK PEAK

The Clemenceau Icefield is of surpassing interest as a spectacular illustration of glacial ramifications. On the north or Wood River valley side it is drained by three main flows of ice which join to form the Clemenceau Glacier. One flows from the portion of the icefield lying directly behind and south of Mt. Clemenceau, between it and a sharp cone of rock to which has been given the name of Tusk Peak. In the centre, between Tusk Peak and another mass which has been named Mt. Duplicate, from the close resemblance to each other of two distinct elevations of the mass, lies an ice-filled basin sending a stream of wildly broken ice to the main glacier. Beyond this a third stream drains a section of the icefield lying between Mt. Duplicate and Ghost Mountain. All three ice-streams converge and join together, their separate flows very dis-

tinctly marked by broad medial moraines and their number being added to by two magnificent hanging glaciers which, in wonderful icefalls, sweep directly from the topmost heights of Mt. Clemenceau. All around the circle of view, from every direction, hanging glaciers send their torrents to swell the main volume below. In twenty-five years of photographic surveying in the Canadian Rockies I have not seen a more wonderful and spectacular panorama of glaciers and their tributaries.

On the north side of the flat two large streams come in to join Wood River: Alnus Creek at the eastern extremity, and Serenity Creek near the western. Alnus Creek flows in a valley having a length of approximately eleven miles and a southeasterly direction. Although the head of the valley is surrounded by snow deposits and a considerable runoff flows from them, the main supply is derived from two glaciers of which the ice-tongues come right down to the very bottom of the valley and have even gone beyond it, for terminal moraines have been left a considerable distance up on the opposite side. Both glaciers head from ice deposits along the watershed, the upper one from below Mt. Scott and the lower from behind Mt. Serenity. One is three and a half miles from the head of the valley and the other five miles.

The valley is a U-shaped, glacier carved one and, although tracts of heavy forest lie on its northern slopes, the largest part is covered by a dense growth of alder, where the timber, if there was any, has been swept from the sides by mighty avalanches of snow. This very dense growth has given rise to the name "Alnus."

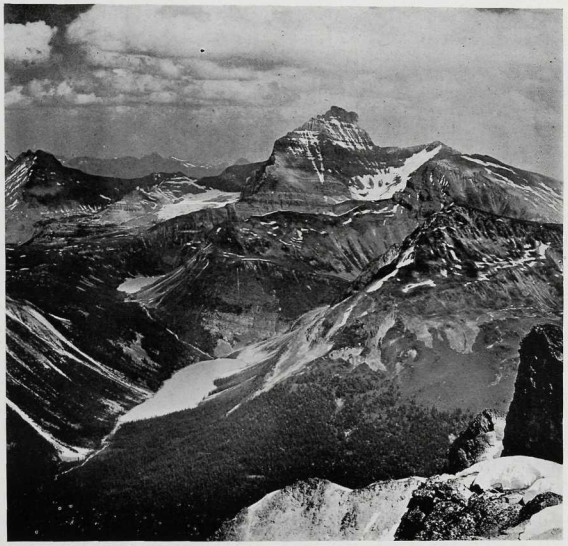
The watershed passes directly at the head of the valley. On the opposite side of the divide lies a small glacier, draining to the Whirlpool River, and here appears a very peculiar occurrence: part way down the valley, which is a double-headed one, lies a narrow lake, three-quarters of a mile in length. It seems to be held in place by an immense fall of rock talus, which has filled up the valley bottom and acts as a dam. Beyond this obstruction the stream appears and flows on its way to the Whirlpool.

Serenity Creek is, for the most part, the runoff from a very prominent icefield and glacier on the southeastern slopes of Mt. Serenity. Not far below the ice-tongue of the Serenity Glacier the stream is joined by a tributary from a smaller ice deposit directly to the north. The united streams join the Wood River about half a mile from the west end of the flat.

Eight camera stations were occupied in this area; they are: Fortress Lake West (8632 feet); Wood River South (7333 feet); Clemenceau Moraine (7153 feet); Clemenceau Snowfield No. 1 (9721 feet); Clemenceau Snowfield No. 2 (9676 feet); Misty South No. 1 (8126 feet); Misty South No. 2 (7390 feet); and Chisel Peak (10,005 feet).

WHIRLPOOL RIVER

Whirlpool River is a tributary of the Athabaska River, which it joins about fourteen miles up stream from Jasper. The name is probably due to the number of whirlpools that are seen at various parts of its course; empty food tins thrown in the stream would go round and round for hours before being swept down the current. The old fur-trading route from Fort Edmonton to the Columbia River, via Athabaska Pass, lies up its valley.



MT. FRYATT AND LAKES
North Source of Divergence Creek

A driving road leads for eight miles along the west side of the Athabaska River, and then a trail some six or seven miles farther to a point where a bridge crosses the Whirlpool several miles up stream from its junction with the Athabaska. From the bridge a trail travels along the west side of the Whirlpool for about eighteen miles to the junction of the north branch with the main stream. In this stretch, about midway of the distance, the eastern slopes of Mt. Edith Cavell (11,033 feet) form the side of the valley. On the opposite side but farther back, rises an outstanding mass of distinctive wedge-shaped form, to which the survey has given the name of Mt. Fryatt (11,026 feet). The north branch heads

in the glaciers of Mt. Fraser and flows southeast to a confluence with the main stream. The volume is about half that of the main stream above the junction. For all of the distance the trail lies through thick pine forest, much of it good merchantable timber.

Five to six miles farther up is the junction of the middle branch which has its rise from a glacial basin at the watershed. Its valley provides a low pass over the watershed, referred to above as Whirlpool Pass. It has no large glacier at its head, and the volume of the stream is small compared with that of the main Whirlpool River. The general direction is northeasterly.

The south branch is the main stream. Some four miles up from the junction with the middle branch the valley floor is a wide gravel flat through which the stream flows in numerous channels. The flat has a length of about two and a half miles. Near the upper end it turns and leads to a large glacier, being divided into two parts by a thickly forested elevation rising between them. The glacier which has undoubtedly originated the gravel flat, is the surplus discharge of a broad icefield at the northeastern corner of which stands Mt. Scott, and Mt. Hooker at the southwestern. The name "Scott" was given to a mountain and to the glacier by A. L. Mumm, Vice-President of the Alpine Club (England), after the celebrated explorer who lost his life in his famous expedition to discover the South Pole. In 1913 Messrs A. L. Mumm and Geoffrey Howard visited Athabaska Pass in an endeavour to elucidate the mystery of Mts. Brown and Hooker. It appears, however, that the name Mt. Scott was conferred upon the mountain that was named Hooker by David Douglas and, in consequence, the name has been transferred to the high mountain at the northeastern corner of the icefield. These gentlemen also appear to have conferred the name Mt. Patricia upon the massif here referred to as Mt. Fryatt. The latter is thought to be more appropriate in conjunction with Mt. Edith Cavell, directly opposite on the other side of the valley of the Whirlpool.

Above the gravel flat of Scott Glacier the trail begins to ascend more rapidly in its approach to the summit of the Athabaska Pass and between nine and ten miles farther on the summit is reached.

The following camera stations were occupied along the course of the Whirlpool River: Whirlpool West (7048 feet); Divergence Creek Ridge (7991 feet); Whirlpool Junction (8730 feet); Whirlpool East No. 1 (9613 feet); and Whirlpool East No. 2 (9559 feet).

ATHABASKA PASS

History and Origin of Name.—The Athabaska Pass summit is the crossing of the Continental Divide used by the North West and Hudson's Bay Fur Trading Companies when travelling to and from their headquarters at Fort Edmonton and the Columbia River trading and hunting grounds. Undoubtedly many parties of hunters and voyageurs must have passed over it but, strange to relate, very little sign of the travel of those early days is left and, outside of a few ancient blazes, the trail has been almost obliterated by time.

Many illustrious men of these two great fur trading companies have passed along the route, men who had much to do with the Dominion of Canada while in the making, some of whom have left records of their early explorations. Foremost among them was David Thompson, astronomer and geographer to the North West Company, which he joined in 1797. In the autumn of 1810 Thompson ascended the valleys of the Athabaska and Whirlpool Rivers, and crossed the watershed by way of the Athabaska Pass. Descending Wood River valley to the Columbia, he founded Boat Encampment at the mouth of Wood River, about eighty miles from Revelstoke on the Canadian Pacific Railway.

During the winter of 1812-13 Alexander Henry, a partner and fur trader of the North West Company appears to have been at Henry House, which was situated in the Athabaska Valley not far north of Jasper. He appears to have crossed the pass and, in 1813 descended the Columbia from Boat Encampment to Fort Astoria.

The Athabaska Pass was one of the two main lines of communication between the east and west, until the advent of the Canadian Pacific Railway, the other route being that by way of Howse Pass. It was travelled almost entirely by members of the North West Company up to the time of amalgamation with the Hudson's Bay Company in 1821, and after that by representatives of the united interests under the name of the latter company.

An interesting account of travel by this route from 1812 to 1814 has been published by Gabriel Franchère, an officer of the Pacific Fur Company, which was absorbed by the North West Company; also by Ross Cox, 1812 to 1817, another officer of the Pacific Fur Company, who subsequently joined the North West Company. To these may be added narratives by John MacLeod, chief trader in the service of the united North West and Hudson's Bay Companies, who crossed the Athabaska Pass with his wife and children in 1822; by Sir George Simpson of his expedition in 1825; the travels of Alexander Ross and the early explorations of David Douglas, the celebrated botanist, by whom Mt. Brown and Mt. Hooker, one on each side of the pass, were named. Records also have been left by the renowned artist, Paul Kane, who travelled the pass in 1846 and again in 1847, when on his way to the lower Columbia River to depict the Indians dwelling by that mighty waterway, their appearance, habits and customs, and so to supplement the written records of the earlier travellers, Thompson, Henry, Franchère and others.

The name Athabaska Pass seems something of a misnomer, and can only be accounted for by the fact that for the largest part of the route through the eastern slopes of the Rocky Mountains the path lies in the valley of the Athabaska River, until it finally turns up the valley of the Whirlpool.

Of all the crossings of the Great Divide it is the most celebrated, owing to the records left by the botanist, David Douglas, who, in 1827, travelled through the pass with the Ermatinger Annual Express from Fort Vancouver, via Boat Encampment at the Big Bend of the Columbia River.

On arrival at the summit of the pass he "set out with the view of ascending what appeared to be the highest peak on the north or left hand side. The height from its apparent base exceeds 6000 feet, 17,000 feet above the level of the sea . . . . . This peak, the highest yet known in the northern continent of America, I felt a sincere pleasure in naming 'Mount Brown,' in honour of R. Brown, Esq., the illustrious botanist . . . . . A little to the south is one nearly of the same height, rising more into a sharp point, which I named 'Mount Hooker,' in honour of my early patron the enlightened and learned Professor of Botany in the University of Glasgow, Dr. Hooker."

It is thus seen that David Douglas gave to the two mountains an altitude of 17,000 feet to the one and to the other "nearly the same height"; that is it might be a little more or a little less.

The highest peak in the main range of the Canadian Rockies is Mt. Robson, 13,068 feet above sea-level, its present computed height. The Topographical division has computed Mt. Brown to be 9156 feet in altitude and there are no mountains of the range of anything like so great an altitude as that given by Douglas to Mt. Brown. The heights of Douglas seem to have appeared for the first time on a map issued with Hooker's "Flora Boreali-Americana" in 1829. The map seems to have been supervised by Douglas and Mts. Brown and Hooker appear upon it as 16,000 and 15,700 feet respectively.

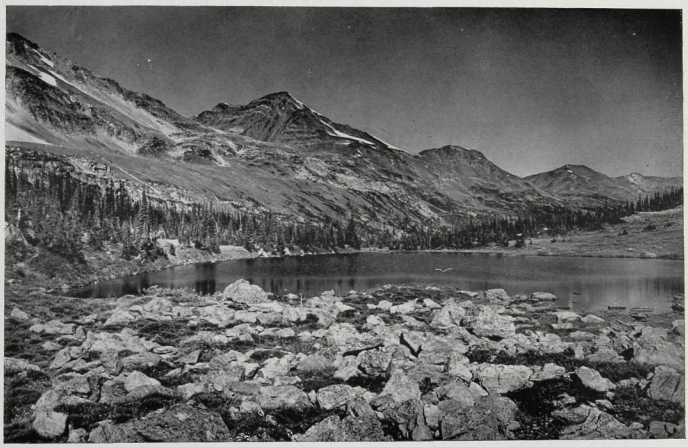
These altitudes have been on many maps since then and have been the cause of several expeditions in quest of the two giant peaks. Of such expeditions those of Dr. A. P. Coleman of Toronto University have been most noticeable. In 1893, accompanied by his brother L. Q. Coleman and Professor L. B. Stewart, also of Toronto University, he journeyed to the summit of Athabaska Pass and the ascent was made of Mt. Brown. Their computations reduced the height from 16,000 to 9050 feet, and placed the summit of the pass at 5710 feet. These closely agree with the deductions of the Topographical division which makes the summit of the pass 5736 feet and Mt. Brown 9156 feet.

Somehow Douglas seems to have assumed an altitude of 11,000 feet for the summit of the pass, and the authority for his conclusion appears to rest either with David Thompson or Sir George Simpson, most probably with the former.

There has been no doubt as to the identity of Mt. Brown, but the question seemed to be "where was Mt. Hooker?" Here again Douglas seems to have made a mistake. In his diary he says that he "set out with the view of ascending what appeared to be the highest peak on the north or left hand side." The direction of the valley of the pass at the divide is practically north and south; thus Mt. Brown would be on the west or left-hand side, and consequently Mt. Hooker, which he says is a little to the south would really be a little to the east. In this direction, about six miles away, is a peak of 10,782 feet which rises "more into a sharp point" and would fill the requirements in all respects except for the considerably greater elevation.

Coleman says, "The question of Mt. Hooker is less certain. A ridge-like mountain climbed by Stewart and Lucius rises to 8600 feet southeast of the pass at the point where Hooker is indicated on Palliser's map; but a much higher, finer peak rises a few miles east of the Punch Bowl, with fields of snow and a large glacier, and was estimated at about eleven thousand feet." This is undoubtedly the peak referred to above as of 10,782 feet altitude, and it would seem probable that it is the peak upon which Douglas conferred the name of Hooker. It is so referred to in this report.

Topography and Characteristics.—The general direction of the pass is a little east of north and west of south. Directly at the crossing of the watershed it is west of north and east of south. The lowest part of the summit is at an



THE COMMITTEE PUNCH BOWL

altitude of 5736 feet. The approach on the Alberta side is by way of the valleys of the Athabaska and South Whirlpool Rivers. The eastern approach throughout is singularly free from hills of great length and steepness. On the British Columbia side the approach is by the valley of Wood River and by the valley of Jeffrey Creek, a tributary, thence climbing over a dividing ridge to the valley of a small stream flowing directly from the summit of the pass, which joins either Wood River or Jeffrey Creek. This part of the western approach, between the summit of the pass and Wood River valley, is very steep.

Directly at the summit of the pass are three little mountain tarns. The centre one, which is on the watershed, is known as the Committee Punch Bowl, according to White's Place Names in the Southern Rockies; "presumably a

reference to the governing committee of the North West Company who are reputed to have frequently celebrated with the assistance of the flowing bowl." This tarn sends its waters both north and south, the two others draining respectively to the Arctic and Pacific Oceans. All three are within a short distance of each other and have connecting streams. The stream flowing from the easterly tarn is shown on Map Sheet No. 27 as Pacific Creek, and that flowing from the westerly one as a branch of Whirlpool River.

The floor of the pass at the summit is not more than an eighth of a mile wide, but the gap widens out as the slopes rise to the west. From rim to rim the valley is about two miles across. The summit is a beautiful park-like spot with open grass-lands and groves of spruce trees. Heather and bright alpine flowers render it very attractive during the summer months.

The watershed passes over Mt. Hooker and, crossing the icefield lying between, ascends McGillivray Ridge, which rises in very precipitous bare rock walls immediately east of the Punch Bowl tarn. From the crest of McGillivray Ridge the watershed drops to Committee Punch Bowl. On the opposite side of the valley it swings southward, and wanders amidst highly glaciated rock ledges, sparsely covered by timber, and so between scattered ponds of water until timber line is reached. The smoothed and rounded rock exposures of this part show that, geologically speaking, they have only recently been uncovered by the ice. Soon after the watershed ascends the southern ridge of Mt. Brown which it follows to a point below the summit of the mountain, where the northern and southern ridges divide. It now traverses the northern ridge and crosses a pass leading to an open narrow valley, the waters of which are tributary to Canoe River, then ascends another mountain mass to a corner where again the north and south ridges divide, and follows the former across a second open pass of which the western valley holds a tributary of Canoe River. The second pass is about four miles northerly from the summit of Athabaska Pass and to reach it the watershed follows the western rim of the Whirlpool Valley.

