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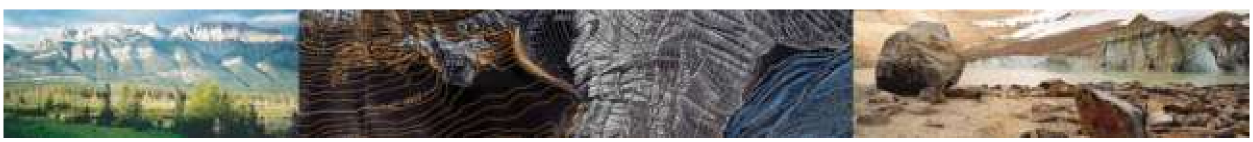
Snow and ice training for climbing Mt. Athabasca
Michael Fisher - second from the right.

At the summit of Mt. Athabasca

High-mountain cartography in Canada - Selected historic maps reviewed



Introduction

Resting within the University of Alberta Libraries, William C. Wonders Map Collection, are numerous historic maps of Canada's western Cordillera and the High Arctic. Some of the best examples of high-mountain cartography in Canada are represented. Only a few selected historic maps will be reviewed.

The main focus will be on the methodology used to create these maps as well as highlight the Canadian pioneers who produced them. Notable high-mountain cartographers/surveyers, including A.O. Wheeler and M.P. Bridgland will represent mapping at the end of the nineteenth and beginning of the twentieth century. Relatively modern middle to late twentieth century mapping created by the National Research Council of Canada/McGill University and the Inland Waters Directorate will be represented.

These maps were not produced using modern day computer and satellite imagery and technology. Instead, these high-mountain cartographers relied on a variety of traditional cartographic skills and tools, survey cameras, theodolites to the more modern aerial survey techniques.

Mountain cartography was to them both the art and the science of making maps.

Selkirk Range of British Columbia - The topographic surveys of A. O. Wheeler.

Arthur Oliver Wheeler's extensive report and a collection of maps was published by the Department of the Interior, Canada in 1904 under the title of "The Selkirk Range". The first volume of this two volume set was an extensive written report. The second volume contained many reproductions of historic maps of surveys conducted in the past of the Selkirk Mountain Range.

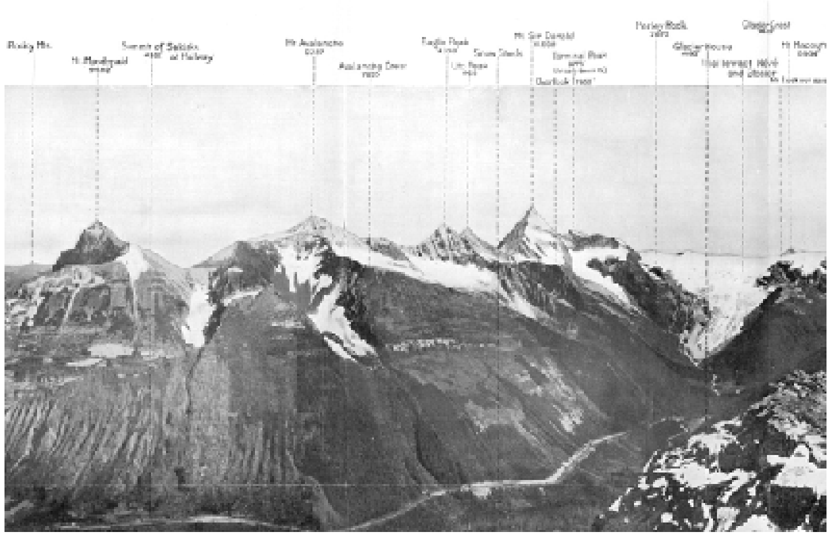


Figure 1. Panoramic photo showing a section of Selkirk Range from Napoleon Mountain.

Sketch maps, diagrams, panoramic photo views and a four panel topographical map of part of the Selkirk Range was published. This map was the result of extensive photo-topographic surveys conducted by Wheeler and others. As part of the introduction in the written volume, Wheeler makes the following views.

“During the second year, the survey was extended southward to embrace all previous travel and exploration of the higher Selkirk summits and to enable a reliable guide map to be furnished to tourists and mountaineers.”

“Owing to the great influx to our Canadian Alps, from all parts of the world, of those interested in mountains and mountain scenery, the subject has become one of great interest. Accurate maps and reliable information are frequently asked for, and on this account, if no other, the accompanying notes may be of use.”

Respectfully submitted, Arthur O. Wheeler, Topographer, Department of the Interior, 1905

