Surveying the 120th Meridian and the Great Divide

The Alberta-BC Boundary Survey, 1918–1924

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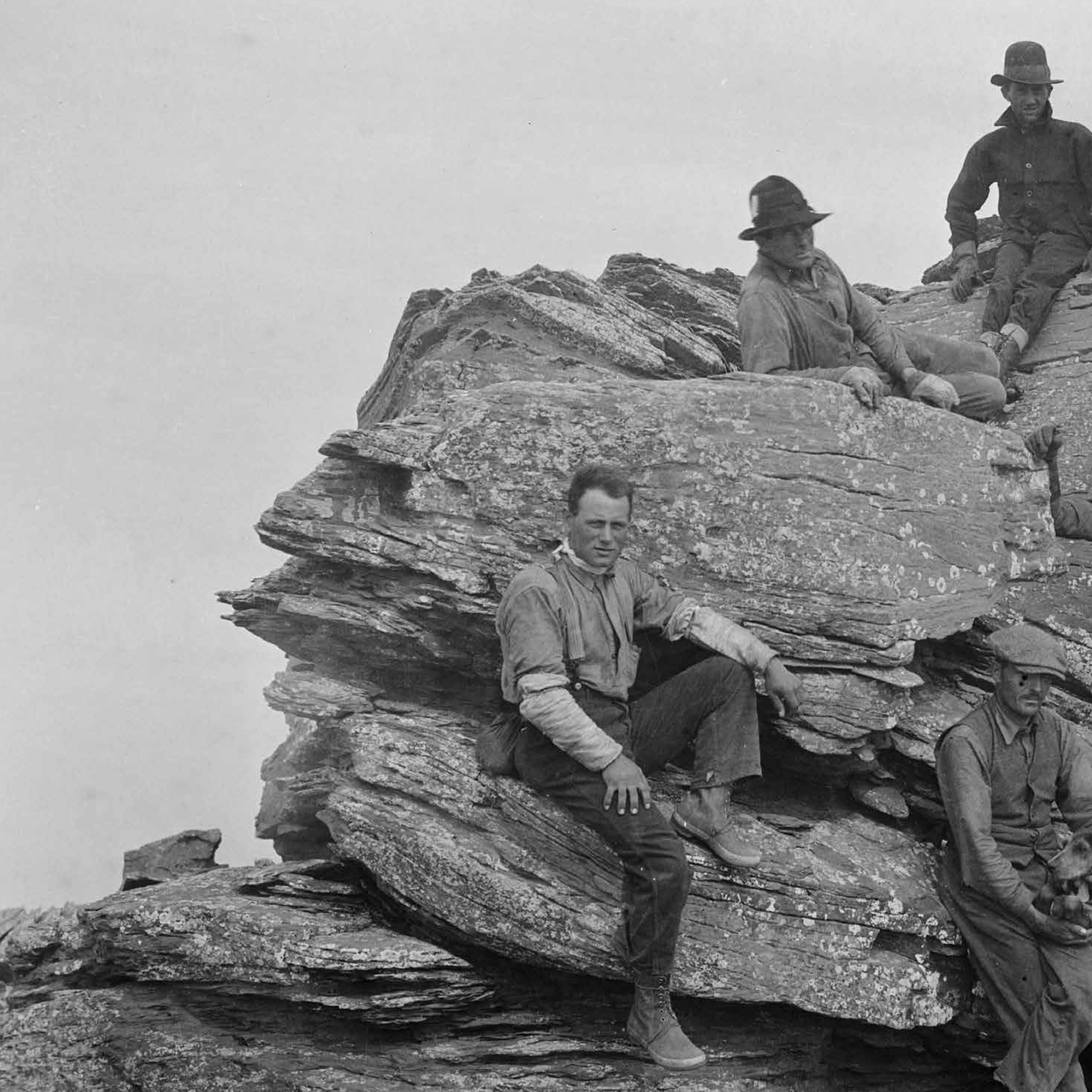
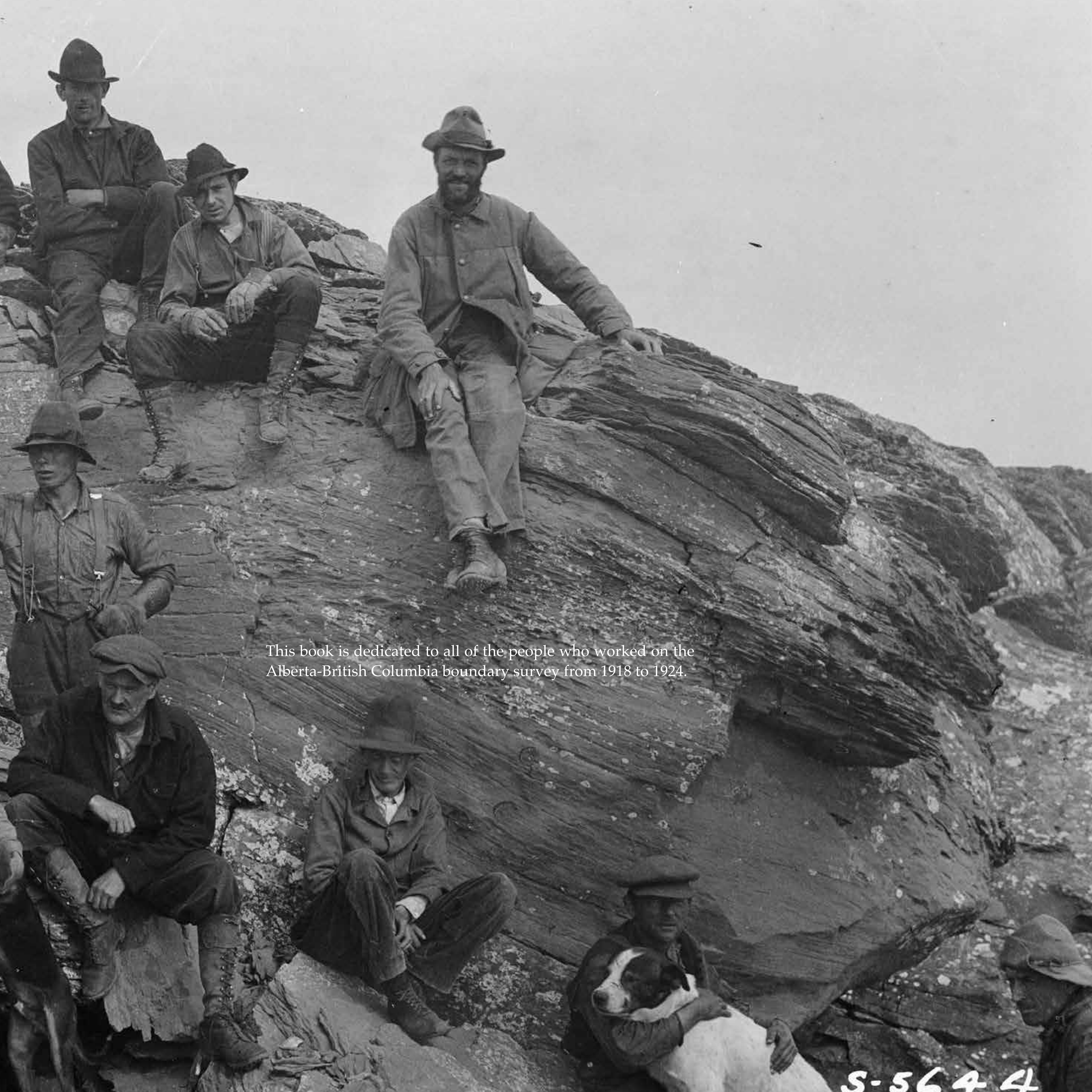
Caitlin Press





