## Pacific Railroad Report

Reports of Explorations and Surveys to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean, Made Under the Direction of the Secretary of War in 1853-54. Vol. 1. Washington: Beverly Tucker, printer, 1855. pp. 3-32. Newberry Library call number: G89.924

## REPORT OF THE SECRETARY OF WAR

WAR DEPARTMENT
Washington, February 27, 1855.
SIR: I have the honor, in obedience to the provisions of the 11th section of the army appropriation act, approved March 31, 1853, to lay before Congress printed reports of the engineers employed under the provisions of that act to make such explorations and surveys as this department might deem advisable, in order to ascertain the most practical and economical route for a railroad from the Mississippi river to the Pacific ocean.

The great amount of labor required in the preparation of the general map, originally designed to accompany this report, and the unfinished condition of the original maps and other data have delayed its completion beyond the period anticipated, but it is confidentially believed that its engraving will be finished in time to accompany the extra copies of the report ordered by the two houses of Congress. It embraces the territory of the United States between the great lakes and the Mississippi river, on the east, and the Pacific ocean on the west. It is based upon the most reliable astronomical data within those limits; and the details having been compiled with care, from all the government explorations and surveys and other reliable authorities, it will present more minute information upon the region embraced by it than has heretofore been exhibited on any general map. It will show the relation to each other of the different railroad routes recently explored, their connection with prominent points on Lakes Superior and Michigan, the Mississippi river and the Gulf of Mexico, and with the ports of the Pacific; and, exhibiting only such features as have been determined by reliable observers, it will be of great value in showing what further explorations are necessary, and in determining their direction and extent.

I have heretofore reported the nature of the explorations and surveys ordered in compliance with this act; and by a reference to the statements there made it will be seen that in order to accomplish as much as possible within the limited period indicated, not only were there many distinct corps employed as there were routes to be surveyed, but several parties were, in some cases, employed upon different sections of the same route. It appears, therefore, necessary, in submitting these several reports, many of which are quite voluminous and in detached parts, to present a general recapitulation of their results, indicating which of the routes surveyed best fulfills the condition of practicality and economy proposed by the act.

I will here repeat the general sketch of the country given in my first annual report, but corrected in accordance with the results of the recent explorations. This will serve, in the absence of a more elaborate description, to give some general idea of the country over which they extended.

The western portion of the continent of North America, irrespective of the mountains, is traversed from north to south by a broad, elevated swell or plateau of land, which occupies the greater portion of the whole space between the Mississippi river and Pacific ocean. The crest of this plateau, or the water-shed of the country, is nearly divided between the Pacific coast and the Mississippi. It may be represented on the map by an undulating line traced between the headwaters of the streams which flow eastward and those which flow westward. It divides the while area between the Mississippi and the Pacific into two nearly equal portions-that on the east being somewhat the larger. This crest of the water-shed has its greatest elevation in Mexico; and thence declines to its lowest point about the latitude of $32^{\circ}$, where it has a height of about 5,200 feet, between the waters of the Rio Grande and those of the San Pedro, a tributary of the Gila. From this parallel it increases in altitude northward, and reaches its maximum near the 38th parallel, where it is about 10,000 feet high. Thence it declines as we pass northward; and, in latitude $42^{\circ} 24^{\prime}$, it has an elevation of, say, 7,490 feet; and in the latitude of about $47^{\circ}$ it is reported to be at least 1,450 feet lower. The heights here given are those of the lowest passes over the
crest or water-shed of the great plateau of the country, and not those of the mountain peaks and ridges which have their base upon it, and rise, in some cases, to the height of 17,000 feet into the region of perpetual snow.

The slope of the plateau on the east and south, towards the Mississippi and the Gulf of Mexico is completely gentle, and in the northern part of Texas, that known by the name of Llano Estacado, or Staked Plain, is by steps. It is traversed by the Missouri, the Platte, the Arkansas, and other large rivers which rise among the mountains near the crest, and flow eastward and southward in channels sunk beneath the general surface-level of the plains.

Its crest, and nearly the entire distance thence to the Pacific, is occupied by high plains or basins, differing from each other in elevation from 1,000 to 3,000 feet, and by mountain peaks and ridges, varying in direction to almost every point of the compass, though they have a general course north and south. Many of these mountains, including those that bound this system, have obtained the name of chains, and a short classification of them will now be attempted, although it is to be premised that our knowledge of them is most imperfect, and the classification now made, future explorations will probably show to be erroneous. The only proper classification must be made by the geologist, after a thorough exploration for this purpose, which it will require a long period to accomplish.

These mountains may be considered as constituting great systems, extending generally throughout our possessions in a north and south direction; and though this arrangement may not be the best or most accurate, yet it will enable us to take a comprehensive view of the whole s regards the construction of a railroad, since any direct line that can be traced from the Mississippi to the Pacific, except near the 48th and 32nd parallels, will encounter each of these systems in some point.

Calling the most eastern system No. 1, we find a portion of it, crossing the Rio Grande, and entering Texas at the Great Cañon. Its extension south into Mexico forms the east front of the Sierra Madre. Running northward, this system includes all of the mountains on either side of the Rio Grande, enclosing its valley and the Salinas Basin. Those on the east from the divide between the Pecos and the Salinas Basin, and between the Rio Grande and Canadian; on the west they divide the waters of the Rio Grande from those that flow to the Gulf of California. Those on the east are sometimes called the Rocky mountains, sometimes the Sierra Madre; and this last name is sometimes applied to those on the west. There seems to be a necessity for considering the mountains on both sides of the Rio Grande as one system. These may be said to unite near the headwaters of the Rio Grande and Arkansas, and here the mountains have their greatest development. The Sierra de la Plata extends to the southwest, the Elk mountains to the west, and the various chains forming the Park mountains to the north. The Park mountains, in latitude $41^{\circ} 30^{\prime}$, sink into the plateau, forming the region of the South Pass; and the only continuation we have of this system is in the Black Hills, which continue to the north, with diminished elevation, till, in latitude $46^{\circ} 15^{\prime}$, they are merged into the coteau through which the Upper Missouri makes its passage.

Among the mountains included in this system are the Sierra Madre, a portion of what is called the Rocky Mountains, the Diabolo mountains, the Guadalupe mountains, Hueco mountains, Oregon mountains, Sandia mountains, Santa Fe mountains, Sierra Blanca, Sierra Mojada, Sierra San Juan, Sierra de la Plata, Elk mountains, Park mountains, Medicine Bow mountains, and Black Hills.

System No. 1 is thus but partially gorged by the Rio Grand, whose passage of the Great Cañon is wholly impracticable for any method of communication; that of El Paso is practicable. It is completely cut through by the North Platte and Sweet Water, forming a practicable route; and is turned by the Upper Missouri.

System No. 2. If from the Great Northern Bend of the Missouri, we travel west for 450 miles, we come again on what are called the Rocky mountains; and still further west lies the Coeur d'Alene, or Bitter Root range, the two enclosing the Bitter Root or St. Mary's valley; and both are considered as forming a part of this system. Following it to the south it includes the Wind River chain, the Bear mountains, the Uinta mountains, and the Wahsatch, which last continue as far south as it has been explored, probably forming the divide between the Great Basin and the Colorado, till the junction of the latter with the Gila.

System No. 3. From the Junction of the Gils and Colorado, we find continuous mountains running to the northwest, and terminating at Point Conception, on the Pacific. On the south they are joined by the mountains forming the peninsula of California, the junction being at the San Gorgonio Pass, in latitude $33^{\circ} 45^{\prime}$.

On the north, two chains leave this range in latitude $35^{\circ}$. One, called the Coast range and Coast mountains, lies to the west of the San Jaoquin and Sacramento valleys, the waters of which break through them at the Bay of San Francisco. The other, called the Sierra Nevada, lies to the east of these valleys. A great depression, forming a plateau, is known to exist in the Sierra Nevada in latitude $40^{\circ} 30^{\prime}$, and another in latitude $42^{\circ} 45^{\prime}$ near Lake Albert. This chain may, perhaps, be considered as termination which extend into the British possessions, being broken through by the Columbia and partly the Klamath rivers.

The Blue mountains, to the south of the Columbia, represented as having a general northeast direction, may be considered along with the mountains mentioned since leaving the Colorado, as forming system No. 3.

The Humboldt River chain, running north and south, (where crossed,) and separating the waters of the Humboldt or Mary's river from those of the Great Salt Lake Basin, is a marked feature; but as to its connection, north and south, with other ranges, nothing is certain.

There seems good reasons for believing that the east and west ranges, represented as separating the Columbia river basin from the Great Basin, as well as the range represented as extending west from the Vegas of Santa Clara, are only apparently such, the description arising from the overlapping of the sides spurs to chains, the general direction of which is north and south.

The "triangular space" lying between the Rio Grande, Gila, and Colorado is everywhere, so far as known, exceedingly mountainous; the ranges, such as Mogollon and San Francisco mountains, having a general northwest direction. Too broad an interval exists between the explorations of Lieutenant Whipple and those of Captain Gunnison, to enable us to speak with certainty of their relation to the systems already alluded to.

In portions of the mountain region, the waters find no outlet to the sea, but drain into lakes and ponds, or sinks, carrying with them all the impurities of the basins to which they belong, and are there uniformly brackish or very salt. Prominent examples of this are the Salinas Basin, of New Mexico, and the Great Salt Basin in Utah.

From most portions of this interior mountain belt, the waters have been able to force their barriers and escape to the ocean. The valleys thus drained are, those of the southern tributaries of the Upper Missouri, that of the North Fork of the Platte, and its tributary the Sweet Water, between the first and second systems; that of the Upper Rio Grande del Norte, in the first system; that of the Great Colorado of the West and its tributaries, between the first and second systems; those of the waters of the Bay of San Francisco and of the Kalmath river, in the third system; and that of the Columbia river and its tributaries, between the second and third systems. Some of these streams, as well as others in the enclosed basins, have in places worn for themselves, though the solid rock, the most stupendous chasms or cañons, often 2,000 feet in vertical height, many of which it is impossible to follow or cross.

The position of the belt of mountain region, stretching from north to south, gives rise to a peculiarity of climate and soil. Fertility depends principally on the degree of temperature and amount of moisture, both of which are much affected by increase of elevation; and the latter also depends on the direction of the wind. The upper or return current of the tradewind, flowing backward towards the northeast, gives a prevalence of westerly winds in the north temperate zone, which tends to spread the moisture from the Pacific over the western portion of our continent. These winds, however, ascending the western slop of the mountain ridges, are deprived of their moisture by the diminished temperature of the increased elevation; and hence it is that the plains and valleys on the eastern sides of the ridges are generally parched and barren, and that the mountain system, as a whole, presenting, as it were, a screen against the moisture with which the winds from the west come laden, has for its eastern margin a sterile belt, which probably extends along the whole range, with a width varying from 250 to 300 and 400 miles.

From the foregoing sketch it will perceived that the lines of exploration must traverse three different divisions or regions of country lying parallel to each other, and extending north and south though the whole western possessions of the United States. The first is that of the country between the Mississippi and the eastern edge of the sterile belt, having a varying width of from 500 to 600 miles. The second is the sterile region, varying in width from 200 to 400 miles; and the third, the mountain region, having a breadth of from 500 to 900 miles.

Explorations show that the surface of the first division, with few exceptions, rises in gentle slopes from the Mississippi to its western boundary, and the rate of about six feet to the mile, and that it offers no material obstacle to the construction of the railroad. It is, therefore, west of the that the difficulties are to be overcome.

The concurring testimony of reliable observers had indicated that the second division, or that called the sterile region, was so inferior in vegetation and character of soil, and so deficient in moisture, that it had received, and probably deserved, the name of desert. This opinion is confirmed by the results of the recent explorations, which prove that the soil of the greater part of this region is, from its constituent parts, necessarily sterile; and that of the remaining part. Although well constituted for fertility, is, from the absence of rains at certain seasons, except where capable of irrigation, as uncultivable and unproductive as the other.

This general character of extreme sterility likewise belongs to the country embraced in the mountain region. From the western slopes of the Rocky Mountains to the 112th meridian, or the western limit of the basin of the Colorado, the soil is generally of the same formation as that lying east of that mountain crest, mixed, in the latitudes of $35^{\circ}$ and $32^{\circ}$, with igneous rocks; and the region being one of great aridity, especially in the summer,
the areas of cultivable land are limited. The western slopes of the highest mountain chains and spurs within this region being of a constitution favorable to fertility, and receiving much larger depositions of rain than the plains, have frequently in their small valleys a luxuriant growth of grasses, which sometimes clothes the mountain-sides; and where the wash is deposited on mountain stream or river-bottom the soil is fertile and can be cultivated, if the elevations are not too great, and the means of irrigation available. Such mountain-valleys and river-bottoms exist upon all the routes, and the difference in the areas found in the different latitudes is not sufficiently great to be of any considerable weight in determining the question of choice of route. It is probable that all routes are nearly on an equality in this respect.