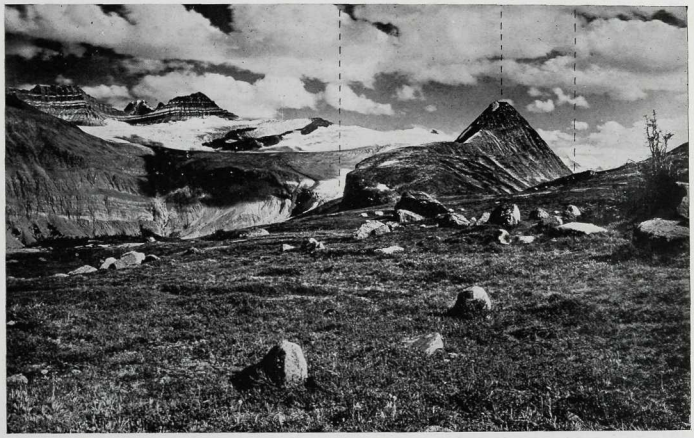
CANOE PASS

The first small pass over the watershed north of Mt. Brown, referred to above, has not been named. The second, a wider one, is here referred to as Canoe Pass, owing to its western waters draining to Canoe River. The summits of both passes are but a short distance below timber line, that of the former having an altitude of 6820 feet, and the latter of 6722 feet.

The summit of Canoe Pass is open with a few bunches of stunted spruce bushes here and there. Just beyond the summit, on the British Columbia side, is a charming little blue tarn partly surrounded by trees; the spot is very attractive and the vistas of mountain peaks both up and down the valley are most alluring. The valley leading to Mazama Creek three and a half miles in length soon gets steep and rough and difficult for travel with a pack-train. The

approach from the Whirlpool Valley is also steep. It is doubtful if this pass over the watershed would serve any useful purpose and it is not considered that a monument survey would be warranted.

The Canoe River tributary called Mazama Creek on Map Sheet 27 flows in a broad, densely timbered valley and soon receives other large streams. Six miles upstream from the junction of the Canoe Pass stream the watershed crosses the valley and on the opposite side of the divide lies the source of the Middle Whirlpool River. The pass is one previously referred to as Whirlpool Pass.



CANOE PASS
Looking South

WHIRLPOOL PASS

History and Origin of Name.—The pass is so called for the reason that the valley of the middle branch of the Whirlpool River crosses the watershed and, on the British Columbia side, becomes the valley of the tributary of Canoe River referred to. No trails were seen leading up the valley on either side of the watershed except between the summit of the pass and a side valley which gives access to the headwaters of Fraser River by a pass, referred to below as Fraser Pass. For this short distance, some two and a half miles, a faint trail followed a line of blazes and led over the Whirlpool Pass. It may have continued down the Middle Whirlpool but was not followed farther than the summit.

Topography and Characteristics.—The distance from the junction of the stream flowing from the summit of Canoe Pass with Mazama Creek to the summit of Whirlpool Pass is a little under six miles. The valley is densely forested, the forest extending over the summit of the pass to the middle branch of Whirlpocl River. The altitude of the summit is approximately 5900 feet or rather more. The general trend of the valley is northeast and southwest and, at the summit of the pass, the direction is the same. Here the valley floor is narrow and the slopes rise very steeply; from crest to crest the valley is about two miles wide.

On the Alberta side of the summit two contiguous rock gorges have been carved out which extend back to the watershed a few hundred yards from where they open to the trough of the stream flowing in the valley. They are filled with immense blocks of rock, piled upon one another in wild confusion. The spot is fiercely picturesque. The watershed crosses the pass directly at their heads.

The approaches on both sides are rough and broken and the forest is filled with heavy windfall, but there is no very steep hill and the valley would appear to offer a good route for a road from the Athabaska to Canoe River. It would seem advisable that a detailed survey should be made of the pass summit and that it should be monumented.

The chief source of Mazama Creek is a large glacier on the northeast side of Mallard Mt. On the opposite side of the divide the middle branch of Whirlpool River derives its supply from a high shelf-like basin bordered by rugged peaks holding several small glaciers in their hollows. There are here two small lakes and a number of minor ponds. One of the lakes is a bright creamy blue, the other is pure milk white. Looking for a reason, it was seen that the terminal moraine of the glacier from which the latter received its supply was composed of a white chalk-like material, rock and clay.

The valley of the middle branch of Whirlpool River also appeared to be well forested, with numerous rockfalls near its head and a wide gravel flat farther on. Beyond, the valley seemed to contract to a sharp V-shape and the stream to flow in a narrow trough which assumes the proportions of a cañon as the junction with the south branch is approached.

FRASER PASS

Some two and a half miles downstream from the summit of the Whirlpool Pass, on the British Columbia side, a valley opens to the northwest and leads by an alpland pass to the headwaters of Fraser River. For such reason it is here referred to as Fraser Pass.

At the junction of this valley with Mazama Creek valley a newly built hunter's cabin was seen from which a faint trail climbed the hillside, and leading over the summit to the Fraser Valley, continued down the same. Apparently horses had been taken over it from the Fraser but not as far as the cabin, owing to the very steep and broken hillside.

The summit portion of Fraser Pass bears northwest and lies well above the timber at an altitude of 6500 feet. It presents open rolling grassy slopes. Two little ponds mark the summit, and several small glaciers on both sides of it send their outflows respectively to the Fraser River and to Mazama Creek.

FRASER RIVER VALLEY

The Fraser River Valley, on the northern side of Fraser Pass, opens out in a wide circle of grasslands. Numerous small glaciers among the encircling mountains send their outflows to form the main stream which, for several miles, lies in a shallow bed with easy, timbered slopes rising on either side.

The watershed, ascending from the summit of Whirlpool Pass, traverses a peak directly north of Fraser Pass summit. This peak was the last camera station occupied and there is not sufficient information to write definitely of the country lying beyond. The watershed lies close along the rim of the Fraser Valley, on the eastern side, and roughly parallels it.

Five or six miles down, the valley is narrower, and the enclosing slopes rise more steeply and are thickly covered with timber. At several places on the western side snow-slides have come down and have left wide grassy hill-slopes, providing excellent pasture for horses.

Some three miles from the summit of Fraser Pass a high valley opens to the north containing a little alpine meadow with a huge rockfall at the end of it. Climbing the rockfall, the watershed is crossed and a beautiful little sky-blue lake disclosed. It lies just beyond the watershed and fills the entire valley floor. On the southern side a fine glacier falls directly into the lake in a very picturesque ice cascade, breaking off to the water in a sheer wall some fifty feet in height. On the opposite side a mighty rockfall from far up on the mountain side has swept beyond the water's edge into the unseen depths of the lake. A narrow rim of rock holds in the lake at the northern end and through it the outflow leaps in a series of cascades to a valley which is tributary to Simon Creek. This pass over the watershed would be of no practical utility.

The general direction of the Fraser Valley is northwest. Its floor is rough and uneven, in many places being filled with broken rock covered by forest growth. At some parts it is narrow, with steep hillsides rising from the river trough; at other parts there are level tracts covered by open pine woods, where good merchantable timber is seen. Marshy places abound, particularly so along the river bottom. Several large streams come in from the south and two in particular from the north, viz.: one flowing from the Mt. Fraser Valley and one from Tonquin Pass on the north side of Mt. Geikie, not far south of the Yellowhead Pass Valley.

The faint hunter's trail referred to as crossing Fraser Pass, gradually becomes better marked and leads to Lucerne, a station of the Canadian National Railways. The distance from the summit of the pass to Lucerne is roughly estimated at from thirty-five to forty miles. Near the junction of the valley

with the valley of Yellowhead Pass the Fraser River flows in a deep, narrow gorge and the trail is high above it on the hillside. By this time the stream is of very considerable size, and close by the railway is joined by the stream from Yellowhead Pass summit, a comparatively small one.

THE WATERSHED—FORTRESS PASS TO DIVERGENCE PEAK

From the lowest part of the summit of Fortress Pass to the highest point of Fortress Mountain (9908 feet) the watershed ascends for a distance of two and a half miles in a northwesterly direction, then in a sinuous northwest course for another two and a half miles to an elevation of 9300 feet on the ridge connecting Fortress Mountain with Mt. Catacombs.

At this point the watershed turns sharply a little south of west and, crossing a low dip (7900 feet) at three-eighths of a mile, follows a ridge, enclosing the Fortress Creek basin, for one and three-quarters miles to a point 8880 feet. On such course, at one and a quarter miles, it passes over the summit of Lick Creek South camera station, 9370 feet. From the camera station a ridge branches southward which forms the western boundary of the basin. The basin is an open grassy spot above timber line but is broken and rocky.

On the north side of the bounding ridge is the basin of Catacombs Creek. The stream flows in a high valley below the mountain of the same name nearly due north to join Lick Creek, a distance of some six miles. There is a glacier at the head and a number of small lakes and ponds in the basin.

From the last-mentioned course the watershed turns northwest again for nearly seven-eighths of a mile to a peak of 8980 feet, from which it travels almost due west across a snow saddle (7680 feet) for one and one-eighth miles to a peak, 9620 feet, directly beside which to the east is another peak of 9290 feet.

From the peak at the eastern extremity of the course, a serrated ridge extends north into Lick Creek Valley and forms the western boundary of the valley of Catacombs Creek. On the highest point of the ridge, at an altitude of 8569 feet, is Lick Creek Bend camera station.

On the other side of the watershed, opposite the same course, two streams have their sources in high, hanging valleys, the eastern one a tributary of Fortress Lake and the western of Alnus Creek. On the ridge separating the two valleys are set Fortress Lake North camera stations Nos. 1 and 2 of the 1920 surveys. Both streams have ice deposits at their sources, the eastern one heading from the snow saddle last referred to.

North of the same course is a small glacier feeding a beautifully blue little lake, into which it falls. The lake is three-quarters of a mile long by a quarter wide and is the southeastern source of Lick Creek.

From the peak, 9620 feet, at the west extremity of the last named course the watershed lies west of south for a little over half a mile to an elevation of 9200 feet. Here it again turns generally northwest for three and five-eighths miles in a sinuous line.

At the commencement of the stretch a ridge extends northward for a mile and three-quarters and forms the west boundary of the valley of the little lake. A mile and a quarter farther along, a second ridge extends northward for three-quarters of a mile, separating two good-sized glaciers, both of which augment the south sources of Lick Creek.

At the end of the course the line turns east of north for three-eighths of a mile to the summit of Lick Peak, 9440 feet. From this point a ragged ridge extends northeast for two miles and separates the two main glacial sources of Lick Creek. The southern basin has a floor of rock boulders, evidently left by the larger glacier that inhabited it in bygone days. The floor is now covered by open spruce timber, and a number of delightfully coloured little tarns lie here and there upon it.

From Lick Peak the course of the watershed is west and northwest a mile and a half to Lick Creek West camera station on a peak of 8890 feet. On the way two peaks of respectively 9120 feet and 8930 feet are passed over.

The course of the watershed is now generally northwest, in curves, from Lick Creek West station to Alnus Creek East station, 8880 feet, a distance of one and three-eighths miles.

From Alnus Creek East station the watershed curves on a course nearly due north for one and a quarter miles to the most easterly peak of a four-pointed mass at 9430 feet. The mass is on the ridge enclosing the glacier at the northerly source of Lick Creek. The ridge continues easterly around the said glacier, separating it from Divergence Creek basin on the north and Alnus Creek basin on the west.

The northern source of Lick Creek has its supply from a good-sized glacier which lies at the head of a high rock cirque. On the north side of the cirque a low dip, 7990 feet, leads to the valley of the southern source of Divergence Creek, a tributary of Whirlpool River. There is here another charming little lake, fed by glaciers lining the sides of the cirque in which it lies. It is three-quarters of a mile long by nearly a quarter of a mile wide. Two miles below it the northern source of Divergence Creek comes in. It has its origin in glaciers and lakes at the base of Mt. Fryatt.

The glacier at the head of the northern source of Lick Creek sends a fine ice cascade to the valley of the southern source of the stream. From the junction the stream flows in a wide, deep, thickly forested valley three miles to the junction of Catacombs Creek. Below this point there rises, on the northwest side, a distinctive mass that is seen prominently up the Athabaska Valley from Jasper. It has three separate peaks. The centre one, a prominent isolated tower (10,370 feet), has been named Brussels Peak with reference to Mt. Fryatt which lies immediately northwest across the valley of Fryatt Creek. The northern peak (10,180 feet) has been named for Mt. Christie of the Palliser Map. From the junction with Catacombs Creek the stream flows some six or eight miles more before emptying into the Athabaska River. Its general direction is northwest.

From the last mentioned 9340 feet point the watershed traverses the three other points of the mass, southwest for nearly three-eighths of a mile to an elevation of 9470 feet at the fourth one. It then swings northwest and north one and a half miles to a point near the summit of Divergence Peak, at an altitude of 8920 feet.

The following camera stations, six in number, were occupied to map the watershed and vicinity from Fortress Mountain to Divergence Peak: Lick Creek South (9370 feet); Lick Creek Bend (8569 feet); Lick Creek West (8890 feet); Alnus Creek East No. 1 (8880 feet); Alnus Creek East No. 2 (7622 feet); and Divergence Peak (9275 feet).

DIVERGENCE PEAK TO ATHABASKA PASS

The altitude of Divergence Peak is 9275 feet. The watershed line does not reach the summit, but at an altitude of 8920 feet is deflected sharply from a little west of north to southwest, for which reason the name has been given to the peak. From this point to Athabaska Pass summit the general direction is southwest and may be described in detail as follows: Leaving Divergence Peak the course is southwest for one and two-eighths miles to Alnus Peak Camera Station, 9763 feet. At three-eighths of a mile it crosses the snow saddle, 7980 feet, separating the head of Alnus Creek valley from the northern head of the valley of the lake and the rockfall, tributary to the Whirlpool River.

From Alnus Peak the course continues southwest for another mile, again crossing a snow saddle, 8170 feet, separating a glacier source of Alnus Creek from the glacier at the southern head of the valley of the lake and rockfall. The watershed now curves westerly around a glacier of Alnus Creek valley for nearly a mile and a half to the summit of a peak, 9840 feet, which has been named Mt. Ross Cox, almost due south of the starting point. Close to the start the course passes over a peak of 9630 feet.

The watershed next travels one and seven-eighths miles on a serpentine course west to the north corner, 10,180 feet, of the mass of Mt. Scott, at the extreme head of the northerly of the two glaciers descending to the stream-bed of Alnus Creek. The ridge along which the watershed lies separates this glacier from one on the north side, which is the source of a stream joining Whirlpool River at the northern extremity of the big gravel flat of the Scott Glacier. It has been shown as Ross Cox Creek on the map.

The course of the watershed is now, generally, a little east of south, with a broad curve in the centre between an eastern source of Scott Glacier on one side and glaciers tributary to Alnus Creek valley on the other. The length of the course is four and five-eighths miles. Half a mile from the start the watershed passes over the summit of Mt. Scott, altitude 10,826 feet, and at one and three-quarters miles reaches the summit of Mt. Oates, 10,220 feet. A mile and five-eighths farther on a peak is reached of 10,080 feet. It is shown as Mt. Ermatinger on the map (sheet No. 26). The southern extremity of the course is at

the head of the lower of the two large glaciers of Alnus Creek, which descends from below the north precipitous face of Mt. Serenity to the bed of the creek.

From the last point mentioned the course of the watershed lies nearly due west for two and a quarter miles across the Hooker Icefield to the summit of Mt. Hooker, 10,782 feet. It continues from the summit on practically the same course for two miles farther to the summit of a peak of 9970 feet.

The Hooker Icefield is of very considerable extent. The part north of the watershed contains, with its ramifications, an area of about nine square miles, and south of the watershed of about eleven square miles, altogether about twenty square miles of ice. It reaches an altitude of a little over 9000 feet and sends out many large glaciers, notably; north, the Scott Glacier, the main source of

MT. OATES, CENTRE

Scott Creek; east, the two large glaciers of Alnus Creek, its chief source, and the glacier from the southeastern face of Mt. Serenity, all tributary to Wood River; south, two other large glaciers from the southern faces of Mt. Serenity and Mt. Hooker, both tributary to Wood River.

Proceeding from the peak of 9970 feet altitude the watershed curves due south for a little over a mile and then swings to a little south of west for one and three-eighths miles to the crest of McGillivray Ridge at 8780 feet. The last two courses cross an accumulation of ice, some six square miles in area, that sends down glaciers which have a run off north to Whirlpool River and south to Wood River and to its tributary from Athabaska Pass.

From the crest of McGillivray Ridge the course is southwest a little more than three-quarters of a mile to Committee Punch Bowl, which is on the watershed and from which the water flows north to the Arctic, and south to the Pacific Ocean.

The following camera stations were occupied to cover this length of the watershed (Divergence Peak to Athabaska Pass summit): Alnus Peak (9763 feet); Alnus Creek W. (8908 feet); Wood River N. (7682 feet); Athabaska Pass S. (7512 feet); Mt. Brown E. (8685 feet); and Punch Bowl at the summit of the pass (5736).

