REPORT

OF

Surveys Across the Continent,

IN 1867–'68,

ON THE

THIRTY-FIFTH AND THIRTY-SECOND PARALLELS,

FOR A ROUTE EXTENDING THE

KANSAS PACIFIC RAILWAY

TO THE PACIFIC OCEAN AT

San Francisco and San Diego.

BY

GEN. WM. J. PALMER.

DECEMBER 1ST, 1868.

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1869.

JOHN D. PERRY, Esq.,

President Union Pacific Railway Co., Eastern Division:

SIR:—I have the honor to submit a report of the surveys made for the Union Pacific Railway Company, Eastern Division, across the western half of the continent, during the fifteen months ending September 30, 1868. Their object was to ascertain the best general route for the extension of the company's road from the end of the track, near Fort Wallace, in Western Kansas, by a southern parallel, through New Mexico and Arizona, to the Pacific Coast.

These surveys were begun at Fort Wallace, early in July, 1867, by three well-organized parties of engineers, under General W. W. Wright, by whom they were completed to the Rio Grande, at Albuquerque and Fort Craig, about the 1st of October. At that time two additional parties, under Colonel Wm. H. Greenwood, were sent out, increasing the corps to five parties, of about 100 men, besides the military escort, teamsters, &c., and the general charge of the survey was placed in my hands.

West of the Rio Grande the surveys were extended by these five parties on two main routes—the 35th and 32d parallels—(the latter better distinguished as the "Gila route")—to the Sierra Nevada in California, and thence to the ocean at San Francisco and San Diego. On the 35th parallel they were conducted by three parties, under charge respectively of J. Imbrie Miller, H. R. Holbrook and Howard Schuyler, Division Engineers; the whole under the direction of Colonel Wm. H. Greenwood, as Chief Engineer. The survey of the *Gila Route* was made by John Runk, Jr., and Leonard H. Eicholtz, Division Engineers. It was extended instrumentally to the mouth of the San Pedro, in Arizona, and thence by reconnoissance of Mr. Eicholtz, by way of Fort Yuma, to San Diego and San Bernardino; and of Mr. Runk, through the San Gorgonia Pass to the Los Angelos Valley, thence by the San Fernando Pass and Soledâd Cañon recrossing the Sierra Bernardino to the

Great Basin, and along the eastern slope of the Sierras to Tehachapá Pass. Here this line intersected that of Colonel Greenwood on the 35th parallel.

The instrumental survey of the mountain passes from this point of junction to San Francisco was made by Messrs. Runk and Eicholtz; the parties on the 35th parallel having been reduced to one, and sent back overland to Kansas, under charge of Holbrook and Schuyler, by whom additional instrumental surveys and explorations were made in returning, disclosing at several points a considerable improvement in the line.

A successful reconnoissance was also made of a route connecting the 35th parallel west of the Colorado River with San Diego, by way of the Morongo and San Gorgonia Passes; and another by Dr. W. A. Bell, of a route through Southern Arizona and Sonora, connecting the surveyed line of the 32d parallel with Guaymas.

Colonel Greenwood, to whose professional ability and conscientiousness, and indefatigable energy in exploration, the success of the route along the 35th parallel is mainly due, has also been engaged with a small party during the past spring and summer in making further surveys for the Company, partially instrumental, in New Mexico and Southern Colorado, the results of which are included in this report.

The preliminary report of General Wright, showing the character of the lines surveyed by him east of the Rio Grande, and the preliminary and final reports of Dr. John L. Leconte, Geologist, exhibiting a view of the physical geography, and the mineral and other resources of this division of the route, have already been published. But as other explorations have since been made of this division, the present report will, for convenience, take up the line at the commencement, and carry it through to the Pacific, treating the subject as a whole, and weighing the relative advantages and disadvantages of each route or line.

Want of space prevents the publication herewith of the Report of Col. Wm. H. Greenwood, Chief Engineer, and only

a few extracts can be given from the report of Dr. C. C. Parry, Geologist and Naturalist, of the Survey on the 35th parallel. The full reports of these officers, together with the journals of each party, contain a large amount of scientific and practical information concerning the topography, climate and resources of the vast belt of new territory, crossed and examined by them, which will be made public, should a final and complete record of these extended explorations be hereafter printed.

It should be remarked, furthermore, that although much of the country covered by these surveys had been previously examined with great fidelity by topographical engineers of the army, those explorations—made with barometer and viameter—could not, of course, claim the accuracy of measurements made with the chain and level. Besides, many developments have been made throughout this region, in the fifteen years that have elapsed since the period of the Government Surveys for a Pacific Railroad, which throw new light upon the question of routes in every respect. Once a *terra incognita*, there is now no longer any necessity for vague estimates or surmises. An amount of carefully gleaned information has been obtained, sufficient to admit of correct deductions upon all points of importance. Our own surveys have extended over every season of the year—crossing the most mountainous regions in the coldest and warmest, and the most arid plains in the dry as well as the wet season; while the alternate lines and side explorations cover a belt wide enough to acquaint us with the topography and resources of a large extent of tributary country.

Only a general summary can, of course, be given of this experience, and even of the topographical data, especially that obtained on the survey of the "32d parallel," or "Gila Route." As will be shown in this Report, the results along the 35th parallel proved to be of such a favorable character that, with its great advantage in distance and accessibility from nearly

every section of the Union to start with, its claims have been found decidedly to outweigh those of the extreme southern line.

Believing that the chief benefits of a Pacific Railroad are to arise from the opening up and development of the resources of a now unoccupied half of our continent, I consider it especially fortunate that the route toward which nature has been the most generous in the distribution of her favors, being in climate and soil the most attractive to population, should have proven satisfactory in all other respects.

Respectfully,

WM. J. PALMER,

Manager of Surveys.

ST. LOUIS, December 1st, 1868.

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REPORT

OF

SURVEYS ACROSS THE CONTINENT,

IN 1867–'68,

ON THE

35TH AND 32D PARALLELS

FOR A

Route extending the KANSAS PACIFIC RAILWAY to the Pacific Coast at SAN FRANCISCO and SAN DIEGO.

THE ROUTE.

Beginning at the great bend of the Missouri River near Kansas City, and at the mouth of the Kaw, where two great Railroad systems—from St. Louis and from Chicago—meet—this point being 275 miles from St. Louis,

488 " Chicago,

1318 " New York,

and having an elevation, at the State line between Missouri and Kansas, of 604 feet above tide, the line follows, in a general westerly course, the Valleys of the Kansas River and Smoky Hill Fork for a distance of 405 miles to Sheridan.

This point, near Fort Wallace and not far from the boundary line between Kansas and Colorado, is the present terminus of the completed portion of the Road.

From the Track at Sheridan, in Kansas, to the Rio Grande, near Albuquerque.

1.—THE PURGATORY, OR RATON MOUNTAIN LINE.

The instrumental survey of this line was made by Gen. W. W. Wright, in the summer of 1867. Subsequent reconnoissance has disclosed improvements at a few points.

Sheridan, the end of the track, is 2957 feet above tide. The line extends thence, south-westwardly, across a rolling plain—dry and timberless, and worthless for any other purpose than grazing—to the Valley of the Arkansas River at Fort Lyon, a distance of 120 miles.

At "Denver Junction," 65 miles from Sheridan, it crosses the divide between the Smoky and Big Sandy, at an elevation of about 4420 feet. This is the highest point reached between the Smoky and the Arkansas Rivers. The Valley of the Big Sandy is 4192 feet—the divide between this and the Arkansas, at "Colton's Spring," about 4350 feet—and the Arkansas Valley at Fort Lyon, 3725 feet above the ocean.

What may be considered the least valuable country on the whole route to the Pacific is now passed. We strike the water courses flowing from the Rocky Mountains and their spurs, and come into an inhabitable and productive country.

The Arkansas River is here 500 feet wide. Crossing it near Fort Lyon, at a point about 130 miles below where it emerges on the plain from an immense cañon in the first range of the Rocky Mountains, the line ascends, still south-westwardly, the narrow but fertile Valley of the Purgatoire. This is a tributary of the Arkansas, heading near the Spanish Peaks and the intersection of the Raton Mountain with the main chain. Near the foot of the Cañon of the Purgatoire, 50 miles from Fort Lyon, at an elevation of 4266 feet, the line deflects to the southward, in order to follow by a gradual ascent the Valley of the Chequaco to the base of the Raton Mountain, a long, easterly spur of the Rocky Mountains, which puts out nearly 100 miles into the Plain. The line crosses the point of Raton Mountain at an elevation of 6166 feet, at Cimarron Pass, 40 miles from the mouth of the Chequaco. Near this Pass, the mountain has its

eastern termination—being succeeded by a high volcanic table-land, known as the "Mesa del Maie," through which the heads of the Cimarron River break by deep and tortuous cañons.

A reconnoissance made by Col. Greenwood in September, 1867, showed the country to be impracticable for a distance of at least 50 miles east of the Cimarron Pass, and careful examination made by Gen. Wright for 60 miles westward, and by Mr. Schuyler, Engineer of Division, still farther westward, disclosed but one other practicable Pass through the Raton Mountain, in all this distance. This was the Trinchera Pass, of which the elevation at summit was found to be 7079 feet—over 900 feet higher than the "Cimarron." For this reason, and because of the easier approach from the Purgatory, the latter pass was preferred by Gen. Wright.

Crossing the waters of the Cimarron, which head in the eastern end of the Raton Mountains, and produce a very difficult country for some 20 miles beyond, the line emerges on the rolling plains of New Mexico. These it traverses in a south-westerly direction to Las Vegas, a distance of 120 miles—during which it is parallel to, and at an average distance of about 15 miles from the eastern base of the first main ridge of the Rocky Mountains.

In 64 miles from Cimarron Pass, the line crosses the Red fork of the Canadian River at an elevation of 5634 feet above tide; in 54 miles more it passes Fort Union, the principal military post and depot of the Plains, which it leaves seven miles to the westward; 15 miles beyond, it crosses at an elevation of 6718 feet the divide which separates the waters of the Mississippi from those of the Rio Grande—here represented by the Canadian and the Pecos—and in 7 miles more, reaches Las Vegas, 350 miles from the end of track in Kansas, and 6233 feet above the ocean.

