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CHANGES IN RIVER COURSES

IN

WASHINGTON TERRITORY

DUE TO GLACIATION

BY

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ILLUSTRATIONS.

CHANGES IN RIVER COURSES IN WASHINGTON TERRITORY DUE TO GLACIATION.

By Bailey Willis.

Drainage lines in Eastern Washington Territory are broadly characterized by an aspect of youth, but they are divisible, according to age, into preglacial and postglacial channels. The general slope of the region presented in Plate I is southward; such streams as the Wenatchie, Methow, Okinakane, and San Puel strike the eye as members of a possibly consequent and unmodified system, determined by processes of subaërial erosion only. Of these, the last named alone enters the area of the volcanic flow of the Columbia River plain; the other valleys are carved upon the older surface of granite and crystalline sedimentary rocks. These valleys are also broader and more advanced in their development than the cañon of the Columbia, which crosses their direction nearly at right angles, and, cutting through the northern corner of the great flow from the Spokane River to the Okinakane, meanders along the contact of the basalt with the granite thence to the Wenatchie. The sudden northwestward turn of the river at the Spokane and its relation to the western limits of the eruptive rocks suggest that its course was determined by southward and by northward and westward volcanic flows, as indicated by arrows on Plate I, the line of least elevation of the cooled surface having lain near the edge, i. e., at the contacts of different coulées and of the earlier rocks with them.

If this be true, an older Columbia Valley lies beneath the great plain, and the converging lines of its watershed should be elsewhere apparent outside the area of the flow. Such channels are found traversing the Cabinet Mountains, but they are no longer occupied by the greater rivers. The Clark's Fork, below Lake Pend d'Oreille, the Columbia, from Kettle Falls to the Spokane, flow through clean cut, rock bottomed cañons, parallel with valleys of equal depth, gentler declivity, and wider expansion, such as those of Colville, Vermilion, and Pack Rivers. The suggestion lies close at hand that the latter belonged to the older system and are sections of valleys now overflowed by basalt in their lower courses. Their abandonment by the great rivers is the result of the much later causes of the glacial period, when valleys were filled with

drift and rivers were driven to seek new channels across the lowest gap in their watersheds.

Through the kindness of Prof. T. C. Chamberlin I am able to give here the unpublished results of his observations of the glaciation of the region about Lake Pend d'Oreille.

The rugged crest of the Cabinet Mountains northeast and northwest of the lake is traversed by a depression a mile wide, known as the Pack River or Kootenay Pass. Gentle slopes descend northward to Bonney's Ferry and southward to the lake; the broad valley of the Kootenay extends far into British Columbia on the one hand and the level gravel plains of the Spokane spread in the opposite direction.

The Kootenay enters upon its placid northward flow from a cañon 50 miles long, one of the deepest and most abruptly walled of the Northwest; the Clark's Fork also descends to Lake Pend d'Oreille by a cañon and leaves it to traverse another, so wild that no one has passed through it. Of these channels, that of the ancient river, which flowed northward or southward through Pack River Pass, is certainly very much the oldest. During the ice age it was occupied by a glacier, which, descending from the north, filled the basin of Lake Pend d'Oreille and spread its moraine before the valleys on either hand. The lakelets that lie along the base of the Rocky Mountains are the products of its morainal dams, and from it sprang the great gravel stream of the Spokane and the Cœur d'Alene plains. Roches moutonnées and glacial striæ are abundant in Pack River Pass and about Lake Pend d'Oreille, but they are wanting on the surfaces of volcanic rocks about Spokane Falls, and there is no evidence that the ice reached so far.

Professor Chamberlin was not equipped for trips into less accessible districts; the western limits of this glacier are therefore undetermined, but the facts observed by him in the vicinity of Lake Pend d'Oreille are paralleled elsewhere in Northern Washington Territory, and similar topographic conditions suggest analogous causes.