The cultivable valleys of the Rocky mountain district near the route of the 47th parallel do not probably exceed an area of 1,000 square miles, though there are extensive tracts of fine grazing lands. In this latitude the great sterile basaltic plain of the Columbia, and the barren table-lands, spurs, and mountain masses of the Cascade range, principally occupy the space between the Coeur d'Alene mountains and the main chain of the Cascade system. In this area, where the rocks are principally of igneous origin, there are likewise occasional valleys of cultivable soil. The western slopes of the Cascade mountains descend to the borders of Puget Sound.

On the routes of the 41st and 38th parallels, in the region under consideration, the only large body of soil capable of productive cultivation, by the construction of suitable works for irrigation, is that of the basin of the Great Salt Lake, estimated to be 1,108 square miles in extent, about one-tenth part of which, being susceptible of cultivation without the construction of irrigating canals, is now cultivated by the Mormons. Here also are extensive grazing lands.

The great elevated plains of the Rocky mountains I latitudes $41^{\circ}$ and $42^{\circ}$, and that of latitude $38^{\circ}$, called the San Luis valley, are covered with wild sage, the narrow border of grass found upon the streams being the chief, almost only, production capable of supporting animal life. The slopes of the mountains bounding them are covered with grass.

The plains of the Great Basin, whose greatest width ( 500 miles) is in latitude $41^{\circ}$, are, with the exception heretofore stated, entirely sterile, and either bare or imperfectly covered with a scattered growth of wild sage. Where a stream or a lake is found in this desolate region, its immediate borders generally support a narrow belt of grass and willows; the former being also found on the mountain slopes, where occasionally a scattered growth of stunted cedars is likewise seen. Water is found on the mountain-side. The predominating rocks, from the Wahsatch mountains to the Sierra Nevada, are of igneous origin. In the southern portion of the Basin the granitic rocks are more abundant than the volcanic.

On the routes of the parallels of the 35 and 32 the valleys of the Pecos, Rio Grande, Gila, and Colorado of the West, contain the largest areas of fertile soil capable of irrigation and cultivation. That in new Mexico is estimated at 700 square miles, exclusive of the regions occupied by Indians, of which of which 200 square miles are now under cultivation. Here the grazing land is of very great extent, the table-lands, as well as the mountainsides being covered with grass. The valley of the Colorado of the West, between its mouth and the 35 th parallel, contains 1,600 square miles of fertile soil, which can be irrigated from the river.

The plains south of the Gila in its lower course, and that west of the Colorado, extending to the Coast range called the Colorado desert, as well as the contiguous portion of the Great Basin, are bare and exceedingly sterile in their aspect, and closely resemble each other. The soil of the Colorado desert, as much of this as well as other parts of the Great Basin is, however, favorably constituted for fertility, but the absence of the essential, quickening element, water, leaves them utterly unproductive.

West of the Coast, Sierra Nevada, and cascade mountains the country is better watered than that just considered; and the soil being mostly well constituted for fertility, is productive in proportion to the yearly amount of precipitation and the means of irrigation.

The general position and direction of the four route to be explored were explained in my report of December 1,1853 , and copies of the instructions given to the parties were appended to it.

They were directed to observe and note all the objects and phenomena which have an immediate or remote bearing upon the railway, or which might seem to develop the resources. peculiarities, and climate of the country; to determine geographical positions, obtain topography, observe the meteorology, including the data for barometric profiles, and two of the parties were to determine the direction and intensity of the magnetic force. They were to make a geological survey of the lines; to collect information upon, and specimens of, the botany and zoology of the country; and to obtain statistics of the Indian tribes which are found in the regions traversed. Thus would be obtained all the information for the general consideration of the question, as well as the data upon which the cost of construction and working a railroad depend.

If the results of the explorations made under these instructions do not furnish the data requisite to solve every question satisfactorily, they at least give a large amount of valuable information, and place the question in a tolerably clear light. We see now, with some precision, the nature and extent of the difficulties to be encountered, and, at the same time, the means of surmounting them.

As the readiest mode of communicating the nature and extent of the information contained in the reports herewith submitted, a brief description of each route, its characteristic features, facilities, difficulties, and probable cost of construction, will be given.

For a long distance west of the Mississippi, the enterprise of private companies, acting under State charters, has explored the country, and has projected or is constructing railroads, stretching towards the Pacific. As the examinations made under these auspices, and our general knowledge of that part of the country, afford the information necessary to determine all questions bearing upon the practicability of a railroad, it has been determined unnecessary to incur the expense and delay of continuing the explorations directed by the act, eastward of the points reached, to which railroads are already projected, and consequently but one of the routes, the most northern, has its starting-point on the Mississippi. The connexion [sic] of the others with that river, as well as with the seaports of Atlantic and Gulf States, is shown by a table (B) hereto annexed, compiled from the best railroad maps.

## ROUTE NEAR THE FORTY-SEVENTH AND FORTY-NINTH PARALLELS OF NORTH LATITUDE

Taking the routes in the geographical order, that near the 47th parallel, the general direction of the exploration of which was intrusted [sic] to Governor Stevens of Washington Territory, will be the first discussed.

The route was to cross the Rocky mountains at the sources of the tributaries of the Missouri and Columbia rivers, and , in approaching and leaving the mountains, to follow as far as practicable the valleys of these rivers and their tributaries.

The general direction of the Missouri from the Rocky mountains to the Great Bend, in latitude $48^{\circ} 30^{\prime}$, is from west to east, and thence to latitude $43^{\circ} 30^{\prime}$ southeast. The point where the direction changes is reached from St. Paul, on the Mississippi, by a line passing up on the east side of that river to Little Falls, 109 miles, and there crossing it; thence gaining the divide between the waters of Hudson's bay and those of the Missouri, keeping on this divide, and approaching, in longitude 103, within a few miles of the 49th parallel; then passing the 104th and 105 th meridians, and entering the valley of the Missouri river. The route then follows this valley to the mouth of the Milk river. The ground near the Missouri here becoming rough and broken, the route is obliged to leave it and follow the valley of Milk river 187 miles; then entering the prairies, which near the mountains are more favorable than near the Missouri river, it continues in a line nearly parallel to the river, across its tributaries, the Marias, Teton, and Sun rivers, and enters either Clark's or Cadotte's pass.

As far as crossing the Sun river, 1,093 miles from St Paul, the route is over river bottom or prairie, the usual expense of construction over such ground being increased by the necessity of guarding against freshets by embankment on the river bottoms, of ballasting in the soft, sticky soil of Milk river, of providing supplies of water during the dry season, over certain portions of the route, by reservoirs and aqueducts, estimated to cost, with planting trees for supplies of fuel, $\$ 3,000,000$, and of transporting ties and lumber for distances of from 100 to 470 miles-forest-growth suitable for tics and lumber not being found at closer intervals on the route. These, in connexion with the uninhabited and uncultivable condition of the country for 740 miles, form the difficulties of this portion of the route, and will materially increase the cost of its construction.

The most difficult portion of the whole route is, however, that which is now entered upon, viz: from Sun river to the Spokane, a distance of 365 miles, embracing the Rocky mountains proper, and a secondary chain lying west of them, called Couer d'Alene and the Bitter Root mountains.

Through the Rocky mountains seven passes were explored; but the only ones among them, upon which the information obtained was sufficiently thorough and complete to enable projects to be made, are two (Clark's and Cadotte's) lying near each other in latitude 47, and connecting the headwaters of Dearborn river, a tributary of the Missouri, with the Blackfoot, a head branch of the Columbia.

The summit ridge of Clark's Pass has an elevation of 6,323 feet, and requires a tunnel $21 / 2$ miles long, at an elevation of 5,300 feet. It connexion with the main line of survey along the valley of the Blackfoot river was not made, though "believed" practicable, with grades of 50 feet per mile. The interval unexamined is $41 / 2$ miles long. This pass has been adopted by Governor Stevens in the railroad estimate and is probably practicable.

The approach to the other pass (Cadotte's) is difficult, owing to the numerous deep ravines of the tributaries of a branch of Dearborn river, which the road must cross. The summit of the pass has an elevation of 6,044 feet; requires a tunnel $41 / 2$ miles long, at an elevation of 5,00 feet, with grades of approach of 60 feet, and of departure of 40 feet, per mile.

A tunnel $41 / 4$ or even $21 / 2$ miles in length, in rock or part rock, at a depth below the summit of 1,000 feet, in a severely-cold climate, 800 or 1,00 miles distant from a thickly-inhabited district, is a work of vast difficulty; and the necessity of the construction of one of these two tunnels, in connexion with the character of the approach, and the difficult nature of the work required, continuing westward as far as the crossing of the Spokane river, in all a distance of 365 miles, is one of the most serious objections to the route.

From either pass the route seeks the Blackfoot river, with the view of reaching Clark's fork, which opens the only pass through the Bitter Root mountains, the practicability of which was determined. In order to reach Clark's fork, two routes were examined. The first follows the Blackfoot river to its junction with Hell-Gate, a distance of 93 miles. The valley is narrow and wooded, the stream winding, and for twenty miles there is a narrow gorge. Numerous bridges will be required. The Hell-Gate, a few miles after being joined by Blackfoot, empties into the St. Mary's, called below this junction the Bitter Root. The construction of the road along this stream to its junction with Clark's fork will be a work of great difficulty and expense, requiring short curves, steep gradients, numerous bridges, heavy side-cutting, and high embankments, in consequence of the spring freshets, (from twenty to thirty feet of vertical rise.) From the nature of the examination, having followed the Blackfoot but a short distance, crosses to the Jocko, descends this to the Flathead, and descends the latter to its junction with the Bitter Root, forming Clark's fork, bounded closely by high, rocky mountains. Having reached Clark's fork, the route continues along this river as far as Lake Pend d'Oreille, between rugged, rocky mountain at which several points crowd upon the river. The valley of this river is heavily timbered, principally with pine, and, with the lake, it is subject to freshets fifteen feet in height. Leaving Lake Pend d'Oreille at its lower extremity, the route crosses to the Spokane without difficulty. At the Spokane river the continuous mountain region and the forest terminate, and "all great difficulties of location upon the route cease." The earth-excavation and embankment throughout this section (from the east base of the Rocky mountains to the Spokane river, 365 miles) will be large in amount, and expensive; there will be frequent rock-excavation, and the bulk of the rock-excavation in the entire route will be in this section. It is evident that the difficulties of construction will be great, and the cost excessive.

Upon the passes of the Rocky mountains, Governor Stevens says: "It is not doubted there are other passes in this portion of the Rocky mountain range, even better than those explored; they are indicated by the general depression of the mountain range, with the greater frequency of the streams stretching out to meet each other from the opposite slopes of the mountains; and I consider it important that instrumental surveys should be made of the pass found to be the most practicable."

Leaving the Spokane, the route enters the Great Plain of the Columbia, a table-land stretching from the Coeur d'Alene to the Cascade mountains, a distance of 200 miles. Its central and western portions are of trap formation, and are described on the map as sandy, rocky, and sterile. Its summit, 800 feet above the Spokane river, is readily attained, the treeless plain is crossed in a distance of 110 miles, and a suitable point for crossing the Columbia river, 400 or 500 yards wide, reached 140 miles distant from the Spokane. This point is about equally distant from the navigable waters of the Pacific in Puget Sound and in the Columbia river. The whole intermediate space is occupied by the Cascade mountains, with their secondary chains, spurs, and high, broken table-lands, through which there are but two passes reported practicable for a railroad-that of the Columbia and that of the Yakima, sometimes erroneously called the Snoqualme.

The Yakima Pass gives the most direct route to Puget Sound, the distance by it being 150 or 160 miles shorter than by the Columbia River Pass. It requires a tunnel through rock, (siliceous conglomerate,) either 4,000 yards long, 3,000 feet above the sea, or a tunnel 11,840 yards long, 2,400 feet above the sea. The reconnaissance did not extend westward from the summit more than three miles. The evidence respecting the amount of snow found on the summit of the pass at the close of winter, makes it probable that it is then 20 feet deep there. This question should be satisfactorily settled, and the reconnaissance completed, before the practicability of the pass can be considered established. In the opinion of the officer making the reconnaissance-Captain McClellan, Corps of Engineers-the pass is barely practicable, and only at a great cost of time, labor, and money. Under every favorable condition of position the construction of either of the proposed tunnels would be seriously objectionable; but where the position itself is so unfavorable, the final advantages should be very great to determine the selection of this route. The information now possessed is sufficient to decide against the selection of this route. The information now possessed is sufficient to decide against this route.