ATHABASKA PASS TO WHIRLPOOL PASS

At the summit of the pass the watershed turns to a little east of south for half a mile, and then again travels southwest seven-eighths of a mile, to the

Pacific Ck. Valley The Big Hill (of Douglas)

JEFFREY CREEK VALLEY

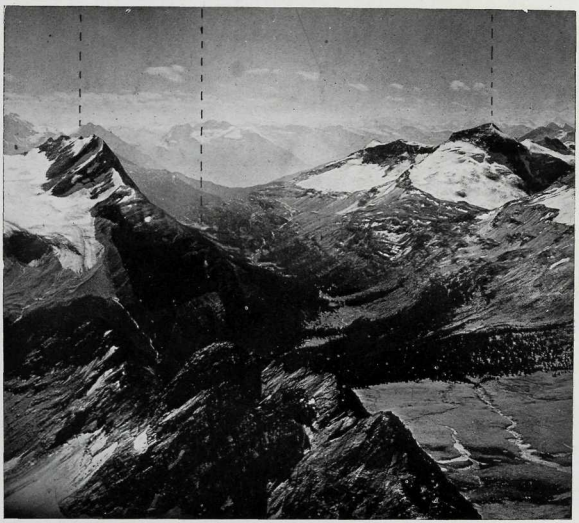
south ridge of Mt. Brown. It follows the ridge northwesterly one and three-eighths miles, to camera station, Mt. Brown No. 2, 8849 feet, which is situated on the east corner of the crest of the mountain.

South of Mt. Brown lies a wide-spreading ice sheet, separated by ridges into several distinctive areas. It contains ten to fifteen square miles of ice and sends glaciers northwest, tributary to Canoe River, and east and southeast, tributary to Wood River; the southeastern flow is the headwaters of Jeffrey Creek.

From the crest of Mt. Brown the general course of the watershed is a little east of north, along the north ridge of the mountain, to the summit of a small

open pass, 6780 feet, at a distance of one and three-eighths miles. This is a narrow U-shaped pass of which the valley at the summit is one and three-quarters miles from rim to rim. The summit of the pass is on the border of the Whirlpool Valley. A number of small tarns directly at the summit form the source of a stream shown as Robert Creek flowing in a deep, rugged valley to the tributary of Canoe River from Whirlpool Pass. The flow is augmented by the runoff from four small glaciers on the northwest face of the Mt. Brown Ridge. Mt. Brown is the northeastern one of the three peaks which form the ridge.

McGillivray Ridge Summit of Pass Mt. Brown



ATHABASKA PASS
North Approach

From the summit of the pass the watershed travels for half a mile northwest and half a mile west to the eastern corner of the opposite ridge, 8810 feet. The ridge culminates in Mt. Brown West camera station, 9077 feet, a mile and a quarter west.

The watershed now lies a very little east of north, for one and five-eighths miles, to the lowest point of the summit of Canoe Pass, 6722 feet. The summit of this pass also is on the western rim of the Whirlpool Valley, and beyond it to the west lies the charming little lake, already referred to, from which the

water drains to the Canoe River tributary flowing from the summit of Whirlpool Pass. The stream derives most of its flow from a glacier of considerable size on the north side of the Mt. Brown West ridge.

The watershed, from the summit of Canoe Pass lies northwest for a little over a mile and a quarter to the highest point of a low, outlying ridge, extending southwesterly from the mass of Mallard Mt. on which Mallard Ridge camera stations Nos. 1, 2 and 3 are set. From No. 1 station, 8408 feet, the highest point of the ridge, the watershed is a little east of north for half a mile to the northern extremity of the ridge. It then curves northeasterly to the summit of the mountain, distant a mile and a quarter. Mallard Mt., 9330 feet, is surrounded by glaciers on three sides, those on the north and west draining to Canoe River, and on the east to the Whirlpool. Below Mallard Mt. to the south is a wide stretch of open alpland which continues over the summit of Canoe Pass.

The course of the watershed is now northeast in serpentine curves for two and one-eighth miles to a peak of 8680 feet. Midway of the course it passes over an elevation of 8210 feet. From the peak 8680 feet, the watershed lies a little west of north on a sinuous course for slightly more than seven-eighths of a mile to the end of a ridge, 8646 feet, which forms the southeastern confine of Whirlpool Pass summit. These last two courses lie along the southeastern border of an area of ice, between two and three square miles in extent, most of which drains to the Canoe River, but outlying portions to the south and middle branches of Whirlpool River.

From the last-mentioned point the watershed turns on a general course a little north of west for one and a half miles to the summit of Whirlpool Pass, at an altitude of about 5900 feet; a definite altitude has not yet been established.

BEYOND WHIRLPOOL PASS

From the summit of the pass the watershed ascends, in the same direction, to the crest of the opposite ridge at an altitude of 8327 feet, a distance of three-quarters of a mile. The valley of the pass has here, from rim to rim, a width of a little over two miles.

The watershed now zig-zags for a mile in a northwest direction, to the summit of a peak on which Fraser Pass Southeast camera station, 8879 feet, is set. Beyond, it continues on the same course for one and three-eighths miles to a peak of 8600 feet, which was the limit of the work for the season of 1920. The ridge followed by the watershed from the summit of Whirlpool Pass, northwesterly, divides the waters flowing respectively to the middle branch of Whirlpool and to Canoe River, and is the western boundary of the broad glacier-lined basin which supplies the chief source of the middle branch of Whirlpool River. On the other side of the ridge is Fraser Pass leading from the Canoe River basin to the headwaters of the southern source of the Fraser River.

Between Athabaska Pass and the terminal point of the season's survey the following camera stations were occupied: Mt. Brown Ridge (8459 feet); Mt.

Brown No. 1 (9156 feet); Mt. Brown No. 2 (8849 feet); Mt. Brown S. (8234 feet); Canoe Pass (6722 feet); Mallard Mt. (9330 feet); Mallard Ridge No. 1 (8408 feet); Mallard Ridge No. 2 (7901 feet); Mallard Ridge No. 3 (8344 feet); Mallard W. (7987 feet); Mt. Brown W. (9077 feet); and Fraser Pass S.E. (8879 feet).

GENERAL REMARKS

Watershed.—The summit of Athabaska Pass lies very little north of due west of the summit of Fortress Pass, and is distant from it, in an air line, slightly over twenty miles. The greatest departure from this air line is attained at the summit of Divergence Peak, nine miles north. Divergence Peak is fifteen and a half miles northwest of Fortress Pass summit. Between, the greatest distance of the watershed from the air line is rather less than one mile and a half, where it makes a bow to the southward for the last two-thirds of its course. The course is erratic but the general direction is fairly uniform. An array of small ice deposits and glaciers lie along the watershed on the northwest side.

From Divergence Peak to the summit of Athabaska Pass, in a straight line, is eleven and three-quarters miles nearly due southwest. The whole of the watershed in the distance lies southeast of the line and the greatest departure from it is three and one-third miles. The course is very erratic. In this section there is much ice and snow lying in broad areas on both sides of the watershed, and many glaciers descend from them to the valleys of the Whirlpool and Wood Rivers.

The direct distance from the summit of Athabaska Pass to the summit of Whirlpool Pass is very nearly eight miles. The larger part of the watershed lies on the western side of the line, but between the Wood River and Canoe River valleys crosses to the eastern side. In no place does the departure from it exceed two miles. Wide areas of ice are seen on the western side in the vicinity of Mt. Brown, and smaller deposits on the crest of the ridge between the two valleys named; outside of that the glaciers along the watershed are few and small.

Trails.—The trails that exist are the only means of access. They have already been referred to. At best they are poor, and the travelling by them is more or less difficult. The two main trails are: one branching from the Athabaska-Sunwapta Trail to Fortress Lake, beyond which there is little better than a track and the paths cut out by the survey during the season; the other, from the Athabaska-Sunwapta Trail up the Whirlpool River valley. This is the old fur-trading route but, as previously stated, it has been much defaced by the lapse of time since it was in constant use. All other routes travelled by the survey party were practically new and had to be cut out, with the exception of the path down the Fraser Valley. It will be many years before the increase of travel will justify the construction of better ones.

Rivers and Streams.—The principal waterways met with east of the Divide are Lick Creek and the three branches of the Whirlpool River, all flowing to the Athabaska River. The south branch, which is the main stream, has its chief source of supply from Scott Glacier. The middle and north branches add very considerably to its volume.

West of the Divide the stream referred to as a tributary of Canoe River may or may not be the main stream. Its small size and limited source of supply seem to suggest that it is not. It was first encountered a few miles from the source, where it is of small proportions but, not a great distance below the range of the survey, its volume is increased by several good-sized tributaries from extensive icefield sources.

The branch of the Fraser followed to Lucerne on the Canadian National Railways is the southern source of that mighty river. Where it enters the Yellowhead Valley it is of considerable size and volume, having been augmented by a number of important tributaries from the west. The length of its valley, from the head to where it joins the Yellowhead Valley, is some thirty-five or forty miles.

Timber.—Much good merchantable timber was seen but for the most part it is at present inaccessible. There is large timber at the west end of Fortress Lake, as well as on the slopes bounding the valley. For several miles up Alnus Creek large timber—spruce, fir and cedar—was noticed; also at the west end of Fortress Lake flat.

Lick Creek valley, in its lower reaches, was seen to be heavily forested. The Whirlpool Valley, between the north branch and the Athabaska-Sunwapta Trail, holds wide areas of timber of merchantable size and it is reported that, during the past winter, a large quantity of railway ties was taken out by Otto Bros., of Jasper, under a contract. The valleys of the north and middle branches of the Whirlpool contain heavy forest near their junctions with the main stream. Above the middle branch the timber is smaller and, although the valley sides are thickly clad, it is of doubtful present utility.

There is good forest growth near the summit of Whirlpool Pass and in the valley leading to Fraser Pass but, at present, it is inaccessible. Many tracts of fair-sized spruce and pine were seen in the Fraser Valley. It is doubtful if the cañon near the junction with the Yellowhead Valley will permit of timber being taken out.

Game and Fish.—The usual kinds of game: mountain goat, deer and bear were in evidence, but not plentifully. Moose and caribou were seen, but only odd ones in the Fraser Valley. Grouse are in the woods and ptarmigan on the heights.

No fish were noticed in any of the streams.

MAPS

The season's surveys added the area southwest of the watershed to sheet No. 23, which area could not be reached in 1919. It was now covered by the assistance of camera stations on the Clemenceau Icefield. The data obtained enabled the basin at the head of Tsar Creek to be mapped, producing a very nearly full sheet.

The same stations enabled sheet No. 24, submitted in 1919, to be enlarged to practically a full sheet.

In addition, new sheets Nos. 25, 26 and 27, filled out as fully as the data obtained permitted, are now submitted.

CHAPTER V.

SURVEYS EXECUTED IN 1921

During the seasons of 1918, 1919 and 1920 Mr. Cautley's division was engaged upon the survey of that part of the Interprovincial Boundary which lies along the 120th meridian of longitude, from the intersection of the Wapiti River in latitude 54° 44′ 30″ to a point fourteen miles north of the Peace River in latitude 56° 20′ 04″.

The report of Mr. Cautley's operations during the above mentioned period will appear in the Third Part of the Report of the Commission, which part will include all matters relevant to the survey of the Boundary northerly from Yellowhead Pass.

For the season of 1921 Mr. Cautley's division was engaged in surveying the passes of the continental watershed, lying between Howse Pass and Yellowhead Pass—both surveyed in 1917—across which it had been decided to mark the position of the Boundary by monuments, viz: Fortress Pass, Athabaska Pass, Whirlpool Pass and Tonquin Pass.

Description of Operations

The work which the Commissioners desired to accomplish during the season of 1921 was the completion of the gap between Fortress Pass and Yellowhead Pass, including the four passes named. The above programme was successfully carried out by the end of the season, thus completing the survey of the Boundary from the International Boundary to, and including the survey of, Yellowhead Pass.

Pass Surveys and Monumenting Division

As stated, during the seasons of 1918, 1919 and 1920, Mr. Cautley's division was engaged on the survey of that part of the Interprovincial Boundary which follows the 120th meridian of west longitude, in the Peace River district. In the same period Mr. Wheeler's division was continuously engaged on the production of the mountain survey, and had succeeded in carrying the photo-topographical survey from the vicinity of Howse Pass to a point about twenty-five miles from Yellowhead Pass, so that his work was extended considerably beyond the point at which Mr. Cautley's work commenced this season, and the two divisions saw very little of each other. Mr. Wheeler was, therefore, obliged to make special trips to each of the four passes surveyed in order that the two Commissioners might determine the position of the Boundary as finally surveyed, and also to help Mr. Cautley in identifying and making connection with the mountain stations previously established by his division.

Mr. Cautley assembled his party at Jasper on June 2nd, 1921, and proceeded to Fortress Lake by the Athabaska trail, a distance of about fifty-six miles. Owing to high water, it was found impossible to ford the Sunwapta River at the usual point—just above its confluence with Athabaska River. Mr. Cautley, therefore, proceeded to Sunwapta Falls and built a horse bridge across the cañon, afterwards cutting three miles of new trail to connect with the old Athabaska trail. The bridge and trail occupied two days of the party's time.

The trail to Fortress Pass is twenty miles from Jasper to Athabaska Falls, where it crosses by a bridge to the east side of the river; nineteen miles from Athabaska Falls to Sunwapta Falls, where it crosses by the survey bridge to the west side of the Sunwapta River; three miles southwesterly by the new survey trail to connect with the old trail along the east bank of the Athabaska River; nine miles up the east bank of the Athabaska River to where the Chaba River enters it from the south; it then crosses the Athabaska River, by an easy ford just above the junction of the Chaba and proceeds five and a half miles up the gravel flats of the Chaba to Fortress Pass. The first thirty-nine miles, along the main Athabaska trail, are good and the rest is only fair. There is excellent horse feed three miles upstream from Athabaska Falls, but very little—and that of poor quality—along the rest of the trail. Mr. Cautley's division reached Fortress Pass on June 10th and completed the survey of the pass on July 13th. The party then moved to Athabaska Pass, where it arrived on July 19th.

Although Athabaska Pass is only about twenty miles in direct distance from Fortress Pass, it is about seventy-seven miles from one to the other by trail. In the first place it is necessary to go forty-one miles back along the Athabaska trail to the Government bridge across the Whirlpool River, which is only fifteen miles from Jasper, and at which the trail to Athabaska Pass branches off from the main trail and follows the west bank of the Whirlpool for about twenty miles, after which the river is so small as to be fordable almost anywhere. It is about thirty-six miles to the summit of Athabaska Pass from the Whirlpool bridge, or fifty-one miles from Jasper. The last twelve miles of the trail passes through some unusually beautiful scenery, with splendid glaciers and wonderful cascades generally in view. There is no horse feed for the first eight miles above the Whirlpool bridge, but beyond that there are numerous small flats growing a poor kind of marsh grass, on which, nevertheless, horses seem to thrive. The survey of Athabaska Pass was completed on August 6th and Mr. Cautley's party proceeded to Whirlpool Pass, which was reached on August 9th.

Previous to the survey there was no trail to Whirlpool Pass, which was very little known, and it was arranged between the Commissioners, at the beginning of the season, that Mr. Wheeler's division would undertake the location and cutting out of a trail good enough to enable Mr. Cautley to freight in his heavy outfit of cement, etc. This proved much more of a task than was expected, and much credit is due to Mr. Campbell, who had charge of the work, for the way in which it was carried out. The only possible location for the

trail is up the middle branch of Whirlpool River, which enters the main river from the west at a point about thirty-four miles from Jasper, and it is between nine and ten miles from this point to the summit of the pass. For the first three miles, after leaving the Whirlpool River, the Middle Whirlpool flows through a deep cañon with very steep sides, so that the trail rises about 1500 feet very rapidly. After the first three miles the grade is easier, but rockfalls and high earth cut-banks made trail building difficult. Between four and five miles from the summit there are extensive beaver meadows with excellent horse feed, but there is no feed closer to the summit, except above timber line. The survey of Whirlpool Pass was completed August 29th and the party proceeded to Tonquin Pass, where it arrived on September 9th.

The only travelled trail to Tonquin Pass summit, at the present time, leaves the automobile road up the Athabaska River at Whistler Creek, four miles from Jasper. From the mouth of Whistler Creek it is only about twenty miles to the summit of Tonquin Pass, but these twenty miles entail 7500 feet of climbing, which is very hard on horses. From the mouth of Whistler Creek, altitude 3500 feet, the trail follows the creek about six miles to one of its extreme sources in Marmot Pass, altitude 7400 feet; it then descends two miles to the bed of Portal Creek, altitude 5900 feet, and follows up Portal Creek a distance of five miles to the summit of Maccarib Pass, altitude 7100 feet; it then descends four and a half miles to Amethyst Lakes, altitude 6300 feet, and reaches the summit of the pass in another two and a half miles. The summit of Tonquin Pass is only 6400 feet above sea-level, or approximately 3000 feet above Jasper, so it is apparent that the present trail includes more than twice as much climbing as is necessary.