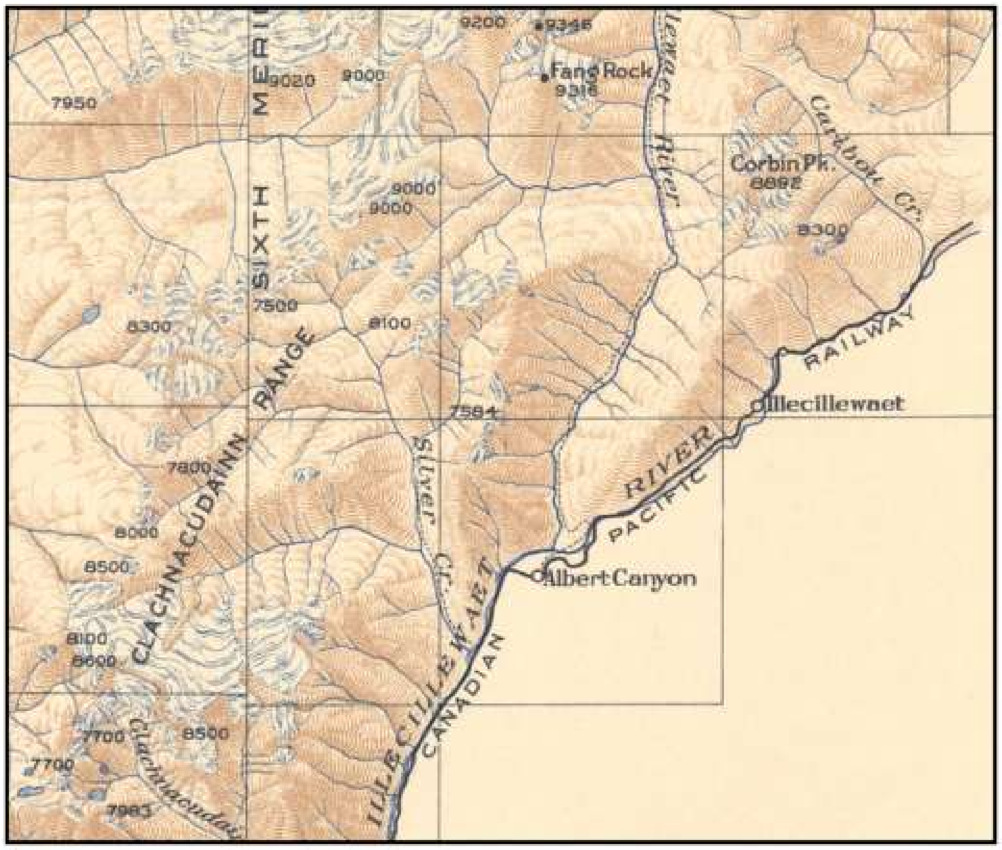
Figure 2. Swiss guides in the Selkirks.

Wheeler, A. O. The Selkirk Range , Government Printing Bureau, Ottawa, 1905 Volume 1, Page V and VI

A. O. Wheeler in 1885 started receiving training in photo-topographical surveying then being applied by Dr. E. Deville, F.R.A.S., Surveyor General of Canada. This survey method was being applied extensively to the mapping of the Canadian Cordilleras.

The topographic map produced of the Selkirk Mountain Range is a fine example of that period for contours and shaded relief mapping.

Whittaker, John A. (edited by) Early Land Surveyors of British Columbia, The Corporation of Land Surveyors of the Province of British Columbia,1990 Page 145



SKETCH MAP
OF
PART OF THE RAILWAY BELT
BRITISH COLUMBIA

Showing the main topographical features in the district lying between the North Fork of the Illecillewaet river and the Columbia river.

Scale: 4 miles to an inch.

NOTE: Triangulation stations are shown thus ▲
Peaks located by triangulation are shown thus ●

Figure 3. Detail of a sketch map showing topographic features.