The first instance of this kind is found in the open valley of the Columbia, above Kettle Falls, and its southward continuation in the valley of Colville River and Chamokane Creek, which contrasts with the cañon now followed by the Columbia below Kettle Falls. This wider valley is now occupied by these two small streams, of insufficient volume or fall to remove the gravel over which they flow, and much less able to cut the channel which should carry a great river. They are separated only by a divide of gravel, terraced by erosion, and do not touch bedrock throughout their courses. The Colville River flows through marshes; Chamokane Creek has a swifter current, but is much smaller. It is apparent that a large river once flowed south or north through this channel and that of the Columbia above Kettle Falls, and it may be inferred that the valley was occupied by a glacier, as was that of the Kootenay, and that with the retreat of the ice the postglacial Columbia

River was forced by a drift dam across a low divide into its present course. On Plate I are given the elevations bearing on this problem, as determined barometrically by Mr. Louis Nell, then of the Northern Transcontinental Survey, in mapping the area east of the Columbia and north of the Spokane River.

Another north and south depression of preglacial age is now occupied by Curlew Creek, which is said to rise in a rolling gravel plain, and which flows northward to Kettle River. The elevation of the divide at its head was found by United States engineer officers of the Department of the Columbia to be about 2,500 feet; that of its mouth is about 1,700 feet, as determined by aneroid, compared with Spokane Falls. This broad, gently sloping valley is gravel floored, and the older stream had cut a deeper channel than the present one. Curlew Creek flows over but a short section of the older valley, but there is little known evidence to trace the latter in either direction. The course of Kettle River toward it is down a precipitous cañon, which is more open below its northeastward turn. Analogy with other great valleys of the region would suggest that the Upper Kettle River was but a tributary of the former stream, which flowed southward to and under the locus of Curlew Creek.

Still another deep channel, now drift filled and abandoned to small sluggish streams, extends from Miner's Bend, on the Similkameen River, southward (Plates II and III). It presents three sections, two of which terminate with open passes, leading eastward to the Okinakane. The northern division, from Miner's Bend to Wagon Road pass, is a comparatively broad valley, a strip of marsh and lake between steep mountain slopes. The terraces on its sides are continuous with others, which cling to the walls of the Similkameen Cañon below Miner's Bend, and they extend southward to the Three Pools, where they merge into the highest portion of the drift filling.

The second section, that between Wagon Road pass and Fish Lake, is a drift clogged cañon, with abrupt granite walls of considerable height; its northern half presents a very gentle northward slope. From the Three Pools southward the drift surface is dotted with kettle-holes. Terraces again appear on the slope of the mountain northeast of Fish Lake and close the entrance of the pass, which trends eastward. The waters of Fish Lake are held by a gravel dam, from beneath which a small stream escapes into the very narrow and crooked upper channel of the southern portion. The descent from Fish Lake is very rapid and is strewn with bowlders of large size. After passing a very deep and narrow pool three-fourths of a mile long, into which the brook sinks, the valley opens out between limestone bluffs and drift terraces, and ends abruptly in a cul de sac at the head of Johnson Creek (Plate III), the further continuation, whether southwestward or southeastward, being now completely filled.

There can be no question that the cañon described is an old subaërial channel, very probably traversed by the Similkameen. One possible interpretation of the facts is that a glacier descended the valley and discharged through the several low passes eastward. In the several stages of its existence and retreat it spread the drift which now terraces the cul de sac, deposited the coarse material of a temporary terminal moraine below Fish Lake, produced the broad gaps in the hills on the east by glacial and subaërial erosion, and in its later stages left the gorge so dammed that the Similkameen found its present direct and rapid descent to the Okinakane River.

The valley of the latter belonged no doubt to the great system of which all these now abandoned channels were part. Like them, it was drift buried, but, unlike them, not dammed, because of its great width. The present river is a quiet stream, having a fall of about 3 feet per mile from Lake Osoyoos to the Columbia River, and usually flowing between terraces 400 feet high. The lake is but a shallow expansion of the river, retained by a drift deposit.

Other evidences of glaciation are found on that part of the Columbia sketched on Plate IV. A broad gravel plateau, the analogue of the terraces along the Okinakane, lies between the right banks of the Columbia and the Methow River, and is continued down the former wherever the cañon walls are not too abrupt.