The route by the pass of the Columbia follows that river from the Great Plain, being generally located, as far as the Dalles, in Bottom-lands which present no difficulties. From the Dalles to near Vancouver, 90 miles, the rocky bluffs close upon the river, and the work required will be similar to that of the Husdon River railroad along the mountain region. In the opinion of Mr. Lander, "The high floods to which the Columbia river is subject, are serious obstacles to obtaining the best location for cheap construction offered by its valley." In 1854, the rise of the river during the flood was 10 feet above spring level, and 17 feet above summer level.

The Columbia river is navigable for sea-going vessels to Vancouver, the point now reached; but the unfavorable character of the entrance to that river, and the great superiority of the ports on Puget sound, seemed to render it expedient to adopt some one of the latter as the Pacific terminus of this route. Continuing down the Columbia, therefore, though bottom-lands, to the mouth of the Cowlitz, the route enters the wide and comparatively flat and wooded valley of that river, ascends it, and, crossing over the wooded and prairie plains, which, "though not fully explored, are sufficiently well known to insure the unusually favorable character of the country for the construction of a railway," reaches Seattle, the best port on the east side of Puget sound.

From the Rocky mountain to Seattle, wood, stone, and other building materials, are found along the line of the route, or at points so accessible to it, that it may be considered well supplied with them throughout.

The information upon the character of the soil upon the route do not admit of satisfactory conclusions to be deducted. It is sufficient, however, to show that in this latitude, as in that of the Arkansas, the uncultivable region begins about the 90th meridian. Immediately under the Rocky mountains the soil improves, probably from mountain wash. The tertiary and cretaceous formation extend, in these latitudes, from about the 97 th meridian to the eastern base of the Rocky mountains, and, under the meteorological conditions found in this space, are unsuitable for agricultural purposes. There are some very limited exceptions to this general character in portions of river bottoms. These tertiary formations in the arid regions of Asia and Africa from the great deserts of those countries.

The country west of the Rocky mountains to the Pacific slopes may likewise be described as one of general sterility. The eastern portion of the Great Plain of the Columbia is represented to be grassed; its middle and western parts almost entirely sandy, rocky, and sterile. The mountain masses, spurs, and table-lands of the Cascade chain, east of the main crest, are sterile. There are exceptions to this general sterility in the mountain valleys, where the soil is better constituted for fertility, and the rains more abundant; but, although portions of these are suitable for agricultural purposes, they are better adapted to grazing. The sum of the areas of cultivatable soil in the Rocky mountain region does not exceed, if it equals, 1,000 square miles. West of the Cascade mountains there are rich river bottoms, clay formations that are arable, and prairies offering good grazing.

The principal favorable characteristics of this route are its low profile, low grades, and the low elevation of the mountain passes, and its connexion with the Missouri and Columbia rivers. The reported sum of the ascents and descents is the least of all the routes; this proportion may, however, be changed when the minor undulations are measured. The principal unfavorable features are, in construction, the tunnel required on the Rocky mountains, and the expense of construction from the eastern approach of the Rocky mountains to the Spokane river, and the expense of the construction along the Columbia river, from the Dalles to near Vancouver. These, when considered carefully, are serious objections to the route, not only in the money, but the time, they will consume. In thickly-populated countries their construction would be difficult and costly; situated as they are- the Rocky mountain region especially-the difficulties, cost, and time required, are greatly increased.

The severely-cold character of the climate throughout the whole route, except for the portion west of the Cascade mountains, is one of its unfavorable features; and, for national considerations, its proximity to the dominions of a powerful foreign sovereignty must be a serious objection to it as a military road.

Its cost has been estimated by Governor Stevens, by the Columbia river valley and the Cowlitz, at $\$ 117,121,000$; the cost of work at eastern prices having had 25 per cent. added to it from the Bois de Souix to the Rocky mountains, and 40 per cent. thence to the Pacific. It has been though safer to add 100 per cent. to the cost at eastern prices from the eastern slope of the Rocky mountains to the Pacific. This would swell the estimate to \$150,871,000.

Should Governor Stevens have included a full equipment in his estimate, $\$ 10,000,000$ should be subtracted from this sum to bring the estimate in accordance with those of other routes, and the cost then becomes \$140,871,000.

The length of the route from St. Paul to Vancouver is 1,864 miles. The sum of ascents and descents, as far as reported, is 18,100 feet, which will be equivalent, in the cost of working the road, to an increased horizontal distance of 343 miles: this added to the length of the line of location, gives for equated length of 2,207 miles.

From St. Paul to Seattle, by the Columbia route, is 2,025 miles, which the sum of ascents and descents increases to an equated distance of 2,387 miles.

The work upon this route, under Governor Stevens, embraced a wider field of exploration than that upon any other explored, and a great amount of topographical and general information was collected in relation to the country traversed. The necessary astronomical observations were not made to determine accurately the longitudes of the several stations, and the loss of his barometrical observations, after the completion of the field-work, left no means of revising and verifying the profile of the route.

The examination of the approaches and passes of the Cascade mountains, made by Captain McClellan, of the Corps of Engineers, presents a reconnaissance of great value, and though preformed under adverse circumstances, exhibits all the information necessary to determine the practicability of this portion of the route, and reflects the highest credit on the capacity and resources of that officer.

## ROUTE NEAR THE FORTY-FIRST AND FORTY-SECOND PARALLELS OF NORTH LATITUDE

About one-half of the route in this latitude, extending from the Missouri river to Fort Bridger, on a tributary of Green river, has not been explored with a special reference to the practicability of constructing a railroad, and the reports do not contain all the details necessary to the elucidation of the subject. The information respecting it is to be found in the reports of Col. Fremont and Capt. Stansbury.

From Fort Bridger to Fort Reading, on the Sacramento river, the exploration has been made by Lieut. E.G. Beckwith, under the appropriation for that purpose.

The route may commence on the Missouri, either at Fort Leavenworth, about 245 miles from the Mississippi at St. Louis, or at Council Bluffs, about 267 miles from the Mississippi at Rock Island, ascend the Platte and enter the eastern chain of the Rocky mountains (the Black Hills) by the North fork and its tributary the Sweet Water. Another route, by the South fork and a tributary called Lodge Pole creek, has been suggested by Capt. Stansbury as shorter and less expensive; but the information respecting it is not sufficiently full to make further mention of it necessary.

From the Missouri river to the entrance of the Black Hills, 30 miles above Fort Laramie, 520 miles from Council Bluffs, and 755 miles from Fort Leavenworth, the route resembles others from the Mississippi to the Rocky mountains, and needs no special mention. Its cost per mile will be about the same.

The route west of this point crosses many lateral streams that have cut deep ravines into the soil, and leaves the Platte just below the Hot Spring Gap, above which it is walled in by cañons. To avoid these, the route crosses a range of hills 800 feet above the river, and descending to the Sweet Water, a branch of the Platte, follows that stream to its source, where the summit of the plateau of the South Pass (elevation 7,490 feet) is attained. The valley of the Sweet Water is generally rather open, but occasionally it cuts through mountain spurs, forming cañons.

From the first gorge in the Black Hills to the summit if the pass, 291 miles, the work will be difficult and expensive, and is assimilated in amount to that of the Baltimore and Ohio railroad.

From the South Pass the route follows down Sandy creek, a tributary of Green river, to the crossing of the latter, and thence to Fort Bridger, (elevation 7,254 feet,) on Black's fork, likewise a tributary of Green river. The amount of work on this section would be considerably less than on the preceding.

From Council Bluffs to Fort Bridger the distance is 942 miles; from Fort Leavenworth 1,072 miles.
The route now ascends the divide between the waters of Green river and those of the Great Salt lake, by the valley of Black's fork, or of one of its tributaries, with grades of 69.5 and 40.3 per mile. The summit is a broad terrace at the foot of the Uinta mountains, and has an elevation of 8,373 feet. From this point on the lien descends over the undulating country separating the Uinta and Bear River mountains, crossing the head of Bear river, and, entering the valley of White Clay creek at its head, follows down that stream to its junction with the Weber river.

The Wahsatch mountains now intervene between this plateau country and the Great Salt lake, and the passage through them may be effected by following Weber river, or by ascending to near the sources of the Timpanogos; and descending that stream-both being affluents, directly or indirectly, of the Great Salt lake-the distances are about the same to their common point on that lake.

There are cañons upon both these streams. That of the Timpanogos is 10 miles in length, and narrow, being from 100 to 300 yards in width. It is direct in its general course, but must be bridged at several points, to avoid short curves. The sides are of blue limestone, and will require rock-blasting at some points. The river, 30 yards wide, descends with a powerful current, and, when most swollen, is six feet above its ordinary level.

On Weber river there are two cañons. The upper is rather a gorge or defile, $81 / 2$ miles long. The mountains rise to a great height above it, and are rocky and precipitous, and much broken by ravines. The river is winding, and it will be necessary to cross it frequently. The lower cañon, near the borders of the valley of Great Salt lake, is four miles long, direct, with an average width of 175 yards, the stream being 30 yards wide, and impinging frequently with great force against the base of the mountains, which, however, are sufficiently retreating to admit the practicable base passage of a railway.

Entering the valley of the Great Salt Lake from either this or the Timpanogos cañon, there is no obstacle to the construction of a railway passing by the south end of the lake, and crossing the Jordan, Tuilla valley, and Spring or Lone Rock valley, to its west side.

By the valley of the Timpanogos, the distance from near Fort Bridger, to the south end of the Great Salt lake there is, on the western side of the valley of the Jordan, is 182,55 mile; the greatest grade required, 84 feet to the mile. The amount of work required on this section, excepting that along the cañon, will not, in the opinion of Lietuenant Beckwith, be great.

From the western shore of the Great Salt lake to the valley of Humboldt river, the country consists alternatively of mountains, in more or less isolated ridges, and of open level plains, rising gradually from the level of the lake on the east, to the base of the Humboldt mountains on the west; that is, from 4,200 feet to 6,000 feet above the sea. West of the Humboldt mountains the country is of the same character, the plains declining until, at the west shore of Mud lake, usually called the foot of the Sierra Nevada, the elevation is 4,100 feet.

The mountains in this space of 500 miles, (by the route travelled 600 miles,) between the Great Salt lake and the foot of the Sierra Nevada, have a general north and south course. Occasionally cross-spurs close in the valleys to the north and south, but more frequently this isolation is only apparent. The mountains are sharp, rocky, and inaccessible in many parts, but are low and easily passed in others. Their general elevation varies from 1,500 to 3,00 feet above the valleys, and but few of them retain snow upon their highest peaks during the summer. They are liberally supplied with springs and small streams, but the latter seldom extend far into the plains. At the time of melting snows there are many small ponds and lakes, but at other seasons the waters are absorbed by the soil near the base of the mountains. Grass is found in abundance upon nearly every range, but timber is very scarce-a small scattered growth of cedar only being seen upon a few ranges. East of the Humboldt mountains the growth of cedars is more abundant, and the grass better, than to the west. The valleys rarely have a width east and west of more than five or ten miles, but often have a large extent north and south. They are irregular in form, frequently extending around the ends of mountains, or uniting to succeeding valleys by level passages. The greater part of the surface of these valleys is merely sprinkled by several varieties of sombre artemisia, (wild sage,) presenting the aspect of a dreary waste. Though there are spots more thickly covered with this vegetation, yet the soil is seldom half covered with it, for even a few cares, and is nowhere suitable for settlement and cultivation. Immediately west of Great Salt Lake there is a plain of mud, clay, and sand, impregnated with salt, seventy miles in width from east to west by its longest line, and forty at a narrower part further south, thirty miles of which must be piled for the passage of a railroad across it. A railroad may be carried over this series of valleys and around the mountain masses, at nearly the general level of the valleys.

The route in this manner reaches the foot of the Humboldt mountains, a narrow but elevated ridge, containing much snow during most of the year, and crosses them by a pass nine miles long, about three of which are occupied by a narrow, rocky ravine, above which the road should be carried on the sloping spurs of the mountains on the western descent; elevation of summit 6,579 feet above the sea. At the time when passed, 21st May, snow covered the high peaks above it, and a few drifts extended into the ravines down to the level of its summit.

The descent is now made to the open valley of Humboldt river, which is followed for about 190 miles. The steepest grade proposed in the pass of Humboldt mountain is 89 feet per mile for eight miles, but this can be reduced by gaining distance to any desirable extent.

The Humboldt river, as described by Colonel Fremont, is formed by two streams rising in mountains west of the Great Salt lake. Its general direction is from east to west, coursing among broken ranges of mountains; its length about three hundred miles. It is without affluents, and terminates near the foot of the Sierra Nevada in a marshy lake. It has a moderate current-is from two to six feet deep in the dry season, and probably not fordable anywhere below the junction of the two streams during the melting of the snows. The valley varies in width from a few miles to twenty, and, excepting the immediate valley (bottom) is a rich alluvion, covered with blue grass, herds-grass, clover, and other nutritious grasses, and its course is marked thought the plain by a line of willow.