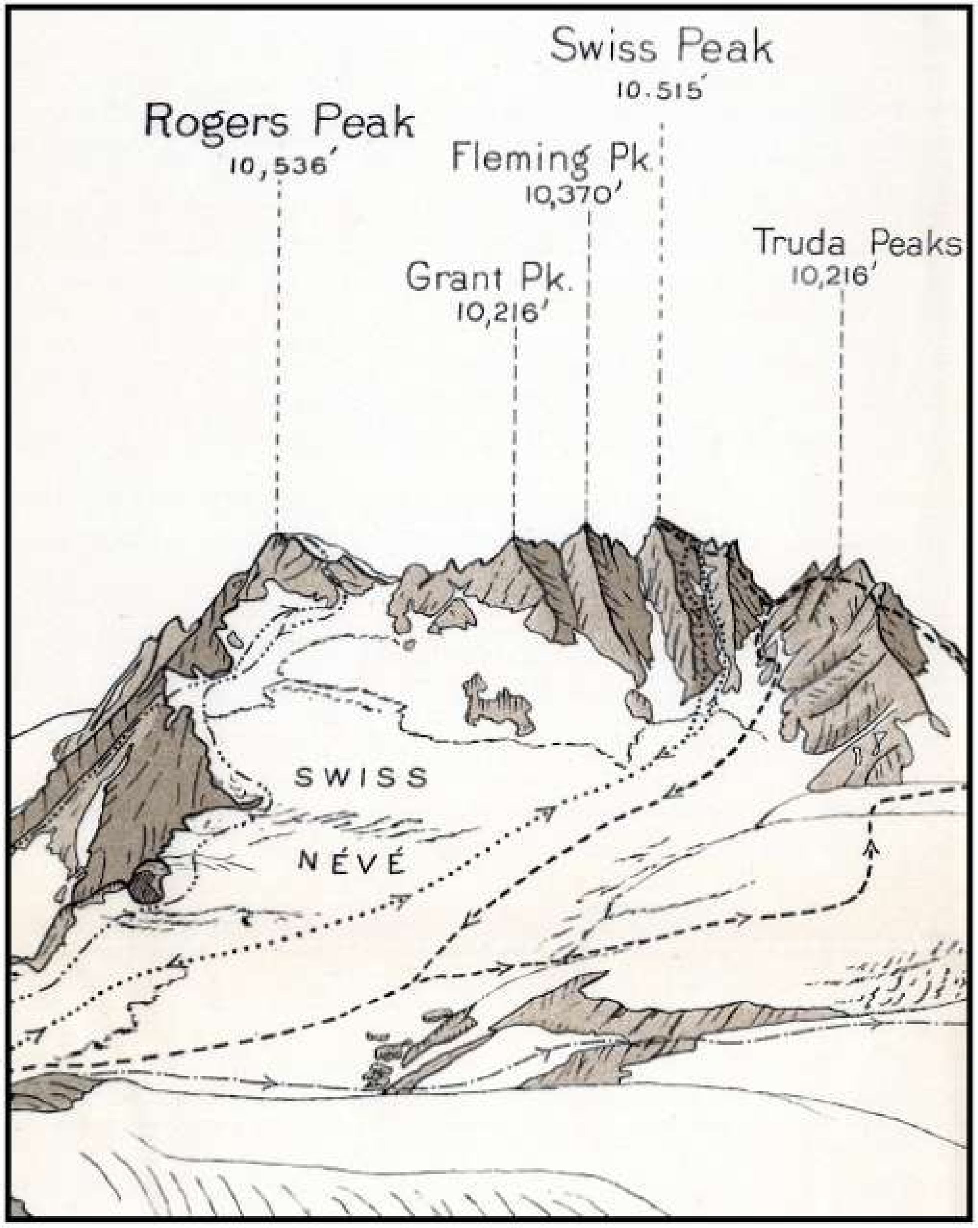


Figure 4.Detail of sketch showing ascent of Swiss and Rogers Peaks.

Figure 5. Title and detail of topographic map showing Geikie Glacier.

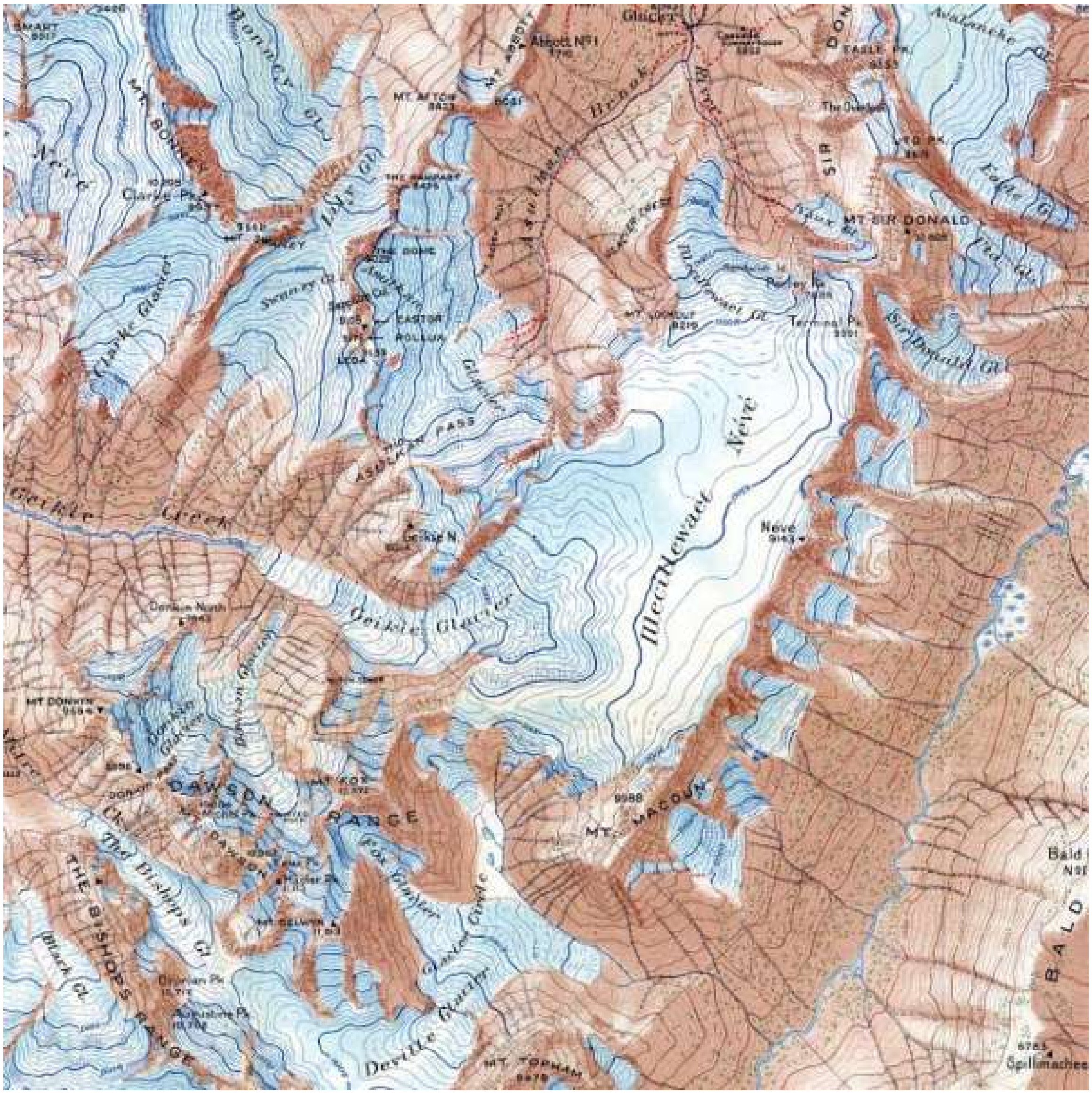


Figure 6. Detail of topographic map showing part of the Selkirk Range.

Amethyst Lakes of Alberta - Photographic Surveying by M. P. Bridgland.