Four miles south of Las Vegas, the line strikes the foot-hills of the Rocky Mountains—indicated here by a timbered ridge from 300 to 800 feet high, which separates two tributaries of the Pecos River—the "Gallinas" and the "Tecaloté." In a distance of 50 miles, north and south of Vegas, this ridge—

known as the "Chupaynas," has but two good passes. At one of these, "Priest's Gap," the line cuts through the Chupaynas Ridge with scarcely an alteration in the grade, and after passing a low summit, descends to and crosses Tecaloté Creek, and in 26 miles from Vegas, reaches the Pecos River—next to the Rio Grande, the most considerable stream of New Mexico. This crossing of the Pecos, is called "Billendante" or Peddler's Ford. It is 10 miles above Anton Chico, has an elevation of 5406 feet above tide, and is 376 miles from Sheridan.

Somewhere in this vicinity, is the most natural point of connection for a line coming from Fort Smith, Arkansas, and Shreveport, Louisiana, by the Valleys of the Canadian or Red River, which will place the Southern States in communication with this Pacific Railroad system.

The distances to the Pecos, near Anton Chico, by Whipple's survey, were as follows:

	Miles.
From Fort Smith, on the Arkansas border, - -	745
" Memphis, - - - - - - - -	1060

By the line of the Kansas Pacific, above described, the distances are

	Miles.
From Kansas City, - - - - - - -	781
" St. Louis, - - - - - - - -	1055

So that Memphis and St. Louis appear to be about equidistant from this junction.

The distance from Shreveport, La., is about the same as from Kansas City—and that of Chicago very nearly the same as from New Orleans.

Here is the proper base of the Rocky Mountains, of whose Easterly Range—which for convenience we have called the "Spanish Range"—the line now begins the actual ascent, reaching the summit at Cañon Blanco Pass, 6917 feet above tide, in a distance of 30 miles from the Pecos Crossing. This summit is about 40 miles south-east of Santa Fe, and 60 miles east of the Rio Grande. The Valley of the latter, where the surveyed line strikes it at "Pajarida," 6 miles south of Albuquerque, is 4833 feet above tide water—the descent from Cañon

Blanco Summit being principally effected by the Tijeras Cañon, (or Carnouille Pass,) a gorge in the San Dia Mountains, which overlook the Rio Grande on the east, and rise on their higher summits to an elevation of 11,000 feet.

The Rio Grande, near Albuquerque, by the line described, is 466 miles from Sheridan in Kansas, 411 miles from Cheyenne Wells, and 871 miles from Kansas City.

2.—THE GALISTEO ROUTE.

For an extension westward on the 35th parallel, a great improvement in grades and character of work on the above line, between Cañon Blanco Summit and the Valley of the Rio Grande, was disclosed by a careful reconnoissance made by Mr. Holbrook, engineer in charge of the return party, showing that the long Valley of the Galisteo may be advantageously used to make this descent.

The line followed from Cañon Blanco Summit on a west course, 4 miles over a rolling country, to the head of the south branch of Galisteo River, and down this branch and the main stream to the Rio Grande at the Indian town of San Felipe, 57 miles from Cañon Blanco Summit. San Felipe is 30 miles north of Albuquerque, and is one of the best bridging points on the whole river. By our levels, it was ascertained to be 5042 feet above tide. It is 463 miles from Sheridan, and 868 from Kansas City.

3.—THE "SAN MIGUEL CUT-OFF."

This was also reconnoitered by Mr. Holbrook. The object was to avoid a portion of the southerly deflection between Las Vegas and the Rio Grande, and obtain a more direct route across the Spanish Range to the Galisteo Valley.

A practicable line was found, leaving Gen. Wright's route near the crossing of Tecaloté Creek, 11 miles north-east of Billendante, and thence passing by way of Bernal to a good crossing of the Pecos River, one mile above San Miguel, and thence to the summit of the Range, two miles west of Pigeon's Ranche. From this summit, the line followed down the main valley of Galisteo Creek, 50 miles to the Rio Grande at San

Felipe—the last 32 miles being common with the "Galisteo Route" above described.

By the "San Miguel Cut-Off," Mr. Holbrook reports the distance from the point of divergence near Tecaloté Creek to San Felipe, on the Rio Grande, to be 90 miles—a saving of only 7 miles on the route by Cañon Blanco Pass, while the grades, as will be hereafter seen, are so much heavier as to more than overcome this advantage.

4.—ABO PASS ROUTE.

This offers still another line of descent to the Valley of the Rio Grande, and was instrumentally surveyed by Mr. L. H. Eicholtz, of Gen. Wright's corps. His line began at the Lagunas, near Cañon Blanco Summit, and extended to the Rio Grande at La Joya, between Albuquerque and Fort Craig, passing through the Organ Range at Abo Pass. It proved to be a very cheap route, with better gradients than by the Tijeras Cañon, and 5 miles shorter to Fort Craig. But being available only for the 32d parallel, it need not be further discussed here. A reconnoissance was also made of the Cañon Inferno, a pass through the San Dia Range, a few miles south of the Tijeras Cañon, and of the Valley of the Tuerto, north of Tijeras Cañon; both were found inferior in grades, and more costly.

5.—THE CIMARRON ROUTE.

This is the shortest by which Albuquerque can be reached from Kansas City, and topographically the best. It is the old wagon route to New Mexico, and its general features are well known. It has also been reconnoitered by Col. Greenwood, for nearly 200 miles of the least favorable portion. This line would diverge from the track in Kansas, in the vicinity of Fort Harker, and crossing in 40 miles to the Arkansas, near the point of its great northerly bend—would follow up that valley for about 100 miles south-westwardly, to a point of crossing the Arkansas above Fort Dodge. It would then traverse the Great Plains in a very direct, south-west course for 300 miles, and intersect the Raton Mountain Line near Fort Union.

This Route saves over 72 miles of distance on the surveyed

line first above described—avoids entirely the Raton Mountains, and extends the section of the Plains with the distinguishing features of light grades and long straight lines, to the foot-hills of the Rocky Mountains near Las Vegas.

But it traverses for 300 miles, from the crossing of the Arkansas to Fort Union, a dry and inferior country, probably worthless, except for grazing, and does not follow the line of settlements, and of mineral, arable and timber wealth—in other words, the line of future local growth and development in Southern Colorado and North-Eastern New Mexico. If not adopted at first, it must be built eventually, to economize the transportation of *through* Passenger and Freight traffic—including all that will originate west and south of Fort Union. The distance to be constructed from Fort Harker to Fort Union Junction, is 443 miles, against 328 miles from Sheridan to the same point by the Raton Mountain Line—a difference of 115 miles in favor of the latter; but the total distance from Kansas City to the Rio Grande, near Albuquerque, is 799 miles by the Cimarron Route, against 871 by the Raton Mountain.

It is possible that the Cimarron Line, instead of intersecting near Fort Union, would be improved by passing entirely to the south of the Chupaynas Ridge, striking the Pecos River nearer to Anton Chico—or that a route nearly as short and level, and traversing a better country than the "Cimarron," may be found between the Arkansas below Fort Dodge, and Anton Chico, on the line or in the vicinity of the Fort Bascom Wagon Road. But more extended surveys will be required to determine these points.

6.—THE AUBREY ROUTE

Lies between the "Cimarron" and the "Raton Mountain Line." It has not been instrumentally surveyed, but has been partially reconnoitered by Col. Greenwood, and its general features are pretty well known, from its having been for some time a favored line of travel to New Mexico. On the reconnoissance made in October, 1867, and heretofore mentioned, to ascertain if the Raton Mountain could be turned by any practicable line, Col. Greenwood demonstrated that the high volcanic

table, known as the Mesa del Maie, and the deep Cañon of the Cimarron, presented an impassable barrier for 50 miles east of the "Cimarron Pass"—rendering it necessary to deflect as far east as the Aubrey Route, in order to avoid those obstacles.

This Route would diverge from the operated track in Kansas, near or east of the 100th meridian, cross the Arkansas River at or near Aubrey, 76 miles west of the Cimarron Crossing, and 88 miles east of Fort Lyon, and intersect the Cimarron Route about 54 miles north-east of Fort Union.

It is about 37 miles longer than the Cimarron Route, and somewhat inferior in grades to that, and more expensive to build—but it traverses a country better watered and nearer to timber, and the distance to construct to a common point would not greatly exceed that on the Raton Mountain Line.

7.—THE HUERFANO ROUTE.

This was instrumentally examined by Mr. J. Imbrie Miller, Division Engineer, under direction of Gen. Wright. It deflects from the Raton Mountain Line at Fort Lyon, and follows up the Valley of the Arkansas and its tributary—the Huerfano—to the summit of the "Spanish Range" at the Sangre de Christo Pass, 141 miles from Fort Lyon—thence 50 miles south-westwardly to the Rio Grande, which it intersects near the mouth of the Culebro, at a point about 33 miles below Fort Garland, and thence down the Rio Grande to Albuquerque. The instrumental examination terminated on reaching the Rio Grande, where the elevation was found to be 7301 feet above tide—that at the summit of Sangre de Christo Pass being 9186 feet.

The "Mosca Pass" was also surveyed by Mr. Miller, but he reports both that and the Sangre de Christo to be impracticable within the Congressional limit of grade, (116 feet per mile,) and there is the additional objection of heavy winter snows.

The line by the Sangre de Christo was found to be 20 miles longer from Fort Lyon to Isletta, on the Rio Grande below Albuquerque, than by the Raton Mountain Route, but 19 miles shorter than the latter to *San Felipe*—(assuming the Galisteo Valley to be used.) It runs mainly through a good country.

8.—THE PUNTIA PASS ROUTE.

This uses the Arkansas Valley for 190 miles above Fort Lyon, to the northern base of the Puntia Pass, then crosses in 25 miles the neck which connects the Spanish Range with the main chain of the Rocky Mountains, and reaches the San Luis Park—thence follows down this Park and the Rio Grande Valley for 193 miles southward to Albuquerque. It was reconnoitered during the past summer by Col. Greenwood, and an instrumental survey was made of the Puntia Pass.

This Route is reported by Col. Greenwood to be practicable throughout. It avoids the Raton Spur, concentrates all the heavy grades at one point—the fall of the Arkansas averaging less than 16, and that of the San Luis Park and Rio Grande less than 20 feet per mile—avoids all intermediate summits, strikes good coal and timber sooner than by any other route, and occupies by far the most productive country. Its objections are, that it is 35 miles longer than the Raton Mountain Line to San Felipe, and 74 miles longer to Isletta—reaches an elevation of 8600 feet above tide, at the summit of Puntia Pass, where there will be some snow, and is off the route of Government posts and transportation. It has the great merit, however, of being best situated, not only to reach and develop the greatest amount of immediate wealth, but also for extensions westward, both in Colorado and New Mexico, as mining developments advance.

By adopting a more direct route from the end of the track in Kansas to the mouth of the Arkansas Cañon than that by Fort Lyon, this difference in distance may be reduced 15 or 20 miles.

