U.S. GEOLOGICAL SURVEY LIBRARY
WESTERN REGION
345 MIDDLEFIELD ROAD, MS-955
MENLO PARK, CALIFORNIA 94025-3591
REFERENCE: (650) 329-5027
CIRCULATION: (650) 329-5026
FAX: (650) 329-5132
(650) 329-5097
Email: men_lib@usgs.gov

CSA TN: **398905**

14 September 2015

ODY / Maxcost :**RECIP**

IL:153462913
Patron:

GIM ILLiad 35681

Borrower: **GIM**
U.S. Geological Survey Library
Lending String: *CSA,HDC,ZAP,CRU,CUS

Location: LL
Call #: American geologist.

Journal Title: The American geologist.

Vol.: 22 No: Mon/Yr: 1898
Pages: 362-369

Article Title: The great terrace of the Columbia and other topographic features in the neighborhood of Lake Chelen, Washington
Odyssey: 206.107.44.98

Interlibrary Loan
OFFICE USE ONLY

Search Info: 1st Date: Initials:
2nd Date: Initials:

Not on Shelf ☐ Tight Binding ☐
Lacking ☐ Poor Condition ☐
Not as Cited ☐

Notes:

Pulled by:
Updated by:
Scanned by:
Delivered by:

Interlibrary Loan **41600101**
Sacramento State University Library
2000 State Univ. Dr.
SACRAMENTO CA **95819-6039**

LIBRARY MAIL
RETURN POSTAGE GUARANTEED

U.S. Geological Survey Library
345 Middlefield Rd.
MS-955
MENLO PARK CA 94025-3591

treat of the ice-sheet in Scotland, Sweden and Norway, measured probably 50,000 or 100,000 years.

It is therefore right that the Acheulian men should be termed primitive. They had not learned how to use the Creator's gifts. The power of invention, ready to bestow dominion and utilization of animate and inanimate nature, lay dormant and was scarcely beginning to awaken; but even then the men in the Somme valley were doubtless mentally and physically developed far nearer to ourselves than to the mist-covered morning and dim dawn of the earliest human divergence from an ancestral anthropoid species perhaps ten or twenty times more ancient.

On leaving Abbeville, our journey continued through Boulogne, Calais, Dover, and Canterbury, to London. Again in that great city, a few days were spent in its libraries, museums, parks, and in excursions to the outlying country. Then we embarked at Southampton, eighty days after our landing there; arrived in New York on August 27th; and, after visiting eastern friends, reached home in St. Paul on September 9th, bringing memories, experience, and note-books of the summer of 1897, long planned for and happily completed.

THE GREAT TERRACE OF THE COLUMBIA AND OTHER TOPOGRAPHIC FEATURES IN THE NEIGHBORHOOD OF LAKE CHELAN, WASHINGTON.

By ISRAEL C. RUSSELL, Ann Arbor, Michigan.

In an article by Mr. William L. Dawson, on "Glacial phenomena in Okanogan county, Washington," published in the October number of this journal, exceptions are taken to my measurement of the hight of the great terrace of the upper Columbia, and to certain conclusions based on my reconnoissance in central Washington in 1892. Having made a second journey through the Lake Chelan region during the past summer and obtained additional data in reference to its surface geology, I feel that I am qualified to reply to Mr. Dawson's criticisms, and to offer in return a few suggestions in reference to his interpretations of the history of some of

the more striking features in the topography of that most interesting country.

The Great Terrace of the Columbia. In my report of 1892* the great gravel terrace, bordering the Columbia in the neighborhood of lake Chelan and occurring at many localities further up the Columbia, was briefly described and the elevation of its surface above the river stated to be 709 feet. This is an aneroid measurement, or rather the mean of several such measurements, and I believed, at the time, was as accurate as the method employed could be expected to yield; especially when opportunities for rating the barometer could be had only at wide intervals. Mr. Dawson states positively that the great terrace is but 300 feet above the Columbia; whether this is an aneroid measurement or the result of some more accurate method is not recorded.

