REPORT

OF THE

CHIEF ENGINEER

ON THE

PRELIMINARY SURVEY, COST OF CONSTRUCTION, AND ESTIMATED REVENUE,

OF THE

Central Pacific Railroad

OF CALIFORNIA,

ACROSS THE

SIERRA NEVADA MOUNTAINS,

FROM

SACRAMENTO TO THE EASTERN BOUNDARY OF CALIFORNIA.

OCTOBER 22, 1862.

SACRAMENTO:
H. S. CROCKER & CO.'S PRINT, 107 J STREET.
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OFFICERS

OF THE

CENTRAL PACIFIC RAILROAD

COMPANY OF CALIFORNIA.

President,

LELAND STANFORD, SACRAMENTO.

Vice President,

C. P. HUNTINGTON, SACRAMENTO.

Treasurer,

MARK HOPKINS, SACRAMENTO.

Chief Engineer,

THEO. D. JUDAH, SACRAMENTO.

DIRECTORS.

LELAND STANFORD.....OF SACRAMENTO.
CHARLES CROCKER.....OF SACRAMENTO.
JAMES BAILEY.....OF SACRAMENTO.
THEODORE D. JUDAH.....OF SACRAMENTO.
L. A. BOOTH.....OF SACRAMENTO.
C. P. HUNTINGTON.....OF SACRAMENTO.
MARK HOPKINS.....OF SACRAMENTO.
D. W. STRONG.....OF DUTCH FLAT.
CHARLES MARSH.....OF NEVADA.

REPORT.

ENGINEER'S OFFICE,
CENTRAL PACIFIC R. R. OF CALIFORNIA.

SACRAMENTO, October 1, 1861.

TO THE PRESIDENT AND DIRECTORS OF THE CENTRAL PACIFIC RAILROAD COMPANY OF CALIFORNIA:

GENTLEMEN—Agreeably to your instructions, I have completed the preliminary survey of a Railroad across the Sierra Nevada Mountains, from the city of Sacramento to a point on the Truckee River, at the eastern base of the mountains; the results of which confirm the facts established by the barometrical reconnoisance made last fall.

A preliminary examination was made, and barometrical observations taken last fall upon three routes—one through El Dorado county *via* Georgetown, another *via* the present route (Illinoistown and Dutch Flat), and the third *via* Nevada and Henness Pass.

These observations demonstrated the existence of a route from Sacramento across the Sierra Nevadas, by which the summit could be attained with grades of 105 feet per mile; accordingly field parties were organized early in the spring, and a thorough Railroad Survey made, the results of which are embodied in the following Report, developing a line with lighter grades, less distance, and encountering fewer obstacles than found upon any other route or

line hitherto examined across the Sierra Nevada Mountains; and proving, by actual survey that the difficulties and formidable features of this range can be successfully overcome for Railroad purposes.

Among the objectionable features which render the Sierra Nevada Mountains formidable for Railroad operations, are found—

FIRST. THE GREAT ELEVATION TO BE OVERCOME IN CROSSING ITS SUMMIT, AND THE WANT OF UNIFORMITY IN ITS WESTERN SLOPES.

It will be observed that in crossing a summit of 7,000 feet in hight, an average grade of 100 feet per mile, can only be attained, with a distance or base of 70 miles. Should any irregularity of surface occur in this distance, the grade would be correspondingly lessened or increased, in conformity with such irregularity of surface.

When it is considered that the average length of the western slope of the Sierra Nevada Mountains, from summit to base, is only about 70 miles, and the general hight of its lowest passes about 7,000 feet, the difficulty of locating a Railroad line with 100-feet grades is correspondingly increased, as it becomes absolutely necessary to find ground upon which to preserve a general uniformity of grade.

In the present instance, the elevation of summit 7,000 feet above Sacramento, is reached by a maximum grade of 105 feet per mile; showing a remarkable regularity of surface, without which the ascent could not have been accomplished with this grade.

SECONDLY. FROM THE IMPRACTICABILITY OF RIVER CROSSINGS IN THE MOUNTAINS.

To those unacquainted with the mountain topography of the western slope of the Sierra Nevadas, and accustomed to the lesser elevations and gentler slopes of the Atlantic States, it would be difficult to convey an adequate idea of the extensive proportions of the irregularities of surface which attach to these mountains.

The general course of the Sierras is north-westerly, and parallel to the line of the Pacific coast.

This western slope being at right angles, extends, therefore, in a southwesterly direction, which is the general course or direction of the rivers and streams upon its western slopes.

Between a point opposite the city of Sacramento (about latitude

38½) and Shasta (about 41 degrees), this western slope is intersected by numerous rivers, having their sources near the summit of the Sierras. They are as follows: The South Fork of American, Middle Fork and North Fork, Bear River, Deer Creek, South Fork of Yuba, Middle Fork, North Fork, the South, Middle and North Forks of Feather River.