It will be seen from the above description, that *four* general routes have been wholly or partially examined, by which Albuquerque may be reached from the Company's track in Kansas. The following tables will show the distances between the various points on each of these lines, and the elevations of such as are known.

No. 1.

FROM THE END OF THE TRACK IN KANSAS TO THE ARKANSAS RIVER AT FORT LYON.

Elevation above tide water. *Feet.*	Distances from	Local Distances. *Miles.*	From Sheridan. *Miles.*	From Kansas City. *Miles.*
2957	Sheridan, Kansas	...	...	405
3056	To Fort Wallace	12	12	417
3126	Pond Creek	3	15	420
.....	Cheyenne Wells, Colorado	40	55	460
.....	Denver Junction	10	65	470
4192	Big Sandy	5	70	475
.....	Colton's Spring	15	85	490
3725	Fort Lyon, Colorado	35	120	525

No. 2.

RATON MOUNTAIN LINE.

Elevations above tide water. *Feet.*	Distances from	Local Distances. *Miles.*	From Sheridan. *Miles.*	From Kansas City. *Miles.*
3725	Fort Lyon, Colorado	...	120	525
4266	To Mouth of Chequaco	50	170	575
6166	Cimarron Pass (Point of Raton Mtn)	40	210	615
.....	Cimarron River	13	223	628
7030	Capulline Summit	6	229	634
.....	Vermejo	...	.....	.....
5634	Red River Crossing,(45 fromCap. Smt	45	274	679
.....	Fort Union Depot, (Krœnig's)	54	328	733
6718	Divide between Canadian and Pecos.	15	343	748
6233	Las Vegas	7	350	755
6156	Priest's Gap	4	354	759
6264	Chupaynas Summit	1½	356	761
.....	Tecaloté Crossing	9½	365	770
5406	Pecos River, (Biyendante)	11	376	781
.....	Capoté Pass	13	389	794
6917	Cañon Blanco Summit	17	406	811
.....	Lagunas	5	411	816
.....	Zuni Timber	8	419	824
.....	Monte Largo	17	436	841
.....	Aguaji Colorado	7	443	848
.....	Tijeras	6	449	854
.....	Rio Grande at Albuquerque	17	466	871
4833	Rio Grande at Pajarida	17	466	871
4803	Rio Grande at Isletta	18	466	871

Remarks.—Summit of Trinchera Pass from Fort Lyon.....111¼ miles.
" " " Elevation.....6973 feet.
Foot of Flagstaff at Fort Union, Elevation.....6613 feet.
Fort Craig, from Pajarida.....103 miles.
" " Elevation.....4361 feet.

No. 3.

GALISTEO ROUTE.

Elevations above tide water. *Feet.*	Distances from	Local Distances. *Miles.*	From Sheridan. *Miles.*	From Kansas City, via Raton mt *Miles.*	From Kansas City, via Cimarron *Miles.*
6917	Canon Blanco Summit		406	811	739
	To Head of S'th F'k of Galisteo	4	410	815	743
	Forks of Galisteo	21	431	836	764
	Santa Fe Depot	5	436	841	769
	Anthracite Coal Mine, (Placier Mountain)	4	440	845	773
5042	San Felipe	23	463	868	796
Remark.	Distances by "San Miguel Cut off."				
	To Tecaloté Intersection		365	770	698
	Bernal	4	369	774	702
	Pecos Crossing, (1 mile above San Miguel)	8	377	782	710
	Summit of Spanish Range (2 miles west of Pigeon's Ranche)	28	405	810	738
	Galisteo Town	15	420	825	753
	Forks of Galisteo	3	423	828	756
	San Felipe	32	455	860	788

No. 4.

CIMARRON ROUTE.

Elevations above tide water. *Feet.*	Distances from	Local Distances. *Miles.*	From Harker. *Miles.*	From Kansas City. *Miles.*
1446	Fort Harker			218
	To Fort Zara, (Arkansas River)	41	41	259
	Fort Larned	35	76	294
	Fort Dodge	51	127	345
	Upper Cimarron Crossing of the Arkansas	24	151	369
	Sand Creek	60	211	429
	Lower Crossing of the Cimarron	14	225	443
	East Side of 8 Mile Ridge	12	237	455
	Middle Cimarron Spring	18	255	473
	Head of 12 Mile Valley	12	267	485
	Crossing of the Cimarron	15	282	500
	Upper Cimarron Spring	8	290	508
	Cold Spring	7	297	515
	Cedar Spring	14	311	529
	Sim's Spring	14	325	543
	Rabbit Ear Creek	23	348	566
	Whetstone Creek	13	361	579
	Rock Creek	11	372	590
	Point of Rocks	14	386	604
	Red River	26	412	630
	Fort Union Depot, (Krœnig's)	31	443	661
6233	Las Vegas	22	465	683
5406	Pecos River above Anton Chico	26	491	709
6917	Canon Blanco Summit	30	521	739
5042	Rio Grande at San Felipe	57	578	796
4803	" at Isletta	60	581	799

No. 5.

Huerfano Route.

Elevations above tide water. *Feet.*	Distances from	Local Distances. *Miles.*	From Sheridan. *Miles.*	From Kansas City. *Miles.*
3725	Fort Lyon, Colorado	120	120	525
3892	To Bent's Fort	18	138	543
4563	Huerfano Junction	50	188	593
6287	Union Cross Roads	50	238	643
9186	Sangre de Christo Summit	35	273	678
7783	Fort Garland	25	298	703
7301	Rio Grande at Taos Cañon	33	331	736
5042	San Felipe	113	444	849
4868	Albuquerque	30	474	879
4833	Pajarida	6	480	885
4803	Isletta	6	486	891

Remark.—Mosca Pass, Elevation ..... 9577 feet.
" Distance from Fort Lyon ..... 158 miles.

No. 6.

Puntia Pass Route.

Elevations above tide water. *Feet.*	Distances from	Local Distances. *Miles.*	From Sheridan. *Miles.*	From Kansas City. *Miles.*
3725	Fort Lyon, Colorado	...	120	525
3892	To Bent's Fort	18	138	543
	Fort Reynolds	54	192	597
	Pueblo	17	209	614
	Cañon City	41	250	655
	McCandless Park	10	260	665
	Pleasant Valley	20	280	685
6500	Forks of the Arkansas	20	300	705
	Point of leaving Arkansas	10	310	715
*8600	Summit of Puntia Pass	15	325	730
	Sahwatch, (East)	20	345	750
	Conejos	40	385	790
	San Juan	83	468	873
5042	San Felipe	30	498	903
4868	Albuquerque	30	528	933
4833	Pajarida	6	534	939
4803	Isletta	6	540	945

* Barometer.

ROUTE FROM THE RIO GRANDE, ON THE 35TH PARALLEL, TO THE GREAT COLORADO, 580 MILES.

For a line descending from the East by Tijeras Cañon, the best crossing of the Rio Grande was found to be at the Indian town of Isletta, 12 miles south of Albuquerque. The approach to the river bank at this point is not as good from the east, but it is a much better bridge site, and affords a far better route for crossing the high ridge west of the Rio Grande than at any point between Isletta and Albuquerque.

An attempt was made to cross this ridge by a line—which was run by Mr. Miller—westward from Pajarida to the Puerco, but it was found in consequence of its greater height it would be necessary, to obtain the same grades, to increase the distance to an extent that would make this line as long as that by way of Isletta, while the work would be exceedingly heavy.

At Isletta, the river is 1,000 feet wide, between banks of hard cemented drift, which can readily be protected from wash. These bluffs are 23 feet high on the west and 38 feet high on the east side, above low water—the river rising 6 feet in the highest flood. The fall of the Rio Grande Valley at Albuquerque and Isletta was found to be about 5½ feet per mile.

If our line should reach the Rio Grande, by the Galisteo Valley, no better bridge site could be desired than that found at San Felipe, 30 miles north of Albuquerque. The river is here 273 feet wide; the western bank 5 feet and the eastern bank 11 feet above the highest water known; and the banks of hard gravel that appear never to have been disturbed by the action of the river. Two spans of 140 feet each would be required, and the bridge would be at right angles to the stream —but in leaving the Rio Grande near the mouth of the Jemez there would be one mile of heavy and expensive work including a short tunnel through the spur of the Mesa, about 1,000 feet long. Westward from this, to an intersection with the common line, the San Felipe route was found inferior in respect of distance, grades, alignment and cost, to that from Isletta. Further examination is needed in this country, especially north of the

San Mateo Mountain—to ascertain if a favorable route can be had from San Felipe direct to Navajo Pass, where, on the Sierra Madre, in 100 miles from the Rio Grande, it would intersect our surveyed line. Our information and the general structure of the country point to the existence of such a route.

Leaving the Rio Grande at Isletta, where the elevation at low water is 4,803 feet above the sea, the line first referred to crosses a volcanic ridge 400 feet high, and in 21 miles from Isletta descends to the valley of the Puerco, a branch of the Rio Grande which it follows northwestwardly 6 miles to the mouth of a small tributary called "El Rito."

From this point the valley of the El Rito is followed westerly —past the Mexican towns of El Rito and Cubero and the ancient Indian town of Laguna—for a distance of 95 miles, with a uniform rise of less than 22 feet per mile—to the summit of the Sierra Madre at Navajo Pass.* The El Rito Valley has a width of from one half to three miles, and drains the eastern slope of the Sierra Madre, the north side of some broken volcanic table lands, and the south side of San Mateo Mountain.

At the summit in Navajo Pass, at an elevation of 7,177 feet above the sea, is found the crest of the continent upon this parallel. It is almost due south of, and nearly 7° latitude distant from the point at which the Union Pacific Railroad crosses the same crest in Wyoming Territory.

We are now upon the waters of the Gulf of California, and find their first representative in the Puerco of the west—whose name, for distinction, we have changed to "Navajo Creek." The valley of this creek—dry in November as we passed down it—is followed by our line southwestwardly, with an average descent of less than 19 feet per mile, for 118 miles to its junction with the Little Colorado. Here the elevation is 4,998 feet. The Little Colorado is about 200 feet wide, and easily bridged: our line crossed it at the mouth of Navajo Creek, and followed westwardly down the left bank for 35 miles, to "Sunset Crossing," where this river makes its great northerly bend to turn the Mogoyon Range.

* Campbell's Pass.

The valley of the Little Colorado has an average width in this part of its course of about three miles—and an average fall of less than 7 feet to the mile, its elevation at Sunset Crossing being 4,765 feet.