During the past field season I again examined the great terrace referred to, at various localities from the mouth of the Methow southward along the Columbia, to where it terminates a few miles south of the mouth of Chelan river. The terrace is especially well displayed at the mouth of the Methow, where it forms a plateau fully a mile-and-a-half broad. I again measured its hight, using an aneroid in which I had learned to place much confidence. This measurement was in duplicate, one set made on descending from the surface of the terrace to the river and the other on returning; the reading on the return was the same as at the start. These observations gave 550 to 560 feet as the hight of the surface of the terrace above the river. On the uplands bordering the great terrace, at the locality just referred to, there are other terraces about 100 feet higher, but these belong in another category and have a different history than the great terrace. The surface of the great terrace is in several places quite irregular, on account of the settling of the material composing it so as to form basins, but in general slopes gently from the bordering uplands to the broken escarpment overlooking the river. This difference where the terrace is broad amounts to fully 100 feet. Another measurement of the hight of the great terrace, at a locality about five miles south of the mouth of

*Bulletin No. 108, U. S. Geological Survey.

the Methow, gave an elevation of 570 feet. Still other aneroid readings on the great terrace farther down the Columbia, without, however, descending to the river, but referring back to the reading obtained at the mouth of the Methow two days previous, gave an elevation of 660 feet. This discrepancy of about 100 feet, I believe to be due mainly to changes in atmospheric conditions.

The great terrace referred to above is, without question, a portion of the same terrace visited by me in 1892, below the mouth of Chelan river and on the left bank of the Columbia. As previously stated, the hight above the river there obtained by aneroid, was 700 feet. This measure is probably somewhat too high, judging by the observations made by me this year, and may perhaps be 100 feet in error, but as the hight of the terrace above the river probably increases somewhat as one follows it down stream, I doubt if the probable error is as much as just stated. Mr. Dawson assigns an elevation of but 300 feet for the great terrace above the river, and the difference between our determinations is from 250 to 400 feet. This wide discrepancy is the more surprising as the difference between the elevation of the Columbia at the mouth of Chelan river, and the surface of lake Chelan, as determined by Mr. Dawson, and by myself in 1892, is the same, namely 325 feet.*

In volume one, of the reports frequently termed the "Pacific Railroad Surveys," there is a paper of Professor George Gibbs, in which the Terrace in question is referred to as follows, (page 483):

"On leaving the Columbia to visit the Chelan lake, our route ascended one of these terraces, rising to a height of six hundred and forty feet in a single slope, and occupying a recess in the hills which bordered it. On reaching the top, it proved to be the entrance of a level valley, extending through the hills and emerging about one hundred and fifty feet above the lake."

As correctly stated by Mr. Dawson, the great terrace of the Columbia is a true stream terrace. It is one of a large

*Recent measurements with engineer levels, made by the Topographic Division of the U. S. Geological Survey, show that the surface of lake Chelan is 1078 feet, and the mouth of Chelan river 670 feet above the sea; the difference is 408 feet.

series of similar terraces which occur along many of the rivers of eastern Washington. There is a similar great gravel terrace in the canyon of Snake river, another along Spokane river, and other in the valleys of the Okanogan, Methow, Yakima, etc. These several terraces have many features in common, but as they have not been adequately studied, more information concerning them is necessary before their histories can be interpreted with confidence. All the streams referred to, however, flow to the Columbia and converge toward the depressed region in east-central Washington. In all cases thus far observed, also, the terraces are conspicuous on the upper course of the rivers where their valleys or canyons are narrow, and disappear lower down the river where their valleys become broad. For example, on following the Columbia southward from the mouth of Chelan river, the valley soon broadens and one looks in vain for the great gravel terrace so conspicuous farther up stream. This termination of the great terrace of the Columbia when traced down stream is one of the reasons for believing in the former existence of a lake in the basin-like portion of south-central Washington. This water body was named lake Lewis by Symons, but full and unquestionable evidence of its actual existence can not be said to have been discovered. With lake Lewis filling the valley of the Columbia below where the great terrace terminates, we are enabled to give a natural interpretation of the great gravel deposit in the valley of the upper Columbia. That is, the Columbia discharged into lake Lewis, and built a delta of coarse material, being, as I am inclined to believe, overloaded with debris like many other rivers in the same general region, on account of the changes in conditions accompanying the Glacial epoch. With the building of the delta the river channel, up stream from it, became deeply filled with gravel, and after the waters of lake Lewis were withdrawn, the Columbia excavated its present inner channel through the gravel, partially filling its old rock-cut valley.