Of the three lines from the Humboldt river to the foot of the Sierra Nevada, the best is that by the Noble's Pass road, as it avoids the principal range of mountains crossed on the line followed by a few miles south. The line followed crosses two ranges of the general character of the Basin mountains, and reaches the foot of the Madelin Pass of the Sierra Nevada, on the west shore of Mud lake, in a distance of 119 miles, and at an elevation of 4,079 feet above the sea.

In this latitude the Sierra Nevada was found to be a plateau about 5,200 feet above the sea, 40 miles in width from east to west, enclosed at these limits by low mountains, the summits of the passes through which are 400 and 500 feet above the base. The plain is covered with irregular spurs, ridges, and isolated peaks, rising a few hundred feet, limiting it in a north and south direction sometimes to a space of a few hundred yards, and at others to that of ten miles. These spurs, \&c., on the eastern portion of the plateau, are sparsely covered with cedar; on the western, heavily covered with pine.

There is no drainage from this plain, the waters of a few small streams and springs forming grassy ponds upon its surface. In its general features it is similar to the Great Basin, excepting that as more rain falls upon it, the vegetation is comparatively luxuriant.

There are two routes by which this plain may be reached from the Great Basin, and the descent made to the Sacramento river. That by Madelin Pass, the more northern, is most probably the better of the two, and is the only one necessary to be considered. Leaving Mud lake, it ascends by the valley of Smoky creek for three miles, though a narrow gorge (from 100 to 150 yards wide) in an outlying spur of the Sierra Nevada.

After this the route is over more open ground, varying, in degree, to the summit of the passage through the eastern ridge bounding the Sierra Nevada plateau. The pass is thus far of a very favorable character-the length of the ascent is 22.89 miles; the difference of elevation, 1,172 feet; the altitude of the summit, 5,667 feet; and the steepest slope is 75 feet per mile.

The plateau being gained, is crossed by a nearly level line to the low ridge bounding it on the west, the summit elevation of which 5,736 feet, is attained by following a ravine valley.

The descent to the Sacramento along one of its tributaries is now commenced, and is at first rapid. A cut is proposed at the summit, 120 feet deep, running out to the surface at either end, making a length of four miles, and a grade of 124 feet to the mile for 2.4 miles. It may be preferable to tunnel or cut only one-half the depth proposed. The open plain of Round valley, on the Sacramento, is reached 15 miles from the summit, (the difference of elevation 1,300 feet, ) located for one-half that distance on the mountain side, which is broken by ravines.

The route now lies over the smooth plain of Round valley for 15 miles, to the head of the first cañon on the Sacramento. This cañon is a formidable obstacle to be overcome. Its entire length is nearly 14 miles, succeeded by an open valley of similar extent, which is followed by a second cañon, nine miles in length, of the same character as the first. From the mouth of Canoe creek, four miles below the foot of the second cañon, for the space of 96 miles, the course of the Sacramento lies entirely through heavily-timbered mountains, which rise precipitously from the river-banks to the height of from 1,500 to 2,00 feet above the stream. Its course is very sinuous, with all varieties of curves greater than a right-angle, and is seldom entirely straight for two miles consecutively. The construction of this portion of the route, 136 miles in length, would be one of no ordinary difficulty or expense under the most favorable circumstances of dense population, and the facilities of railroad construction which it would afford. It is impossible, with the data presented, to form a reliable opinion of its probable cost.

Seventeen miles above Fort Reading the open valley of the Sacramento is attained, over which a railroad may be carried to the bay of San Francisco, 250 or 300 miles distant.

The distance from Fort Bridger to Fort Reading by the line of Lieutenant Beckwith's profile is 1,012 miles; from Fort Leavenworth to Fort Reading 1,072 miles-making the whole distance from Fort Leavenworth to Fort Reading, on the Sacramento, 2,084 miles, and to Benicia 2,264 miles.

The distance from Council Bluffs to Benicia by the above route is 2,134 miles.
Using the ling along which the route can be located in the Great Basin, about 103 miles shorter than that travelled, the distances become, from Fort Bridger to Fort Reading, 909 miles; from Fort Leavenworth to Fort Reading, 1,980 miles; and to Benicia, 2,161 miles.

The distance from Council Bluffs to Benicia becomes 2,031 miles.
The points of supply for ties, lumber, \&c., are at distances apart of $500,300,200$, and 700 miles, as timber is only found at the eastern extremity of the route, on the Black Hills, Wind River mountains, the Uinta and

Wahsatch mountains, and on the western slopes of the Sierra Nevada. The scattered growth of cedar upon the basin mountains may, perhaps, be found available for ties.

Should the coal-beds of Green river prove to be of such quality and extent as to admit of being profitably mined, the points of supply of fuel-the same as those just designated for lumber-will be importantly increased. Coal may then be had for nearly the cost of mining it at the eastern terminus of the road, for cost of mining near its middle, and at its western terminus for the cost of mining, and freight to that point from Puget sound.

Fuel for working-parties will generally be found contiguous to the route.
The winter climate is know to be severe on the plains east of the Rocky mountains in this latitude. That is more severe, and of long duration, upon the great table-land of the Rocky mountains is to be inferred. Lieut. Beckwith found the sun had not yet begun to melt the snow upon the terrace divide on the western border of the plateau, and about 1,000 feet above it, when he crossed the former, on the 10th April. The snow was here from twelve to sixteen inches deep, and had accumulated in deep drifts on the northeast slopes of the hills and ravines. Captain Stansbury found the Uinta mountains covered with snow for a considerable distance from their summits on the 19th August. The quantity of snow that falls upon the great undulating plain between Fort Laramie and Fort Bridger is not exactly known. It is probable that no unusual difficulty may be apprehended from it on this plain, or on the terrace divide, where crossed by Lieut. Beckwith; but the fall of snow in the Wahsatch and other mountains is very much greater, and accumulates in their gorges, ravines, and cañons, to great depths. Apparently, Lieut. Beckwith does not apprehend unusual difficulties from this cause along the proposed railroad route in this region, or in that of the Madelin Pass.

The supply of water along the Rocky mountain plateau must be very limited at certain seasons of the year; the distances apart of these supplies are not given.

Abundant supplies of water were found by Lieut. Beckwith on the mountains of the Great Basin. The season of the year when he crossed it-the spring-was the most favorable in this respect.

On this route, as on others, from the 98th or 99th meridian to the western slopes of the Sierra Nevada, a distance of 1,400 miles, the soil is uncultivable, excepting the comparatively limited area of the Mormon settlement, and an occasional river-bottom and mountain valley of small extent.

West of the Black Hills the plains are covered with artemisia, rarely furnishing and grazing except along the water-courses - the mountains being generally clothed, to a greater or less extent, with grass. The barren aspect of the Great Basin has already been described. In that desolate region there are but few and very limited areas where the conditions of soil, water, and temperature requisite for cultivation, are found.

The features of this route, favorable to the economical construction of a railroad, are apparent from the description of it which has just been given. Its unfavorable features may be briefly described: as the costly construction, for nearly three hundred miles along the Platte and Sweet Water, in ascending to the summit of the South Pass, in the cañon of the Timpanogos; in the two canons of the Sacramento, fourteen and nine miles in length; and in the very sinuous course of the river, for the space of ninety-six miles, through heavily-timbered mountains rising precipitously from the stream - the cost of constructing a railroad along which cannot be properly estimated until minute surveys are made.

Although the route passes over elevated regions, the sum ascents and descents is the next least after that of the 47th parallel, which is to be attributed to the table-land character of the mountain districts.

It partakes of the character of the route near the 47th parallel, in the long and severe winters on the plains east of the Rocky mountains and westward to the Great Basin.

The cost, as estimated in the office, from Council Bluffs to Benicia, a distance of 2.031 miles, is $\$ 166,095,000$.

The statistics of the route will be found in the table appended.
The survey of the western portion of this route by Lieutenant Beckwith, has resulted in the discovery of a more direct and practicable route than was believed to exist from the Great Salt lake to the valley of the Sacramento. Since his report was made, a brief communication from Brevet Lieutenant Colonel Steptoe, commanding the troops in Utah, has announced the discovery of a still more direct route from the Great Salt lake to San Francisco. The new portion of this route passes to the south of Humboldt river, or Mary's river, and, entirely avoiding the difficulties experienced by travelers along that stream, proceeds to the valley of Carson river, being well supplied with water and grass. From Carson river it crosses the Sierra Nevada, being practicable throughout for wagons.

In the absence of instrumental surveys affording data for the construction of profiles, no opinion can be formed as to the practicability of this route for a railroad. Should it be found practicable, however, it will lessen
the length of the route of the 41st parallel, and still further diminish it difficulties, already known to be less than on any other route except that of the 32d parallel.

## ROUTE NEAR THE THIRTY-EIGHTH AND THIRTY-NINTH PARALLELS OF NORTH LATITUDE

The general consideration that determined the position of the route to be examined near the $38^{\text {th }}$ and $39^{\text {th }}$ parallels of latitude, was its central position geographically, it being about midway between the northern and southern boundary lines of the Unites States, which is likewise the position, nearly, of the Bay of San Francisco; the two termini of the route, St. Louis and San Francisco, being respectively in latitudes $39^{\circ}$ and $38^{\circ}$, nearly. Moreover, a route near these parallels would probably give the shortest road from the Bay of San Francisco to the navigable waters of the Mississippi.

The exploration of the route conducted by Captain J.W. Gunnison, corps of Topographical Engineers, commenced on the Missouri at the mouth of the Kansas, about 245 miles from the Mississippi at St. Louis. The Kansas, and its branch called the Smoky Hill fork, were followed to a convenient point for crossing to the Arkansas, the valley of this latter river having been entered west of the Great Bend and near the meridian of $99^{\circ}$. The route then ascended the valley of the Arkansas to the mouth of the Apishpa creek, fifty miles above Bent's Fort; leaving it here, and crossing to the entrance of the Rocky mountains, here called the Sierra Blanca, at the Huerfano Butte, on the river of that name, a tributary of the Arkansas. The elevation at this point is 6,099 feet; its distance from Westport. mouth of the Kansas river, by the railroad route, 654 miles.

Of the several passes through the Ricky mountains connecting the tributaries of the Huerfano with those of the Rio del Norte, but one, the Sangre de Cristo, was found practicable for a railroad, the new and only practicable approach to this pass being explored by Capt. Gunnison. By side location the summit, 9,219 feet above the sea, 692 miles from Westport, was attained, and the descent made to the valley of the Rio Grande with practicable though heavy grades; and thence the grades were favorable to the vicinity of Fort Massachusetts.

The western chain of the Rocky mountains is now to be crossed in order to gain and traverse the basins of the two great tributaries of the Colorado of the West, Grand and Green rivers. For this purpose the valley of San Luis, an extensive, uncultivable plain, covered for the most part with wild sage, was ascended with easy grades to Sahwatch mountains, known by the name of the Coo-che-to-pa Pass.

The approach to the summit of the pass, 10,032 feet above the sea, 816 miles from Westport, is not favorable, the pass in this part having a defile character, overhung occasionally by walls of igneous rock. To cross the summit, a grade of 124 feet per mile for several miles, and a tunnel nearly two miles long, are required. The descent, with grades varying from 41 to 108 feet per mile, is by the valley of Pass creek, along which much cutting and filing will be necessary, as the hills are cut by numerous ravines. For 16 miles before the junction of Pass creek with Coo-che-to-pa creek, the former passes though a broken canon. After following Coo-che-to-pa creek seven miles, the valley of Grand river is attained.

The route follows the valley of this river 173 miles, then crosses the divide to Green river, 68 miles, and by the tributaries of the latter approaches the pass through the Wahsatch mountains. A tunnel three-quarters of a mile long is here required, the eastern approach to which is by means of grade 125 feet per mile for $6 \frac{1}{2}$ miles, and a descent to the west for 5 miles of 131 feet per mile. Thence westward along the valley of salt creek for 18 miles the grade is 95 feet per mile, 16 miles of which is through a rocky canon, intersected by lateral streams. The route then enters the valley of the Sevier, the exploration terminating on this river, 86 miles further on, and 1,348 miles from Westport.

From the western border of the state of Missouri to the Rocky mountains, 650 miles, no timber suitable for railroad purposes will be found, upon which reliance can be placed. From the Coo-che-to-pa Pass to the Great Basin, 500 miles, there is none available on the route, and the nearest supplies on the mountains bordering the Great Basin are in latitudes $40^{\circ}$ and $41^{\circ}$. With building stone it is about as well supplied as the other routes. Of water there is a sufficient supply, except between the Green and Grand rivers, a distance of 70 miles, where, at certain seasons of the year, little or none is found.