We have now reached a point 275 miles from the Rio Grande, and find it impossible to follow the Little Colorado for any considerable distance longer—both because it deflects too much to the northward, and because in 40 miles below Sunset Crossing, it encounters rapids, having nearly a perpendicular fall of seventy-five feet—and then enters a cañon which gradually deepens until at the mouth of the river, it is as deep as the Grand Cañon of the Colorado into which it has its outlet. Numerous side cañons also prevent further advance.

It is therefore necessary, from Sunset Crossing, to turn westward and cross the Mogoyon Range, a long and formidable chain of mountains, which traverses Arizona and New Mexico in a northwest and southeasterly direction—separating in the greater part of its course, the waters of the Gila on the south and west from those of the Little Colorado on the north and east. Our surveyed line crossed this range at "Tonto Pass," immediately south of a high extinct volcano, known as the San Francisco Mountain—but whose name, for distinction, we changed to "Mt. Agassiz." At Leroux Summit, in Tonto Pass, our line finds its highest elevation on the entire route, 7,510 feet above which the snow-crowned peak of Mt. Agassiz towers to an additional height of 5,000 feet.

It was found best in crossing the Mogoyon Range, to hug up close to the foot of Mt. Agassiz, both in order to avoid the deep and abrupt depression of the Verde River west of the Range—the valley of which is less than 3500 feet above tide near the mouth of Clear Creek—and also because the crest of the Range was found to be lower at the immediate base of the great crater than farther south. In crossing at Tonto Pass, the southward flowing tributaries of the Verde, all of which form impracticable cañons before reaching the main stream are avoided entirely, east of Leroux summit—and even on the west side, it is more likely that the waters found flowing south-

ward across our line, sink in the numerous Parks of this region, than that they cut their way through the high precipitous wall which faces the Verde on the north continuously, from its great bend westward to the Bill Williams mountain. Our examinations proved that the waters of Leroux, Antelope and San Francisco Springs, heretofore considered among the sources of the Verde, are entirely cut off from any outlet in that direction, and that they sink in the wet season, in a basin 7 miles northeast of Antelope Springs, where the course of their drainage is eastward towards the Little Colorado.

The ascent of 2745 feet from Sunset Crossing of the Little Colorado to Leroux Summit is made very uniformly in 67 miles. The line is very direct and crosses four cañons, viz.: Cañon Diablo, Pine Cañon, Cottonwood Cañon and Padre Cañon —varying in depth from 100 to 240 feet. None are over 200 feet wide or present any serious engineering difficulty, except the last, which has a width of 800 feet at the grade line and 240 feet depth, and will require a suspension bridge.

The region which we enter upon at this cañon, 49 miles from Sunset Crossing, and in which we continue for over 60 miles, is one of as great natural beauty as any I have ever seen.

The summit of the Mogoyon Range at this Pass is 342 miles from the Rio Grande and 238 from the Great Colorado. Towards the latter, we now commence a descent, which is broken at but five points, to wit: .

1st.—At Whipple Pass, where the rise is about 150 feet.

2d.—In crossing the divide between Cedar and Partridge Creeks —100 feet in height.

3d.—In ascending the Val de Chino from the mouth of Partridge Creek Valley to the summit of Beale's Pass, in which the elevation to be overcome is less than 400 feet.

4th.—In skirting the west side of Aubrey Valley from Beale's Pass to a higher summit, at Yampa Pass—the rise being 114 feet.

5th.—In following the Wallapi Valley south-westwardly from Peacock Springs to Wallapi Pass—where the total elevation to be overcome is 303 feet.

The last may be avoided and a level grade adopted, if desired, by increasing the distance.

Excepting at these points, the descent of about 7000 feet from the crest of the Mogoyon Range—which it is impossible to avoid—to the navigable waters of the Great Colorado, is constant and extraordinarily uniform.

The first part of this descent, from Leroux Summit to the Val de Chino, 78 miles, is made through an exceedingly broken and difficult country in which the southward flowing tributaries of the Gila, represented by the branches of Partridge Creek; and the waters flowing northward into the grand cañon of the Colorado, represented by the branches of Cedar and Lava Creek, are found constantly interlacing. The line continues from Leroux Summit through a country of alternate parks and pine forests, past Park Spring and New Year's Spring to the summit of Whipple Pass. This is a depression at the western foot of Mt. Whipple, 20 miles from Leroux Summit, and having an elevation of 7206 feet. A more rapid descent now ensues—and crossing Park and Cedar Creeks and the divide separating the latter from the east fork of Partridge Creek, the line strikes the valley of the latter at a point 38 miles from Leroux Summit and about 6000 feet above tide—and thence continues down Partridge Creek Valley with an average fall of from 20 to 30 feet per mile, for 40 miles to its mouth in the Val de Chino.

Partridge Creek drains the western slope of the Mogoyon Range between the Black Forest and the Laja Range. The Val de Chino is an extensive grass-covered valley, 100 miles long and 10 miles wide—having a north-west and south-east direction, which here drains and divides the Aztec Range on the west, and the Laja and Black Forest Ranges on the east. Although without any running water course except in the wet season, it is the real head of the Verde River, a branch of the Gila. It constitutes one of the most noticeable topographical features of Central Arizona, and evidently forms in connection with a similar large basin, which we called "Aubrey Valley," lying to the northward and separated from it by a low neck at

Beale's Pass, the "great valley" which Aubrey followed in his early exploration of this country, and from the use of which he anticipated so great an advantage to a Pacific Railroad Route on the 35th parallel.

From the mouth of Partridge Creek Valley, where our line has an elevation of 5088 feet, it deflects northwestward—in order to turn the Aztec Range—and descending in 8 miles to a level of 4748 feet on the slope of the Val de Chino, then begins the ascent of that valley and a westerly fork thereof, which it continues for 20 miles, to the summit of the divide between Val de Chino and Aubrey Valley, at Beale's Pass. Here the elevation attained is 5127 feet—the rise having been less than 20 feet per mile.

Aubrey Valley is a great depression, lying north and south, resembling, in many respects, the Val de Chino, but having its drainage to the north and westward, by Yampa Creek which heads in this basin.

At points, Aubrey Valley is 20 miles wide—is covered with gramma grass, but by no means so luxuriantly as the Val de Chino—and in the first part of its course, like that Valley, separates the Aztec from the Laja Range. Subsequently, however, the Aztec unites with the Aquarius Range lying still farther west—and our line which from Beale's Pass has followed northwestwardly the eastern slope of the former, overlooking the Aubrey Valley—now skirts in a westerly course the northern foot of the connected group until it reaches Yampa Creek. It then follows this drainage through Yampa Gap 25 miles from Beale's Pass—where by a cañon it cuts through the northern end of the mountains referred to, and passing between the Peacock and Music mountains at Truxton's Spring, emerges into a third great elevated valley also drained northwardly into the Yampa, and called the *Wallapi Valley.*

Wallapi Valley is enclosed between, and drains the slopes, of the Cerbat and Wallapi Ranges of mountains on the south and west and the Peacock Mountain (of the Aquarius group) on the east—and is about 10 miles in width and covered with grass except in the dry season. Our line, emerging from Truxton's

Cañon, strikes it at an elevation of 3170 feet near Peacock Spring, and follows it southwestwardly for 14 miles in order to turn two precipitous and formidable ranges of mineral mountains which still separate us from the Colorado River.

The first of these is the Wallapi Range—which is turned on the south at the "Wallapi* Pass"—where a very low neck of volcanic rock alone connects it with a still higher Range, the Cerbat Mountains, on the south. The summit at Wallapi Pass is 3473 feet above tide—the ascent from Peacock Springs having been 303 feet in 14 miles and very uniform.

The second Range is known as the "Black Mountain," and rises like a great wall from the east bank of the Colorado River. It terminates about 20 miles south of Fort Mojave, and at this point our line following from Wallapi Pass southwestwardly down the uniform slope of a fourth great valley, turns it at "Mojave Gap." This fourth valley is 15 miles in width—separates and drains the Wallapi, Black Mountain and Cerbat ranges—and we named it the Cerbat Plain. It was destitute of all vegetation except that peculiar to the desert. The shallow "Wash" which drains it, cuts through a low terminal spur of the mountains at Mojave Gap, 27 miles from Wallapi Pass—and following the banks of this Wash with an almost unbroken uniform descent, our line reaches, 22 miles farther, the Great Colorado River.

The point of crossing the Colorado is about three miles north of the "Needles" and 25 miles south of Fort Mojave. It is a very favorable site for a bridge over a navigable stream—the banks and bed being of a hard diluvial conglomerate 78 feet high at low water. The distance between the bluffs, to be bridged is 1000 feet. The river is 12 feet deep when low, 300 to 400 feet wide, and rises 21 feet in summer, from the melting of the snow near its sources. This is besides a favorable point for the departure of the line westwardly across the Great Basin of California.

*Rail Road Pass.

Alternate Routes surveyed or reconnoitered between the Rio Grande and the Great Colorado.

☞ 1st.—"LAGUNA CUT OFF."—An instrumental line was run by Mr. Holbrook between the Rio Grande at San Felipe, and a point 4 miles east of Laguna in the Valley of El Rito, where it intersected the main route 52 miles west of Isletta. The object was to connect the best line east of the Rio Grande—that by the Galisteo Valley—with our surveys west, without making the detour down the Valley of the Rio Grande to Isletta. A practicable line was obtained 78½ miles in length, but the grades were heavy and the general alignment so bad that the saving in distance was found to be only 16 miles over a line from San Felipe to Laguna by way of Isletta. From Cañon Blanco Summit (east of the Rio Grande) to Laguna, the distance was 18 miles longer by San Felipe and Holbrook's line than by the Tijeras Cañon and Isletta.

There are many reasons to believe, however, that the Route which has been spoken of, passing to the north of San Mateo Mountain, and intersecting our line of survey at Navajo Pass in the Sierra Madre, will be found much superior to the Laguna line. This will reduce the distance from San Felipe to Navajo Pass to about 100 miles—and the distance from Cañon Blanco to Navajo Pass to 157 miles, a saving of 25 or 30 miles on the route by Tijeras Cañon and Isletta. The line here indicated is one of the most important of those yet requiring examination. It approaches near to large pineries and to coal —and is reported to traverse some good country, especially in the vicinity of "Valles Grandes."

2d.—ZUNI PASS LINE.—An instrumental line was run by Mr. Miller from the "Remances" in the Valley of El Rito 78 miles west of Isletta, by way of the Agua Frio and Zuñi Pass to an intersection with the main route at Signal Hill on Navajo Creek. The length of this loop was 119 miles, and the saving in distance over the line by Navajo Pass, 8 miles. The country it traversed was also better and contained more abundant timber. But the summit of the Sierra Madre at Zuñi

Pass was found to be 7926 feet above tidewater against 7177 feet at Navajo Pass—and the requirement of a tunnel of three fourths of a mile, with grades rising to 105 feet—and heavier work and grades throughout, more than counter-balanced the slight reduction of distance and the other advantages named. It need not therefore be further considered.