Under the Department of the Interior, the Topographic Survey of Canada, published a bulletin in 1924 entitled "Photographic Surveying" by M. P. Bridgland, D.L.S. Contained therein is a practical presentation of methods and instruments used in the field and in the mapping office. Morrison Parsons Bridgland gives technical details of photographic methods of surveying used by the Department of the Interior in order in produce accurate and economical methods in mapping in the Canadian Cordilleras. In the historical notes, Dr. E. Deville, F.R.A.S., is again acknowledged in contributing to the introduction of photographic surveying into Canada.

The survey instruments were designed for rugged transportation and practical usage on mountain peaks. An overview of the camera, transit and tripod can be described as follows.

Camera and transit are constructed as separate instruments. The transit has three-inch circles and reads to minutes.The tripod is three feet four inches with sliding legs. Both are made of metal and wood construction.The surveyor observes either in a sitting or kneeling postion.

For the purpose of packing, the head of the tripod is removed, and placed in the transit box. The tripod legs folded down to twenty inches and placed under the transit box.

The camera and the transit have identical bases, so that both may fit the same tripod. Either a horizontal or vertical side of the camera may be set up.

The camera is carried in a heavy leather case fitted with shoulder straps and designed to hold it, the sunshade and twelve plate holders. The total weight of the case with camera and plate holders is about twelve pounds.

When setting on the tripod, a canvas bag was suspended between the legs and filled with stones, and then the legs and bag are blocked with more stones, so that the instrument may be rigid in any wind.

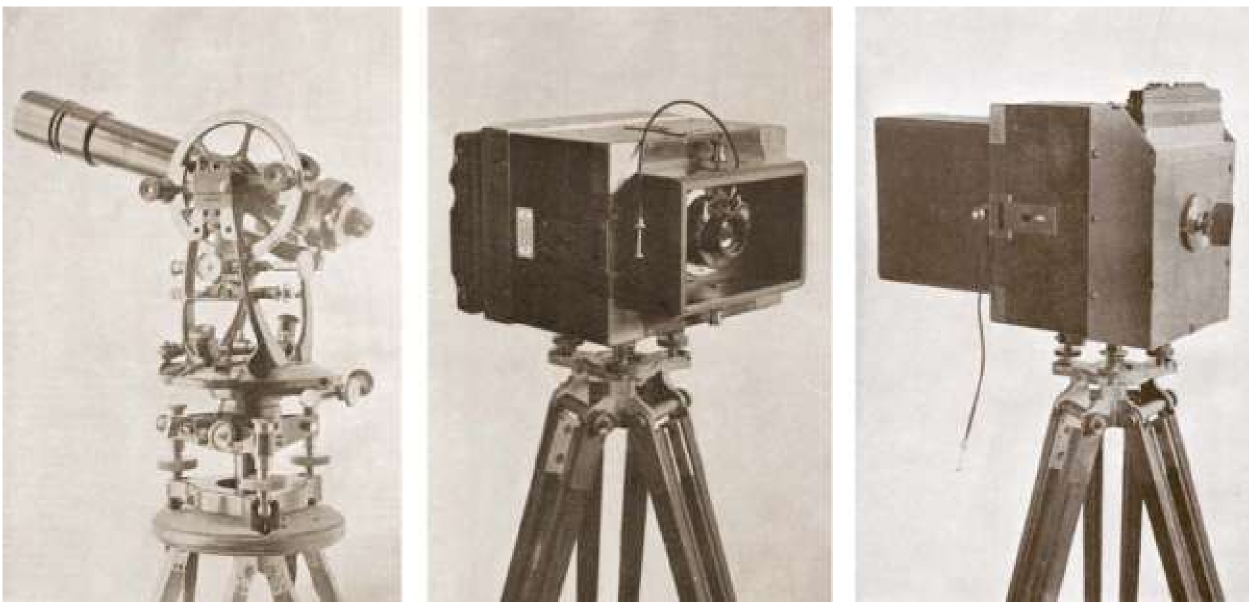


Figure 7. Transit theodolite and survey camera (Horizontal and Vertical positions).

Bridgland, M.P. Photographic Surveying, Department of the Interior, Topographical Survey of Canada, Bullentin No. 56, Ottawa, 1924 Page 3 and 11

As a practical example of a survey done in the field, Bridgland selected the survey of the Amethyst Lakes of Alberta. Selected mountain peaks or other station points are used for triangulation and topographic surveys. Where practical, triangulation and photography may be executed at the same time. After the topographic survey has been completed in the field , the photographic plates and field data is brought back into the mapping office. Triagulation and control, scale, geometry of perspective as applied to the photographs, plotting of points and the determination of elevations are part of the requirements in the stages of the mapping production.

Custom drafting instruments were designed and used for specific purposes. An instrument called the “Perspectometer” was used when *"relatively level features such as swamps, lakes, or rivers with comparatively small fall are plotted".*

Bridgland, M.P. Photographic Surveying, Department of the Interior, Topographical Survey of Canada, Bullentin No. 56, Ottawa, 1924 Page 35 and 36, Fig 32