This book is dedicated to all of the people who worked on the Alberta-British Columbia boundary survey from 1918 to 1924.

Surveying Methods, 1918–1924

The Alberta and British Columbia survey crews used different methods of surveying for different purposes during this part of the boundary survey.

From 1913 to 1916, R.W. Cautley surveyed the main passes along the Great Divide between the United States border and Kicking Horse Pass, west of Lake Louise. In 1917, he surveyed Howse Pass, the first pass north of Kicking Horse, along with Yellowhead Pass, west of Jasper. Through a series of monuments constructed in each pass, Cautley physically defined the location of the divide. (Cautley made a preliminary survey of a pass and then conferred with Wheeler. After both surveyors concurred with the location of the monuments, Cautley would make the final survey and establish the monuments, many of which still exist today, a century later.)

From 1918 to 1924, Cautley surveyed passes only in 1921 and a portion of the 1924 field season. The passes along the northern part of the divide were smaller and more remote. Only the Yellowhead, with the Grand Trunk Pacific and Canadian Northern rail lines, had any economic significance.

The main objective for Cautley during these seven years was to define the Alberta-BC boundary along its northern portion, the 120th meridian north from its intersection with the Continental Divide. As with his work in the passes, Cautley and the Alberta crew cut a survey line and physically defined the 120th meridian with a series of monuments. They initially used the same concrete design. However, Cautley found it difficult to find suitable gravel in many locations. Unlike the Rocky Mountains, the terrain along the 120th meridian had almost no bedrock on which to construct the monuments, so the monument-builders had to establish a full monument at each station, making their work slower and more difficult.