The soil west of the meridian of $99^{\circ}$ is, under the present meteorological conditions, uncultivable, except in limited portions of river-bottoms and small mountain valleys; there latter, from their great elevation, being better adapted to grazing than agricultural purposes. This description is completely in accordance with the geological formation and meteorological condition; the former, from the meridian of $99^{\circ}$ west, being apparently tertiary, excepting in the high mountain passes.

This route may be considered to posses, in common with that of the 41 st parallel, the large body of fertile soil in Utah Territory occupied by the Mormons, the area of which is about 1,108 square miles.

The coal field of Missouri lies at the eastern extremity of this route; the indications of coal in the Grand and Green River basins make it highly probable that seams sufficiently thick for profitable mining exist there.

In regard to grade and construction, it is unnecessary to enter into any discussion of that portion of the route from Westport to the Sangre de Cristo Pass. It presents no peculiar difficulties or advantages, but is similar to the route of the 47 th and 41 st parallels.

It would appear that the Sangre de Cristo and Coo-che-to-pa Passes are practicable in grade; but the construction of the road through the Coo-che-to-pa Pass, and the western approach to it, would be costly under favorable circumstances of population, \&c., not only on account of the tunnel, but of the numerous ravines that are crossed west of the pass, and the cañon that follows.

The following brief enumeration of the character and extent of the difficulties to be encountered between the Coo-che-to-pa Pass and the Great basin, make it evident that the route must be considered impracticable.

From the head of the canon on Grand river, not far below the mouth of Coo-che-to-pa creek, to the Uncompahgra river, a distance of 70 miles, the ground is cut up with deep, wide, precipitous ravines, the largest several hundred feet deep. These ravines cannot be turned near the mountains without encountering similar difficulties, and at a cost greater than that of a route along the river. Thus the route is forced upon Grand river, and along its canon, 60 miles in length, broken and interrupted by the deep ravines already mentioned and numerous small gullies. The roadway throughout the greater part of this distance must be blasted out of solid rock, and these wide ravines, from 100 to 200 feet deep, where they cut through the canon, crossed by viaducts or filling.

Then follow 50 miles to the mouth of Blue river, the construction still of a difficult and costly character, from the canons of the river and broken nature of the ground. From Blue to Green river is 100 miles, over which the road will require numerous bridges and culverts, and a costly road-bed foundation of broken stone or piling over a clayey soil, which in wet weather is almost impassable.

From Green river to the Wahsatch Pass, about 80 miles, the construction would still be of a costly character, the country being of the same ravine and chasm-like nature as that between the mouth of Coo-che-to-pa creek and Uncompahgra river, though on a smaller scale.

Next follows the Wahsatch Pass, the work in which is difficult and expensive. The greatest grade is 131 feet per mile; a tunnel not quite three-quarters of a mile is requisite; and finally, a canon 16 miles long on Salt creek, the walls of which are frequently broken by lateral streams, gives the only route along which the road can be brought, by cutting in solid rock at very great expense.

The difficulties of engineering and the cost of construction of this portion of the route from the Coo-che-topa Pass to Sevier river, in the Great Basin, a distance of about 500 miles, would be so great that it may be pronounced impracticable; and it is evident, from the report of Lieutenant Beckwith, that, to use his own language, " no other line exists in the immediate vicinity of this, worthy of any attention in connexion with the construction of a railroad from the Mississippi to the Great basin."

It is unnecessary, therefore, to consider the route further, or to enter into any discussion connected with the probable practicability and cost of constructing and working a railroad over other portions of the route where counterbalancing advantages are not found to compensate, in any degree, for the enormous cost of that under consideration.

Laying aside the utterly impracticable nature of this route, the following considerations will show its disadvantages as regards expenses of working, supposing it constructed:

From Westport to the west base of the Un-kuk-oo-ap mountains is 1,323 miles; sum of ascents 23,190 feet; of descents, 19,052 feet; length of equivalent horizontal line for the route, 2,123 miles.

Of the direct route form the point at the western base of the Un-kuk-oo-ap mountains, near where the survey under Capt. Gunnison terminated, to the Tah-ee-chay-pah Pass, there is no survey or positive information. There is every reason to believe that it is, for the most part, a desert of the same general character as other portions of the Great Basin. Supposing the route to be a straight line, with uniform descent from the Un-kuk-oo-ap mountains to the entrance of the Tay-ee-chay-pah Pass, in latitude $35^{\circ} 5^{\prime}$. (no pass being known to be practicable to the north of it in this portion of the Sierra Nevada, ) the distance will be 430 miles, and the descent 1,830 feet; the equated horizontal distance, 464 miles.

From the entrance of the Tay-ee-chay-pah Pass to San Francisco is 326 miles; sum of ascents 1,308 feet; sum of descents, 4,608 feet; equated length, 440 miles. Adding these together, with the equated distance from the
mouth of the Kansas to the west base of the Un-kuk-oo-ap mountains, we have total equated distance from Westport to San Francisco, 3,027 miles-the length of the straight horizontal line, which supposes no obstacle to be avoided, being only 1,500 miles.

The distance from Sevier river to Great Salt lake is 120 miles; sum of ascents and descents, 1,600 feet; equated distance, 150 miles; thence to Benicia, by the route near the $41^{\text {st }}$ parallel, explored by Lieut. Beckwith, is 872 miles; sum of ascents and descents, 15,200 feet: making the equivalent horizontal line 1,160 ; which added to the equated distance from Westport to Sevier river, 2,050 miles, we have a total of 3,360 miles, as the equated distance by this route from Westport to Benicia.

Neither in soil, climate, productions, nor in any other respect, does it possess advantages superior to other routes favoring the construction and working of a railroad.

The exploration of this route, conducted by Capt. Gunnison, of the corps of Topographical Engineers, exhibits the high professional skill and sound judgment which characterized that officer. The extensive and reliable information which he collected, and the exact manner in which his operations were conducted, up to the period in which he lost his life in the discharge of his duty, show how thoroughly he would have completed the task he had commenced, and how great a loss the service sustained in his untimely death. Several of his civil assistants fell with him, and the charge of the survey devolved upon Lieut. Beckwith, of the artillery, who has made, with the field-notes left by Capt. Gunnison, a thorough report of his explorations. Satisfied of the impracticability of the line he had traversed, Lieut. Beckwith commenced an exploration eastward from the Great Salt lake, to connect with that position with the line of the 41 st parallel, and then returning to Salt lake, continued the survey westward to the waters of the Pacific. This work, in all its parts, has been well done, and the topography well respected. More than ordinary credit is due to this officer, as the task performed by him was not in the line of his usual duties, and was executed without the aid of his assistants, and with the means left to the party after a season of field operations.

## ROUTE NEAR THE THIRTY-FIFTH PARALLEL OF NORTH LATITUDE

The general features which have determined the position of this route, the exploration of which was conducted by Lieut. A.W. Whipple, Topographical Engineers, are the extension, west and east, of the interlocking tributaries of the Mississippi, the Rio Grande, and the Colorado of the West. It would appear to possess also a greater yearly amount of rain the than regions immediately north and south of it-and, consequently, a better supply of fuel and timber.

Commencing at Fort Smith, on the Arkansas river, about 270 miles from the Mississippi at Memphis, the route, as far as the Antelope Hills on the Canadian, a distance of 400 miles, may follow either the valleys of the Arkansas and Canadian, or a shorter line perhaps, but over more ground, south of the Canadian, this latter route branching again, and following either the valley of the Washita, or the dividing ridge between it and the Canadian.

From the Antelope Hills the route continues along the bottom of the Canadian, on the right bank, to the mouth of Tucumcari creek, about 250 miles, and ascends by the valley of Tucumcari, or by that of Pajarito creek, to the dividing-ridge between the Canadian and the Pecos rivers, elevation about 5,543 feet, and enters the valley of the latter. It follows this valley until, by means of a tributary, it rises to the high table-land, or basin, lying east of the Rocky mountains, elevation about 7,000 , crosses the elevated Salinas basin, 30 miles wide, the lowest point being 6,471 feet, and gains the divide in the Rocky mountains, elevation about 7,000 feet; from which point it descends to Albuquerque, or Isleta, on the Rio Grande, though the San Pedro Pass; or it may descend to the Rio Grande by the valley of the Galisteo river, north of Sandia mountain. A third route is indicated along the valley of the Pecos to its headwaters; thence to an affluent of the Galisteo; and thence, as before, to the Rio Grande.

Isleta, on the Rio Grande, is 854 miles from Fort Smith, and 4,945 feet above the sea.
Crossing the ridge separating the Rio Grande from the Puerco, the route follows the valley of its tributary, the San José, to one of its sources in a pass of the Sierra Madre, called the Camino del Obispo; at the summit, (elevation 8,250 feet,) a tunnel three-fourths of a mile long, at an elevation not less than 8,000 feet is required, when the descent is made to the Zuñi and near the Pueblo of Zuñi; the route then crosses, over undulating ground, to the Puerco of the West, at the Navajo spring.

Another route across the Sierra Madre, about twenty miles further north, was examined by Mr. Campbell, which is apparently far more favorable. The profile, however, is not from reliable instrumental examination. The height of the summit is about 7,750 feet above the sea. The Puerco of the West heads in this pass, and the route follows the valley of this stream, (intersecting the other line at this stream,) to its junction with the Colorado

Chiquito; then the valley of that stream to the foot of the southeastern slopes of the San Francisco mountains, elevation 4,775 feet; distance from Fort Smith 1,182 miles, and from the crossing of the Rio Grande 328 miles. Here it ascends to the dividing ridge between the waters of the Gila on the south, and of the Colorado of the West on the north, and continues (or nearly so) upon it for about 200 miles, to the Aztec Pass, elevation 6,281 feet; distance from Fort Smith 1,350 miles. The highest point reached upon this undulating ridge is 7,472 feet, at Leroux's spring, at the foot of the San Francisco mountain. From the Aztec pass, the descent to the Colorado of the west is made by a circuitous route northward along valleys of its tributaries, the largest and last being Bill Williams's fork, the mouth of which, on the Colorado, is 1,522 miles from Fort Smith, and at an elevation above the sea of about 208 feet.

The Colorado is now ascended 34 miles, when the route, leaving it at the Needles, follows what was erroneously supposed to be the valley of the Mohave river, but which proved to be the valley of a stream, dry at the time, whose source was in an elevated ridge, which probably divides the Great Basin from the waters of the Colorado. The summit having been attained, at an elevation of 5,262 feet above the sea, the descent is made to Soda lake, the recipient at some seasons of the waters of the Mohave river, 1,117 feet above the sea, with an average grade of 100 feet to the mile for 41 miles-the steepest grade yet required on this route. From Soda lake the ascent to the summit of the Cajon Pass, elevation 4,170 feet, in the Sierra Nevada, is made by following the valley of the Mohave river. The summit of this pass, by the line of location, is 1,798 miles from Fort Smith, and 242 from the point of crossing the Colorado. Here a tunnel of $2 \frac{1}{2}$ or $3^{4} / 10$ miles through white conglomerate sandstone is required, descending to the west with an inclination of 100 feet to the mile, which grade will be the average for 22 miles into the valley of Los Angeles, if the broken character of the hills should be found, upon careful examination, to admit of such side location as would reduce to that degree the natural grades varying between 90 and 171 feet per mile. Thence to the Port of San Pedro the ground is favorable for location.

The principal characteristics of this route, in comparison with others, are, probably, its passing through or near more numerous cultivatable areas, its more abundant natural supply of water as far west as the Colorado, and the greater frequency and extent of forest growth on the route between the Rio Grande and the Colorado. These two latter characteristics entail a third, however, of an unfavorable nature-the large sum of ascents and descents.

Near the meridian of $99^{\circ}$ the change from fertile land to uncultivable is complete, excepting in the river bottoms, which are more or less fertile. Some portions of the upper valley of the Canadian, the upper valley of the Pecos, the valleys of the Rio Grande, Zuñi, Colorado, Chiquito, San Francisco, Colorado of the west, and its tributaries, possess a fertile soil, requiring generally irrigation to make it productive. That portion of the southwest corner of the Great Basin traversed by this route, and over which the explorations of Lieut. Williamson also extended, is well constituted for fertility, its barrenness resulting from the absence of rain. Generally the uncultivable plains have an abundance of nutritious grass, though there are extensive tracts where little or none is found.

The route may be considered sufficiently well supplied with good building-stone, since sandstones suitable for the bridge-building required are reported to exist in the generally soft trias formation, extending from Delaware mountain, on the Canadian, to the Rocky mountains, a distance of 600 miles.