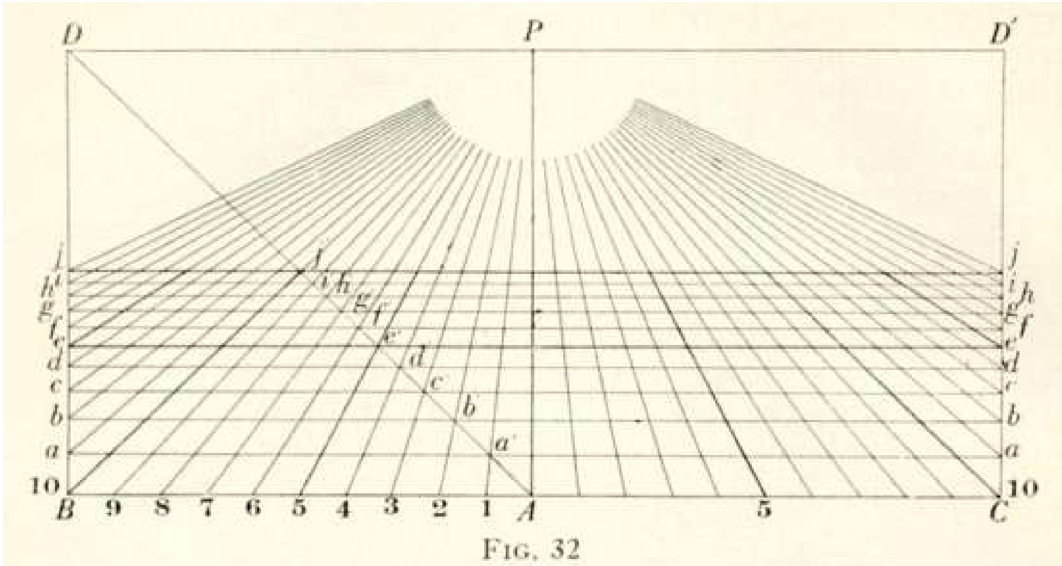


Figure 8. Perspectometer instrument.

The plotting of points and determination of elevations were made with custom instruments originally created by D. B. Dowling and H. Matheson, of the Canadian Geological Survey.

Bridgland, M.P. Photographic Surveying, Department of the Interior, Topographical Survey of Canada, Bullentin No. 56, Ottawa, 1924 Page 33, Fig 29.

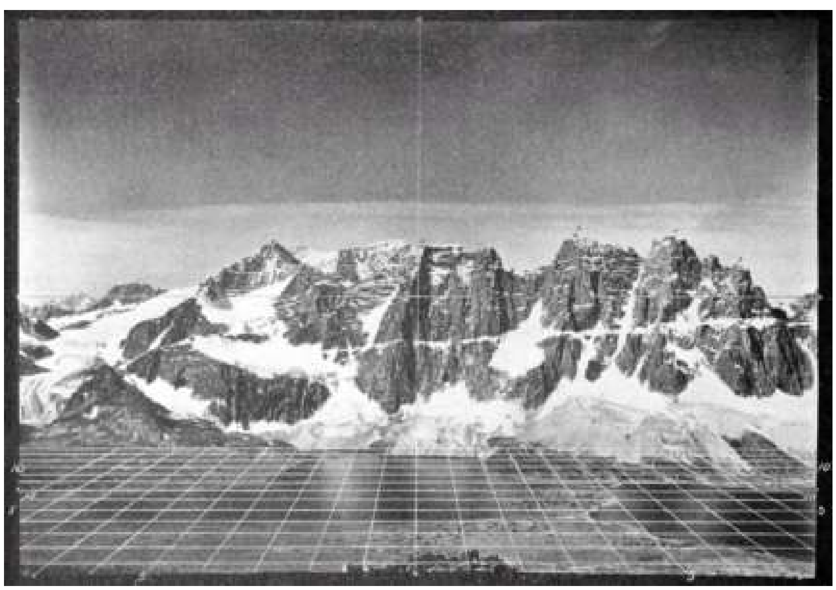


Figure 9. Camera station view overlooking part of Amethyst Lakes.

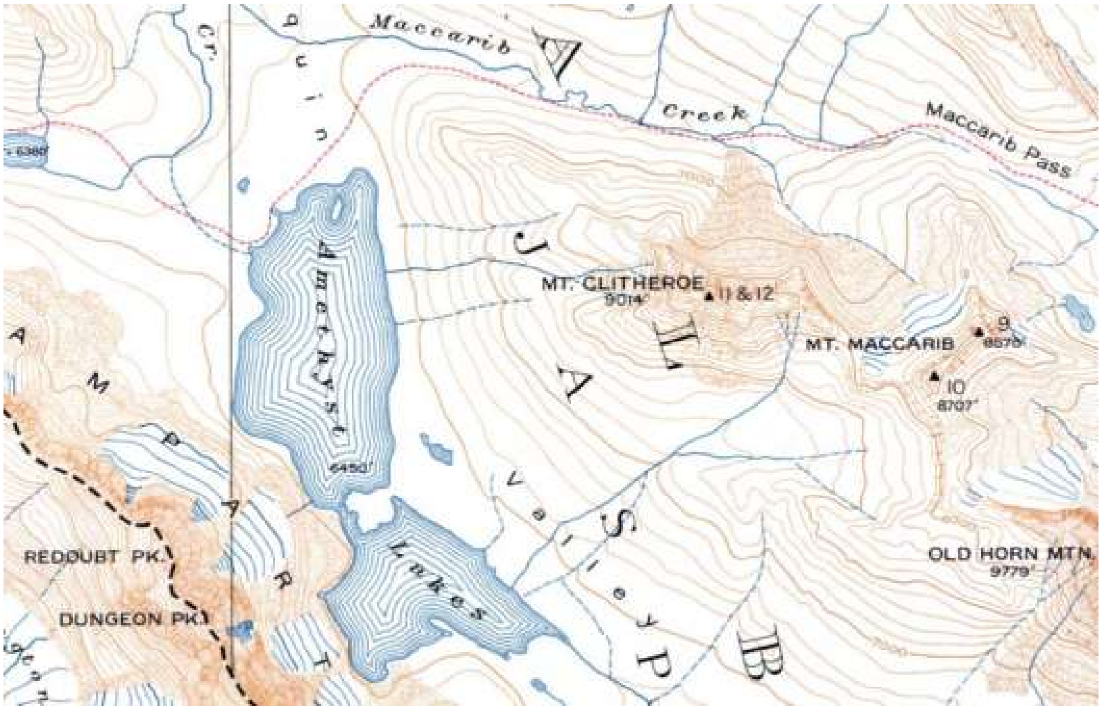


Figure 10. Amethyst Lakes topographic map detail.