In a letter to Deville in 1919, Cautley wrote:

> There is one point in connection with the subject that makes monument building on the 120th meridian a more arduous business than it is in the mountains, namely that whereas in the mountains a great many monuments—particularly in the higher sites—only require one third of the material used in a full-sized monument, because they are built on bedrock very close to, or even above, the general surface, every monument built on the 120th meridian is of full standard size and requires 3000 lbs [1360 kilograms] of gravel, cement and water for its construction.

Beginning in 1922, changes were made to the monuments Cautley used along the meridian line.

Cautley's work was labour-intensive. Except for 1918, during World War I, he had a crew of about fifteen people each year. Cautley had an assistant surveyor (except in 1918), chainmen for measuring the survey line, a leveller and assistant to measure elevation, and a monument-builder and assistant. In many places along the 120th meridian, the timber was very thick, so several axemen were hired to cut the line. To support the crew, there were cooks and packers.

F.A. McDiarmid from the Dominion Observatory came to Pouce Coupe during the summer of 1917 and established a longitude pier near the community. Using signals from the telegraph line, he determined the longitude at that location. When Cautley and his crew arrived in 1918, they had to make a connecting survey to the 120th meridian. The longitude pier was 8.3 kilometres west of the 120th meridian, so it was imperative to measure the exact distance to this location. The Boundary Commission report stated that

> the connecting survey called for extreme care since any error in its measurement would have resulted in the entire boundary being out of place by the full amount of such error. The connection was made along the north boundary of Township 77 and chained twice by the transit and tripod method, after the chain had been very carefully compared with standard tapes.
>
> As soon as the above survey had been made, concrete Monument 78-1 was built 3.079 chains [61.6 metres] north of the north boundary of Township 77 and forms the initial point from which the survey of the 120th meridian was subsequently carried north and south.

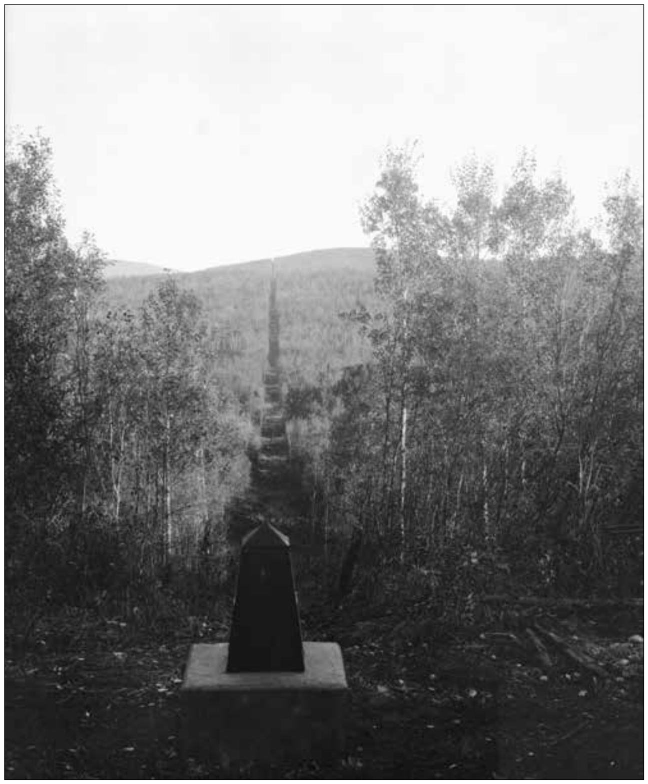
Cautley described his work: "The running of the 120th meridian is a simple survey, depending for its correctness on the accuracy of the astronomical observations, instrument work and chaining of the surveyor in charge and based, in the first place, upon data as to the location of the meridian." He needed to survey south until he intersected the Great Divide and connected with the British Columbia survey. Cautley also had to delineate the 120th meridian line north through the agricultural land of the Peace River region, for there had not yet been a definitive survey, and many people did not know whether their land was in Alberta or British Columbia.

From 1913 to 1916, Wheeler made a phototopographic survey along the Great Divide from Kicking Horse Pass south to the United States border. In 1917, he started the second section, from Kicking Horse to Yellowhead Pass. Wheeler and his crew surveyed to Howse Pass, the first main pass to the north, and then joined Cautley in defining the boundary through Yellowhead Pass and some adjacent terrain.