3d.—THE CAÑON GALLO, lying between the Zuñi and Navajo Passes was reconnoitered by Col. Greenwood, who found it to be very little shorter than the Zuñi Pass and decidedly inferior to it in respect of gradient.

4th.—ASCENT OF THE MOGOYON RANGE.—Two additional lines were instrumentally surveyed between Sunset Crossing of the Little Colorado, and the summit of this Range at Tonto Pass—and a reconnoissance made of a third around the north side of Mt. Agassiz.

The first of these is the *Cosnino Line.* It was run by Mr. Miller and had for its purpose the avoiding of Padre Cañon and the other cañons found on the direct route first described, before the latter was discovered to be practicable. Deflecting at Sunset Crossing, it followed down the west bank of the Little Colorado for 33 miles to the mouth of Cañon Diablo, where it began the ascent of the Range, and passing, in 26 miles, by Cosnino Caves, intersected the main line at a point 6 miles west of the caves. Its total length was 65 miles, and the increased distance 13 miles over the Padre Cañon route—the grades were also heavier, and it had nothing to recommend it in comparison with the more direct route.

THE SUNSET GAP LINE, had also for its object, the turning of these cañons. It diverged at Sunset Crossing, turned southwestwardly and ascended in 32 miles to "Sunset Gap," and then having reached the plateau at whose edge most of the cañons leading to the Little Colorado start, it followed a north-west course to an intersection with the main line near Antelope Springs. Its length was found to be 80 miles—or 13 miles longer than by the cañon line. As it also required heavier grades it has been thrown out, together with a modification by which it was thought the ascent of the Mogoyon plateau might

be made more gradually, cheaply and in less distance, by leaving the Little Colorado near the mouth of Navajo Creek and completing the ascent at a point near Sunset Gap. But it proved unfavorable, if not impracticable, in consequence of the interposing cañons of "Big Dry" and "Chevelons" forks, which could not be crossed within reasonable limits of cost and gradient.

MOQUI PASS LINE.—The reconnoissance around the north side of Mt. Agassiz was made by Mr. Schuyler, who considers it at least 500 feet lower at the summit than Tonto Pass, and probably much more. The distance thereby from Sunset Crossing to Cradlebaugh's Tank, a common point on the west slope of the range, is 105 miles—being 10 miles longer than the route by the south side of the mountain. The work will be less expensive, but the grades probably about the same.

This line should receive a careful instrumental examination, as it appears to have some notable advantages which may more than compensate for the increase of distance. Beside, if the "White Mesa Line" be adopted for the descent of the western slope of the Mogoyon Range, this route by "Moqui Pass" may prove the *shortest* as well as the best way to the Mesa Gap.

5th.—THE VERDE LINE.—Reconnoissance was made by myself of the country south of the San Francisco Mountain (Mt. Agassiz), lying between the Little Colorado and the Val de Chino near Prescott. The object was to shorten the line from Sunset Crossing by avoiding the detour to the northward—to find a lower summit than Tonto Pass (Leroux) at which to surmount the Mogoyon Range—to keep entirely out of the snow belt, and to approach nearer to the rich mining districts of Central Arizona.

To accomplish these desirable results, a pretty thorough examination was made of the intervening country from Tonto Pass southward for 50 or 60 miles, to the mouth of Clear Fork, and westward to "Postles" and "Hell Cañon." In consequence of the interposition of the Verde River and its tributary cañons, the whole of this region was found to be of the most impracticable character for a rail road and it evidently

continued the same for a long distance southward. The crest of the Mogoyon Range was not found to be materially lower (if indeed as low) to the southward, as at Tonto Pass, while the Verde cuts in deep and abruptly at its western base, being by my estimate from 3000 to 3500 feet only above tide at the mouth of Clear Creek, while the Mogoyon crest exceeds 7000.

The slope or base of the San Francisco mountains parallel to and north of the Verde could not be followed because of numerous impassable cañons and spurs, while even had it been possible to descend to the Verde from the eastward, the plateau of the Tonto Buttes, 2000 feet above the river, presented itself on the west side, it not being practicable to follow up the valley of the Verde to the Val de Chino because of its shutting up into long and tortuous cañons.

The northern slope of the Tonto Buttes was also found too difficult for an outlet.

So the idea of getting across this range by a more southerly line had reluctantly to be given up. Fortunately the excellence of the line by Leroux Summit and the beauty of much of the country through which it runs, and the extent of the timber growth, served partially to compensate for its increased length and comparative remoteness from the Prescott mines.

6th.—Alternate Routes Descending the West Slope of the Mogoyon Range.—Two of these (besides the "Whipple Pass Line" already described) were instrumentally run, and one other reconnoitered. This complicated country, the most formidable portion of the whole route to the Pacific, was pretty thoroughly examined, both by our outward and returning parties. While very great improvements will be made on location, it is doubtful whether any other general line can be found than those which are here described. On the north, the field of investigation was terminated by the Grand Cañon of the Colorado, and on the south by Bill Williams Mountain with its spurs and the great gulf of the Val de Chino.

Still south of this a line was *proposed* by Whipple and Campbell, leaving our surveyed route east of Leroux Summit, and intersecting the Val de Chino south and east of the mouth of

Partridge Creek—on a more direct route to the Colorado by way of Bill Williams Fork. But an exploration from Antelope Springs to "Hell Cañon" and Prescott did not encourage me to expect any thing from such a line. The Val de Chino falls to the eastward, so that the amount of descent from the Mogoyon Range is increased, while the distance afforded for its accomplishment is lessened. This might be to some extent counterbalanced by the saving of a portion of the elevation at Leroux Summit, but that the easterly spurs of the Bill Williams Mountain present a formidable barrier, apparently at least as high as Leroux Summit itself, to any approach from that direction.

What is really wanted, after ascertaining that the crest of Mogoyon Range does not materially diminish in altitude south and east of the Tonto Pass, is to obtain distance for the western descent—and, as the Verde and Val de Chino are tributaries of the Gila, this can manifestly be accomplished best by keeping to the northward—and other things being equal, the best topographical line would be that which would flank this southward drainage entirely.

The line which comes nearest to doing this is the *White Mesa Line*, which was discovered and reconnoitered by Col. Greenwood, and instrumentally run by Mr. Holbrook. It diverges from the main route at Park Spring, 15 miles west of Leroux Summit, and intersects it again at Yampa Gap, a distance of 95 miles. It crosses the Great Colorado Plateau, through which, 20 miles to the northward, the famous Grand Cañon winds; and turning the north end of the Laja Range and skirting the extreme upper border of an easterly prong of the Val de Chino, descends at the "Mesa Gap" into Aubrey Valley, which it crosses to Yampa Gap. It saves 17 miles over the Partridge Creek line, if the crossing of the Colorado River, near Fort Mojave, be the objective point.

This saving may be increased to 32 miles, if a modification, suggested after a reconnoissance by Mr. Schuyler, be found satisfactory. This is the *Laja Gap Line*. It would diverge from the former at the Crossing of Cedar Creek, and avoiding the

northern detour by the "Blue" and "White Mesas," would cross the Laja Range at Laja Gap, (descending into and crossing the above mentioned eastern prong of the Val de Chino,) and intersect the "White Mesa Line" at the summit of Mesa Gap.

The objection to these lines is that they traverse a dry, barren country, which we called the "Dismal Plain," in which no mineral wealth has yet been disclosed, and that they are from 30 to 60 miles more distant from the rich Prescott district, than the route by Partridge Creek.

THE PARK CREEK LINE was instrumentally run by Mr. Miller. It diverges to the right from the Whipple Pass Line at Park Spring, and is common with the White Mesa Line as far as the western rim of the Spring Valley Park, 15 miles. Here it keeps to the southward, and crossing the waters of Cedar Creek and the divide between these and Partridge Creek, descends the north fork of the latter, and is joined by the "Whipple Pass Line" of Schuyler at the forks of Partridge Creek, 37 miles from Park Spring. Although very heavy work was encountered, the grades were lighter than by Whipple Pass and the country in the vicinity of and north of this line (which lies a little northward of the Beale Wagon Road) probably offers the best topography for a route to reach the Val de Chino by Partridge Creek. The distance is very nearly the same as by Whipple Pass.

THE PICACHO LINE was instrumentally run by Mr. Holbrook. It diverged to the right from the Partridge Creek route at Russell's Tank, 7 miles south of the forks of this creek, and crossed the Laja Range north of the Picacho. Here it descended into the Val de Chino (at a point about 30 miles north of the mouth of Partridge Creek), and crossed the same to Beale's Pass where it intersected the main route. It was run to avoid the southern detour by the mouth of Partridge Creek—and saved 17 miles, but the grades were too heavy in crossing the Laja Range to warrant its further consideration.

It will be seen that of the above lines, those by the mouth of Partridge Creek, flank the Laja Range on the south, and that by the "White Mesa," flanks it on the north—while the two inter-

mediate ones, the "Picacho" and "Laja Gap" lines, *cross it*, The White Mesa line *heads* the Val de Chino or nearly so—while all the rest cross it or descend into and follow it to one of its sources.

To this scope of about 60 miles of latitude, the detailed examinations for the western descent of the Mogoyon Range may be confined when the line comes to be located—provided it is desired to strike the Colorado River where it is navigable. Otherwise it would be worth while to ascertain if the Grand Cañon be at any point narrow enough to admit of being spanned by a suspension bridge, and whether the country west thereof in the vicinity of the Mormon trail and the neck dividing Soda Lake from Death Valley can be advantageously reached from such a crossing.

7th.—THE AZTEC PASS LINE.—West of the Val de Chino, an instrumental line was run by Miller and Schuyler, across the Aztec (or Juniper) Range at Aztec Pass.

This was the route adopted by Whipple. The Aztec Pass was found to be practicable with 80 feet gradients, but sharp curves and heavy work were required in making the ascent from the east, while on the western slope some heavier grades were found to be necessary, and the maximum of 116 feet per mile was required in following the cañon of White Cliff Creek, through the Aquarius Range and across the Big Sandy to Wallapi Valley. Of course the long southern detour made by Whipple on this line by the Valley of Bill Williams Fork, could not be thought of.

On the Aztec Pass line, the work as well as the grades were heavier throughout, and as it proved to be about 10 miles longer than the line up the Val de Chino, this route need not receive further attention.