This is only a small representative part of the publication " Photographic Surveying". Bridgland's other contributions such as the topographic surveys of Jasper National Park and the archive of photographic plates are also a heritage of our mountain cartographic in Canada. The University of Alberta located in Edmonton, Alberta, Canada has the Bridgland Repeat Photography Collection site. You can reference this at http://www.sunsite.ualberta.ca/Projects/Bridgland/index.html for research or educational purposes.

Surveying Glaciers on Axel Heiberg Island - National Research Council of Canada/McGill University.

The surveying and mapping of glaciers on Axel Heiberg represents an early achievement of mountain cartography in the high arctic of Canada. Modern precision theodolites, aerial surveys and photogrammetry represent technology of the beginning of the 1960's. The maps were produced by the Photogrammetric Research Section of the National Reasearch Council of Canada, in conjunction with the Jacoben-McGill Arctic Research Expedition (McGill University, Montreal) to Axel Heiberg Island.

The main effort centred around Thompson Glacier region. The first field survey started in the summer of 1960 in order to establish the basic ground control for measurements and mapping by aerial photography.

Figure 11. Wild T2 theodolite (left), stone cairns (center) and tripod signals (right).

A Wild T2 theodolite was used for the ground survey. Tripod signals were used for the main points of triangulation. Targets made of aluminum foil and painted orange were placed on the ground and weighted down with stones. Stone cairns were also made and painted yellow giving visiblity over distances of twenty kilometres. Photogrammetric work was done on a Zeiss stereoplanigraph C-8 compiled from vertical aerial photographs taken during the months of July and August, 1959 with a flying height of 9000 metres (30,000 feet). The final printing of the maps was done by the Army Survey Establishment, R.C.E. 1962.

Haumann, D. Surveying Galciers on Axel Heiberg Island, The Canadian Surveyor, June 1963 Page 81 - 93

From a statement of T. A. McKortell, The Army Survey Establishment, "Reproduction of the Thompson Glacer Map"

" From a purely cartographic point of view the map is a novelty in North America. It is the first map at this scale produced on this continent that employs not only relief shading but also rock drawings, and is probably also the first map of its kind of the arctic and antarctic regions."

McKortel, T.A. The Reproduction of the Thompson Glacier Map, The Canadian Surveyor, June 1963 Page 93

Figure 12. Detail of Thompson Glacier map.

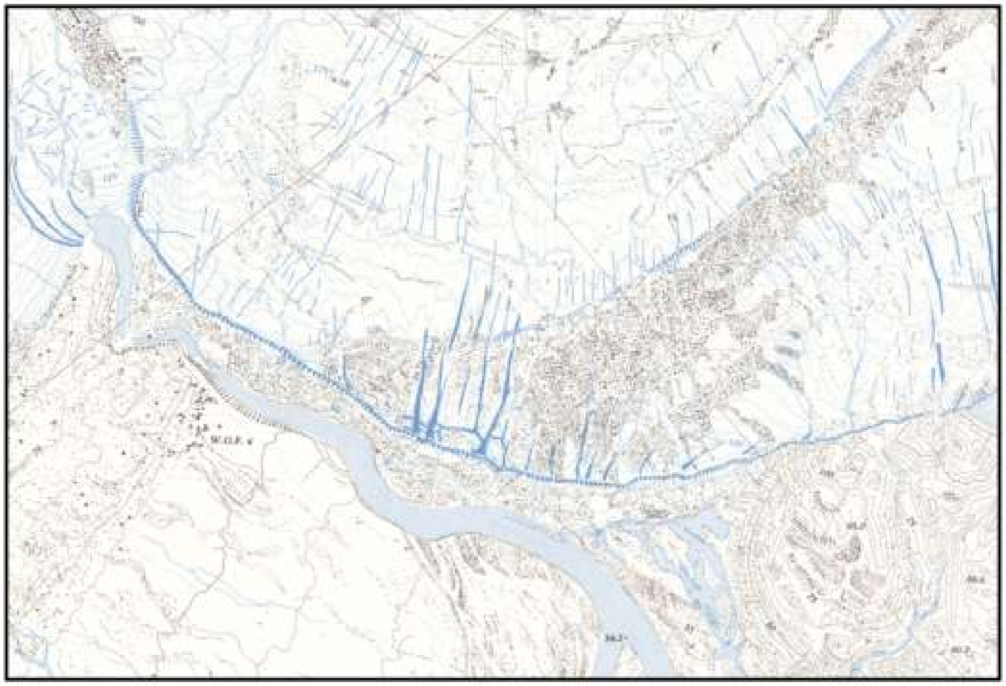


Figure 13. Thompson Glacier snout detail.