The surveying methods used by Wheeler and the BC crew remained unchanged during the second part of the survey. The Boundary Commission report stated: "The topographical work of the Commission

Marcus Platz, monument-builder (left), and Harold Clutton at Monument 73-7. e011205469, Library and Archives Canada

is entirely in the hands of Mr. Wheeler. It consists in the delineation of the watershed along the main range from the International Boundary northward to the final crossing of the 120th meridian of west longitude." There were two main aspects to Wheeler's work: the triangulation survey and the photography. In triangulation surveying, if two angles and a side distance of



The 120th meridian line cut by Cautley's crew. e011205436, Library and Archives Canada

a triangle are known, the remaining angle and distances can be computed. From mountain peaks, Wheeler would survey to other stations and peaks in the area, creating a network of triangles. While the surveying provided the framework for mapping the Rocky Mountains, the phototopography enabled him to map the details. The report commented that "it was decided to adopt the method of photo-topography as the one best suited to the mapping of the highly accentuated contours of mountain areas."

The report described the process.

> The work requires a specially constructed camera and mountain transit-theodolite. It is carried on by climbing to previously selected stations at the summits of peaks, or to high points on mountain ridges that command a view of the area to be mapped. From these a series of views is taken and their direction established by the use of the transit-theodolite, frequently entailing a precarious balancing over dizzy depths. Rock cairns are erected at the selected stations, either in advance or at the time they are occupied, and are used for identification purposes.
>
> The stations are fixed in position by a triangulation of a greater or less degree of precision, expanded from a given base and extended over the required area. This triangulation may be made independently or be carried on at the same time as the photographing.

Usually the triangulation surveying and phototopography were done simultaneously, for the surveyors did not want to climb a mountain more than once if it wasn't necessary. In addition to the main surveying station, Wheeler or his assistant, Campbell, would occasionally establish a second station that was used primarily for phototopography. Usually this station was at a lower elevation but with a better view of the terrain.

The phototopographic camera was designed to fit on the same tripod as the transit, so that both operations could be completed while working at a survey station. In addition to measuring angles, it was important to determine the elevation of the stations and the geographical features. The Boundary Commission report explained the process.

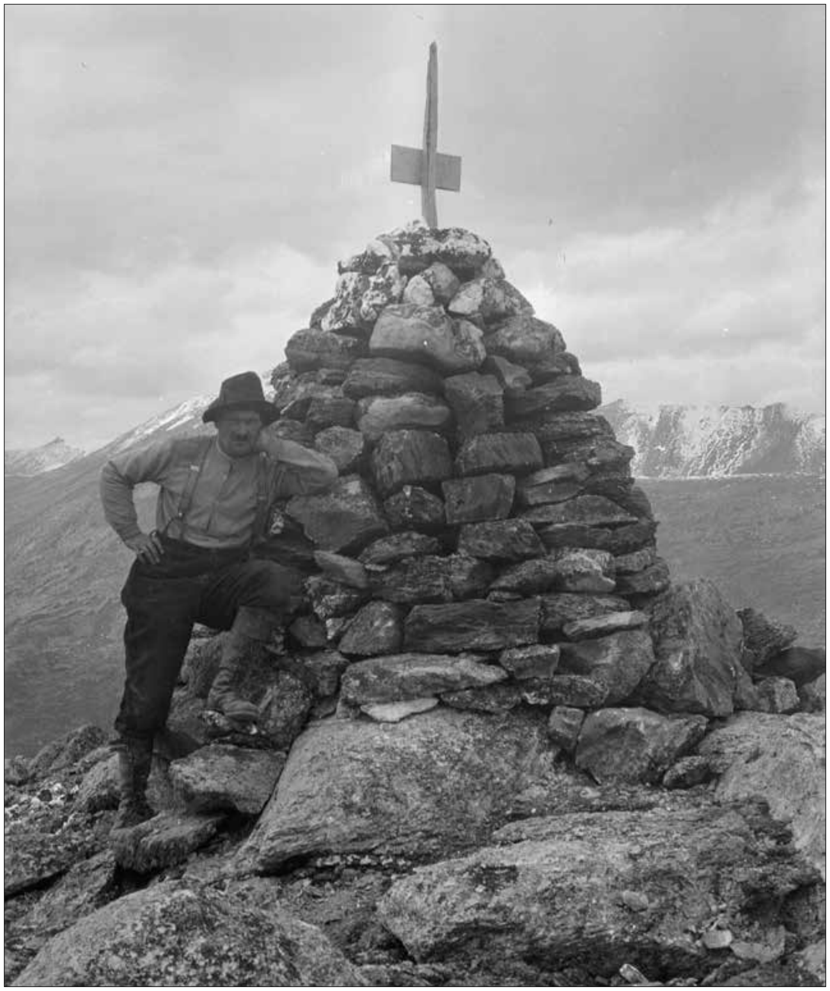
> The altitudes of the various points are obtained by reading angles of elevation or depression back and forth from point to point and applying the necessary corrections for curvature and refraction, a process known technically as trigonometric levelling.
>
> The chief advantage of the method is its rapidity for work in the field. It is much more rapid than any other that can be applied to the same class of country and the standard of accuracy is a high one. It is true that work can only be carried on in