SUMMARY.—Generally it may be said in regard to alternate routes west from Mt. Agassiz:—

1st.—That without reference to any other consideration than *through traffic*, if the vicinity of Fort Mojave or any point

north thereof be selected as the best crossing of the Great Colorado River, the "White Mesa line" or its modification by Laja Gap, should be preferred.

2d.—If it be desired to follow or skirt a richer and better watered country, one more tempting to agricultural occupation, as well as to approach nearer to the existing settlements and developed mining region of Central Arizona, the *Partridge Creek line* is the best, even should it subsequently ascend the Val de Chino to Beale's Pass, in order to reach the Colorado near Fort Mojave. This line approaches within about 55 miles of Prescott at the mouth of Partridge Valley.

3d.—But if the mouth of the Bill Williams Fork or its vicinity be selected as the point of striking the Colorado River, and a favorable route be found thereto from the Val de Chino, turning the south end of the Aztec Range, then the Partridge Creek line is pre-eminently the best for the descent from Leroux Summit.

The richness and abundance of the auriferous copper ores of the Bill Williams River, the greater proximity to the Prescott, Wickenburg and Le Paz mines and the centrality of position in reference to this whole mineral territory suggest the importance of a more southerly route from the Val de Chino to the river than that by the Cañon of the Yampa and Wallapi Pass—especially if it can be found of as favorable a character topographically as the latter.

Before location, therefore, a careful examination should be made, beginning at the mouth of Partridge Creek, following a southerly tributary of the Val de Chino to its head in the low neck connecting the Black Mountain near Prescott, with Mt. Hope of the Aztec Range, and thence descending the waters of the Santa Maria or Date Creek to the Bill Williams,* and thence to the Colorado.

If this examination should prove satisfactory, it should be continued westward to ascertain if a favorable outlet may be had from the Colorado River, either by the Chemeuevis Valley and

* Part of this route was suggested by Whipple.

Perry Basin, turning the south end of the Providence Range; or by the Morongo basin *direct* to the Mojave River and Tehachapa Pass.

Such a line would considerably shorten the route to San Diego, and if found not materially to increase it to San Francisco, would offer some important advantages.

There is but little doubt, it would be more expensive to construct than our surveyed line.

5th.—Only one other route of approach to the Colorado suggests itself as worthy of examination, for which a rapid reconnoisance would probably suffice. That is from the vicinity of Peacock Springs at the north end of Wallapi Valley, down Yampa Creek (wholly or partially) to the Colorado above Fort Mojave, and thence westward to the neck dividing Death Valley from Soda Lake. Thence to the Mojave River or direct to Tehachapa Pass.

The examinations here suggested should be thoroughly made, before the point of crossing the Colorado River, or the line of descent from the crest of the Mogoyon Range are decided upon.

Tables showing distances and elevations between the Rio Grande and the Colorado River.

No. 1.

THE PRINCIPAL LINE, (*via* NAVAJO PASS, WHIPPLE PASS, PARTRIDGE CREEK AND THE YAMPA.)

Elevations above tide-water. *Feet.*	Distances from Isletta. 12 miles south of Albuquerque.	Local distances. *Miles.*	From Isletta. *Miles.*
4803	*Isletta* (low water in Rio Grande) to		
5276	Rio Puerco Summit	14	14
5031	*Mouth of El Rito*	13	27
5310	Sheep Springs	13	40
5535	El Rito	8	48
5633	Laguna intersection	4	52
5711	Laguna	4	56
5870	Cuvero	8	64
6185	Remances (Picket Post)	14	78
6375	Near Ft. Wingate	10	88
6557	Aguo Azul	12	100
7177	*Navajo Pass* (Summit of Sierra Madre)	22	122
	Carizo Springs	6	128
6619	Old Ft. Fauntleroy (New Ft. Wingate)	10	138
6220	Zuni and Ft. Defiance Road	18	156
5855	Canon of Navajo Creek	30	186
5626	Near Navajo Springs	14	200
5512	Signal Hill	5	205
4998	*Little Colorado* (Mouth of Navajo Cr'k)	35	240
4765	*Sunset Crossing*	35	275
5294	*Cañon Diablo*	28	303
	Cottonwood Cañon	11	314
6358	Padre Cañon	10	324
	Near Antelope Springs		
	San Francisco Spring		
7101	San Francisco Ridge		337
7196	Near Leroux Spring	2	339
7510	*Tonto Pass* (Leroux Sum't Mt. Agassiz)	3	342
7558	Bald Peak (unnecessary summit)	9	351
7199	*Park Spring*	6	357
7206	*Whipple Pass* (summit)	5	362
5512	*Forks of Partridge Creek*	32	394
5285	Russel's Tank	6	400
5088	*Mouth of Partridge Creek Valley*	20	420
(4648)	*(Crossing of Val de Chino)	11	431
5127	*Beale's Pass*	17	448
5241	*Yampa Gap* (entrance to Yampa can.)	22	470
3783	Truxton's Spring	27	497
3170	Peacock Spring	20	517
3473	*Wallapi Pass* (Railroad Pass)	14	531
1286	Mojave Gap	27	558
353	*Colorado River* (above the Needles and 25 miles south of Ft. Mojave)	22	580

	Miles.
From the Rio Grande to the Colorado by "White Mesa Line"	563
From the Rio Grande to the Colorado by "Laja Gap† Line"	548
From the Rio Grande to the Colorado by †proposed Route north of San Mateo Mountain, and Partridge Creek Line	558
From the Rio Grande to the Colorado by Route north of San Mateo Mountain and "Laja Gap L ne"	526

* Line keeps 100 feet higher on east side of valley.

† Estimated.

No. 2.

LAGUNA LINE.

Elevations above tide-water. *Feet.*	Distances from San Felipe, on Rio Grande, 10 miles north of Albuquerque.	Local distances. *Miles.*	Distance from San Felipe. *Miles.*
5042	*San Felipe*, (Rio Grande,) to Mouth of Jemez	7	7
	Mouth of Salt Creek	21	28
	Rio Puerco Summit	11	39
	Rio Puerco	14	53
	San Antonio Summit	10	63
	Ojo de Chamisa	7	70
5633	*Laguna* intersection	8	78

No. 3.

WHITE MESA LINE.

Elevations above tide-water. *Feet.*	Distances from	Local distances. *Miles.*	Distance from Park Springs. *Miles.*
7199	*Park Spring* (357 miles from Isletta) to		
6102 to 6132	Junction with Park Creek Line	15	15
5579	Cedar Creek Canon (Crossing)	10	25
5498	Point of White Mesa	23	48
5677	Point of Blue Mesa	11	59
5908	Summit between Val de Chino and Cataract Creek	10	69
6166	*Yampa Gap*—Summit	7	76
5178	Crossing of Aubrey Valley	10	86
5369	Junction with Principal line near *Yampa Gap*	9	95

No. 4.

LAJA GAP LINE.*

Elevations above tide-water. *Feet.*	From	Local distances. *Miles.*	Distance from Park Springs. *Miles.*
7199	*Park Spring* (357 miles from Isletta) to *Laja Gap* (Summit)	44	44
	Val de Chino	9	53
6166	Mesa Gap	8	61
5369	*Yampa Junction*	19	80

* Estimated.

No. 5.

COSNINO CAVES LINE.

Elevations above tide-water. *Feet.*	From Isletta.	Local distances. *Miles.*	From Isletta. *Miles.*
4765	To Sunset Crossing		275
4580	Mouth of Canon Diablo	33	308
6090	Cosnino Caves	26	334
6428	Junction with Padre Canon Line	6	340

Being 13 miles longer than from Sunset Crossing to same Junction by Canon Line.

No. 6.

Aztec Pass Line.

Elevations above tide-water. *Feet.*	From Isletta	Local distances. *Miles.*	From Isletta. *Miles.*
7199	To Park Spring		357
6132	Junction of "Park Creek" with "White Mesa" Line	15	372
5810	In Dry Canon	5	377
5731	In bed of Cedar Creek	5	382
6033	Summit bet. Cedar and Patridge Cr.	5	387
5521	Junction of "Park Creek" with "Whipple Pass" Line	6	393
	To same point via "Whipple Pass Line,"	8-10	393 8-10
5315	Pearl Spring	6	399
5285	Russel's Tank	1	400
5088	Mouth of Partridge Valley	20	420
4653	Junction with Yampa Line	8	428
4649	Crossing of Val de Chino	2	430
5139	Turkey Creek	12	442
5609	Connection of Miller and Schuyler	6	448
6117	Summit of Aztec Pass	9	457
5170	Anvil Rock	13	470
4980	Canon	8	478
5052	South of Cross Mountain	3	481
5076	Divide between Canon Creek and Fort Rock Spring	4	485
4972	North of Fort Rock Spring	3	488
4892	Divide between White Cliff and Canon Creek	5	493
4783	End of Line	2	495

ROUTE FROM THE COLORADO RIVER TO SAN FRANCISCO, 575 MILES.

We now enter the State of California, and traverse the "Mojave Desert," 235 miles by the windings of our line, to the eastern foot of the Sierra Nevada. This range is crossed at Tehachapa Pass, 50 miles from foot to foot, the line then entering at its head, a great north and south valley called the "Tulare Valley," which separates the Sierra Nevada from the Coast Range.

The Tulare Valley is 70 miles wide, and in connection with the San Joaquim Valley, which forms its northern extension, is 300 miles long, the drainage from the upper part being into a fresh water basin, "Tulare Lake," and from the lower part by the San Joaquim River into the Sacramento. From the western foot of Tehachapa Pass, the line may either follow down the east or west side of Tulare Valley, a distance of about 300 miles, to the navigable waters above San Francisco, the valley having an average fall of less than two feet per mile; or, secondly, it may intersect near the lower end of the valley the Western Pacific Railroad, and enter San Francisco by that line, through the Coast Range at Livermore's Pass; or, thirdly, it may take a more direct route to San Francisco, by crossing the Tulare Valley from Tehachapa to the west side, and making the transit of the Coast Range at one of five other passes.

In the last event, after crossing this Range, it will follow down one of the rich but narrow valleys west thereof, until at Gilroy it connects with the Southern Pacific Railroad* of California, now completed to that point from San Francisco.

But let us trace the route more in detail.