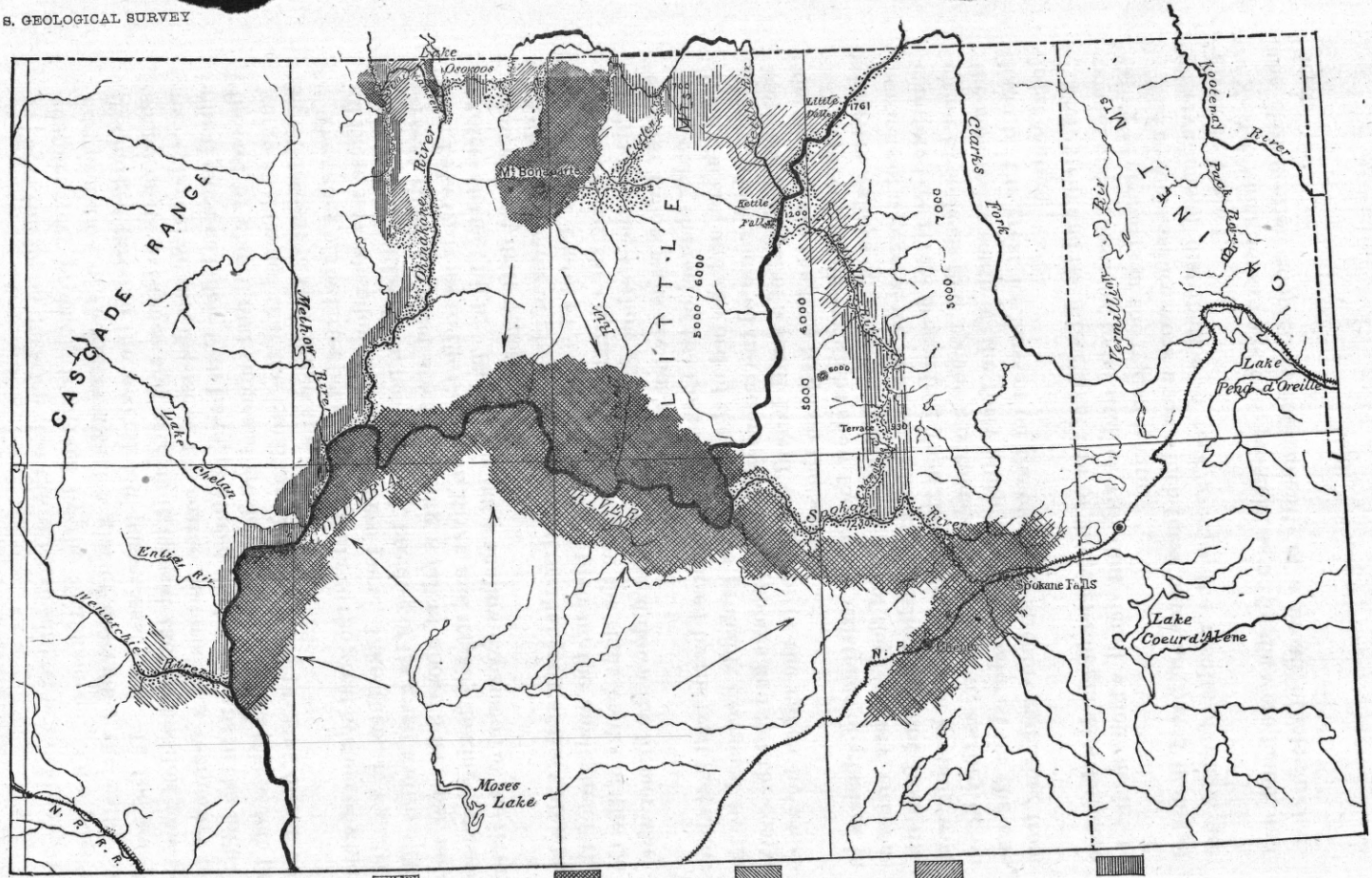
An older channel of the Columbia is traversed by the trail just above Lake Chelan, and the bed of the latter was probably deepened by the glacier, which rounded the outcrops about its shores and left the coarse morainal material of a small lateral discharge in the cañon by which the trail leaves the lake basin on the south.

The preceding observations show the former existence of glaciers in the river valleys of the extreme northern part of the Territory, either as portions of a general ice sheet or as tongues pushed forward from disconnected ice rivers descending from the north. It is in keeping with either hypothesis that roches moutonnées should occur, as they do on the mountains south of the forty-ninth parallel, produced on the one hand by the great ice mass or on the other by streams radiating from local centers.