As the scenery in Tonquin Pass is particularly beautiful and possesses a somewhat unique character, and the pass is within such very easy distance of Jasper, it is to be hoped that a good trail will be located and built along Meadow Creek in the near future. There is any amount of good horse feed in the immediate vicinity of the pass.

The survey of Tonquin Pass was completed on September 21st and the party returned to Edmonton, where it was disbanded on September 24th.

Topographical Division

The Topographical division organized at Banff and commenced work by testing the survey cameras and other instruments. The horses and part of the outfit travelled by trail to Jasper, some of the party and the balance of the outfit going by rail, and that place was made headquarters for the season.

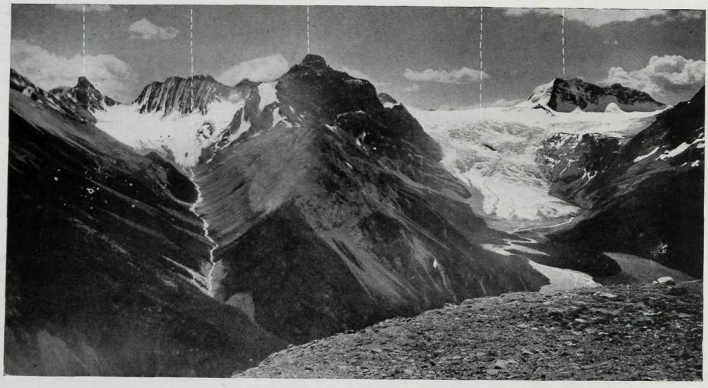
On June 27th a party in charge of Mr. A. J. Campbell, D.L.S., proceeded up the Athabaska Valley and occupied photographic stations there and in the Sunwapta Valley, four in number, for the purpose of covering the country lying between the Athabaska and Whirlpool Rivers near their junction.

On July 9th the same party travelled up the Whirlpool Valley to the mouth of the middle branch of that stream.

Meanwhile, Mr. Wheeler, with an assistant and a small outfit, had gone to Fortress Lake, where he collaborated with Mr. Cautley in establishing the sites for the several monuments erected to mark the Boundary across Fortress Pass, and in placing brass bolts and cairns on prominent points of the rock ridges bounding its valley.

Mr. Campbell now explored up the Middle Whirlpool Valley and commenced cutting out a trail to enable the two divisions to reach Whirlpool Pass summit at its head.

On July 15th, a light camp was taken to the summit of Athabaska Pass and two camera stations, Hooker West No. 1, 8248 feet, and Hooker West No. 2, 7535 feet, were occupied to obtain some data missing from the previous season's surveys.



MAIN SOURCE OF WHIRLPOOL RIVER

By this time Mr. Cautley's surveys at Athabaska Pass were sufficiently advanced to enable the Commissioners to decide upon the location of monuments at Athabaska Pass, and he and Mr. Wheeler established the positions of the same, as also of the brass bolts and cairns.

From July 21st to August 8th the Topographical division, under Mr. Campbell, was employed in putting a trail up the valley of the Middle Whirlpool, and in occupying camera stations along the route and in the vicinity of Whirlpool Pass summit.

A trail was then cut down the valley of Mazama Creek, a tributary of Canoe River flowing from the summit of Whirlpool Pass on the western side, for several miles to connect with a trail that the division had cut in 1920, which

leads from Canoe Pass, near Athabaska Pass (see Chapter IV, 1920 Surveys), up Mazama Creek Valley to reach the summit of Fraser Pass. On August 11th the party moved over this pass and camped at the head of Fraser River.

From August 12th to September 2nd the photographic party occupied camera stations on both sides of the Fraser Valley during such time as the weather permitted. Bush fire smoke and, later on, rain and clouds interfered greatly with this part of the work. The Fraser Valley parallels the line of the watershed, which follows the crests of the serrated ridge confining the valley on the eastern side as far as the southern ridge of the Geikie Creek basin, where the watershed turns eastward to Mt. Fraser.

By August 18th, Mr. Cautley's division had located the watershed across Whirlpool Pass and the Commissioners were able to decide upon the positions of the monuments. This was done between the 19th and 23rd and brass bolts and cairns were placed at prominent rock points above timber-line.

Mr. Campbell now moved the photographic and triangulation party to the mouth of Geikie Creek, a strong tributary of Fraser River, flowing from glaciers on the north and west slopes of Mt. Fraser. Geikie Creek heads in a large amphitheatre lying at the southern base of the Ramparts, a very rugged and much serrated ridge of peaks, of which Mt. Geikie is the outstanding height. From September 5th to 8th five camera stations were occupied in the vicinity, two of which overlook Tonquin Pass.

This closed the survey with that made southward from Yellowhead Pass in 1917, and the party travelled back to Jasper by way of Tonquin Pass, Maccarib Pass and Marmot Pass, arriving there on September 10th, when some of the members were paid off.

In accordance with an arrangement between the Commissioners, Mr. Campbell with two assistants now proceeded up the valley of Miette River to its head in order to ascertain how many passes of the continental divide, lying between Yellowhead Pass and Robson Pass, would be likely to require survey and monumenting; also to ascertain the best and easiest line of travel to keep in touch with the watershed and continue the survey of it north of Yellowhead Pass next season. The exploration took until September 21st, on which date the party arrived back at Jasper.

Meanwhile, one man had been left with horses at Dominion Prairie in the Miette Valley, where there was an abundance of good pasture, and, on completion of the Miette exploration, Mr. Campbell and his assistant with the packers and outfit returned to Banff by trail over Wilcox Pass, reaching that place on October 4th.

September 13th Mr. Wheeler joined Mr. Cautley at Tonquin Pass and collaborated with him in locating the positions for monuments across the two passages of the pass, and placed bolts and cairns upon Tonquin Hill, between the two passages, and upon the bounding rock ridge of the northern side. No bolt and cairn was set upon the rocky heights of the southern side owing to inaccessibility.

The last phase of the season's work consisted of testing the cameras and transits used upon the survey. This was done at the usual site at Banff. It is a very necessary operation, in order to check up possible errors of adjustment that may have accrued owing to the rough methods of pack train transport, which are the only ones available.

FORTRESS PASS

History and Origin of Name.—The location of the watershed across the valley of Fortress Pass was made by the Topographical division in 1919 and a short sketch of the history of the pass and the origin of the name will be found in Chapter III (page 72) of this report.

Topography and Characteristics.—It was not until 1921 that a detailed survey of the watershed across the pass was made by Mr. Cautley's division and monuments erected, and bolts and cairns placed to mark the Boundary. The results of the survey are now available and are here set forth in Mr. Cautley's own words:

Fortress Pass is in several respects extraordinary. Travelling up the open gravel beds of the Chaba River, with its wide, straight and well-defined valley stretching for miles to the south and ending in a mighty glacier, Fortress Pass appears as a small, timbered flat on one's right, without in any way suggesting the idea of a mountain pass. The Chaba River at this point is still a big river, with gravel beds from 700 to 1300 feet wide and numerous water channels.

The timbered flat which forms the summit of the pass is roughly 20 chains square, lying parallel to the west bank of the Chaba River, which runs about 10° east of north. On the west it is bounded by the low, marshy shore of Fortress Lake, which extends six and a half miles west between high, confining mountains (for description of Fortress Lake and Wood River Valley see Chapter III, page 75; also Chapter IV, page 88); on the north, by the lower slopes of Fortress Mountain; and on the south, by the lower slopes of the high mountain referred to on the map, sheet No. 24, as Fortress Lake S. camera station.

The curious fact about the flat is that, while the highest point is close to the bank of the Chaba River and only three feet above its water level, the whole flat has a uniform grade from the Chaba towards the lake which is actually greater than the grade of the river itself; for instance, the grade of the water in the Chaba was found to be 0·57 per cent, between two points 23·00 chains apart, while the grade from water level of the Chaba to water level of the lake was found to be 0·81 per cent.

One result of the above phenomenal condition is that, at all times of high water in the Chaba River, there is an undoubted seepage flow from the river to the lake *across the watershed.* This seepage is subterranean for about 5 chains from the river bank but, thereafter, occurs as a small rivulet in a well-defined channel leading to the lake. There is no room to doubt the fact that a small quantity of the Chaba River water flows into British Columbia through Fortress Lake but the proportion is so infinitesimally small that it would be absurd to

consider the Chaba River as a stream flowing both ways. How a geologist would account for the above described condition your Commissioners are unable to say, but two points may be noted in connection with it; first, that the easterly edge of the flat, on which the present-day watershed is located, was at one time quite evidently a part of the bed of the Chaba River, being composed of clean, blue gravel similar to that of the riverbed; secondly, that the valley of the Chaba, both above and below the pass, is singularly well-defined and unrestricted at any point, so that there is no apparent ground to suppose that the course of the river has ever been other than it now is.

The direction of the pass is here east and west, and the slopes of the mountains, both north and south, are covered with virgin forest in which there is no sign of fire, either old or recent—a condition which is unfortunarely so rare as to be notable.

The forest timber includes white spruce (*Picea Canadensis*), balsam fir (*Abies subalpina*) and pine (*Pinus Murrayana*), and there is an exceptionally fine stand of sound and commercially valuable spruce from twenty to thirty inches in diameter. Your Commissioners have often had occasion to note that mountain timber, while apparently sound and healthy, is often rotten at the heart, but the spruce at Fortress Pass summit was generally found to be sound throughout. No larch was observed.

Fortress Lake is a beautiful sheet of water. Reference has been made to the low, marshy shore at its eastern extremity, but except at this point and the delta of Chisel Creek, the mountains extend right to the water's edge.

The country abounds with game. Grizzly bears are found in the numerous rock-slides grown up with alder. Black bears are plentiful and tore down two of our canvas signals. Mountain goats were seen on the higher altitudes. Deer were frequently seen within a few chains of camp, and porcupines were a downright nuisance.

Boundary Line.—Fortress Pass is designated by the letter O. Monument 1-O is situated near the southeast corner of the flat forming the summit of the pass, about 1·50 chains from the west bank of the Chaba River.

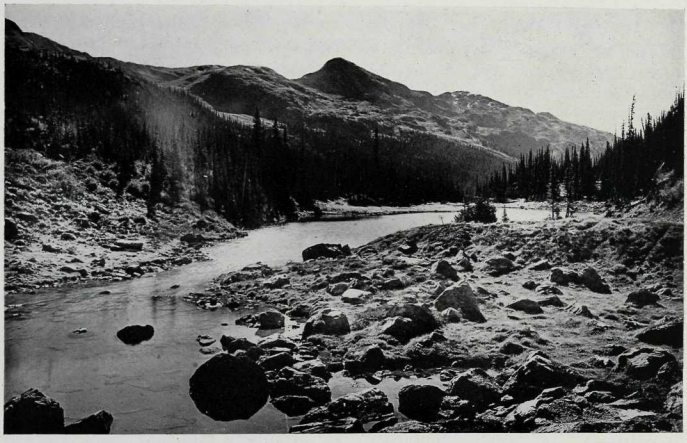
Towards the north, Monuments 2-O, 4-O, and 6-O were built, the last straight-line course in that direction lying between Monument 6-O and Bolt 8-O. Bolt 8-O is situated on the edge of a precipitous rock escarpment forming the southerly face of a steep-sided shoulder of Fortress Mountain, and the cairn surmounting it appears to be on the sky-line from Monument 6-O or from anywhere on the summit flat.

Towards the south, Monuments 3-O, 5-O and 7-O were built, the last straight-line course in that direction lying between Monument 7-O and Bolt 9-O. Bolt 9-O is situated on a small, level narrow shelf of a steep rock ridge which forms the northeasterly wall confining a wild, rocky gorge that cuts up into the heart of the mountain on the summit of which Mr. Wheeler's station, Fortress Lake South, is situated. The cairn built over Bolt 9-O appears on the sky-line from Monument 7-O.

Altogether, seven concrete monuments and two brass bolts and cairns were established to mark the survey. The total length of straight-line boundary surveyed in Fortress Pass is 326·508 chains.

ATHABASKA PASS

History and Origin of Name.—The 1920 work of the Topographical division embraced a general location of the summit of Athabaska Pass, prior to a detailed survey and monumenting of it by Mr. Cautley's division in 1921. A brief sketch of the history of the pass will be found in Chapter IV of this report (page 93), which covers the topographical survey for the 1920 season. Mr. Cautley's report upon the detailed survey made in 1921 follows:



FLOW TO THE PACIFIC OCEAN FROM THE COMMITTEE PUNCH BOWL

Topography and Characteristics.—Athabaska Pass is the best example, so far dealt with by your Commissioners, of a mountain pass of which the actual summit is a small lake, with a visible flow both towards the Arctic and Pacific Oceans. This small lake, which, as stated above, is known as Committee Punch Bowl, is nine chains long in the direction of the pass and six chains broad; it varies in depth from three to fourteen feet and lies close under the foot of a very steep mountain, named McGillivray Ridge, from which rockfalls have encroached upon its easterly bank and have extended right across its southerly outlet.

Before definitely deciding to treat Committee Punch Bowl as a summit lake, and therefore the key of watershed determination, your Commissioners

examined it together, very carefully, and found: first, a small but perfectly obvious stream flowing from its northerly end into Alberta; secondly, a small flow into British Columbia from its southerly end. This latter flow was much obstructed by the ancient rockfall, referred to above, but was quite perceptible. Your Commissioners particularly desire to put themselves clearly on record in regard to the above facts, because it seems probable that the conditions found by them in July, 1921, may easily be found quite otherwise by subsequent visitors to the pass, for the following reasons: The northerly bank of Committee Punch Bowl, towards Alberta, is, for the most of its distance, a well-defined bank, several feet above water level, with one small break in it, over which the outflowing stream falls six feet in a distance of twelve feet; consequently, a very slight dam at the above point would divert all the water of Committee Punch Bowl into British Columbia, whereas twenty minutes work with a mattock at the same point would divert it all into Alberta. Moreover, the whole of Committee Punch Bowl is at all times subject to the action of rockfalls from the McGillivray Ridge.

The general direction of the pass at the summit is 18° west of north, towards Alberta, and 40° east of south towards British Columbia. The altitude of the lowest part of the summit is 5724 feet above sea-level.

In appearance the pass is very picturesque, consisting of a narrow belt of alpine meadow, bordering Committee Punch Bowl and two other small lakes or ponds, one on either side of Committee Punch Bowl. The above little meadow is studded with small groups of balsam fir and great blocks of limestone, the home and playground of hundreds of hoary marmots.

The east side of the pass is completely shut in by McGillivray Ridge, which parallels the general direction of the pass for two miles and acts as a great retaining wall, behind which there is a large glacier that finds an outflow round its southerly end.

The west side of the summit meadow is confined by a succession of rock ledges parallel to the general direction of the pass, the first prominent ledge being 500 feet above the summit and only fifteen chains from Committee Punch Bowl. Beyond this first ledge there are others, each higher than the last, culminating in the southeast ridge of Mt. Brown, with an almost sheer escarpment of 800 feet towards the summit of the pass or east and a permanent snowfield beyond it. To the south the floor of the pass divides, as it were, the greater and westerly portion rising to a rocky, barren plateau, 500 feet above the summit, which forms the watershed, while the outlet of the pass finds its way through a narrow valley, lying at the foot of McGillivray Ridge and continuing range of mountains, and separated from the above plateau by a precipitous rock wall. To the north the approach from Alberta has a very easy grade, but there is evidence that the valley is frequently swept by snow-slides.*

*It was while camped in this northerly approach from Alberta on the 10th January, 1811, that David Thompson, in his "Narrative" described the effect of recent snow-slides and recorded that his men "suffered strong feeling of personal insecurity." This year, 1921, the valley was obstructed for its full width by the debris of a big snow-slide at a point that is probably very close to the site of Thompson's camp.

Athabaska Pass is essentially a bare-rock pass, from which the soil has been scraped and carried away by glacial action. The scoring, planing or polishing action of by-gone glaciers is evident everywhere; in the vicinity of Monument 8P there are some huge masses of stratified rock in place which have been planed off against the grain very smoothly. Whereas every one of the seven concrete monuments built in Fortress Pass has a base extending into the ground a full three feet, all of the six monuments in Athabaska Pass are built upon solid rock.

The rocky, soil-bare nature of the pass is reflected very clearly in the character and extent of the timber found in it. Near the bottom of the pass there is a good deal of hardy balsam fir of the kind usually found near timber-line, namely: very heavy at the base of the trunk and of comparatively insignificant height; but there is practically no timber of any kind above an altitude of 6200 feet.

Athabaska Pass is in the same latitude as Fortress Pass, and only about twenty miles west of it, but the timber in the former is similar to that which is found in the latter at 500 feet higher altitude, and timber line in Athabaska Pass is from 400 to 500 feet lower than in Fortress Pass. When Mr. Cautley's party arrived in Athabaska Pass on July 19th, there was still a great deal of snow in all sheltered places, most of which had disappeared by August 8th.