fine weather, when the stations are below the clouds and the landscape is sufficiently clear to be photographed, but the same limitation applies to any other method that can be used. Only a small party, generally a surveyor and one or two assistants, is required to carry the instruments, take the views, record the transit reading and build the rock cairns or other signals that may be erected to mark the stations it is desired to perpetuate. The instrument outfit, adapted by Dr. Deville, weighs about 45 lbs [20 kilograms], and is so disposed as to be easily carried, even when the climbing is dangerous.

The camera is of fixed focus and has a wide-angle lens covering about 52 degrees of arc for one view. It is adapted in two positions to a light, strong tripod with sliding legs, to which are attached levelling screws to bring the plate exposed in the camera to a vertical position, an absolute necessity to obtain suitable views. The same tripod fits the transit-theodolite. [Each photograph covered about 45 degrees of the landscape with a couple of degrees of overlap on each side. A set of eight photographs would cover the scene.]

The size of the plate used is 6½" by 4¾" [16 by 11 centimetres], and the lens gives very nearly a true perspective. Later, in the office, the plates are developed and bromide enlargements, 9½ by 13 inches [24 by 32 centimetres] are made for mapping purposes. Practically speaking they are perspectives of the views and, by means of geometric and perspective constructions, the position and altitude of points seen in them can be obtained and the contour outlines of the various topographical features drawn on the plan.… In the mapping room, this chaotic condition soon resolves itself into orderly array.

There are certain factors necessary to the conduct of a survey such as this, for instance: the triangulation on which the photographic work depends must start from a measured base and be expanded in sufficiently symmetrical proportions; the altitude above sea-level of one or both ends of the base must be known; and there must be independent checks on the expansion of the triangulation at sufficiently close intervals to keep the work within bounds of the limit of accuracy.



A rock cairn constructed at a station on the top of a mountain.
e011205452, Library and Archives Canada

The maps that Wheeler produced from the phototopographic surveying were used to delineate the entire

A.O. Wheeler's crew surveying on a mountain. The man on the left is by the transit, while the man on the right is recording data in the field notes. PA64-27, Jasper Yellowhead Museum & Archives

Below: After the angles were read with the transit, the phototopographic camera was used to take a series of pictures at the same station. 89.03.206, Jasper Yellowhead Museum & Archives

Continental Divide from the United States border to the 120th meridian. Unlike Cautley's work, the boundary was not physically marked, although some stations were located on it. In the section between Kicking Horse Pass and Yellowhead Pass, Wheeler and Campbell had very few surveys to connect with their work. In the final section north of the Yellowhead Pass, Deville arranged for the Geodetic Survey to provide assistance for the BC surveyors.

In his 1913 report to the BC government, Wheeler wrote that surveying on the mountains had both a routine and dangerous aspect.

> Outside of the difficulties of carrying the survey instruments to the summits of commanding peaks, a process entailing all the delights and dangers of mountaineering of a high order, after a few years' experience, the work becomes mechanical, except for the glories opened up by each new climb amidst the wonderful alpine scenery displayed by the Canadian Rockies.

The vagaries of the weather in the mountains often produced difficulties. On many occasions, the survey crews would leave camp in clear weather in the morning, only to find that conditions had changed by the time they reached the locations on the mountains where they planned to survey. Wheeler wrote:

> To be perched on a high peak with standing room only when a tempest of snow scours over it is by no means a joy; neither is an electric storm, when your transit sings like a telegraph wire and to touch it gives you a sharp shock, when the rocks around you hum and your hair stands straight on end.

The surveying talents of both Cautley and Wheeler were essential for the success of the Alberta–British Columbia boundary survey.

One man is reading the horizontal angle, one the vertical. Speed and efficiency were important when surveying on the mountains.
A10727, Provincial Archives of Alberta

Steam tractor and wagon on way to Pouce Coupe passing Cautley's camp. e011205439, Library and Archives Canada