This is in outline my interpretation of the history of the great terrace of the Columbia, but as only a portion of the field has been studied and this in connection with reconnoissance work, I hold my conclusions lightly and am willing to change them if additional observations demand it.

The Methow Glacier. In the article by Mr. Dawson, referred to above, it is stated that formerly three glaciers flowed eastward from the Cascade mountains and reached the Columbia; these ice streams "swept down the Chelan, Methow and Okanogan valleys, respectively." The evidence in reference to the Chelan and Okanogan glaciers, as is well known, fully confirms a portion of this statement, but, as to the Methow glacier, I wish to say that I followed the Methow river during my reconnoissance of last summer, from near its source at the crest of the Cascade mountains to its junction with the Columbia, and found abundant evidence of the former presence of glacial ice from the source of the river to Winthrup. At Winthrup the river receives an important tributary from the north, and its valley broadens. The former glacier expanded in this broader portion of the valley and reached some four or five miles south of Winthrup and deposited a fine group of kames with undrained basins between, some of which still hold lakelets. From the locality just mentioned to the mouth of the river I failed to find any evidence of the former presence of a glacier. The Methow glacier according to my observations did not reach within about 40 or 50 miles of the Columbia, and hence cannot be appealed to as having any connection with the origin of the coulée crossing the promontory on the east bank of the Columbia, opposite the mouth of the Methow. I refer to the so called "glacial channel" shown on Dawson's instructive diagram forming figure one, page 206, in the article under review. According to the explanation advanced by Mr. Dawson, the Methow glacier dammed the Columbia, and caused the river to rise "to a hight sufficient to enable it to cut across the corner, where it excavated a deep transverse channel some 150 feet down into the granite." The transverse channel referred to attracted my attention last summer, while on the opposite or west side of the river, but I did not visit it. Some of its features, however, may be better studied from a distance than by close inspection, as I believe will be shown by my interpretation of it made in the field. I therefore transcribe the following passage from my note book: "The great terrace occurs on each side of the Columbia and extends far up its course above the mouth of the Methow. Just opposite

where the Methow comes in there is a bold rocky promontory, on the plateau-like surface of which there are a few crags rising above the level of the great terrace. This rock mass is separated from the mountains to the east by a coulée through which the Columbia or a part of its waters once flowed. The bottom of the coulée is below the level of the great terrace." The explanation of the origin of the coulée which presented itself to me, from the facts as I saw them, is, that the river when its channel was occupied from side to side by the gravel deposit now represented by the great terrace, was greatly expanded, being a broad, swift stream, and that a portion of its current followed the now abandoned coulée, leaving the crags on the surface of the mesa at the summit of the promontory, as islands. Later, when the Columbia re-excavated its channel, the branching passage in solid rock was abandoned. The river did not make the coulée, but simply modified its bottom to some extent. The origin of the coulée need not be discussed at this time but the fact that it is older than the great terrace is beyond doubt. This explanation meets all of the conditions as I saw them, and is in harmony with the histories of other coulées, similar to the one described above, and besides is independent of the Methow glacier, which according to my observation did not come within at least forty miles of the region under discussion.