1st. *The Mojave Desert.*—We have seen that the site proposed for the crossing is near the "Needles," about 25 miles below Fort Mojave, where the elevation of low water was

*San Francisco and San Jose Railroad.

found to be 358 feet above tide. This point is 250 miles by the river above Fort Yuma; 400 miles above its mouth, at the head of the Gulf of California, and 100 miles below Callville, the actual head of navigation below the foot of the Grand Cañon. Being a navigable stream, the bridge seat should be at least 75 feet above the water, for which the bluffs are favorable. This will give the line an elevation of 428 feet above tide, from which it starts northwestwardly to make the ascent of the Piute Mountains. In 40 miles, by following the "Piute Wash," to Sacramento Springs, and thence the west branch of that wash, it reaches the summit at Piute Pass, 2,579 feet above the sea.

The ascent is remarkably uniform. Piute Pass is five miles in width, and partakes of the general character of all the passes on this desert, being merely a broad swell at the summit of two long, gravelly or sandy valleys, which slope in opposite directions, and lie between granitic or volcanic mountains, that rise from one to three thousand feet above their bases.

From Piute Pass, the line follows southwestwardly, with almost unbroken uniformity, the long slope of Schuyler Valley, for 36 miles, to its mouth, at "Chemeuevis Pass," where it enters "Perry Valley," at an elevation of 675 feet above the sea.

Chemeuevis Pass is an opening between two detached mountain ranges, and Perry Valley is one of the largest of those numerous valleys which constitute the sole receptacles of the drainage of these desert plains and mountains. It lies at the southern end of the Providence Range,) apparently an extension of the Wahsatch Range, of Utah,) and is larger than Soda Lake, being 40 to 50 miles long, and an average of 20 in width.

Our line skirts the northern margin of this basin for 20 miles to "Volcanic Point," rising slightly from Chemeuevis Pass, although the "sink" proper, (10 miles in diameter, and lying to the left of the line,) is but 530 feet above the sea. In the sink is a recent extinct volcano, 200 feet high, very symmetrical in shape, with a crater 75 feet deep, whose streams of lava

surround its base, and extend in various directions for several miles. The line then ascends northwestwardly another broad and gently-sloping valley for 25 miles to "Squaw Summit," where the elevation is about 1,700 feet above tide. 15 miles west of this point it crosses the summit of "Crater Pass," about 2,100 feet above tide, and descends therefrom in 10 miles to a smaller basin lying nearly due south of Camp Cady, which we called "Malpais Sink."

The elevation of this sink, which also contains an extinct volcano very similar to the first, is about 1,900 feet. The line crosses it, and follows for 25 miles a westward course, skirting the northern foot of the Ellet Range of mountains, being for this distance nearly parallel to, but gradually approaching the Mojave River, which it finally crosses near the Great Bend of that river.

The point of crossing is between the "Grapevine" and "Cottonwood," about 70 miles west of Soda Lake, and 170 miles by our line from the crossing of the Colorado River, and has an elevation of about 2,375 feet above the sea. The distance thence to the eastern foot of the Sierra Nevada is 65 miles; the direction a very little north of west, over a gently rolling plain of sand and gravel, without vegetation, except the artemesia and yucca, and a thin and scattered growth of grass.

2d. *The Sierra Nevada.*—Tehachapa Pass, about 40 miles east and north of Tejon, was found to be the best at which to cross this great range, which is not here, by any means, the formidable barrier that it is further north. The elevation of our line at the summit is 4,008 * feet above tide, while at the Donner Lake Pass, east of Sacramento, where the Central Pacific Railroad crosses the same range, the altitude exceeds 7,000 feet. The line through Tehachapa Pass was run by Mr. John Runk, Jr., Division Engineer; from an elevation of 3,080 feet, at the eastern foot of the mountain, it reached the summit in 15 miles, with a gentle inclination over a smooth surface. The summit is a broad, smooth park, crossing which, in four miles, there

*Barometer elevation.

begins a precipitous descent to the westward, the fall in the succeeding 31 miles being 3,045 feet to the western foot on the Tulare Plain. The gorge is narrow, crooked and steep, but the mountain slopes are favorable to supporting the grade.

We are now at the head of Tulare Valley, 795 feet above tide-water, towards which a broad way presents itself to the northwestward without the necessity of crossing a single intervening summit.

3d. But to reach San Francisco by a more *direct* line, it is necessary to cross the coast or "Monte Diablo" Range. Four passes were examined in this range, (one instrumentally,) which were found to rank in order of merit, increasing from north to south, as follows:

1st. "*Pachecos*," the most difficult of all, though practicable. The distance from the western base of Tehachapa Pass to San Francisco, following the east side of Tulare Lake by Visalia and Pachecos Pass, is 325 miles.

2d. The "*Panoche Grande*," distance 285 miles, instrumentally run by Mr. Eicholtz.

3d. The "*San Benito*" *Pass*, reconnoitered by Col. Greenwood, distance 290 miles. This is the shortest good line to San Francisco, and has much to recommend it as a "through route."

4th. The "*Chalama*," which was found to be a very excellent pass, and decidedly the best of those examined. It was reconnoitered by Mr. Eicholtz, who reports the distance from the western foot of Tehachapa Pass, across Tulare Valley, to the summit of the Coast Range at Chalama Pass, to be 82 miles; to the terminus of the Southern Pacific Railroad at Gilroy, 228 miles, and to San Francisco, 308 miles. It is 18 miles longer than by San Benito, but superior in every other respect.

Of these, the "Panoche Grande" was the only Pass instrumentally surveyed. As our levels were not carried west of the Perry Basin, in California, except at the mountain Passes, the height of the Coast Range above the sea cannot be positively stated, but at Panoche Grande Pass the elevation of the summit above the eastern base, at the head of the Cañon, was

found to be 1,593 feet, and as the Tulare Lake, by barometer, is 398 feet, the summit of this Pass may be estimated at less than 2,200 feet above tide.

The summit at Chalama Pass, which lies west of the southern end of Tulare Lake, is apparently lower, and we estimate its altitude at between 1,500 and 2,000 feet. From this summit the line of reconnoissance followed by easy gradients down "Chalama Creek," to the Estrella, and the Estrella, Salina and Pajaro Valleys, to Gilroy, from which point the Southern Pacific Railroad is completed, *via* San Jose, to San Francisco, a distance of 80 miles.

Generally, it may be affirmed, that if the main purpose be to obtain the largest amount of local traffic, the line down the east side of Tulare Valley, developing the pastoral and agricultural resources of this Great Basin, and of the rich San Joaquim Valley, and affording access to the mines and forests of the Sierra Nevada, should be adopted. But if the interests of a through route to San Francisco predominate, the line should evidently cross the Coast Range at the San Benito Pass, Chalama Pass, (or a pass south of the latter, known as the Estrella, which may possibly prove superior to the Chalama, but which time did not permit us to examine,) and thence follow down the fertile, but more confined valleys of the Salinas and its tributaries.

As the Tulare and San Joaquim Valleys may be so readily and advantageously tapped by a branch from Stockton or a point between Stockton and Livermore's Pass, on the Western Pacific Railroad, it may be preferable, even from local considerations, to adopt a route for the *Southern Continental line*, which will the sooner open up and populate the fertile valleys west of the Coast Range, while saving from 40 to 50 miles in distance between Tehachapa Pass and San Francisco.

SAN DIEGO BRANCH.

211 *Miles Long; or, from the Colorado River, below Fort Mojave,* 287 *Miles.*

A reconnoissance was made by myself from the Crater, in Perry Basin, about 80 miles west of the Colorado crossing, southwestward to San Bernardino, which disclosed the existence of a favorable route for connecting our surveyed line of the 35th parallel with San Diego.

The outlet from Perry Basin is by the "San Diego Pass," a smooth pass of long and uniform grade, whose entrance is 10 miles, nearly due southwest, from the crater, between Gashed Mountain on the right or west, and Mt. Baird on the left.

The entrance may be reached either from the Chemeuevis Pass, by a line 20 miles long, running westwardly across Perry Basin; or from a point on the main line, a few miles northwest of the crater, which would shorten the branch and avoid a portion of the descent into the sink, but at the expense of an increase in the through distance to San Diego.

Starting from an elevation of about 600 feet above tide in Perry Basin, at the mouth of San Diego Pass, the line runs west and south, through "Lucky Gap," for 17 miles, to the summit of the Bullion Range, where it attains an estimated elevation of 2,000 feet above tide, the inclination being uniform and between 80 and 90 feet per mile. Thence it descends in 10 miles by a uniform slope to the Morongo Basin, estimated at 1,500 feet above tide, and follows this long depression westwardly by a very gradual ascent for over 20 miles, with an almost imperceptible inclination to the summit of *Morongo Pass*, where it attains an estimated elevation of 2,300 feet. The line then descends in 3 miles to the head of Morongo Cañon, which it follows southward for 7 miles, emerging in the Coahuilla Valley, south of the Morongo Range, at a point about 11 miles northeast from the mouth of San Gorgina Pass.

The "San Gorgina" is the best pass known in the whole range of the Sierra Nevadas, north or south of its junction with the Coast Range. It is from 3 to 5 miles in width, and of a

remarkably uniform surface. At its eastern base it has an elevation of 1,101 feet and 22 miles west therefrom, at the summit, 2,808 feet, as ascertained by Lieut. Williamson—the average ascent being 78 feet per mile, and the descent to the westward the same. From the San Gorgina summit it is about 100 miles southwestward to San Diego. Mr. L. H. Eicholtz, Division Engineer, who made the reconnoissance of this last portion of the line, reports that the difficulties presented by the numerous streams flowing from the Cordilleras to the ocean will probably compel the adoption of a coast route.

On this branch, from the route of the 35th parallel to San Diego, no grade exceeding* 90 feet per mile will be required; and as far as the San Bernardino Valley, 120 miles from the diverging point at Chemeuevis Pass, the work will be inexpensive, or rather such a large portion of it will be so that the few points at which any cutting or filling occurs will not raise the average above a low rate.

For the remaining 90 or 100 miles to San Diego the work will be much more costly. In crossing the Great Basin, except for one mile on the Morongo slope of the Bullion Range, near the summit of the San Diego Pass, the line passes over hard sand, not changeable by the wind. Some precautions may be necessary in crossing the alkali sink of Perry Basin if that route be adopted.

The great importance of this branch, in placing the fine harbor of San Diego, and the rich valleys of Southern California within reach from our main line, without sacrificing in any respect the interest of the latter as a route from the Mississippi Valley to San Francisco, will not fail to be appreciated.

By it the Pacific Ocean is reached at San Diego, in 288 miles less distance than San Francisco, and at Los Angelos (Wilmington) in more than 300 miles less distance.

The total distance from Kansas City to San Diego is only 1,646 miles, and from New York, *via* Kansas City, to San Diego, 2,964 miles.

*See Chapter on Gradients.