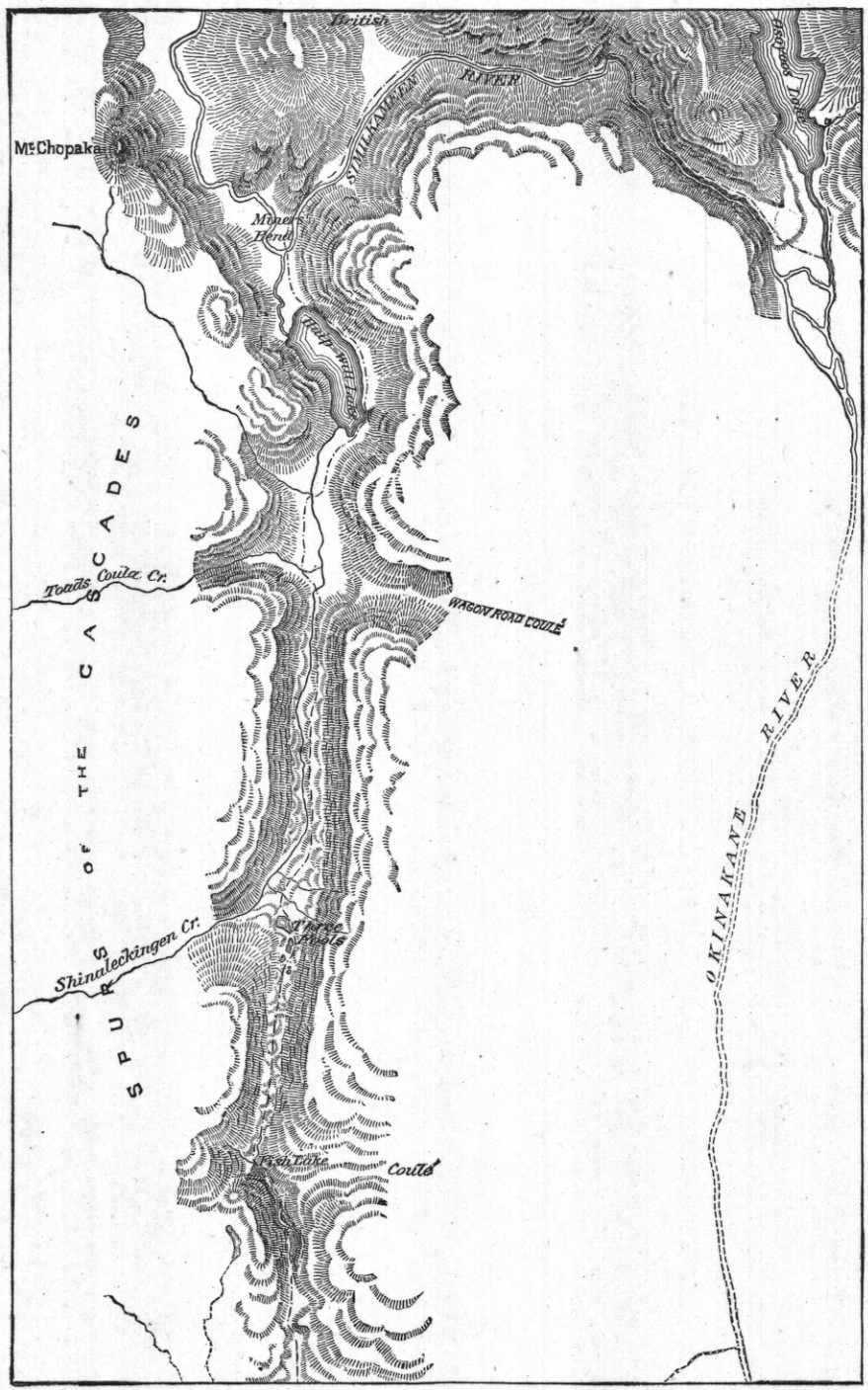
The extent and the direction of flow of the glacier or glaciers therefore remain open questions, to be studied with that detail which the interesting phenomena of the region invite.