Antwine's Coulée: On the west side of the Columbia valley and south of the mouth of the Methow, there is a deep, narrow channel, similar in character to the one referred to above, but of much larger size, known as Antwine's coulée. As correctly stated by Dawson, Antwine's coulée connects the Methow valley at a locality about four miles above its mouth with the Columbia valley, some ten miles to the south. This deep, narrow defile is described by the author cited above as a glaciated channel, "which the ice has hollowed out between some sturdy outlying spur and its parent mountain."

I traversed the entire length of Antwine's coulée last September, but failed to find any evidence to suggest that it had once been occupied by a glacier. The narrow, steep sided trench is crossed from side to side by alluvial cones, and talus slopes, between which there are several undrained basins, three of which hold lakelets. The coulée is also obstructed by

blocks of rock which have fallen from the bordering cliffs, but is entirely without glacial scorings, moraines or other evidence of ice work.

Below or south of the southern end of Antwine's coulée, as also stated by Dawson, there is another short coulée, similar in character to those just considered, the course of which in general, is parallel with the Columbia. The author just referred to, states that this coulée is about a mile in length and occupied at present by glacial debris. My study of the coulée in question, however, failed to show that it contained any glacial debris or that it was either produced or modified by glacial action. I did find alluvial cones, talus slopes, fallen blocks, etc., of the same character as those obstructing Antwine's coulée.

Knapp's Coulée: On the south side of lake Chelan, about three miles from its eastern end, there is another coulée, similar to those referred to above, known as Knapp's coulée. This is a deep narrow trench in a mountain mass that rises from 1800 to 2500 feet above the lake's surface, and has a length of four or five miles. Its general course is nearly at right angles to the trend of the eastern portion of Chelan valley, and at its southern end it opens out into the valley of the Columbia. In describing this channel and discussing its origin, Mr. Dawson states that: "It is an ice-hewn valley, a discharge pipe of the Chelan glacier. Originally consisting of two opposite valleys heading at near the same point on the divide, it was selected by the ice as presenting the easiest avenue of escape across the rampart; i. e., the lowest point, and was subsequently deeply excavated by the long continued and gradually concentrated ice-flow. To-day its superficial features of kettle-holes and morainic banks have not been obliterated or even noticeably modified by subsequent changes."

I traversed the entire length of Knapp's coulée last September, and, as in the similar instances cited above, failed to find any evidence of the work of ice; but I did find alluvial cones, talus slopes, and fallen blocks in abundance, together with undrained basins between the larger obstructions.

The relation of Knapp's coulée to the valley occupied by lake Chelan is in itself sufficient to show that the great Chelan

glacier could not have divided so as to send a branching ice-distributary through it. The conditions as they existed at the northern end of the coulée during the maximum extension of the Chelan glacier, are paralleled, I think, in every essential particular at the present day, on the east border of Hayden glacier, near Yakutat bay, Alaska. At the locality referred to, a deep, narrow, transverse channel, a remnant of an ancient stream channel, cuts across a mountain spur. This channel is at right angles to the east border of the Hayden glacier, which forms a wall of ice from 150 to 200 feet high across its upper extremity but does not extend into it. A small stream, fed by the melting ice, courses down the lateral channel, but this is all the direct influence that the glacier has upon it. The Chelan glacier rose about 200 feet above the lowest point in the entrance to Knapp's coulée, but did not enter it. The melting of the ice very likely fed a small stream which found its way southward down the coulée, but of this I have no good evidence.

There are several other portions of Mr. Dawson's interpretation of the topographical history of the region drained by the Columbia, which differ widely from the conclusions based on my own observations, but it does not seem as if farther discussion at this time would be profitable. It is to be remembered that no detailed geological studies have been carried on in the portion of the country under consideration, at least my own work there is entirely of the nature of a reconnoissance, and the radical differences between Mr. Dawson's conclusions and my own, can, apparently, only be adjusted after more extended field-study.