These rivers run through gorges or canons, in many places from 1,000 to 2,000 feet in depth, with side slopes varying from perpendicular to an angle of forty-five degrees.

The ridges formed by these rivers are sharp, well defined, and in many places so narrow on top, as to leave barely room for a wagon road to be made without excavating surface of ridge.

The branches, also, of many of these rivers have worn out gorges as deep as those of the rivers, and present physical barriers to a line of communication either crossing them, or extending in a northerly and southerly direction.

These rivers are generally made the dividing lines between mountain counties, which are of oblong shape, long and narrow; the counties of El Dorado, Placer and Nevada, extending from base to summit of Sierra. The thoroughfares of travel extend into these counties along these ridges; the focus of travel for the large counties of El Dorada, Placer, Nevada and Sierra, being Sacramento (a portion of this travel, however, concentrating at Marysville).

No wagon road exists across the Middle Fork of the American. The inhabitants of El Dorado county, in order to reach the divide between Middle and North Fork of the American, by wagon, are obliged to proceed down to within eight or ten miles of the Sacramento valley, in order to obtain a crossing.

The towns of Forest Hill, Yankee Jim's, Todd's Valley, Michigan Bluffs, Bird's Flat, Sarahsville, etc., lying in the divide between the North and Middle Forks of the American, are reached by crossing the North Fork, about four miles above Auburn, at which point the road is excavated on the face of a steep side-hill above the river canon, which is about 1,000 feet high, closely following its bends and sinuosities; the hill upon each side being about four miles in length, or a total of eight miles in length; the grade for wagon road varying from 250 to 300 feet per mile.

Iowa Hill and Wisconsin Hill, although upon this same divide,

are separated from the above mentioned towns by two or three canons, or branches of the North Fork, running nearly parallel.

One of these canons is deeper and more precipitous than the crossing of North Fork, above Auburn; the descent into the canon being about one thousand five hundred perpendicular feet. A wagon road wide enough for a single team, with occasional turning-out places, has been built across, but a distance of ten miles of road is rendered necessary in order to reach across a direct line of about three miles, the grades being between three hundred and four hundred feet per mile.

From Iowa Hill to Illinoistown and Nevada, the canons of Bear River, of Steep Hollow, Greenhorn, Wolf Creek, and Deer Creek intervene.

Above Nevada, the South, Middle, and Main Yuba also intervene.

The present traveled stage road from Nevada to Eureka, etc., crosses South Yuba about eight miles from Nevada, the road descending in about two miles one thousand feet, and in the next five miles ascending two thousand feet, to the top of ridge.

Thus it will be seen that in order to reach the summit of Sierra Nevada, a Railroad line must avoid the crossings of any of the canons; for were it even practicable to follow down into them with a grade of one hundred feet per mile, it would still be necessary to retrace the line upon the opposite side, which would involve (in a canon of, say, one thousand feet in depth) the additional length and cost of twenty miles of line of maximum grade, with the crossings of side ravines and tributaries.

The *present line* pursues its course along an *unbroken ridge from base to summit of Sierras*, the only river crossing in the mountains being Little Bear River (a tributary of Main Bear River, about three miles above Dutch Flat), which is crossed at an elevation of fifty feet, and will require only about fifty feet span of bridge.

THIRDLY. IN ITS ENTIRELY AVOIDING THE SECOND SUMMIT OF THE SIERRA NEVADA MOUNTAINS.

A cross section of the main range of Sierra Nevada presents a profile showing two summits, with a range of elevated table-land lying between; thus, upon the profile of Lieutenant BECKWITH'S survey across the Sierra Nevada *via* Madelin Pass, are shown two distinct summits, thirty-five miles apart, with a range of elevated table-land between them.

The present Placerville wagon road to Washoe also crosses these two summits; passing the first range *via* Johnson's Pass, it descends into Bigler Lake Valley, and ascending again, crosses the second summit *via* Daggett's Pass, into Carson Valley.

Lake Bigler lies in this valley between the two summits—is about 35 miles long, and from 12 to 15 miles in width; is entirely surrounded by mountains and lofty peaks, excepting at one point on its western shore, where the Truckee River forms its outlet.

Running at first north-westerly about eight miles, then northerly about ten, thence north-easterly about twelve miles, the Truckee passes down between these two summits with a nearly uniform fall of about thirty-five feet per mile; thence sweeping round to the eastward, it passes through the second range or summit, at a depression where it seems to be entirely worn away down to the level of the river, thence pursuing its way through an extensive plain known as the Truckee Meadows; thence through the Washoe Mountains to the Big Bend; thence northerly about twenty miles, finds its way into Pyramid Lake.

At the Donner Lake Pass, where our line crosses the first summit of Sierra Nevada, the altitude of line is about 1,200 feet above the Truckee River. Donner Lake lies immediately beneath, at a depth of 1,000 feet.

Two long side ranges or spurs inclose the lake and its valley, declining in hight gradually to the Truckee River, about eight miles below.