Mountain goats, moose, deer and foxes were observed in the pass. An unusual sight was that of a big bull moose crossing the snow-field on the west side of Mt. Brown Ridge, at an altitude of 8400 feet. He was evidently crossing from one feeding ground to another. (For Topography and Characteristics, see also Chapter IV, page 96.)

Boundary Line.—The characteristic letter of Athabaska Pass is P. Monument 1 P is built on a solid mass of slide rock, weighing many tons and embedded in the ground. It is opposite the centre of Committee Punch Bowl and about thirty feet from its westerly edge. Towards the south and west, Monuments 2 P, 4 P, 6 P and 8 P were built.

Monument 8 P is built on a high rock ledge to which it was found impossible to get horses, but which was unsuitable for a bolt because, owing to its position, a cairn built at the point could not have been distinguished from the general rock background for any appreciable distance; accordingly, 700 pounds of monument material were man-packed up 650 feet of rock bluffs to build a monument. The last straight-line course in the above direction lies between Monument 8 P and Bolt 10 P.

Bolt 10 P is situated near the edge of the great escarpment which forms the easterly face of Mt. Brown Ridge. The cairn built over Bolt 10 P appears on the sky-line from all points of the survey, and was subsequently read on from Whirlpool Pass, eight miles distant.

Towards the north and east Monument 3 P was built, and the last straight-line course in that direction lies between Monument 1 P and Bolt 5 P, Monument 3 P having been built in the same straight line. Bolt 5 P was established

on the highest point of McGillivray Ridge, and the cairn built over it is on sky-line from all points of the survey except Bolt 10 P.

Altogether, six concrete monuments and two brass bolts and cairns were established to mark the survey. The total length of straight-line boundary surveyed in Athabaska Pass is 214·975 chains.

For mapping purposes two camera stations were occupied in the vicinity of Athabaska Pass by the Topographical divison: Hooker West No. 1 (8248 feet) and Hooker West No. 2 (7535 feet).

WHIRLPOOL PASS

The 1920 Surveys of the Topographical division gave a general location and altitude for the summit of Whirlpool Pass, but, owing to the dense growth of forest, it was not until a detailed survey was made by Mr. Cautley in 1921

Mt. Edith Cavell, 11,033′

MIDDLE WHIRLPOOL VALLEY

that definite data could be obtained, and the preliminary information given in Chapter IV, page 98, amplified by a more precise report, is as follows:

History and Origin of Name.—As far as is known by the Boundary Survey, Whirlpool Pass has no history. The approach to it, on the Alberta side, is from the main Whirlpool River valley, which heads at the summit of Athabaska Pass. Whirlpool Pass, on this side, consists of the valley of the middle branch of Whirlpool River. The length of the valley to its head, where lies the summit of the pass, is about nine miles.

On the British Columbia side the continuation of the pass is the valley of Mazama Creek which, from the information available to the Survey, is assumed to be a tributary of Canoe River, flowing to the Columbia.

No trail was found to lead up the valley of the Middle Whirlpool and, as previously stated, one was cut out and graded, where necessary, by the Topographical division. In the Mazama Creek valley also, no trail was discovered, although in 1920 a hunter's line of blazes and some little cutting was noticed, and was followed from the valley of Fraser Pass to the summit of Whirlpool Pass, where it appeared to stop. In 1920 sufficient cutting was done to enable a pack train to be taken from Athabaska Pass summit over Canoe Pass and up the valley of Mazama Creek to the summit of Fraser Pass by way of a tributary valley. During the past season a trail was cut out from the summit of Whirlpool Pass to connect with that leading from Mazama Creek valley to Fraser Pass summit, cut out the previous season.

With regard to the name, that of Whirlpool Pass may not be very appropriate, but it has been used for lack of a better one. Perhaps, more appropriately, Athabaska Pass summit should be known by the name of Whirlpool Pass, but the former name was given in the early days of the fur trade—probably due to the fact that the Athabaska River was then the outstanding feature of this main pass over the Great Divide. It has become historical and cannot now be changed. As a substitute the name Whirlpool Pass was given by the Survey, with reference to its approach up the Main and Middle Whirlpool Valleys.

Topography and Characteristics.—Whirlpool Pass summit is a narrow, rock-strewn pass over the watershed, which the centuries have succeeded in clothing with scrub timber. It has an altitude of 5936 feet, and lies between two mountains that rise about 2400 feet above the summit, on either side. From the summit the general direction of the valleys forming the pass is northeasterly towards Alberta and southwesterly towards British Columbia. There is a good deal of timber in Whirlpool Pass but, owing to lack of soil, it is mostly of stunted growth and has no commercial value.

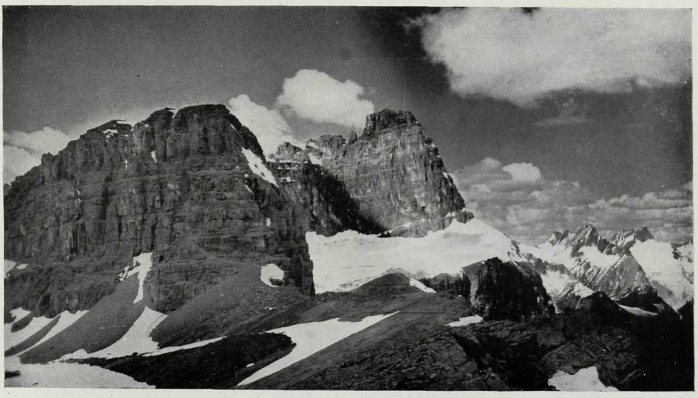
The most remarkable feature of the pass is that the actual summit occurs at the head of one of two little rock cañons which lie in the general direction of the pass and lead into Alberta. These cañons extend about twelve chains into Alberta, where they run into one another and form the head of the main valley trough; they are from twenty-five to sixty feet deep, with precipitous rock sides, and are filled with large masses of broken rock piled up in the greatest confusion; in one of them there is a deep pool of apparently stagnant water.

Although Whirlpool Pass is comparatively low in altitude, it is never likely to have much importance as a route of travel, because the approach from the Alberta side is such that it would be difficult to construct a good road; in the first place, there is a great deal of unavoidable climbing in the first three miles from the Whirlpool River, and in the second, the valley floor, both at the summit and at many other places, is composed of loose rockfall, thinly covered with moss and earth, over which it would be very expensive to make even a fairly good trail. On the opposite side of the summit, in the Mazama Creek

valley, the same conditions are found, and thinly covered rockfall is met with for as far down the valley as was penetrated by the Topographical division.

The summit of the pass is thickly clad with scrub timber and is somewhat nondescript in appearance; there is no open meadow, no lake, no clearly defined summit ridge and the mountain crests between which it lies are of secondary importance. On the other hand, there are fine scenic features in its immediate vicinity, including high peaks, glaciers, lakes and waterfalls.

About a mile on the north side of the summit, the main stream of the Middle Whirlpool River proceeds out of a large mountain amphitheatre to the west and, in plunging over the rim of the valley, forms a magnificent waterfall of considerable volume. Viewed from the ridge on which Bolt 7 Q is situated, the above amphitheatre is seen to have a wide expanse of alpine meadows surrounded by high mountains and many glaciers, with a number of small lakes dotted about it.



NEEDLE PEAK ON NORTH SIDE OF MIDDLE WHIRLPOOL RIVER

A grizzly bear and several herds of mountain goats were seen near Bolt 7 Q, and there is an active beaver colony in the large meadows five miles from the summit on the Alberta side. Trout up to three pounds in weight were caught in the Whirlpool River, and also in that part of the Middle Whirlpool flowing through the above mentioned beaver meadows, and smaller fish in other parts of its course. (See also Chapter IV, page 92.)

Boundary Line.—The characteristic letter of the Whirlpool Pass survey is Q. Monument 1 Q is built on the easterly edge of the most westerly of the two small cañons already mentioned.

Towards the west, Monuments 2 Q and 4 Q were built, and the last straight-line course in that direction lies between Monument 4 Q and Bolt 6 Q. Bolt 6 Q, situated on the ridge leading to the summit on which Mr. Wheeler's station, Whirlpool Pass West, lies, is not quite on the summit of the ridge, where it would have been invisible from below, but the cairn built over it appears on sky-line from Monuments 1 Q and 4 Q.

Towards the east, Monuments 3 Q and 5 Q were built, and the last straight-line course in that direction lies between 5 Q and Bolt 7 Q. Bolt 7 Q is placed on the brow of the mountain to the east of the pass, which is really a northerly spur of Mt. Mallard and which has a large, rather flat top; the surface rises gently for another eighteen chains beyond 7 Q to the edge of a precipitous escarpment facing east.

From Bolt 7 Q Mr. Cautley was able to read on Bolt 5 P. Bolt 10 P and the cairn at Mt. Brown No. 2 of the Athabaska Pass survey, and the cairn built over it appears on sky-line from all points of the survey except Bolt 6 Q.

Altogether, five concrete monuments and two brass bolts and cairns were established to mark the survey. The total length of straight-line boundary surveyed in Whirlpool Pass is 158·429 chains.

The following camera stations were occupied by the Topographical division along the valley of the Middle Whirlpool: Beaverdam No. 1, 7514 feet; Beaverdam No. 2, 6850 feet; Needle East No. 1, 8160 feet; Needle East No. 2, 8103 feet; and Needle South, 8548 feet.

WHIRLPOOL PASS TO TONQUIN PASS

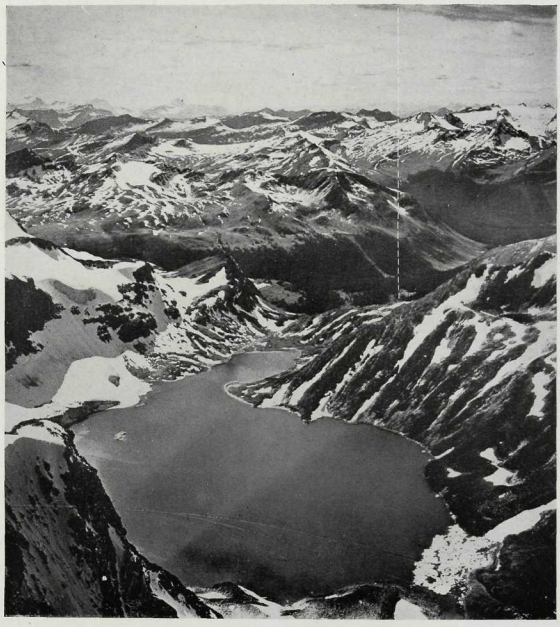
In Chapter IV, under the caption "The watershed beyond Whirlpool Pass," a description of the course of the watershed is given from the summit of Whirlpool Pass to a peak of 8600 feet, one and three-eighths miles beyond Fraser Pass Southeast camera station, which was the limit of the 1920 season's work.

The survey made last summer by Mr. Cautley's division renders necessary a slight change in the description, viz: From the summit of the pass the watershed follows a general direction of northwest for one mile to the crest of the ridge bounding the valley on the north side at 8380 feet. It then zig-zags for a mile in a northwest direction, following the ridge, to the peak on which Fraser Pass Southeast camera station is set at an altitude of 8879 feet. Thence it continues on the same general course for one and three-eighths miles to a peak of 8600 feet, above referred to.

From this point the divide line travels, on a nearly due west course, for half a mile across the head of a glacier which falls directly to Beacon Lake, and another half mile in a due north direction carries it to Beacon West camera station, 8768 feet in altitude.

The course so far lies along the ridge dividing the wide glacial basin, which is drained by the Middle Whirlpool River, from the valley leading to Fraser Pass summit, the summit of Fraser Pass and the extreme head of the Fraser Valley. The peaks dominating this glacial basin, are two in number. Beacon Peak, 9795 feet, and Needle Peak, 9668 feet; the former is two miles and the latter four and a quarter miles from Beacon West camera station in a north-easterly direction.

Fraser Valley



BEACON LAKE AND PASS
Looking West

From Beacon West camera station the course of the watershed is generally north for three-quarters of a mile to the summit of a small pass. The summit is the crest of a gigantic rockfall that has filled in the head of the valley leading westward to the Fraser Valley. As previously stated Beacon Lake fills the entire floor of the valley of the pass. It lies at an altitude of 7040 feet and is a sheet of gloriously blue water above the timber line. The greatest length is

one mile and the width half a mile. Access on the south side is blocked by a wall of ice, the termination of the glacier at the head of which the watershed passes, referred to above. This wall of ice is some fifty feet in height and drops sheer into the waters of the lake. On the north side a rockfall from the southern slopes of Mt. Whitecrow, composed of blocks of enormous size, has been pre-

BEACON LAKE AND PASS
Looking East

cipitated right into the lake and can be seen far down in its depths. The ice on the south and the rockfall on the north make access, except on foot across the rockfall, prohibitive. At the eastern end of the lake there is a very steep rock descent of some six hundred feet to a valley leading northeast to the main valley of Simon Creek, and down this steep descent the outlet of Beacon Lake cascades in a series of broken and spectacular falls to join the main stream, two and a half miles away. It is a wonderfully beautiful piece of mountain scenery, and the little blue tarn, set in ice and rock, surrounded by high sharp peaks and glistening icefalls, with the valley approaches showing meadow and forest, remains long in the memory.

From the summit of the small pass the watershed travels northeast for one and five-eighths miles to the summit of Mt. Whitecrow, 9288 feet, midway passing over an outlying peak of the same mass with an altitude of 9200 feet.

Standing on the summit of Mt. Whitecrow, an exceedingly fine panorama is displayed of the magnificent ice-filled basin at the head of Simon Creek. Ten or more glaciers may here be counted, sending their outflows to swell the torrent of the stream. Directly at the head of the basin stands Mt. Fraser, a great central mass crowned by three outstanding peaks, of which the western and highest is named Simon Peak, 10,899 feet. It is well spoken of as a central mass, for it sends down glaciers on all sides and is a pivotal point of the area. Seven large glaciers showing spectacular icefalls spring from its flanks: three feed the Geikie Creek torrent, which is a strong tributary of the Fraser River; of the other four, three are tributary to Simon Creek and two help feed Astoria River, a tributary of the Athabaska, one of the two draining both ways. It is the climax of the region and worthy of the mighty river, whose name commemorates the famous explorer, the first to navigate its awesome cañon by means of canoes. Directly across the valley from Mt. Whitecrow and in line south of Mt. Fraser are Mt. Erebus, Eremite Mt., Alcove Mt., and Angle Peak.

From Mt. Whitecrow the watershed travels northwest one and five-eighths miles to the northerly summit of Mt. Blackrock, 9520 feet, first passing over its highest summit, 9580 feet. In this course two glaciers descend to Simon Creek valley. On the opposite side of the divide is the amphitheatre at the head of the small tributary of Fraser river.

The watershed now continues northwest, curving to the north, two and seven-eighths miles to the western summit of Mt. Elephas, 9810 feet; the higher summit, 9850 feet, is an eighth of a mile to the east. This curve forms an amphitheatre containing the southern source of Simon Creek, and has four small-sized glaciers which feed it. On the Fraser River side are four smaller amphitheatres sending tributary waters to that stream.

The watershed now lies in a zig-zag, slightly west of north, seven-eighths of a mile to the highest point of Mt. Mastodon, 9800 feet. From the depression of the ridge between Mt. Elephas and Mt. Mastodon a fine glacier flows to Simon Creek and two smaller glaciers on the Fraser River side.

Four distinct points form the crest of Mt. Mastodon, of which the most easterly one is the highest; the middle two are 9700 feet, and the most westerly 9650 feet. The watershed passes over all four, the distance traversed being slightly over three-eighths of a mile and the direction almost due west.

From the western summit of Mt. Mastodon the course is in curves, and the general direction slightly west of north, for two and one-eighth miles to a corner peak of 9900 feet altitude, Scarp Mt., where the watershed turns to a northeasterly direction and begins the circuit of the wide glacial basin at the head of Geikie Creek. On the eastern side of this course a large glacier descends to Simon Creek and on the Fraser side lie two small ones, or rather pockets filled with ice. En route the course passes over two distinct elevations of respectively 8900 feet and 9400 feet.

The course of the watershed from the summit of Scarp Mt. to the highest summit of Mt. Fraser, Simon Peak, is very erratic and lies northeasterly between large bodies of ice, descending on the north side in steep broken icefalls to Geikie Creek basin, and on the south side in more gently sloping accumulations of snow-covered ice, sending out even-surfaced ice tongues into the basin at the head of Simon Creek. The distance is two and a half miles. The watershed passes a little south of the actual summit.