Forest growth, furnishing timber of size suitable for ties and lumber for railroad uses, is found in the following localities: continuously on the route east of longitude $97^{\circ}$; in or near the Pecos valley; in the Rocky mountains and Sierra Madre; in the Mongollon mountains, (south of the route,) in which the Colorado Chiquito and some of its tributaries rise; on the slopes of the San Francisco mountain; and continuously with short intervals, for more than 120 miles; and on the Sierra Nevada. The distances apart of these points of supply are respectively 540 miles, 100 miles, 150 miles; from the Sierra Madre to San Francisco mountain, 250 miles; then for a space of about 120 miles the supply may be considered continuous; thence to the Sierra Nevada, 420 miles. If the road be built from the two termini, the greatest spaces over which ties, lumber, \&c., must be brought by it are 400 and 500 miles. The route, therefore, in comparison with others, is favorably circumstanced in this respect.

The same localities will supply fuel; and, in addition, the coal fields of Delaware mountain will furnish the eastern portion of the route where wood cannot be economically used. It is reported that coal exists in several localities in the Rocky mountains, both east and west of the Rio Grande, near this route, but there is no positive and reliable information that it has been found in sufficient quantities for profitable mining.

The route for 540 miles east of the Sierra Nevada must receive its fuel from the ports of the Pacific.
Over portions of this route, as upon all others, no fuel whatever, not even sufficient for working parties, will be found. The greatest distance over which this total absence of fuel exists, is between the Colorado and Mohave rivers, 115 miles.

The exact distances over which water is not found at certain seasons is not stated.
Between the 100th meridian and the Pacific there are spaces destitute of it, where, from the known character of the geological structure, there is no doubt that sufficient supplies can be obtained either by deep common wells, artesian wells, or reservoirs.

These more abundant supplies of timber and water, west of the Rio Grande, are attained at the expense of great elevation and somewhat rugged ground.

The Galisteo Pass in the Rocky mountains, and the passes in the Sierra Madre, being wide openings, or valleys, rather than mountain passes, no difficulty need be apprehended from snow, even if it fell to greater depths than those known; over the remainder of the route no difficulty from this cause is to be met with.

The sum of the ascents from San Pedro to Fort Smith is 24,641 feet; of descents 21,171 feet; equivalent, in the cost of working the road, to an increased horizontal distance of 924.5 , which added to the length of the line of location, 1,892 miles, gives for length of equated distance 2,816 miles.

The general features of the country indicated lines fro examination at more than one point, which will probably greatly improve the route by reducing the ascents and shortening distances. The party was, however, unable to examine them.

The heaviest grades that will probably be required on the route from Fort Smith to San Pedro, do not equal those in use on the Baltimore and Ohio railroad.

The description of the topographical features of the route is not sufficiently minute to enable one to form a satisfactory opinion of the difficulties of ground to be encountered, and, consequently, of the probable cost of the formation of the road-bed. Lieut. Whipple assimilates the several portions of the route to roads already built, possessing, as nearly as possible, similar features and difficulties.

Four hundred and eighty (480) miles of the route are assimilated to the Hudson River railroad, 151 to the Worcester and Albany railroad, (Western railroad,) and 374 miles to the Baltimore and Ohio railroad - making 1,005 miles assimilated to railroads among the most costly that have been constructed in the United States.

The impression given by the description of the route in the report induces the opinion that the ground is more favorable than the comparison of Lieut. Whipple supposes.

Assuming this assimilation to be correct, and bringing the estimate to a uniform standard of increased cost over eastern prices and equipment, the estimated cost of the route from Fort Smith to San Pedro becomes \$169,210,265.

The estimate is believed to be, as above stated, in excess: but the data for reducing it have not yet been reported to the department.

Should it be desired to reach San Francisco by the Tulares and San Joanquin valleys, the route should leave the Mohave valley some 30 miles before reaching the entrance to the Cajon Pass, 1,768 miles from Fort Smith elevation about 2,555 feet - and proceed across the southwest corner of the Great Basin towards the Tah-ee-chaypah Pass, reaching its entrance at an elevation of 3,300 feet, in a distance of abotu80 miles. The route from this point is coincident with that hereafter described for the 32d parallel.

The sum of ascent from San Francisco to Fort Smith, by eh route from Mohave river to Tayee-chay-pah Pass is 25,570 feet; of descents, 25,100 feet; the equivalent in miles of horizontal road is 963 miles, which added to the location-distance between those two points, 2,174 miles, gives for equated length of road 3,137 miles.

The exploration of the route by Lieut. Whipple, and his report thereon, are entitled to the highest commendation, for the completion of the work in all its parts, the full and exact observations which he made for the determination of longitudes and latitudes, and the wide range of scientific research which he instituted into all the collateral branches connected with the question which his exploration was designed to solve.

## ROUTE NEAR THE THIRY-SECOND PARALLEL OF NORTH LATATUDE

Among the considerations which determine the general position of the route near the 32d parallel, are the low elevation of the mountain passes in this latitude, and their favorable topographical features, as well as those of the table-lands, extending over more than 1,000 miles of the route; the favorable character of the surface generally, on the route, by which the most costly item of construction in railroads, the formation of the road-bed, is, in a great measure avoided; the shortness of the line, 1,600 miles, from the navigable waters of the Mississippi to the Pacific, and the temperature climate on the elevated portions in this southern latitude.

The explorations made upon this route are, from Preston, on Red river, to the Rio Grande, by Capt. John Pope, Topographical Engineers; from the Rio Grande, near Fort Fillmore, to the Pimas villages, on the Gila, by

Lieut. John G. Parke, Topographical Engineers. From the Pimas villages to the mouth of the Gila, the reconnaissance in New Mexico and California of Major W.H. Emory, Topographical Engineers, in 1846, has been used; and from the mouth of the Gila to San Francisco, the exploration of Lieut. R.S. Williamson, Topographical Engineers, has furnished the data.

Fulton, on the Red river, about 150 miles from the Mississippi, may be considered the eastern terminus of the route, although the examination of Capt. Pope extends only to Preston, 133 miles further west. A direct line from Fulton to the point on the eastern border of the Llano Estacado selected by Capt. Pope for crossing it, would give more favorable ground than that traversed by him between Preston and this point; the latter in a distance of 325 miles gives generally easy grades and cheap construction through a country alternately wooded and open, abundantly supplied with water and fuel, and with forest growth suitable for ties and lumber for two-thirds of the length. From Fulton to the eastern border of the Llano Estacado is 485 miles, 370 of which are wooded.

The exploration of Capt. Pope comprised three distinct belts of country, the first of which has just been described above. The second is the Llano Estacado, whose mean elevation is 4,500 feet, the smooth surface of which along the route proposed, 125 miles from the eastern border to the Pecos river, presents in this respect great facilities for the construction of a railroad. It is, however, at certain seasons of the year destitute of water, is scantily supplied with grass, and not a single tree is to be seen upon it. Its geological formation is such as to render the success of obtaining water by artesian wells, at moderate depths, highly probable. During, and for some time subsequent to the rainy season, there are here, as on most other arid plains, numerous ponds, the contents of which might be collected in reservoirs; but the distance from the Colorado Springs to the Pecos, 125 miles, is not so great as to form a serious obstacle to the working of a railroad.

Between the Pecos and the Rio Grande, 163 miles, three mountain chains rise from the table-lands, the Guadalupe, Hueco, and Organ mountains. The Guadalupe mountain is crossed without a tunnel, elevation of summit 5,717 feet, and with a grade of 108 feet to the mile for 22 miles. A high viaduct and heavy cutting and filling for three miles near the summit, form the costly and difficult part of the pass. The Waco Pass is still more favorable, the greatest grade begin about 80 feet to the mile; the elevation of the summit, 4,812 feet. The Organ mountains turned just before reaching the Rio Grande at Molino and El Paso.

A peculiarity of the mountains in the western part of the continent, in this and in other latitudes, is, that they have no intervening deep secondary valleys between the main chain and the plains. Over the unusually uniform and smooth surface of these lat, the general elevation of which, between the Pecos and the Rio Grande, is from 4,000 to 4,500 feet, the valley of the Rio Grande is attained near Molino, at an elevation of 3,830 feet, and at a distance of 787 miles from Fulton.

The region between the Rio Grande and the Pimas villages on the Gila, just above which point the latter leaves the mountain region, may be described as a great plain, interrupted irregularly and confusedly by bare, rugged, abrupt, isolated mountains or short ranges, around or through the passes in which a railroad may be constructed with quite practicable grades. The mean elevation of this plain, or series of basins into which the ridges divide it is above 4,100 feet; the mean elevation of the summits of the passes through the ridges is 4,700 feet, the highest, through the Chiricahui range, being 5,180 feet. Except through the passes, the surface is so smooth as to require but little preparation to receive the superstructure of a railroad; and even in the two most difficult of the passes, the natural slope of the ground may be used for a railroad until the construction of the road reduces the cost of materials and supplies to the lowest rates. In one of these two passes (the Chiricahui) the steepest natural slope is 194 feet per mile for $2 \frac{1}{4}$ miles. In the second pass the steepest natural slope is 240 feet per mile for three-fourths of a mile. Both these grades are within the power of a thirty-ton engine carrying 200 passengers and baggage.

In one case deep cutting in rock, or a tunnel near the surface, at the summit, with heavy side cutting and high embankments for short distances; and in the other, a short cut of 60 feet probably through rock, are proposed by Lieut. Parke, to attain grades of 46 feet and 90 feet per mile, or less by increasing distance.

The great difficulty experienced in crossing this distance is in the long distances over which no water is found at certain seasons. The survey by Lieut. Parke was made during the driest season of the year, and, irrespective of the springs found at intermediate points, the whole distance between the two rivers, Rio Grande and Gila, may be divided into five spaces, varying from 80 to 53 miles in length, at the termination of which large permanent supplies of water are found at the most unfavorable season of the year.

These spaces and points are-
From the Rio Grande to the Rio Mimbres
71 miles
From the Rio Mimbres to the stream of the Valle de Sauz.

From the Valle de Sauz to the San Pedro........................................................... 80
From the San Pedro to the Tuszon..................................................................... 53
From the Tuzcon to the Gila 79
Not counting the stream of the Valle de Sauz, the distance from the Rio Mimbres to the San Pedro is 152 miles; which distance is not so great that railroad trains could not cross without water, special arrangements having been made for the purpose. But this is the worst aspect of the case. At other seasons the supply of water is more abundant, and lakes and ponds are formed upon the plains, which may be drained into tanks; and the geological is such as to indicate the existence of sufficient supplies of water beneath the surface which may be brought to it by artesian wells.

The line proposed by Lieut. Parke leaves the Rio Grande near Fort Fillmore, 35 miles from Molino, between which points the river, where confined to one channel, is about 30 yards wide, crosses the district just described, and enters the valley of the Gila near the Pima villages, the elevation above the sea being 1,365 feet. The route then follows this river to its junction with the Colorado, a distance of 223 miles, with a general slope of 5.6 feet per mile. The Gila, in this distance, flows through a plain with occasional mountains, ridges, and peaks; its valley is highly favorable to cheap construction from its generally smooth surface and from not being liable to freshets.

From the point now attained, the nearest point in out territory is San Diego, but the passes of the intervening Coast range are very difficult, if not impracticable, and the route is forced northward to the San Gorgonio Pass, which is much the most favorable of the passes in the coast range explored by Lieut. Williamson for this route. It is an open valley, from two to five miles wide, the surface smooth and unbroken, affording, in its form and inclination, every facility to the building of a railroad. The entrance of this pass is 133 miles from the mouth of the Gila, in a straight line over the Colorado desert, a smooth and nearly horizontal plain, requiring but little preparation for the superstructure of a railroad. Thirty-five miles of this is a gravel plain; the remainder is alluvial soil, which only needs irrigation to be highly productive. On this latter soil, water is found at a depth of 30 feet.

The steepest natural slope, in ascending to the summit of this valley pass, (elevation 2,808 feet) is 132 feet per mile for two miles.

San Diego and San Pedro can be reached by lines of about equal length from the San Gorgonio Pass. To the former, the first section of the route to San Luis Rey (about 75 miles long) would pass through a country generally favorable to the construction of a railroad, being a plain with numerous hills from 500 to 1,00 feet high, irregularly distributed on its surface, between and around which a road may be carried with favorable grades. Between San Luis Rey and San Diego, however, about 40 or 50 miles, the coast is cut into numerous deep intricate gullies by the drainage of the plain.

To San Pedro, about 125 miles, the route lies almost wholly over the same description of ground as that constituting the first section of the San Diego route, and avoids the obstacles presented by the second. It is, therefore, assumed that the terminus of this route should be at San Pedro, the point which it has now reached. It may, however, be proper to remark that San Pedro is an open roadstead, and would require the construction of a breakwater to constitute it a safe harbor.