The reconnaissance work upon which these notes are based included observations of distribution of rock groups, the results of which are given on Plate I.

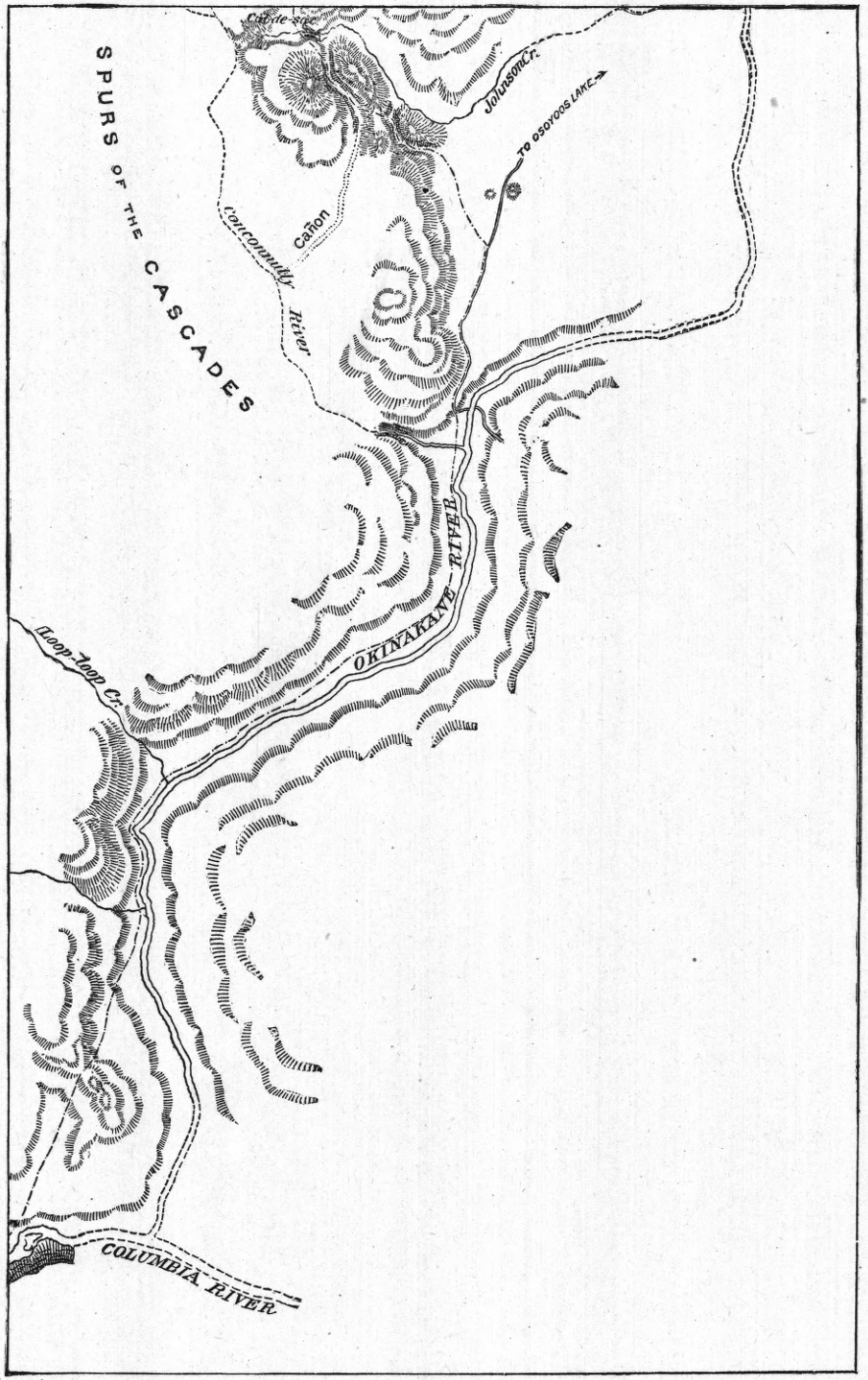
No determinations of age were possible, as no fossils were found, and the classification adopted is consequently of a broad lithologic character.