Half a mile to the southeast is the centre peak of Mt. Fraser, 10,700 feet, which has been named McDonell Peak after Simon Fraser's wife, who was a McDonell. Another half mile northeast is the eastern peak 10,726 feet, which we have named Bennington Peak after the place in Vermont where Simon Fraser was born. On the north side Geikie Glacier flows in a very spectacular

FRASER RIVER VALLEY

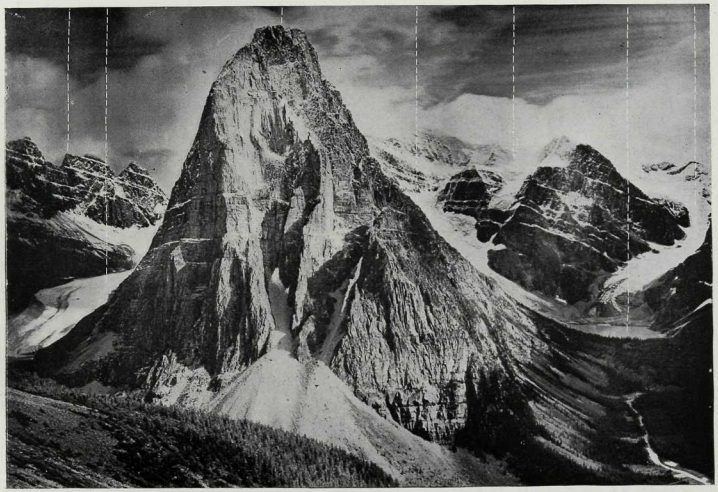
icefall to form the eastern source of Geikie Creek, and so to the Fraser. On the opposite side Fraser Glacier feeds both Astoria River and Simon Creek; in each case the stream is tributary to the Athabaska.

From the last mentioned point the watershed lies, in a general course, a little east of north on its way along the crest of the Ramparts, curving in a wide arc around the Geikie Creek basin. The distance along this serrated ridge to the summit of Dungeon Peak, 10,200 feet, is two and three-eighths miles. At Dungeon Peak the general direction of the watershed changes and, passing over Redoubt Peak, 10,200 feet, and two other outstanding elevations, arrives at the summit of Bastion Peak, 9812 feet, in a distance of two and seven-eighths miles.

The great circle of the Ramparts continues from Bastion Peak in a west-northwest direction for another three miles, passing over Turret Mountain, 10,200 feet, and Mt. Geikie, 10,854 feet, the highest of the group, and then on to Barbican Peak, 10,100 feet, the northwestern terminal point of the great cirque. Opposite to it on the southern side of the entrance, is Gateway Peak, 8860 feet, and close by Portcullis Peak, 8680 feet. Gateway Glacier and Icefall Lake, from which the flow is subterranean, furnish the southern source of Geikie Creek.

The Geikie cirque is truly wonderful. It is entered by a narrow gap between Mt. Geikie and Portcullis Peak, and, immediately beyond, the broad basin is

The Ramparts | Geikie Glacier | Postern Mt. | Casemate Glacier | Mt. Fraser | Icefall Lake | Scarp Glacier



THE GEIKIE CREEK CIRQUE

split by the towering heights of Postern Mountain, 9720 feet, which, seen from this viewpoint, rises as an isolated rock cone. Behind it is Casemate Mountain, 10,160 feet, and beyond that again the broken icefalls of the Geikie and Casemate Glaciers, showing magnificent accumulations of ice and snow around the entire end of the cirque, and above, on skyline, the snow-crowned heights of Mt. Fraser.

North of Postern Mountain the Geikie Glacier flows at the southern base of the Ramparts. South of the same mountain the Scarp and Casemate Glaciers

unite at their ice tongues to supply the bright blue waters of Icefall Lake. It is indeed a weirdly beautiful and remote place, and well worthy of access by the lover of Nature as seen in the mountain wilderness.

At the summit of Bastion Peak the course of the watershed turns at right angles and crosses Moat Passage of Tonquin Pass to the summit of Tonquin Hill. This part was surveyed and monumented last summer by Mr. Cautley and is definitely described in this chapter under the headings "Topography and Characteristics" and "Boundary Line." The course is a little east of north and the distance, from the summit of Bastion Peak to that of Tonquin Hill, two and one-eighth miles.

At Tonquin Hill the course turns to northwest and the watershed travels two miles across the valley of Vista Passage to the brass bolt and cairn, No. 14 R, on the corner of the Vista Peak Ridge, which forms the sky-line height of the valley. It then follows the said ridge one and five-eighths miles in a northwest direction to the summit of Vista Peak, which was the farthest south camera station occupied in 1917, at the time of the Yellowhead Pass survey. For a description of the watershed from Yellowhead Pass summit to Vista Peak see Chapter I, under the heading "Yellowhead Pass to Tonquin Pass."

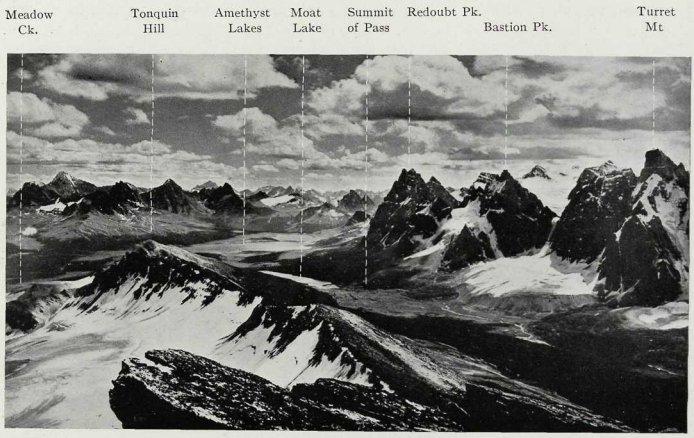
Between Whirlpool Pass and Tonquin Pass, inclusive, the following camera stations were occupied during the past season: Whirlpool Pass West, 8327 feet; Whirlpool Pass East No. 1, 8646 feet; Whirlpool Pass East No. 2, 8112 feet; Beacon Peak, 9795 feet; Fraser Pass West, 7974 feet; Beacon West, 8768 feet; Mt. Whitecrow, 9288 feet; Cornice Ridge, 8420 feet; Blackrock, 8846 feet; The Cube Ridge, 7887 feet; No. 170, 7770 feet; Reunion, 8903 feet; Nub, 8311 feet; Rufus, No. 1, 9053 feet; Rufus No. 2, 9011 feet; Brûlé Hill, 6860 feet; Garnet Ridge, 7580 feet; Geikie Slide No. 1, 7332 feet; Geikie Slide No. 2, 7156 feet; Geikie Creek South, 7523 feet; Tonquin Ridge No. 1, 8084 feet; Tonquin Ridge No. 2, 8061 feet.

TONQUIN PASS

History and Origin of Name.—The Tonquin Pass opens a line of travel across the continental divide from the Athabaska Valley above Jasper to the Fraser Valley above Lucerne. Both are stopping places on the Canadian National Railways, the former being the official headquarters of Jasper Park and a divisional point of the railway, and the latter situated in Mt. Robson Park, a few miles west of the summit of Yellowhead Pass, near the lower end of Yellowhead Lake.

Except as a scenic route and a resort for mountain lovers, Tonquin Pass will never be a useful one, for several reasons, chief among which are: (1) The Miette River Valley, which is traversed by the railway, is very nearly the shortest distance between the points named above, and travel by Tonquin Pass is more than twice as far. (2) The difficulties of travel by the Tonquin Pass route are many and the expense of putting in a good pony trail would be great.

To build a road would be prohibitive, not alone on account of the excessive differences of level that would have to be overcome at numerous places, but also on account of the nature of the ground over which the road would have to be constructed. Along the route at certain parts the valley slopes for considerable distances seem to be formed of ancient rockfalls, which are but thinly covered by forest growth, vegetation and humus, and would practically require a causeway to insure a safe road bed; again, there is much boggy ground, which would need large quantities of ballast to render a road sufficiently stable for travel. (3) In addition to an ascent of between 3000 and 4000 feet from the Athabaska Valley to the summit of Tonquin Pass by either the Whistler or Portal Creek valleys there is a descent on the western side of the divide of close on 3000 feet to the Fraser Valley at Lucerne, and a route along the steep sides of the said



TONQUIN VALLEY AND PASS

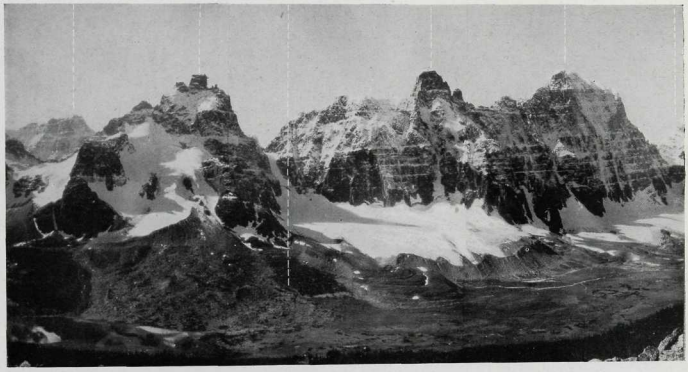
valley that would present difficulties of a nature that would be prohibitive for road construction owing to cost. It may, therefore, be assumed that the value of the route is purely of a scenic nature, in conjunction with the attractions of Jasper and Mt. Robson Parks.

The best that can be expected here is a possible trail for tourist travel, and even that will be a large undertaking either by the Whistler Creek route or by the Portal Creek route. It may, however, be found possible to put in a serviceable trail to the pass summit by way of Meadow Creek valley, which heads close by, and joins the Miette River valley about eight miles west of Jasper.

As a scenic centre the Tonquin Valley and Pass are very fine and no more comprehensive or entrancing view of mountain surroundings can be had than from the summit of Tonquin Hill, which stands midway between the two passages of the pass. From this point of vantage, on a fine, bright day, the view is magnificent beyond conception. Southward the valley is walled in by the precipitous towers and pinnacles of the Geikie Range, shown on the map of Jasper Park as the Ramparts.

The great mass of Mt. Geikie, 10,854 feet, dominates the scene; on either side, east and west, stand isolated Turret Mountain and Barbican Peak, the last named at the extreme western end of the wall. Beyond, eastward, rise peaks, towers, aiguilles and gendarmes in apparently endless array; and behind the wall are seen the snow-crowned summits of lofty mountains, whose glaciers,

Casemate Mt. Bastion Pk. Summit of Pass Turret Mt. Mt. Geikie 10,854′



TONQUIN PASS AND THE RAMPARTS

cascading down their sides in wildly broken icefalls, send rushing torrents to swell the volume of the Fraser River, soon to become a mighty waterway.

Wide, open, grassy alpland meadows lie in front of the Ramparts, and great falls of rock, holding blocks weighing hundreds of tons, and masses of ice and snow have been arrested at their base, spreading in fan-shaped formations far out into the valley. Moat Lake at the base of Tonquin Hill and, southeastward, the Amethyst Lakes, both a beautiful blue, add colour to the scene. North, east and west, tributary valleys extend as far as the eye can see; all with wide, open, grassy bottoms, their lower side slopes clad with belts of dark green forest; and, rising above and beyond their margins, are mountain peaks innumerable, varied and striking of form, and often topped with snow.

Between the masses white fields of snow and broken icefalls glisten in the sunlight. It is indeed a scene from fairyland and one whose memory a lifetime cannot efface.

And yet appearances are deceptive, for these beautiful alpland meadows, as seen from a height, are upon closer inspection found to provide the worst kind of travel. The rockfalls of bygone ages have apparently covered the floors of the valleys in many places, and are still so lightly clad with humus that they are almost impassable for horses, and uncomfortable, and even difficult, for travellers on foot; the more particularly that where the hollows are sufficiently filled in to cover the rocks the ground is boggy and often like a sponge filled with water. Where the uneven floor of rock boulders has been buried deeper soft, marshy places are encountered that are treacherous and particularly obnoxious to both man and beast. As alpland flower gardens these meadowlands are superb, and numerous delightful camping grounds can be found along the tree margins, where white heather, yellow avalanche lilies, columbines and asters carpet the ground, where thick balsam boughs can be had for beds, and crystal rills from numberless hillside springs provide a water supply.

Tonquin Pass has no history, in so far as your Commissioners are aware, other than the visits of sundry tourists since Jasper Park became a centre of scenic attractions a few years ago and the advent of the photo-topographical survey made by M. P. Bridgland, D.L.S., in 1915, of which the maps are now available to the traveller. The very attractive Guide Book to Jasper Park, edited by Dr. E. Deville, Surveyor General of Canada, of which the historical notes were written by Mr. R. Douglas, Secretary to the Geographic Board, and the topographical part by Mr. Bridgland, has been the outcome of the said survey, and furnishes much useful information that enables visitors to acquire a knowledge of their surroundings in any part of the park covered by the work. Pages 45 to 52 inclusive deal with the Tonquin Valley and Pass and include some excellent illustrations that not only excite interest and desire to visit this unique centre but, by means of annotations, supply most desirable data concerning its respective features.

The name, Tonquin, as applied to the valley and the part of it that constitutes the pass over the continental watershed, was given by the Geographic Board of Canada. It was conferred in commemoration of John Jacob Astor's ship, the Tonquin, which in 1810 sailed from New York and founded Fort Astoria, a trading post at the mouth of the Columbia River (see Mr. Douglas' notes, pages 18 and 19 of the Guide Book).

Topography and Characteristics.—The continental watershed at the summit of Tonquin Pass can now be reached from the Athabaska Valley by three routes, one of which is quite distinct and the other two dependent upon one another. The first and most southerly one, by the valley of Astoria River, has a good government-made road and trail as far as Cavell Lake. A pass at the head of the valley leads to the Tonquin Valley, close by the southern extremity of the Amthyst Lakes.

The most northerly route, by the valley of Whistler Creek, climbs over Marmot Pass at its head and descends to the valley of Portal Creek, which it follows over Maccarib Pass, and by the valley of the same name to the northern end of the Amethyst Lakes. There is no trail up Portal Creek from Athabaska Valley to the foot of Marmot Pass, but if one could be put in it would very greatly reduce the difficulties of the present route up the valley of Whistler Creek, through cutting out the steep ascent and descent over Marmot Pass (see Bridgland's map of the Central Part of Jasper Park).

From the north it might be possible to find a route from Jasper to the summit of Tonquin Pass by way of the Miette River valley and Meadow Creek valley, but the distance would be very slightly less and it is doubtful if the going would be any better than by way of Portal Creek.

Tonquin Pass is the eighteenth major pass of the Rockies to have been surveyed by your Commissioners and, in looking back, it seems extraordinary that no two of them can be said to resemble each other very closely, for, while there are points of similarity between some of them, there is not one that does not possess some striking characteristics of its own.

Tonquin Pass is, perhaps, more unique than any of the others. It has two distinct summits, which are just one mile apart and are separated from one another by an isolated ridge named Tonquin Hill. Your Commissioners suggest that the name of Moat Passage should be given to the lower summit, in reference to Moat Lake, a pretty sheet of water, one mile long, which approaches within a few chains of the summit on the Alberta side; and that the other summit should be named Vista Passage, in reference to Vista Peak, which is the highest point of the mountain ridge confining it on the northwest side.

Moat Passage has an altitude of 6393 feet, and the general directions of the valleys which lead from it are almost in a straight line, with an approximate bearing of S. 77° E. in the direction of Alberta from British Columbia. The above valleys are closely hemmed in on the south side by a chain of magnificent mountains, known as the Ramparts, of which Mount Geikie (10,854 feet) is the highest. So close are these mountains that it is difficult to realise their great height from the summit of the pass, and it is necessary to get farther away in order to appreciate their true proportions.

Vista Passage, altitude 6834 feet, is 441 feet higher than Moat Passage, and the valleys leading out of it are of a secondary character with general directions of east-northeast.

The streams leading from Moat and Vista Passages on the Alberta side are both tributaries of Meadow Creek flowing north to Miette River, a tributary of the Athabaska; that from Moat Passage flowing round the southerly and easterly bases of Tonquin Hill, while that from Vista Passage lies to the north of it. Similarly, the streams flowing from both passages on the British Columbia side are tributaries of the Tonquin Creek flowing westerly down the main valley from Moat Passage and joining the Fraser River within a few miles.

Both passages, and the valleys that lead from them are practically open, with a few scattered thickets of small scrub. On the hillsides facing south there is a good deal of open timber, but none of any commercial value. The valleys are wide and grassy, and there is so much grassland in the vicinity that it has been adopted as the habitat of the wood caribou, of which handsome animals, a number were seen during the survey. Unfortunately, the wide grassy valleys that look so beautiful from a distance are very disappointing from the traveller's point of view, the surface as a rule being either saturated with water, and very marshy, or consisting of a bed of loose slide rock, more or less covered with vegetation.

Tonquin Hill is an isolated, mile-long ridge, rising to a definite summit at its northwesterly extremity, which has an altitude of 7861 feet; it is, therefore, 1468 feet above the summit of Moat Passage and 1027 feet above the summit of Vista Passage. The line of watershed between the provinces was found to pass fairly over the summit of the hill, approaching it from the southwest and, making a reflex angle at the summit, leaving it in a due west direction.

Owing to its position as an island summit of moderate height and to the fact that it is surrounded by a country of wide, open landscapes, containing many notable features, it would be difficult to exaggerate the charms of Tonquin Hill as a viewpoint.

Boundary Line.—The characteristic letter of the Tonquin Pass survey is R. Monument 1 R is built on the southerly edge of a slight draw in which the actual summit of Moat Passage is located.