From the report of Capt. Pope, it would appear that the belt of fertile land which lies on the west side of the Mississippi throughout it length, extends on this route nearly to the headwaters of the Colorado of Texas, in about longitude $102^{\circ}-$ that is, about three degrees further west than on the more northern routes. The evidence adduced in support of this opinion is not, however, conclusive; and, until it is rendered more complete, the fertile soil must be considered in this, as in other latitudes, to terminate about the 99 th meridian. Thence to the Pacific slopes the route is over uncultivable soil, though generally grasses, the exception being as on the route of the 35 th parallel, in portions of the valleys of the Pecos, Rio Grande, Gila, and Colorado of the West. The table-lands and mountain slopes are usually well covered with grama-grass, and in New Mexico have supported immense heads of cattle. There are exceptions to this, however, on the greater portion of the Llano Estacado, on portions of the plains between the Rio Grande and the Gila; and (comprised in that space) from Tuczon to the Gila, 80 miles, there is no grass on the route travelled, nor is it to be found on the Lower Gila valley; occasional patches of bunch-grass only being found on the plain, and a species of grama-grass sometimes upon the mountain sides. No grass is found on the Colorado desert, 135 miles long along the line of location.

The length of the route along this generally uncultivable soil is 1,210 miles. Upon descending from the summit of the San Gorgonio Pass, on the route to San Pedro, the soil is fertile, and either well watered or can be irrigated.

The climate throughout the route is salubrious, the heat due its southern latitude being moderated by the elevation of the table-lands. on the Colorado desert it is torrid, but not unhealthy, and much of the country west of the Sierra Nevada and Coast range is celebrated fro health and agreeableness.

The principal characteristic of this route is the great extent of high, arid, smooth, and nearly horizontal tablelands which it traverses, reaching an elevation of 4,000 feet upon the dividing ridge between the Brazos and Colorado rivers of Texas, near which elevation it continues until it descends from the pass of the Guadalupe and Hueco mountains, east of the Rio Grande, 5,700 and 4,800 feet, respectively. Between the Rio Grande and the Gila, the greatest elevation, which is twice attained, is 5,200 feet; the mean elevation, before the descent to the Gila is commenced, being 4,1000 feet. From the eastern edge of the Llano Estacado to the pass of San Gorgonio, 1,052 miles, the route crosses three rivers, the Pecos, the Rio Grande, and the Great Colorado of the West. The peculiar features of the arid region over which the route lies from the eastern edge of the Llano Estacado to the summit of the San Gorgonio Pass, proves when closely examined, to be most favorable to the construction of the railroad, since they obviate to a great degree the necessity of the most costly item of railroad construction, the preparation of a road-bed for the superstructure; this preparation, with few and limited exceptions, throughout a distance of about 1,000 miles, having been already made by nature. This item amounts to from one-half to threefourths of the whole cost of a railroad. Draining and ballasting are also dispensed with at the same time. Over the remaining portions of the route, the ground is generally favorable to the construction of a road-bed. The mountain passes are, of their kind, highly favorable, those west of the Rio Grande requiring no difficult engineering for location through them, and but little rock excavation or expensive embankment and side-cutting. The Guadalupe and Hueco Passes are more difficult.

The most favorable supposition for supplies of ties and lumber for the construction of that portion of the route between the eastern limit of the Llano Estacado and the summit of the San Gorgonio Pass, 1,052 miles, is that they are to come from either end of the road, from 300 miles east of the Llano Estacado, and from the port of San Pedro on the Pacific, 1,400 miles apart.

It is supposed that the road is to be built from both ends, in sections not greater than 50 miles each, and made to aid in building itself, transporting its own material, \&c., so far as the proper adjustment of economy and means will admit; this would bring the mean cost of lumber over this distance of 1,052 miles to $\$ 521 / 2$ per 1,000 feet, and the mean cost of ties to $\$ 1,760$ per mile.

The worst case having been examined, it remains to be said that ties and lumber can be obtained on and near this portion of the route from the Guadalupe and Hueco mountains, from the headwaters of the Rio Mimbre, from Pinal Lleno, from the Salinas river (tributary of the Gila) and headwaters of the San Francisco, and from the San Bernardino mountains of the Coast range; which source of supply, the length apart of the most distant being 500 miles, may be found to materially obviate the necessity of transporting lumber from the two ends of the road.

The coal of the Brazos and that from Puget sound may be used over the 1,200 miles from San Pedro, to within 200 miles of the Brazos, at a mean cost per ton of $\$ 16$.

The portions of the route where unusual means must be resorted to for supplies of water, have already been pointed out. Under the most unfavorable suppositions, the cost per mile. over these portions, of obtaining water by artesian wells, will not probably exceed $\$ 1,000$, an expenditure greatly overbalanced by the savings in roadbed formation, from the regularity and smoothness of surface of the arid regions.

The mode and probable cost of obtaining water at short distances in these dry regions. by artesian wells, reservoirs, and deep common wells, are discussed in the accompanying detailed reports. The practicability of the method by artesian wells is now being subjected to trials.

If these should fail, of which, however, in the Llano Estacado, there is little probability. the permanent streams and large springs are sufficiently near for the purposes of a railroad, and since its construction over these districts will require small working parties, the expense of supplying them with water and fuel, when necessary, will not largely increase the cost of construction. It is probable that the region between the Rio Grande and the Gila, 350 miles by the route explored, is more arid than corresponding regions on the more northern routes, but the construction of works of an unusual kind on railroads for supplies of water, are as essential on all these routes as upon that now under consideration.
The length of this route from Fulton to San Pedro is ..............................................1,618 miles.
The sum of the ascents and descents. .32,784 feet;
To overcome which is equivalent, in the cost of working the road, to traversing a
horizontal distance of 621 miles; and the equated length of the road is.
.2,239 miles.
The estimated cost is.
. $\$ 68,970,000$

## EXTENSION OF THE ROUTE OF THE THIRTY-SECOND PARALLEL TO SAN FRANCISCO

For a connexion with the Bay of San Francisco, the most direct route from the San Gorgonio Pass would be through one of the passes leading from the plain of Los Angeles to the valley of the Salinas river. The practicability of the passes is yet to be determined, and an exploration is now being made for this purpose. With the information now possessed, the Bay of San Francisco must be reached by crossing the Coast range to the Great Basin, passing over its southwestern extremity, then crossing the Sierra Nevada and descending to the Tulares valley.

The best pass by which to reach the Great Basin is the "New Pass," made known by Lieut. Williamson's explorations.

Descending from the summit of the San Gorgonio Pass to the town of San Bernardino, 24 or 25 miles distant, with natural slopes less than 80 feet per mile, excepting for 1.3 mile, where the slope is 127 feet per mile, the route to the Mission and Low Pass of San Fernando (about 100 miles from the summit of San Gorgonio) is over a country giving gently undulating grades, and in other respects favorable to construction, in fertile soil, building-stone, water, and fuel.

The San Fernando Pass is about eight miles through. Its summit has an elevation of 1,949 feet. A tunnel is required one-third of a mile long, through soft sandstone, 203 feet below the summit. An ascent of 620 feet is made on the south side, with grades of 155 feet per mile for four miles along the natural slopes, which cannot be reduced by side location without great expense, and a descent of four miles of 115 feet per mile, with heavy sidecutting in earth on the north side. The ascent to the New Pass in the valley of Santa Clara is now begun, and with a cut of 50 feet for a short distance at the summit in drift, the summit is attained in 29 miles over natural slopes without side location, and with grades varying from 55 to 105 feet per mile. For the space of one mile on the ascent, the mountains close in precipitously, and the streams wind abruptly; and it may be necessary here to cut two or perhaps three short tunnels, from 100 to 300 feet long, through slaty granite. The elevation of the summit is 3,164 feet. Descending to the Great Basin, cutting and filling will be required for two or three miles to adjust the natural slope to the grade west of the summit. After that, and until descending into the Tulares valley by the Tah-ee-chay-pah Pass, a distance of about 70 miles, the ground will require little preparation for the superstructure. The lowest level descended into the Great Basin is about 2,900 feet.

The Tah-ee-chay-pah Pass, first explored throughout by Lieut. R. S. Williamson, is the most favorable in the part of the Sierra Nevada. Its summit is a nearly horizontal prairie for $7 \frac{1}{2}$ miles. The elevation of its entrance from the Great Basin is 3,300 feet, from which the natural slope ascends at the rate of 22 feet to the mile for 12 miles, then at 80 feet per mile for 9 miles, to the prairie summit.

The descent to the Tulares valley is $15 \frac{1}{2}$ miles by the natural slopes, which vary from 153 to 192 feet per mile, a side location in earth-cutting giving an average grade of 114 feet per mile for 17 miles, which may be reduced still further by an extension to 21 miles-the Tulares valley being entered at an elevation of 1,489 feet. There are two intervals of 13 and 17 miles in the Great Basin where there is no water. Artesian wells here, as in similar formations between the Rio Grande and the Gila, will probably reach supplies at moderate depths. Deep common wells may be successfully resorted to.

The natural slopes of the three passes just considered are within the power of a thirty-ton engine with a load of 200 passengers, each with 100 pounds of baggage.

Supposing twenty-ton engines used, and that they carried the maximum load adapted to the other portions of the road, where the greatest grades are 40 feet to the mile, it would be necessary to divide this load into three parts to pass a grade of 150 feet per mile; and the grades being brought to that, its disadvantage consists in the expense of two additional engines worked though the passes.

From the head of the Tulares valley, the navigable waters of the Bay of San Francisco may be reached in several ways.

The eastern side of the Tulares and San Joaquin valleys is intersected by numerous streams from the Sierra Nevada. The western is bounded by the Coast chain, and has few streams. That part of the Tulares valley between Kern and San Joaquin rivers, a space of 150 miles, having a soft alluvial sol, is, at certain seasons, miry; a road, therefore, extending through it, should keep near the foot-slopes of the mountains. From the Tah-ee-chaypah Pass to the best point of crossing Kern river, $21 \frac{1}{2}$ miles, the route passes over a dry, dusty plain, destitute of water and fuel, the soil of which is not well constituted for fertility.

From the crossing of Kernriver to the second crossing of San Joaquin, near Grayson's, the numerous riverbeds or bottoms should be crossed on piles, the spaces varying from 50 to 300 feet-the greatest width to be spanned not exceeding 100 feet. From Tah-ee-chay-pah Pass to the Straits of Martinez, the location distance would be 288 miles. The most direct route to San Francisco from the Tah-ee-chay-pah Pass will be found through one of the passes known to exist in the mountain range separating the Tulares and San Joaquin valleys from those of the Salinas and San José rivers. The distance through it is about 10 miles; the elevation of the passes about 600 feet. From Tah-ee-chay-pah Pass the route should cross the western side of the Tulares valley, around the head of the lakes, and enter the Salinas valley as soon as practicable.

The soil of the Tulares valley, north of Kernriver, and of the San Joaquin valley, is well constituted for fertility, and needs merely the proper amount of water to be highly productive. Sufficient water and fuel for working parties can be found at convenient distances on this section, (excepting where it crosses the Great Basin, and approaching Kern river; the amount of deficiency on these portions having already been given.) Lumber and good building-stone are found at various points in the mountains, accessible from their foot slopes. For fuel for locomotives, the coal of Puget sound and Vancouver's island must probably be depended on.

The topographical of this extension of the route are, with the exception of the mountains, favorable to cheap construction. The mountain passes are likewise of a favorable character, their only objectionable character being their high grades. The nature and extent of this objection has already been stated, and, it is seen, is not serious.

From Fulton to San Francisco the distance is 2,039 miles; the sum of the ascents and descents 42,008 feet, which is equivalent to 795 miles; and the equated length of the road is 2,834 miles; the estimated cost is \$93,120,000.

To Lieut. Williamson, assisted by Lieut. Parke, was instructed the survey of a route from the Bay of San Francisco to the junction of the Gila and Colorado rivers, connecting with the ports of San Pedro and San Diego on the one side, and on the other with the most practicable mountain passes. His work has been thoroughly and handsomely executed, presenting much new and valuable information of the mountain passes on the southern portion of the Sierra Nevada and Coast range. The geological examination, made under his orders, is highly credible and instructive.

The examination of the middle section of the route of the 32d parallel, by Lieut. Parke, was very thorough, and highly credible, though executed with small means; and his report very satisfactorily exhibits the character and essential features of the country over which he performed in this region, rendered it unnecessary to do more than make what may be strictly called a railroad exploration.

The examination of the eastern portion by Capt. Pope, assisted by Lieut. Garrad, of the dragoons, was made under the most disadvantageous circumstances, the party having been organized at a remote point, where neither instruments, nor assistants specially instructed in the scientific branches connected with the survey, could be procured. It was, however, creditably performed, and satisfactorily exhibits the topography and general character of the country along the line surveyed.