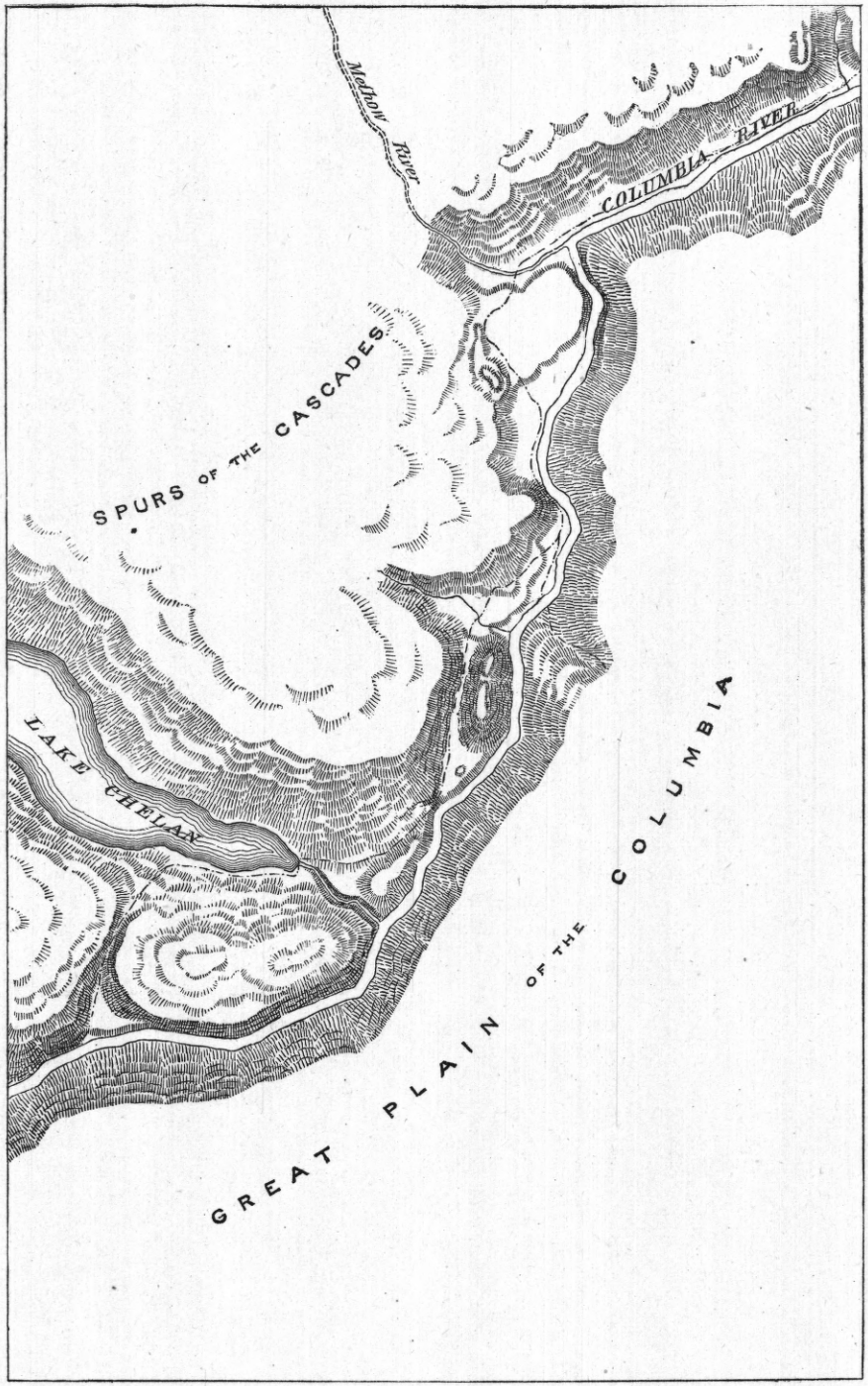
MAP OF EASTERN WASHINGTON TERRITORY.



PREGLACIAL CHANNEL OF THE SIMILKAMEEN RIVER.



LOWER VALLEY OF THE OKINAKANE RIVER TO THE COLUMBIA RIVER.



COLUMBIA RIVER FROM OKINAKANE RIVER TO LAKE CHELAN.