Monument 2 R, Bolt 4 R (at the summit of Tonquin Hill) and Monuments 6 R, 8 R and 10 R were built to the north and west of Moat Passage of which 8 R is at the summit of Vista Passage.

The last straight-line course to the northwest of Vista Passage lies between Monument 10 R and Bolt 12 R, and Bolt 14 R was also established as a point of the watershed.

Bolt 12 R was located, with a view to its suitability as an extremity of the straight-line survey, on the edge of a rock escarpment forming the easterly face of the long mountain ridge of which Vista Peak is the highest point, and Bolt 14 R occupies the summit of a prominent peak of the same ridge. The cairn built over Bolt 14 R appears on the skyline from all points of the survey.

Towards the south, Monument 3 R was built, and the last straight-line course in that direction lies between Monument 3 R and a very sharply defined point of natural rock at the summit of Bastion Peak, which lies 190° 04′ 58″ a distance of 91·538 chains therefrom. The above point was agreed upon by the Commissioners as the site of 5 R, although it was impossible to place a bolt owing to its inaccessibility. A photograph of Bastion Peak, showing the above point, may be seen at page 132 of this report.

The total length of straight-line boundary surveyed in Tonquin Pass is 314·533 chains.

GENERAL REMARKS

Watershed.—Under "General Remarks" in Chapter IV the respective relation of Fortress Pass, Athabaska Pass and Whirlpool Pass to each other is dealt with. It now only remains to consider the relation of Tonquin Pass to Whirlpool Pass to the south and to Yellowhead Pass to the north in order to close the second section of the survey of the Boundary, viz: the part lying between the Canadian Pacific Railway through Kicking Horse Pass and the Canadian National Railways through Yellowhead Pass.

The Moat Passage summit of Tonquin Pass lies N. 16° W. of Whirlpool Pass summit and is seventeen and three-eighths miles from it in direct distance. For the most part of the distance the watershed lies west of this line, the greatest departure from it being two and three-quarters miles. It is quite erratic in its course and at Mt. Whitecrow approaches to within less than a quarter of a mile of the direct line.

Five and a half miles southeast of Moat Passage summit the watershed crosses the direct line of distance on the summit ridge of Mt. Fraser. It then follows the crest of the Ramparts ridge around the head of the Geikie Creek amphitheatre, with a maximum departure of one and a quarter miles to the east of the said line. Following the serrated crest of the Ramparts it again crosses the direct line one and a half miles southeast of Moat Passage summit and travels to the summit of Bastion Peak, half a mile further west. From this point it drops direct to the Moat Pass summit.

While there are a number of high possible crossings over the watershed from the Fraser Valley to valleys tributary to the north branch of Whirlpool River, the only one that can properly be termed a pass is that situated directly north of Beacon Peak. As already stated, this pass is completely blocked at its summit by Beacon Lake and is not likely to be of economic value. The majority of the crossings referred to have steep rocky ascents from the Fraser Valley and the connecting valleys on the eastern side are filled with ice, sending glaciers down to the main valley of Simon Creek.

The valley of Geikie Creek, a strong flowing torrent, joins the valley of the Fraser, on the eastern side, some fifteen miles below Fraser Pass summit. It heads in a deep, rock-walled amphitheatre around the crest of which the watershed passes, as stated above.

The direct distance from the summit of Moat Passage to the summit of Yellowhead Pass is twelve and a half miles on a bearing N. 25° W. The watershed swings back and forth across this line in sweeping curves, the greatest departure from it being slightly over one and three-quarters miles.

Between Tonquin Pass and Yellowhead Pass there is one small pass leading from the head of Rockingham Creek to Clairvaux Creek, a tributary of Miette River; Rockingham Creek flows to Yellowhead Lake, which is tributary to the Fraser River. The pass is referred to in Chapter I under the heading "Yellow-

head Pass to Tonquin Pass." It is an easy crossing and a trail of sorts leads from the village of Lucerne to the valley of Rockingham Creek, up which it goes to the summit of the pass.

Trails.—The trails travelled over during the season have already been referred to. None of them are good and some are very bad. A certain amount of work has been done upon the main trail up the Athabaska Valley to the Falls and it is understood that the continuation of this trail up the Athabaska and Sunwapta Valleys to the crossing of Poboktan Creek was much improved during the past summer, which was a move in the right direction, as previously it had been greatly obstructed by windfall; as part of the direct route from Jasper to Lake Louise on the Canadian Pacific Railway, distant about 160 miles from Jasper, it is of special importance. It is also understood that a trail was cut out up Poboktan Valley to give access to the southern interior of Jasper Park, thus permitting access to the south end of Maligne Lake and a return to Jasper by the northern route—a most delightful round trip full of varied and magnificent mountain scenery.

The trail to Fortress Lake and Pass, an offshoot from the Athabaska Valley trail, is little better than a horse path and leads through brûlé and windfall, and through marshy places, following the line of least resistance. Around the north side of Fortress Lake there is only a hunter's track that was cleared out by the Topographical division in 1920. Beyond the west end of the lake there is no trail, although pack horses were taken by the survey to the head of Alnus Creek.

The trail up the Whirlpool Valley is fair for half a day's travel, owing to having been used considerably to reach a tie camp which has been in operation for the past two years. From the camp to the summit of Athabaska Pass and beyond, although used extensively by the North West and Hudson's Bay Fur Trading Companies in the nineteenth century as a main line of travel, it is now so grown over and out of use as to be little better than a horse track, in some places very stony and in others swampy.

As already stated a trail was put in up the Middle Whirlpool Valley by the Topographical division during the past season, and some grading done along the very steep hillsides. The survey has no knowledge of any trail up Simon Creek valley.

Beyond Whirlpool Pass summit, at the head of the Middle Whirlpool River, a track was cut out down the valley of Mazama Creek to connect with a similar track up the same valley from the valley of Canoe Pass, through which a track had been cut in 1920, leading from the summit of Athabaska Pass.

In the same year a track had been cut out to the summit of Fraser Pass, leading to the head of the southern source of the Fraser River. A line of trappers' cabins, some five in number, extends from Lucerne up Fraser Valley, the last one having been built on the northern side of the Mazama Creek valley where it is joined by the valley leading to Fraser Pass. Between these cabins are hunters' trails, a mere line of blazes at the southern end but increasing in

clearness as the Yellowhead valley is approached. The main one was cleared out sufficiently to take pack horses over it. It cannot be called good travelling except at a few places where it lies through belts of open pine timber.

Beyond the junction of Geikie Creek with the Fraser, the Topographical division forced a way up the eastern slopes of the valley and over a low ridge to the Tonquin Valley, and then through open grassland meadows to the summit of Tonquin Pass. As stated above, the going here is very bad, owing to rock and swamp conditions that prevail for the whole of the way to the Athabaska valley, via Maccarib Creek valley, Portal Creek valley, Marmot Pass and Whistler Creek valley, as already described under "Topography and Characteristics" of Tonquin Pass.

Rivers and Streams.—The principal rivers and streams within the past season's survey have already been referred to in Chapter IV under "General Remarks."

The Middle Whirlpool River is a small stream deriving its supply chiefly from the large glacial basin at its head, where several small lakes collect the waters feeding it. Here, on the north side of the valley, is seen a magnificent waterfall of very spectacular appearance. The stream can be forded at frequent intervals and is only deep where flowing through the long stretch of meadowland referred to in the text as being frequented by beaver. Through this meadowland it winds in serpentine curves and, at the lower end of the stretch, has been dammed back by beaver.

Geikie Creek flowing from a deep rock and ice-bound amphitheatre at the western base of Mt. Fraser, is the chief tributary of the Fraser on the eastern side of the valley, and is the only one of important size. From the west, however, a number of larger streams, draining distant and unknown areas, come in. The streams flowing from the Tonquin Valley have been referred to above: Astoria River flowing to the Athabaska, Meadow Creek to the Miette and Tonquin Creek to the Fraser.

Timber.—The timber at Fortress Lake, in the Whirlpool Valleys and in the valley leading to Fraser Pass has been referred to in Chapter IV, under "General Remarks." In the Fraser Valley very little timber of economic value was seen although that valley and the valleys of tributary streams are thickly forested. The trail leading down the Fraser Valley passed through several tracts of fairly open pine forest from which a goodly supply of tie timber could be obtained but little of a size large enough for lumber purposes was noticed. Presumably any such timber would have to be taken out by way of the Fraser River, and the numerous cañons that create broken rapids in its flow would be likely to prove a highly deterrent factor.

The forest growth throughout showed the usual species of spruce, pine, balsam, and balsam fir, and on the Pacific slopes Douglas fir was noticed but not of large size.

Game and Fish.—The species of game in the areas surveyed were much as usual: mountain goats, several species of deer, and bears, brown and grizzly.

In the Tonquin Pass valleys the woodland caribou was seen, singly and in bunches. In 1920 this species was seen at the head of Fraser River, near Fraser Pass summit, but none was seen east of the watershed.

As previously stated, large sized trout were caught in the Whirlpool and Middle Whirlpool Rivers; as also plenty of a smaller size; presumably they find their way to these sources up the Athabaska River.

There may be trout in the Fraser River headwaters, but none were seen; as fish are caught in Yellowhead Lake, which discharges to that river, it is not unlikely that some would be found if properly fished for.

MAPS

The camera stations occupied in the Sunwapta and Athabaska Valleys, increased the mapped area of Sheet No. 25. Additional area has also been added to Sheet No. 27. The whole of Sheet No. 28 is mapped and, thus, the survey linked up with Sheet No. 29, surveyed in 1917. The last mentioned sheet includes Yellowhead Pass and covers an area of some ten miles in depth both north and south of it.

In addition to the above, Sheets Nos. 24A, showing the survey and monumenting of the boundary at Fortress Pass summit, 27A at Athabaska Pass summit, 27B at Whirlpool Pass summit and 28A at Tonquin Pass summit are herewith submitted.

APPENDIX I

DESCRIPTION OF BRASS BOLTS AND CAIRNS PLACED TO MARK THE LINE OF THE WATERSHED

Howse Pass

No. 9 N.—Brass Bolt 9 N is on the watershed, at the edge of a rock bluff below timber line, where the watershed passes over an outstanding corner of the southwestern ridge of Howse Peak. Altitude of bolt, 6935 feet.

About ten feet from the bolt, in the direction of 7 N, there is a perpendicular drop of twelve feet to a steep rocky, timbered slope, falling 1200 feet to the concrete monument at 7 N.

Towards 11 N the watershed rises over fairly easy rounded slopes of rock, partially covered by mountain herbage and scattering small trees; above timber line are smooth rock ledges and scree.

Spruce timber up to eight inches in diameter surrounds the bolt and the cairn over it.

The bolt is definitely fixed in position by the straight-line survey across the pass. 11 N is not visible from 9 N.

A hole was drilled in an outcrop of solid greyish sandstone rock and a brass bolt cemented therein.

The bolt was marked "Alberta" and "British Columbia" on respective sides, "No. 9 N" on both ends and "+" on top.

A cairn 5 feet high and 4·5 feet wide at base was built over the bolt.

A brass bolt and cairn were here placed to mark the intersection of the courses 7 N to 11 N for the reason that it was impossible to transport material for a concrete monument up the mountain side.

No. 11 N.—Brass Bolt 11 N is on the southwest ridge of Howse Peak at a point where the watershed is a naturally defined boundary. Altitude of bolt, 7696 feet.

The bolt is placed about eight feet south of a precipitous rock wall falling to the amphitheatre of the stream joining Howse Creek a short distance northwest of 1 N.

Beyond 11 N the watershed line follows the edge of the precipitous rock wall, referred to, southwest around a V-shaped gap in the ridge to its apex and then northeast to the summit of the elevation of the ridge on which 13 N is placed.

The bolt and cairn are near the northerly end of a fairly level part of the ridge.

MONUMENTS "N"—HOWSE PASS

1 N

3 N

5 N

7 N

9 N Looking S.W.

11 N Looking N.W.

13 N Looking W.

2 N

4 N

6 N

8 N Looking N.E.

Line from 1 N to 3 N

The bolt is at the northeastern extremity of the straight-line survey and is definitely fixed in position by the same; 9 N is not visible from 11 N.

A hole was drilled in an outcrop of sandstone rock and a brass bolt cemented therein.

The bolt was marked "Alberta" and "British Columbia" on respective sides, "No. 11 N" on both ends and "+" on top.

A cairn 5·7 feet high and 5 feet wide at base was built over the bolt.

No. 13 N.—Brass Bolt 13 N is on the watershed at the western end of an outlying elevation of the southwestern ridge of Howse Peak, which is separated by a saddle, 200 feet lower, from the main mass of the peak. The crest of the elevation is nearly level and is about 2300 feet in length, lying in an almost east and west direction. The bolt is at the highest point. Altitude of bolt, 8657 feet.

From 11 N the watershed follows the summit of a flat-topped part of the ridge, rising gently, to near the apex of a V-shaped gap; it then falls about thirty feet to a saddle at the apex of the gap and, turning sharply northeast, ascends a smooth, steep slope of shale and scree to where 13 N is placed.

North of 13 N is a precipitous rock wall falling to the amphitheatre of the stream joining Howse Creek a short distance northwest of 1 N. The watershed line from 11 N to 13 N follows the edge of the V-shaped gap referred to above.

South are steep rounded slopes and ledges, covered with scree, falling to the valley of a stream tributary to Blaeberry River.

A hole was drilled in an outcrop of schist rock, protruding in thin slabs, which shattered somewhat in the drilling; drilling was continued until solid rock was obtained and a bolt was cemented in the hole.

The bolt was marked "Alberta" and "British Columbia" on respective sides, "No. 13 N" on both ends and "+" on top. A cairn 5·6 feet high and 4·5 feet wide at its base was built over the bolt.

No. 8 N.—Brass Bolt 8 N is on the watershed at the northern extremity of the northeast ridge of Mt. Conway. From the pass summit this point appears as a distinct peak. Altitude of bolt, 8155 feet.

Some soil grown with mountain herbage is in the hollows in the vicinity of the bolt.

Towards 6 N the ridge falls in a fairly easy slope of rock and scree about 200 feet to the edge of a steep descent of broken rock and boulders falling to timber line.

Southwesterly the watershed follows the ridge and is a naturally defined boundary to the summit of Mt. Conway.

Northwesterly precipitous slopes fall to the tongue of Conway Glacier.

Southeasterly are easier slopes of rock, scree and grassy benches, falling to Blaeberry River.

The bolt is at the southwestern extremity of the straight-line survey and is definitely fixed in position by the same.

MONUMENTS "S"—YELLOWHEAD PASS

1 S

3 S

5 S

7 S

9 S

11 S

13 S

15 S

17 S

19 S

21 S

23 S

A hole was drilled in an outcrop of solid sandstone rock of yellowish colour and a bolt cemented therein.

The bolt was marked "Alberta" and "British Columbia" on respective sides, "No. 8 N" on both ends and "+" on top.

A cairn 5·6 feet high and 5·5 feet wide at base was built over the bolt.

Yellowhead Pass

No. 33 S.—Brass Bolt 33 S is on a flat-topped elevation of the northwest ridge of Miette Hill, directly above a little tarn which drains both ways, but of which the chief discharge is to Miette River, the western discharge being only through seepage. Altitude of bolt, 6844 feet.

The bolt is at the eastern end of the straight-line survey of the boundary across the pass, by which it is definitely fixed in position.

The elevation on which the bolt is placed is of solid rounded rock and is just at timber line; some spruce brush at nearly the same altitude is close by; there is some soil and mountain herbage in patches in the vicinity of the bolt.

The flat top extends southwesterly for about 200 feet and then falls in fairly easy timbered slopes and benches to the monument at 31 S.

The ridge continues northwesterly and from it the ground falls north and east in easy slopes towards the Miette Valley.

Southeast of the bolt the watershed crosses the flat-topped elevation and drops about thirty feet to the little tarn, mentioned above, which is about 250 feet distant.

Between 33 S and 35 S the boundary is naturally defined.

A hole was drilled in the rock top of the hill and a bolt cemented therein.

The bolt was marked "Alberta" and "British Columbia" on respective sides, "No. 33 S" on both ends and "+" on top.

A cairn 6·5 feet high and 5 feet wide at base was built over the bolt.

No. 35 S.—Brass Bolt 35 S is on a second flat-topped elevation of the northwest ridge of Miette Hill, which rises between elevation 33 S and the main mass of Miette Hill, directly southeast of the little tarn referred to. Altitude of bolt, 6977 feet.

Northwest the watershed line follows the flattish top of the elevation for several hundred feet and then falls sharply, about 100 feet, to the little tarn.

Southwest the ground falls rather steeply towards Fitzwilliam Creek and northeasterly more easily to Miette Valley.

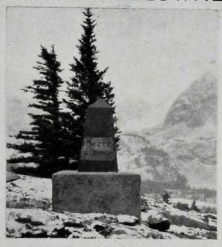
The bolt is above timber line but patches of soil and mountain herbage are here and there.