## CONCLUSION.

To aid in a comparison of the several routes, reference is made to a table prepared by Capt. A. A. Humphreys, and hereto appended.

With regard to the estimates of cost, although believed to be as accurate as can be made under present circumstances, they are to be considered as intended not so much to show the absolute sums of money which would build the several roads, as to represent the relative quantities of materials and labor required for the purpose. If now tested in the actual construction of any one of the roads, they will doubtless be found to contain errors; but as the same data have been assumed on all the routes, the same amount of error will probably be found in each, and the actual expense will thus preserve the same proportion.

With regard to the equated length of the several roads, or, in other words, the influence of ascents and descents on the expense of working, it is proper to direct attention to the remarks of the engineer, appended to the tables, in which he states that, on all the routes, the amount reported will be subject to increase when the minor undulations of the ground shall be measured; and this increase will be the greatest on those routes and in those portions where the features of the country are less irregular-that is, where there are most of such minor undulations to be measured. The equated distances also affect the cost of working on a road only under certain circumstances, which may or may not exist on the contemplated route.

A comparison of the results stated above, and of those exhibited in the tables referred to, conclusively shows that the route of the 32d parallel, is of those surveyed, "the most practicable and economical route for a railroad from the Mississippi river to the Pacific ocean."

This is the shortest route; and not only is its estimated cost less by a third than that of any other of the lines, but the character of the work required is such that it could be executed in a vastly shorter period. It is obvious that a road on any of there routes, with the exception perhaps of the 47th parallel, must be built continuously from the two extremities, and an obstacle that arrests it progress at any point defers the commencement of all the work in advance. The tunnels and much of the other work on the more northerly routes in the most desolate regions are such as could not be commenced until a road was constructed up to those points, and would then require a long period for their completion.

On the southernmost route, on the contrary, the progress of the work will be regulated chiefly by the speed with which cross-ties and rails can be delivered and laid, the nature of the country being such that throughout the whole line the road-bed can easily be prepared in advance of the superstructure. The few difficult points, such as the Pass of the Guadalupe and Hueco mountains, and the passes between the Rio Grande and Gila, would delay the work but an inconsiderable period.

This peculiarity of the ground presents another advantage in the fact that temporary tracks could be laid upon the natural surface of the earth to almost any extent, to serve for the transportation of materials and supplies.

The climate on this route is such as to cause less interruption to the work than on any other route.
Not only is this the shortest and least costly route to the Pacific, but it is the shortest and cheapest route to San Francisco, the greatest commercial city on our western coast; while the aggregate length of railroad lines connecting to it at its eastern terminus with the Atlantic and Gulf seaports is less than the aggregate connexion with any other route, as will be seen by reference to the appended table B.

With regard to the circumstances which affect the cost of working and maintaining the road, they are more favorable than on any other route. In this dry climate the decay of cross-ties and other timber would be very slow, and the absence of severe frost would have a most important influence upon the permanence of the road-bed, and heavier grades could be adopted than in a climate where ice and snow prevail.

The snows on all the other routes, except that of the 35th parallel, could not fail at certain seasons to suspend the working of the road, for on all, such snows are known to have fallen as would interpose an effectual barrier to the passage of trains. Such an occurrence in this desolate region would be attained with more serious consequences than in inhabited districts.

In only one important aspect is this route supposed to be lass favorable than some of the others, and that is, in the supply of fuel. The difference, however, in favor of the others is not great, unless the existence of coal at certain points along these routes where it is indicated should be verified by further examination. The cost of fuel is about one-fifth of the whole expense of maintaining and working a railroad.

The grades of the several routes, and other similar information, will be found upon the sheets of profiles compiled in the office.

In the determination of the explorations proper to be made-in the examination of the reports of the surveying parties, the preparation of the profiles, and of a general map to exhibit, in their geographical relation to each, all the routes of which an instrumental examination had been made-I am greatly indebted to the assistance which has been rendered by the officers of the corps of topographical engineers employed by the office established here in connexion with the explorations directed by the act; and I will here especially acknowledge my obligations to Major W. H. Emory, whose extensive knowledge of the western regions of our country, no small part of which he had actually explored, and whose sound judgement in all things connected with topographical reconnaissance and field operations, gave me important aid in the organization of the work and the subsequent office examinations necessary to systematize its results.

When, in August, 1854, Major Emory's duties as commissioner to run the boundary-line between Mexico and the United States separated him from further connexion with these explorations, he was succeeded by Capt. A. A. Humphreys, whose high scientific attainments and power of exact analysis had been manifested in several important positions which he had held, and are further shown in the able and comprehensive examination, herewith submitted, of the reports of the several parties of exploration.

Lieut. G. K. Warren, first under Major Emory, and subsequently under Captain Humphreys, has been specifically intrusted with the preparation of the materials and construction of the general map, together with the compilation of profiles of all the routes which had been instrumentally surveyed, and the collection of all general
information which would aid in the determination of the question before the department. In these duties he has recently had the zealous and efficient aid of Lieut. H. L Abbot.

These laborious and important duties have been performed by the officers above named with the most commendable diligence and intelligence, and much of whatever success belongs to the preparation and presentation of the matter collected is due to these officers.

Capt. McClellan, of the corps of engineers, after the completion of his field operations, was directed to visit various railroads, and to collect information of facts established in the construction and working of existing railroads, to serve as data in determining the practicability of constructing and working roads over the several routes explored. The results of his inquiries will be found in a very valuable memoir herewith submitted.

Very respectfully, your obedient servant, JEFF'N DAVIS, Secretary of War.

Hon. Linn Boyd, Speaker of the House of Representatives.

TABLE OF LENGTHS, ETC.
A.

Table showing the lengths, sums of ascents and descents, equated lengths, cost, \&c., of the several routes explored for a railroad from the Mississippi to the Pacific. (For Grades, see the profiles accompanying the report.)

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|  |  |  |  |  |  |  |  |  |  |  |  |  | 8 8 $i$ 0 0 8 8 - | 8 8 0 0 0 0 $i$ |  | $\begin{aligned} & 8 \\ & 0 \\ & 0 \\ & 0 \\ & 0 \\ & 0 \\ & 0 \\ & 8 \\ & 0 \end{aligned}$ |  |  |  |  |
| Route near 47th and 49th parallels, from St. Paul to Vancouver | Miles <br> 1,445 | $\begin{aligned} & \text { Miles } \\ & 1,864 \end{aligned}$ | $\begin{aligned} & \text { Feet } \\ & 18,100 \end{aligned}$ | $\begin{aligned} & \text { Miles } \\ & 2,207 \end{aligned}$ | * $\$ 130,781,000$ | 374 | $1,490$ | $\\| 1,000$ | 470 | 580 | 720 | 130 | 97 | 28 | $\ldots$ | $\ldots$ | . | $\cdots$ | $\begin{aligned} & \text { Feet } \\ & 6,044 \end{aligned}$ | Tunnel at elevat'n of 5,219 feet. |
| Extension thence to Seattle | $\ldots .$. | 161 | 1,000 | 180 | * $10,090,000$ | 161 | . | $\cdots \cdots$ | 161 |  |  |  |  |  |  |  |  |  |  |  |
| Route near the 41st and 42d parallels, via South Pass from Council Bluffs to Benicia | 1,410 | 2,032 | 29,120 | 2,583 | 116,095,000 | 632 | 1,400 | \|| 1,100 | 180 | 170 | 210 | 160 | 580 | 285 | 270 | 107 | 20 | . | 8,373 |  |
| $\dagger$ Route near the 38th and 39th parallels, from Westport to San Francisco by the Coo- che-to-pa and Mandelin Passes | 1,740 | 2,080 | 49,986 | 3,125 | Cost so great that the road is impracticable | 620 | 1,460 | \|| 1,100 | 340 | 276 | 165 | 348 | 466 | 170 | 60 | 155 | 80 | 20 | 10,032 | Tunnel at elevat'n of 9,540 feet. |
| The same, from Westport to San Francisco by the Coo-che-to-pa and Mandelin Passes | 1,740 | 2,290 | 56,514 | 3,360 | . do.... | 670 | 1,620 | 1,100 | 275 | 308 | 190 | 143 | 725 | 284 | 110 | 155 | 80 | 20 | 10,032 | Tunnel at elevat'n of 9,540 feet. |


| Route near the 5th parallel, from Fort Smith to San Pedro | 1,360 | 1,892 | 48,812 | 2,816 | $\ddagger 169,210,265$ | 416 | 1,476 | 2,300 | 305 | 347 | 260 | 185 | 160 | 305 | 235 | 95 | . | . | 7,472 |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Brach road to San Francisco, from the Mohave river | $\ldots$ | 406 | 7,500 | 506 | 19,935,000 | 322 | 84 | $\ldots$ | 290 | 10 | 72 | 35 |  |  |  |  |  |  |  |  |  |
| Route near the 32d parallel, from Fulton to San Pedro | 1,400 | 1,618 | 32,784 | 2,239 | 68,970,000 | 408 | 1,210 | 2,300 | 485 | 300 | 100 | 170 | 503 | 60 | $\cdots$ | $\cdots$ | $\cdots$ | . | 5,717 |  |  |
| Extension to San Francisco | . | 440 | 10,510 | 632 | 25,100,00 | 376 | 70 | $\ldots$ | 290 | 50 | 65 | 35 |  |  |  |  |  |  |  |  |  |

[^0]
## NOTE TO TABLE A.

The sum of ascents and descents given for the various routes, does not take into account those minor undulations which sometimes largely increase the aggregate.

I think it probable that when detailed surveys are made, it will be found that this sum for the route near the 32d parallel will be less increased than the others.

The equated lengths corresponding to these sums, may give erroneous impressions. If the loads to be habitually carried over the roads are within the power of the engines over the greatest grades proposed, then the sums of ascents and descents really have little meaning or value. The wear and tear of rail and machinery, and consumption of fuel, would be somewhat greater on the road having the largest sum; but the difference would not be worth taking into account, unless there was an equality in all other respects between the routes.
If there are some grades so steep as to require the division of loads habitually carried over other portions, the cost of the extra locomotives, and of working them over those portions, will show the extent of the disadvantage and yearly cost.

So far as any estimate has been made by me of the amount of work to be done on the roads, these sums of ascents and descents have little practicable value, since those portions of the routes have been indicated where it may be considered advisable to steep natural slopes with extra engines, to expedite the completion of the road, and save expensive road-bed preparation. With a full equipment and a heavy freight business, the sum of ascents and descents becomes important.

The nature of the surveys does not admit of a comparison of the degree of curvature on the several routes.

## B.

> Distances of the eastern termini of several Pacific railroad routes to the Mississippi river, Boston, New York, Charleston, and New Orleans, by railroads built, building, and projected, as measured on the "Railroad Maps."

Miles.

to New York................................................................................................. 1,190
to Charleston.................................................................................................... 1,193
to New Orleans................................................................................................. 198
Aggregate................................................................................................4,897
2. Council Bluffs to Rock Island, (Miss. river)..................................................................... 267
to Boston.......................................................................................................... 1,374
to New York.................................................................................................. 1, 252
to Charleston............................................................................................................ 195
to New Orleans......................................................................................................... 075
Aggregate............................................................................................163
3. Westport, mouth of Kansas, (near Fort Leavenworth,) to St. Louis, (Miss. river)................... 245

to New York................................................................................................... 1, 220




to Boston.......................................................................................................... 1,540
to New York.................................................................................................. 1, 345
to Charleston............................................................................................................. 960
to New Orleans.............................................................................................................. 655
Aggregate......................................................................................... 4,770

to Boston.......................................................................................................... 1,530
to New York.................................................................................................... 1, 335
to Charleston............................................................................................................. 950

Aggregate........................................................................................ 4,367


[^0]:    * These are the estimates of the office, those of Gov. Stevens having been brought to the same standard of increased cost as the other routes, and his equipment reduced to that of the other routes. His estimates were $\$ 117,121,000$ and $\$ 7,030,000$.
    $\dagger$ Supposing the route to be a straight line, with uniform descent from the Un-kuk-oo-ap mountains (near Sevier river) to the entrance of the Tah-ee-chay-pah Pass, the most favorable supposition.

    This estimate for the route near the 36th parallel is thought to be largely in excess.
    || These sums do not include the areas of cultivable soil as far west as the Cascade and Sierra Nevada mountains.
    The sum of the minor undulations (not included in the sum of ascents and descents here given) will probably be greater for the route of the 47th parallel than for the other routes; that for the route near the 32d parallel will probably be the least of all.

    With the amount of work estimated for the roads in this report, the equated lengths corresponding to the sum of ascents and descents has but little practical value. With a full equipment and heavy freight business, the sum of ascents and descents becomes important. A comparison of the degree of curvature of the routes cannot be made.