Reproduction of the Thompson Glacier Map:

Scale-1:50 000
9 Printing Colours
25 metre contour interval

Colour selections:
Type, borders, rock drawing - Black
Drainage - Dark blue
Water fill - Light green
Submerged terrain - Dark blue tint
Hill shading - Blue
Positive for masking hill shading - Light green mask
Contours - Black, Brown, Blue
Vegetation areas - Brown tint
Unvegetated areas - Grey tint

McKortel, T.A. The Reproduction of the Thompson Glacier Map, The Canadian Surveyor, June 1963 Page 93 - 94

Thompson Glacier Region, Axel Heiberg Island, N.W.T., Canada.
Map produced by the Photogrammetric Research Section of the National Research Council of Canada, in conjuction with the Jacobsen-McGill Arctic Research Expedition to Axel Heiberg Island, N.W.T.

Glacier maps in the Canadian Cordilleras - Inland Waters Directorate, Department of the Environment, Ottawa

Prior to the mid 1960's high mountain cartography in the style of Swiss mapping had not been tried in Canadian mapping. Training and skills were required for the complex maps with contours, hatched bedrock portrayal and shaded relief.

Peyto Glacier was chosen for mass energy and water balance studies as part of Canada's contribution to the particapation in the International Hydrological Decade (1965-1974). The initial studies were by the Geographical Branch, Department of Energy, Mines and Resources in 1964, after which the Glaciology Division, Inland Waters Directorate, Department of the Environment continued the work. Similar studies with maps of other glaciers were produced in the Canadian Cordillera as well as in the Arctic region.

Professor R. Dauwalder of the Swiss Federal Topographic Service was invited to Ottawa to conduct an extensive training in hachured bedrock portrayal for several staff members of the Surveys and Mapping Branch, and the Glaciology Division, Inland Waters Directorate, Department of the Environment.

Additional training was also given to a selected staff member for a seven month period in Switzerland in shaded relief. The Swiss cartographers taught the necessary skills and expertise in high mountain cartography for Canadian cartographers to produce their own work.

With the Peyto Glacier Map - New Edition much experience and expertise has been obtained by many individuals in the production of this map. The result of which is the later production and printing of the Columbia Icefield Map in 1980. A further example of the workmanship in high mountain cartography in Canada.

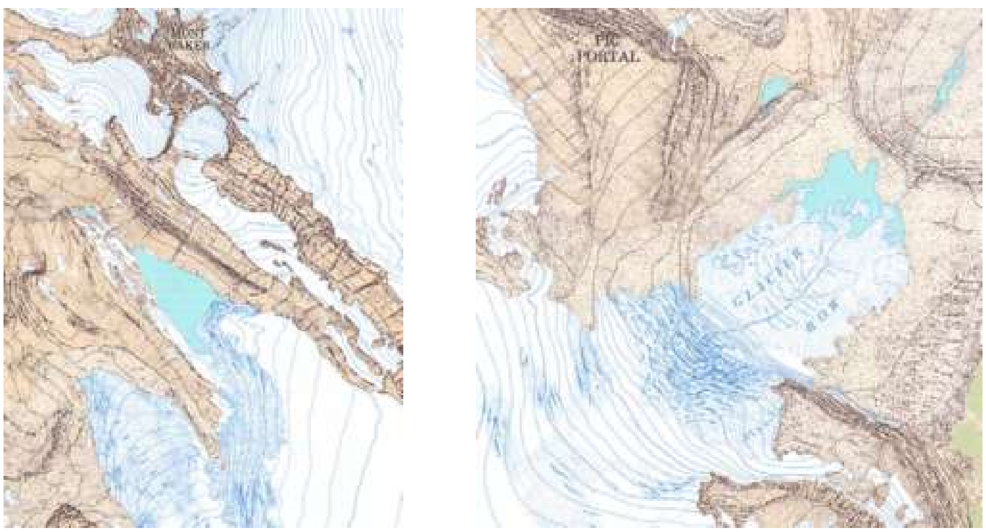


Figure 14. Ayesha (left) and Bow Glacier (right) from Peyto Glacier Map – Provisional Edition.

Reproduction of the Peyto Glacier Map - Provisional Edition

"French technique of bedrock portrayal as exemplified by the map of Aiguille Verte (Mont Blanc), scale 1:10 000, produced by the Institut Geographique National (IGN) in Paris France, in 1958".

Scale-1:10 000
9 Printing Colours
10-metre contour intervals on ice
50-metre contour intervals on land
Interpretive text is printed on the back of the map, which is bound in an illustrated soft-cover folder.

Croizet, J.L. and Henoch, W.E.S. Peyto Glacier Map / A three-dimensional depiction of mountain relief, The Canadian Cartographer Vol. 13 No. 1, June 1976 Page 75