Southeast the watershed follows the northwest ridge of Miette Hill around the head of some boggy ground and rises steeply up rock edges. The boundary is here naturally defined.

A hole was drilled in an edge of solid light-grey limestone rock covered with lichens and a bolt cemented therein.

MONUMENTS "S"—YELLOWHEAD PASS

25 S



27 S

29 S

31 S

35 S Looking N.W.

37 S Looking N.W.

S

2 S

4 S

6 S

8 S

10 S

The bolt was marked "Alberta" and "British Columbia" on respective sides, "No. 35 S" on both ends and "+" on top.

A cairn 6·2 feet high and 4·8 feet wide at base was built over the bolt.

No. 37 S.—Brass Bolt 37 S was placed on the highest point of Miette Hill. Altitude of bolt, 7799 feet.

From 35 S the watershed line follows the ridge southeasterly. On reaching the crest of the hill it keeps along the north edge and, at the summit, doubles back at a very sharp angle. Gradually diverging from the previous course, the watershed now follows the south edge of the crest of the hill down an easy, rocky slope to the north ridge of Mt. Kataka. A shallow, dry watercourse, very indistinctly marked, drains between the two courses to Fitzwilliam Creek.

South and east from 37 S rocky slopes fall steeply to Clairvaux Creek; northward the slopes fall more easily to Miette Valley.

A hole was drilled in an outcrop of rotten limestone rock at the summit of the hill and a bolt cemented therein.

The bolt was marked "Alberta" and "British Columbia" on respective sides, "No. 37 S" on both ends and "+" on top.

A cairn 6 feet high and 5 feet wide at base was built over the bolt.

No. 32 S.—Brass Bolt 32 S is on the eastern edge of Tête Roche, forty-nine and a half feet distant from 34 S, which is on the highest point of the rock. Altitude of bolt, 7929 feet.

The bolt was placed here so as to be clearly visible on sky-line from the monument at 30 S. It is at the western extremity of the straight-line survey, by which it is definitely fixed in position, and is nineteen feet distant from the actual watershed line, which passes west and north of it.

To north and east Tête Roche falls precipitously for nearly a thousand feet and then in steep grassy and timbered slopes to 30 S situated northeast of and close by a little pond directly on the watershed; the bolt is fifteen feet from the edge of the precipitous drop.

A hole was drilled in a solid outcrop of light grey limestone, being a huge slab or projecting corner of the strata which here slopes steeply to the northwest, and a bolt cemented therein.

The bolt is one foot above the general level to the northeast; there is a drop of three feet on the southeast side; the edge of the rock lies in a northerly direction.

The bolt was marked "Alberta" and "British Columbia" on respective sides, "No. 32 S" on both ends and "+" on top.

A cairn 6 feet high and 4·5 feet wide at base was built over the bolt.

No. 34 S.—Brass Bolt 34 S is on the watershed at the highest point of the summit of Tête Roche. Altitude of bolt, 7932 feet.

The bolt was placed at the southerly end of an outcropping stratum of rock lying in a northerly direction for forty feet. The stratum slopes sharply to northwest and is overlaid on the surface by blocks and slabs of rock, which are covered with dark-green lichen.

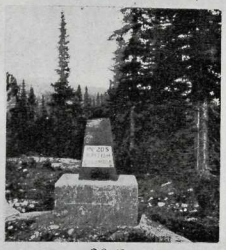
MONUMENTS "S"—YELLOWHEAD PASS

12 S

14 S

16 S

18 S



20 S

22 S

24 S

26 S

28 S

30 S

32 S. Looking N. by W.

34 S. Looking S. S. W.

From 34 S the actual watershed line runs along the summit in a northerly direction, nineteen feet westerly from 32 S; then curves easterly across a saddle with a twenty-foot drop to another and somewhat lower elevation; then, with a sharp turn to the east, goes down a couple of steps to the edge of the precipitous fall below which concrete monument 30 S is erected.

From 34 S the watershed line runs in a southwesterly direction along the crest of the main ridge of Yellowhead Mt. and here the boundary is naturally defined.

Southeast of the bolt the ridge falls gently some 200 feet to the edge of the precipitous face of Tête Roche.

A hole was drilled in solid light-grey limestone, lichen-covered rock and the bolt cemented therein.

The bolt was marked "Alberta" and "British Columbia" on respective sides, "No. 34 S" on both ends and "+" on top.

A cairn 5·2 feet high and 4·5 feet wide at base was built over the bolt. There is a drop of two and a half feet from the edge of the cairn on the east side.

Fortress Pass

No. 9 O.—Monument 9 O is situated on a small, level, narrow shelf of a steep rock ridge which forms the northeasterly wall confining a wild, rock gorge that cuts into the mountain on which Fortress Lake South camera station is placed. It is just 4 chains northwest of the cairn at Fortress Divide South camera station No. 2, and is on the same ridge.

The point was marked by a brass bolt cemented in a hole drilled in the rock.

The bolt was marked "Alberta" and "British Columbia" on the respective sides, "9 O" on both ends and "+" on the top. It is at an altitude of 7010 feet above sea-level. A cairn 4·5 feet in height was erected over the bolt. A wooden pole with a target was placed in the centre of the cairn for reference from the concrete monuments in the valley.

The position of the bolt and cairn is fixed by Mr. Cautley's survey.

No. 8 O.—Monument 8 O is situated on the southwest shoulder of Fortress Mountain, where the hill descends steeply towards the summit of the pass, and northerly, descends steeply to the valley of Fortress Creek. About 40 to 50 feet away, eastward, the southwest arête of Fortress Mountain rises in an almost perpendicular wall of shattered blocks of quartzite.

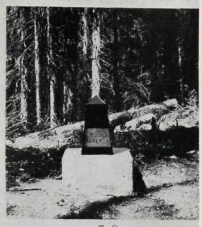
The point just commands Monument 6 O and has a full view of all of Fortress Lake and of the Chaba Valley, clear to the junction of the southeast and southwest branches. It gives a view well up Chisel Creek and shows the flat at the west end of Fortress Lake. It also commands all of the Fortress Creek Valley except a little cut out by the edge of the shoulder, about 30 to 40 feet from the bolt.

The point was marked by a brass bolt cemented in a hole drilled in a quartzite boulder about 4 feet by $2\frac{1}{4}$ feet—a chunk cracked off from the mass.

MONUMENTS "O" FORTRESS PASS

1-0

3-0



5-0

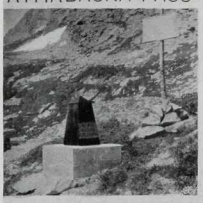
9-0 Looking N.W.

2-0

MONUMENTS "P"

1-P

ATHABASKA PASS



3-P

2-P

4-P

6-P

8-P

10-P Looking N.E.

It is on a steep hill slope, covered by broken quartzite boulders. The bolt was marked "Alberta" and "British Columbia" on the respective sides, "8 O" on both ends and "+" on the top. It is at an altitude of 7730 feet above sea-level. A cairn 4·7 feet high was erected over the bolt, and a picket with a cross set in the centre of the cairn. The cairn is on sky-line from Monument 6 O or from anywhere on the pass summit flat.

The position of the bolt and cairn is fixed by Mr. Cautley's survey.

Athabaska Pass

No. 5 P.—Monument 5 P is situated on the highest point of McGillivray Ridge, directly above Committee Punch Bowl. McGillivray Ridge is, at this place, a blunt wedge, falling very precipitously on the northeast side to a snowfield, and on the southwest side to the summit of Athabaska Pass. The crest of the ridge is here of broken quartzite blocks; pink, green and grey in bands, thickly covered by black and greenish-yellow lichen.

About 150 feet to the southeast the ridge breaks off in a cliff, not very high, and a lower part of the ridge is reached, leading to the most southeasterly summit, where the cairn of the camera station, Mt. Brown E., was built in 1920.

The point was marked by a brass bolt cemented in a hole drilled in a block of quartzite about 4 by 4 by 2 feet, lying on the crest of the ridge against another pointed block which, until the cairn was built, was the highest point of the ridge directly above Committee Punch Bowl.

The bolt was marked "Alberta" and "British Columbia" on the respective sides, "5 P" on both ends, and "+" on the top. It is at an altitude of 8779·5 feet above sea-level. A cairn 4·3 feet high was built over the bolt; very little space was available to build a cairn.

The position of the bolt and cairn is fixed by Mr. Cautley's survey.

No. 10 P.—Monument 10 P was placed on the south ridge of Mt. Brown on sky-line, at the end of the line 6 P to 10 P, on a bearing 89° 25′ 46″. Directly behind and to the west rises the snowfield south of Mt. Brown. The uncovered part of the ridge is here about 10 feet wide and, about 7 feet from the cairn, eastward, falls precipitously to the snowfield below.

The point was marked by a brass bolt cemented in a hole drilled in a shale block of which the strata dip to the south at an angle of about 60°. The block is about 9 by 4 feet, the first dimension lying in a north and south direction. The bolt was marked "Alberta" and "British Columbia" on the respective sides, "10 P" on both ends, and "+" on the top. Its altitude is 8347·5 feet above sea-level. A cairn 6 feet high was built over the bolt.

The position of the bolt and cairn is fixed by Mr. Cautley's survey.

MONUMENTS "Q" WHIRLPOOL PASS

1-Q

3-Q

5-Q

7-Q Looking N.W.

2-Q

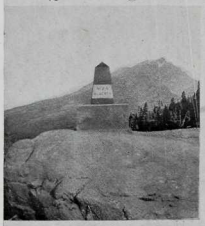
4-Q

MONUMENTS "R" TONQUIN PASS.

6-Q Looking S.W.

1-R

3-R



2-R

4-R Looking N.E

6-R

Whirlpool Pass

No. 7 Q.—Monument 7 Q is situated on a northerly, flat-topped spur of Mt. Mallard, which bounds the valley of the pass on the east. The surface of the ridge here rises gently for 18·37 chains beyond 7 Q to the edge of a precipitous escarpment facing east, on which camera station Whirlpool Pass E. No. 1 is set.

The point was marked by a brass bolt cemented in a hole drilled in a projecting block of schistose rock, showing mica specks (possibly sandstone shale), seen at sky-line from the bottom of the valley. The block is an irregular truncated pyramid, with base of 11 feet and a height of 5 feet—the longest edge facing westerly towards the valley of Mazama Creek. The bolt was marked "Alberta" and "British Columbia" on the respective sides, "7 Q" on both ends, and "+" on the top. Its altitude is 8416·5 feet above sea-level. A cairn 5·6 feet high was erected over the bolt.

The position of the bolt and cairn is fixed by Mr. Cautley's survey.

No. 6 Q.—Monument No. 6 Q is set on the ridge bounding the valley of the pass on the west side.

The point was marked by a brass bolt cemented in a hole drilled in an outcrop of solid, quartzite rock at the head of a small couloir up which the watershed passes—couloir with snow in it—on the sky-line from Monument 4 Q.

The bolt is set on the east side of the little couloir, in the wall of the same, just above a little fan-like draw where it closes to drop over the edge, about 50 feet from a very steep drop. Here a low bank of rock projects from the broken rock floor. The bolt is set in the top of this rock at its highest point, from which Monument 4 Q is visible when standing up.

All the rocks here are covered by bright yellow and green lichens, and are full of cracks. On the opposite side of the couloir (south side) is what appears to be the highest point of sky-line as seen from the summit of the pass. It was intended to set a bolt here, but a transverse fissure in the rock cuts off access to a view of Monument 4 Q, and the mass so cut off may fall at any time.

The bolt was marked "Alberta" and "British Columbia" on the respective sides, "6 Q" on both ends, and "+" on the top. Its altitude is 7936·5 above sea-level. A cairn 5·5 feet high was erected over the bolt.

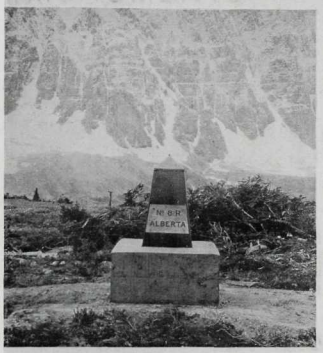
The position of the bolt and cairn is fixed by Mr. Cautley's survey.

Tonquin Pass

No. 4 R.—Monument No. 4 R is situated on the summit of Tonquin Hill, rising between the two passages of the pass.

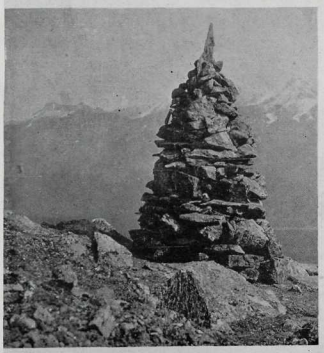
The point was marked by a brass bolt cemented in a hole drilled in a large embedded boulder of crystaline granite-like rock. The boulder is coffin-shaped; its greatest length is about 10 feet; its greatest width about 5 feet; its top slopes

MONUMENTS "R" TONQUIN PASS

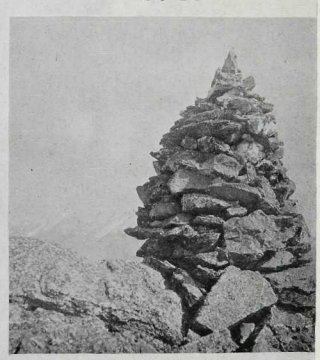


8-R

10-R



12-R Looking E.



14-R Looking E.

gently to the south; black and green lichens occur on the rock; on the north edge is one spot of bright orange-coloured lichen, and another small patch of orange-coloured lichen, a little above the other to the left, looking south.

The rock is on the westerly corner of the highest summit of the hill. Mr. Bridgland's cairn is at the easterly corner of this highest part, and is distant from 4 R, 26·4 feet, on a bearing 84° 22′.

The bolt was marked "Alberta" and "British Columbia" on the respective sides, "4 R" on both ends, and "+" on the top. Its altitude is 7861 feet above sea-level. A cairn 6 feet high was erected over the bolt.

The position of the bolt and cairn is fixed by Mr. Cautley's survey.

No. 12 R.—Monument No. 12 R is situated on the southeast end of the long mountain ridge of which Vista Peak is the highest point. The point was marked by a brass bolt cemented in a hole drilled in bedded crystaline, granite-like rock. From the bolt the hill descends steeply to the southwest, covered by broken, jagged rock boulders, until slopes of micaceous shale are reached; then occur turf-covered slopes to the summit of Vista Passage, these slopes lying to the south.

Ten feet from the cairn, on the northeast, precipitous slopes fall to the cirque from which water flows to the Alberta side of the pass. The bolt was marked "Alberta" and "British Columbia" on the respective sides, "12 R" on both ends, and "+" on the top. Its altitude is 8028 feet above sea-level. A cairn 6 feet high was erected over the bolt.

The position of the bolt and cairn is fixed by Mr. Cautley's survey.

No. 14 R.—Monument No. 14 R is situated on the summit of Caniche Peak, an elevation of the Vista Peak ridge. The point was marked by a brass bolt cemented in a hole drilled in solid bed rock; the rock is here very hard and looks like crystaline granite with a good deal of quartz running through it. The top of the peak is of solid rock and scattered loose blocks of the same nature. There is a steep hill slope to the south with fallen blocks of rock and micaceous shale. To the north, 10 feet from the bolt, the slopes fall sheer to a cirque at the head of the valley tributary to Meadow Creek. The westerly ridge extends to the next elevation on the way to Vista Peak. The southeast ridge falls very steeply for a short distance and then gently to the cairn at Bolt 12 R.

The bolt was marked "Alberta" and "British Columbia" on the respective sides, "14 R" on both ends, and "+" on the top. Its altitude is 8368 feet. A cairn 5·5 feet high was erected over the bolt.

The position of the bolt and cairn is fixed by Mr. Cautley's survey.

APPENDIX II

TABLE OF LATITUDES AND DEPARTURES REFERRING BRASS BOLTS AND CAIRNS TO NEAREST BOUNDARY MONUMENT

(Distances are given in chains)

No. of Bolt and Cairn	Latitude		Departure		No. of Reference Monument
	North	South	East	West	
		HOWSE PASS			
9 N		4.69	43.94		7 N
11 N		12.63	74.78		7 N
13 N		23.44	124.10		7 N
8 N		53.60		23.49	6 N
		YELLOWHEAD PASS			
33 S	12.43		53.70		31 S
35 S	2.94		63.95		31 S
37 S		14.60	117.17		31 S
32 S		26.21		42.86	30 S
34 S		26.96		42.83	30 S
		FORTRESS PASS			
8 O	58.101			24.772	6 O
9 O		53.525		44.864	7 O
		ATHABASKA PASS			
5 P	34.154		27.257		3 P
10 P		0.566		56.820	8 P
		WHIRLPOOL PASS			
6 Q	21.111			22.005	4 Q
7 Q		7.916	39.815		5 Q
		TONQUIN PASS			
4 R	23.144		22.167		2 R
5 R	(Inaccessible Point)	90.125		16.026	3 R
12 R	25.055			22.327	10 R
14 R	42.239			32.861	10 R

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