Our line is carried down along the side-hill of the spur or range immediately above the lake, and upon its south side to the Truckee River, which point it reaches in a distance of eleven and a half miles of line, with an uniformly descending grade of 105 feet per mile from the summit.

The Truckee thus reached, all further difficulty of location ceases, as it pierces its way through all obstructions with an uniform descent not exceeding forty feet per mile, to the Humboldt Desert, which forms the sink of the Humboldt and Carson Rivers.

Thus, the second summit of Sierra Nevada and the crossing of the Washoe Mountains are entirely avoided; and from the western base to the summit of Sierra Nevada, the grade is uniformly ascending or level, there being no descending grade going eastward; while from the summit to Big Bend of Truckee or Humboldt Desert, a uniform grade is likewise maintained.

THE PROMINENT FEATURES OF THIS LINE MAY BE BRIEFLY ENUMERATED AS FOLLOWS:

1st. It crosses the Sierra Nevada Mountains, and reaches the Truckee River, in 123, and State line in 145 miles from Sacramento.
2d. Big Bend of Truckee, or Humboldt Desert, is reached in 178 miles.
3d. It crosses the State at nearly its narrowest width.
4th. It pursues nearly a direct course from Sacramento to the Big Bend of Truckee.
5th. It forms a local road for the counties of Sacramento, Placer and Nevada.
6th. It commands and will perform the entire business of Nevada Territory, Washoe, and the Silver mineral region.
7th. It will also command the business of the newly discovered Humboldt mineral district, Pyramid Lake, Esmeralda, and Mono mineral districts.
8th. It crosses the Truckee Meadows at the head of Steamboat Valley, which, with Washoe Valley and Eagle Valley, connects with Carson Valley, enabling a branch road, with light grades, to be built to any point on Carson River.
9th. It reaches eastern base of Sierra Nevada in 11½ miles from Summit.
10th. It follows the valley of Truckee River, without obstacle, to Big Bend, or Humboldt Desert.
11th. It entirely avoids the second summit of Sierra Nevada.
12th. Its maximum grades are 105 feet per mile, or less than those of the Baltimore and Ohio Railroads.
13th. The grades down the Truckee will not exceed 40 feet per mile.
14th. The elevation of line is maintained, continuously to the summit—there being no down grade running easterly to Summit.
15th. An uniformly descending grade is maintained from the summit easterly to the Truckee, or eastern base.
16th. Encounters no elevated plateau of table-land at Summit.
17th. Running to and from summit with maximum grades, cannot have an extensive snow-line.
18th. Runs through extensive forests of Pitch and Sugar Pine, Fir, Cedar, and Tamarac, which latter two species of timber are abundant, and will furnish excellent cross-ties.
19th. Crosses no deep river canons or gorges.
20th. Its longest tunnel will not exceed 1,350 feet in length, and no shafting will be required.
21st. Shortest radius of curvature, 573 feet.
22d. Navigable waters of the Sacramento River at all seasons of the year its western terminus; Washoe and the Great Basin its eastern terminus.

23d. At Big Bend of Truckee, the line is in position to proceed *via* the Humboldt to Salt Lake, or follow the Simpson route to some point.

24th. *Saving in distance* over route *via* Madelin Pass and headwaters of Sacramento, as surveyed by Lieut. BECKWITH, from Lasseur's Meadows, or Humboldt crossing, 184 miles.

25th. Saving in cost of Pacific Railroad line, taking Lieut. BECKWITH's estimate from Lasseur's Meadows, or Humboldt crossing, as compared with cost of present proposed line, in thirteen and one half millions of dollars.

26th. Reduces the time of passenger transit to and from Washoe to 8½ hours. Passengers leaving Virginia station at 5 A. M., will reach San Francisco the same evening.

27th. Saving in cost of transportation of freight to citizens of Washoe or Nevada Territory, one million of dollars per year.

28th. Affords a market for low-class silver ores (now thrown aside), for shipment to Europe, from over 3,000 mining claims.

29th. Is advantageously located for an extension to Oregon.

30th. Completes first western link of Pacific Railroad, overcoming its greatest difficulties.

GENERAL REMARKS CONCERNING LOCATION AND DESCRIPTION OF RIDGE OR DIVIDE.

This divide is the strip of land lying between the American River and its North Fork (on the south), and Bear River and the South Yuba (on the north).

The American River unites with the Sacramento River at the city of Sacramento; Bear River unites with Feather River (a tributary of the Sacramento) about 30 miles north of the city of Sacramento.

The direction of divide is north-easterly and south-westerly. Its width opposite Sacramento is about 30 miles.

The foot-hills of Sierra Nevada begin at Folsom, on the American, and at Johnson's Ranch on Bear River; the line of foot-hills running through or near Lincoln (about 15 miles northerly, from Folsom, and 10 miles, southerly, from Johnson's Ranch), forming a piece of land in Sacramento Valley, between the foot-hills and Sac-