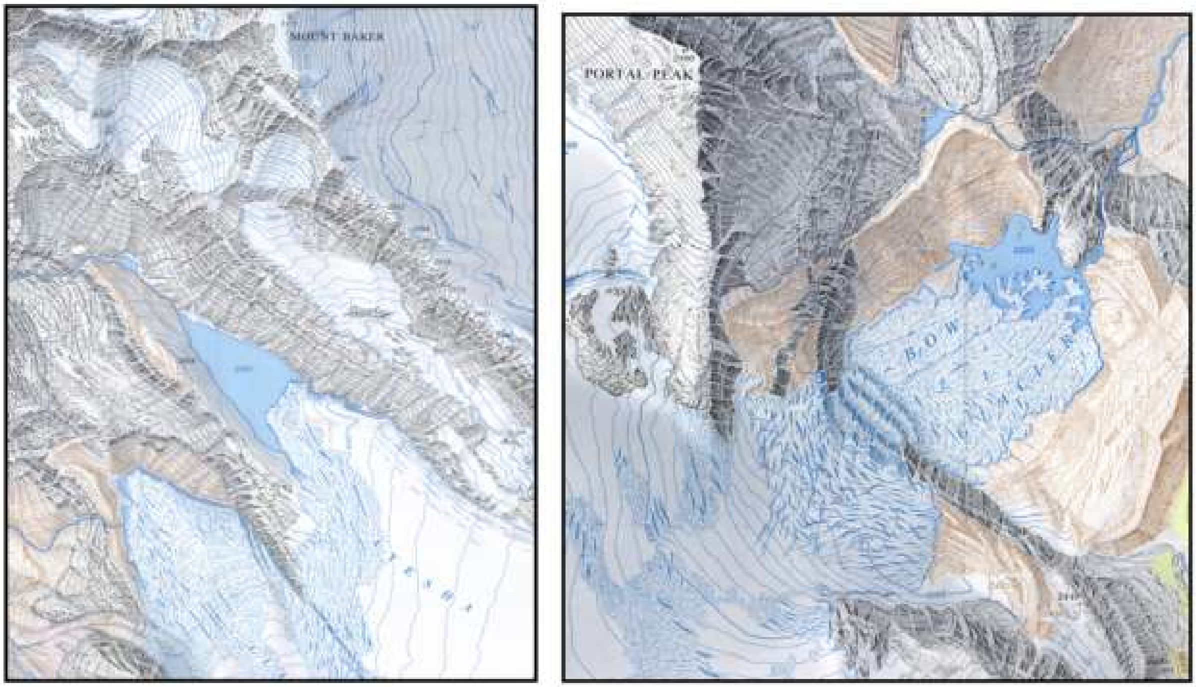


Figure 15. Ayesha (left) and Bow Glacier (right) from Peyto Glacier Map – New Edition.

Reproduction of the Peyto Glacier Map - New Edition:

Scale-1:10 000
8 Printing Colours
10-metre contour intervals on ice
10-metre contour intervals on land
100-metre contour where bedrock outcrops are drawn in hachures.
30 page interpretive booklet accompanies the map both in English and French.

Croizet, J.L. and Henoch, W.E.S. Peyto Glacier Map / A three-dimensional depiction of mountain relief,
The Canadian Cartographer Vol. 13 No. 1, June 1976 Page 77

Colour selections:
Unconsolided ground (mountain-top detritus) - Black symbols
Scree slopes - Black dots (Varying size and alignment)
Moraines - Brown dots (Varying size and density) and contours
Glacier relief - Blue contours and symbols to show Ice-falls, crevasses,
and surface expressions of ice structure reflecting ice-flow patterns
Coniferus forest and Alpine vegetation - Green (two tones)
Contours - Black, Brown (vegetated areas)
Relief shading on ice and land - Gray-blue

Croizet, J.L. and Henoch, W.E.S. Peyto Glacier Map / A three-dimensional depiction of mountain relief,
The Canadian Cartographer Vol. 13 No. 1, June 1976 Page 80, 82

Hachures:
Drawn in trembling, but not undulating, lines.
Two types of hachures are used to depict rock outcrops.
1.Outlined main features of outcrops, examples edge of a rock cliff, shape of ridge, rock bedding, fault lines.
2.Vertical or parallel to contours to show details of relief and shading.

Croizet, J.L. and Henoch, W.E.S. Peyto Glacier Map / A three-dimensional depiction of mountain relief, The Canadian Cartographer Vol. 13 No. 1, June 1976 Page 82

Figure 15 Peyto Glacier Map detail.

Figure 17. Detail of the Columbia Icefield, British Columbia and Alberta

Figure 18. Detail of Columbia Icefield Map.

Conclusion:

We have reviewed the topographical surveys and mapping conducted by A. O. Wheeler and M. P. Bridgeland, Glacier maps produced by National Research Council of Canada/McGill University in the high Canadian Arctic, and the Glaciology Division, Inland Waters Directorate, Department of the Environment in the Canadian Cordilleras. All of which show traditional skills and technology for its time in producing contours,hatched bedrock portrayal and shaded relief mapping.

Figure 18. Cavell Pond below Angel Glacier at Mount Edith Cavell – photography by Michael Fisher.

What does the future hold in high mountain cartography in Canada? Are cartographers being trained with the skills required for the art and science of making maps with the new digital technology? I feel that there is great potential in the area of high mountain cartography. This can be in the research sciences and in the practical world of mountaineering, tourism and recreation. There is no limit to the art and science of making maps in the development and use of the new technology of today.

Bibliography:

Wheeler, A. O. The Selkirk Range , Government Printing Bureau, Ottawa, 1905

Bridgland, M.P. Photographic Surveying, Department of the Interior, Topographical Survey of Canada, Bullentin No. 56, Ottawa, 1924

Haumann, D. Surveying Galciers on Axel Heiberg Island, The Canadian Surveyor, June 1963

McKortel, T.A. The Reproduction of the Thompson Glacier Map, The Canadian Surveyor, June 1963

Croizet, J.L. and Henoch, W.E.S. Peyto Glacier Map / A three-dimensional depiction of mountain relief, The Canadian Cartographer Vol. 13 No. 1, June 1976

Whittaker, John A. (edited by) Early Land Surveyors of British Columbia, The Corporation of Land Surveyors of the Province of British Columbia, 1990