ALTERNATE ROUTES WEST OF THE COLORADO RIVER.

The topographical features of the "Great Basin" are so strongly marked, that once given the point of crossing the Colorado River, there remains but little room for the consideration of alternate routes by which to reach the Sierra Nevada.

The Providence Range was explored by our parties for a distance of 60 miles, north and south, without offering what we regarded as a practicable pass. To the northward, where Whipple's line crossed it, the summit was nearly 5,000 feet above the sea, and the descent in 47 miles westward, into Soda Lake Basin, nearly 4,000 feet. This summit might, indeed, have gone far toward condemning the whole route of the 35th parallel, had it been found impossible to avoid it. But our line turns the whole range, on the south, at Perry Basin—the highest elevation attained being 2,579 feet at Piute Pass, and the lowest 675 feet at Chemeuevis Pass, and ascends by easy grades and long straight lines to the Mojave River, at a point most favorable for crossing it, on a good route to the base of the Sierras.

The passes of the Sierra Nevada had been so thoroughly examined and reported upon by Lieut. Williamson, that it was evident two of them in this vicinity, the "Cañada de las Uvas" and "Tehachapa Pass," had such undoubted superiority as to render it useless to examine the others.

Our instrumental line was, therefore, run through "Tehachapa," with the best results, as will be seen under the head of grades, although the Cañada de las Uvas (the new "Tejon Pass") was reconnoitered by Mr. Runk's party.

The only lines that suggest themselves for further examination in California are as follows:

1st. The *Estrella Pass*, through the Coast Range.—This is at the head of the main fork of the Estrella Creek, a branch of the Salinas, and lies about 70 miles southeast of the Chalama Pass. It is referred to favorably by Lieut. Parke, who did not, however, make more than a rapid reconnoissance of it; and may possibly prove to be superior to the "Chalama," although

we could hear nothing to recommend it from the settlers, and the distance would evidently be longer. Time did not permit us to examine it.

If the line crosses the Coast Range at all, the choice of location will be limited between this pass, the "Chalama," and the "San Benito"—depending upon the policy of the Company in reference to through and local traffic

2d. If the line heretofore suggested in Arizona, as following down Yampa Creek, wholly or partially from the north end of Wallapi Valley to the Colorado River, above Fort Mojave, should prove meritorious, a reconnoissance should be made west of the river in California to ascertain if a good line can be had thence across the desert to the neck dividing Soda Lake from the Armagosia, and so on to the Mojave River or direct to Tehachapa Pass.

Such a line would be considerably longer, both to San Francisco and San Diego, than the one we have surveyed, would also encounter the disadvantage of crossing the Colorado from 50 to 100 miles higher up than the "Needles," (but still at a point below the head of navigation,) and would seem altogether to have very little to recommend it. But this part of the Great Basin presents such a confused alternation of "Lost Mountains," denuded ranges, and basins of great variation in altitude, that until it has actually been explored, as that portion has been by our parties southward along the Providence Range and into the Morongo Basin, it is not wise to pronounce against such a route.

The only improvements possibly to be expected from it are:

1st. A more constant and regular descent from Peacock Spring to the Colorado River, avoiding the rise of 300 feet in crossing the Wallapi Valley on our surveyed line.

2d. A greater altitude at the Colorado River of from 200 to 300 feet, in consequence of striking it higher up.

3d. Possibly a lower summit than Piute Pass, west of the river, which is doubtful; and lastly, a higher elevation than Perry Basin, in getting from this summit to the Mojave or Tehachapa Pass, which is pretty certain.

It would require very great superiority in the last two particulars to counterbalance the disadvantages which have been named.

3d. In this connection it may also be repeated, that if the Grand Cañon of the Colorado, which Ives found at points to be not over 50 yards wide at the bottom, with very precipitous walls, should be ascertained to be narrow enough at the top to be spanned by a suspension bridge at any point on the Colorado Plateau, in Arizona, that can be reached from the vicinity of the "White Mesa Line," Aubrey Valley, or the Yampa, the temptation of a possible saving of 5,000 feet of rise and fall would warrant a reconnoissance westward in California, to ascertain if this point of crossing could be favorably connected with Tehachapa Pass. The innumerable side cañons, of great depth, with which this plateau everywhere in the vicinity of the "Grand Cañon" appears to be furrowed, might, in any event, render such a line impracticable. But if it should prove otherwise, although the distance would be increased, both to San Francisco and San Diego, and the river could not, of course, be reached for purposes of navigation, yet the saving of the great plunge into the Colorado Valley may possibly be considered as going far toward compensating for these drawbacks.

As the Valley of the "Armagosia" is probably very low, (its sink, in Death Valley, being considered beneath the level of the sea,) it would apparently be unnecessary to examine the country north of the old Mormon trail, or south of it, as Soda Lake is known to be but 1,000 feet above the ocean.

4th. If the line suggested, east of the Colorado, striking it at or near the mouth of Bill Williams' Fork, should prove favorable, there is but little doubt that a good line exists across the desert westward, skirting the southern base of "Old Dad's" and "Old Woman's" Mountains, and entering by a pass at its eastern end, the Morongo Basin, whose estimated altitude is between 1,300 and 1,500 feet above tide water; thence 50 miles westward along this basin to an outlet by a long mesa to the Mojave River, at a point about 20 miles above the Point of Rocks, and thence direct to Tehachapa Pass.

From what I saw with Mr. Spears, in a reconnoissance of the Morongo Basin, I believe such a route to be practicable. It would, however, be somewhat longer to San Francisco, (although considerably shorter to San Diego,) and the portion in Arizona more expensive to construct than our surveyed route. Strong local attractions in the way of rich developed mines in Arizona might excuse this detour, but it is not very likely that the descent from the Val de Chino to the Colorado would be any more uniform than by the excellent line through Beale's Pass and the Cañon of the Yampa.

5th. It is also possible, but not very probable, that a shorter route, with a lower summit than Piute Pass, may be found from our surveyed line in Arizona, near the south end of the Black Mountains, to Perry Basin, in California, by following the Colorado below the "Needles," and thence striking westward from the Chemeuevis Valley.

6th. Consulting solely the interests of a line to *San Diego*, it might be found best to leave the Colorado River at some point at or north of Le Paz, so as to avoid the Morongo Basin, and reach the San Gorgonia Pass by a line keeping to the south of the Halfway Mountains and the Morongo Range.

Now that this desert region is becoming better known, its bare, rugged mountains, and sandy basins, once so formidable, are found to present but few real obstacles to the cheap construction of a railroad, with reasonable grades, in various directions across it. The main difficulty is scarcity of water, but sufficient experience has been had, in about as dry a region farther north in Nevada, to demonstrate that this can be removed by sinking wells. The material for the road-bed is generally of the very best, and very little drifting sand will be encountered.

DISTANCES AND ELEVATIONS WEST OF THE COLORADO RIVER.

TABLE No. 1.

ROUTE TO SAN FRANCISCO, (VIA SAN BENITO PASS.)

Elevations above Tide, at low water. Feet.	From the *Colorado River*, near the Needles, (1451 miles from Kansas City, by Raton Mountain route; 1379 miles from Kansas City by Cimarron route.) 353 feet above Tide, at low water; 428 feet above Tide, at Bridge-seat	Local Distances. Miles.	From the Colorado River. Miles.
1,159	To Sacramento Springs,	22	22
2,579	Piute Pass, (Summit.)	18	40
675	*Chemeuevis Pass*, (Entrance to Perry Basin,)	36	76
*(530)	Sink of Perry Basin,	...	...
1,000	Crater Station,	14	90
1,200	Volcanic Point,	20	110
†1,700	Squaw Summit,	10	120
†2,100	Crater Pass, (Summit.)	15	135
†1,900	Malpais Sink,	10	145
2 375	*Mojave River*, (Crossing near Grapevine,)	25	170
2,388	Desert Lake.	30	200
3,080	East Foot of Sierra Nevada.	35	235
4.008	*Tehachapa Pass*, (Summit of Sierra Nevada,)	15	250
2,020	Bird Point,	20	270
795	Tulare Plain, (Western Foot of Sierra Nevada,)	15	285
†700	Buena Vista Oil Works,	35	320
†700	Polvero,	75	395
†2,100	Summit of Coast Range, (San Benito Pass,)	15	410
Railroad completed 1868.	*Gilroy*,	85	495
	San Jose,	30	525
	San Francisco,	50	575

* Line does not descend to level of Sink.
† Estimated.

TABLE No. 2.

THE CHALAMA PASS ROUTE.

Elevations above Tide. Feet.	Distance from	Local Distances. Miles.	From Colorada River. Miles.
4.008	Summit of Tehachapa Pass,	...	250
2,020	To Bird's Point,	20	270
795	Western Foot Sierra Nevada,	15	285
*700	Buena Vista Oil Works,	35	320
*1,500to2,000	*Chalama Pass*, (Summit of Coast Range,)	47	367
	Forks of Estrella,	15	382
	Mouth of Estrella,	18	400
	San Benito Ranch, (at lower end of canon and head of Salinas Valley,)	30	430
	Natividad,	58	488
	Head of Pajaro Valley,	12	500
R. R. completed, '68.	*Gilroy*,	13	513
	San Jose	30	543
	San Francisco,	50	593

* Estimated.

TABLE No. 3.

PANOCHE GRANDE ROUTE.

Elevations above Tide. Feet.	From	Local Distances. Miles.	Distances from Colorado River. Miles.
4,008	Tehachapa Summit,	...	250
2,020	To Bird Point,	20	270
795	Western Foot of Sierra Nevada,	15	285
*700	Point of Buena Vista Lake,	26	311
	North Point of Tulare Lake,	66	377
	Posey China Creek,	22	399
	Panoche Grande Creek,	23	422
*2,200	Panoche Grande Pass, (Summit of Coast Range,)	22	444
	Polvadero,	19	463
	Gilroy,	27	490
	San Jose,	30	520
Tide-water.	San Francisco,	50	570

* Estimated.

TABLE No. 4.

*TULARE VALLEY ROUTE, (EAST SIDE.)

Elevations above Tide. Feet.	From	Local Distances. Miles.	Distances from Colorado River. Miles.
4,008	*Tehachapa Summit*,	...	250
795	*To West Foot of Sierra Nevada*,	35	285
	Kern River,	7	292
	Posey Creek,	9	301
	White River,	24	325
	Deer Creek,	15	340
	Tule River,	5	345
	Outside Creek,	20	365
	Deep Creek	4	369
	Packwood Creek,	3	372
	Visalia,	2	374
22	*Stockton*,	180	554
Tide-water.	San Francisco,	79	633

*PACHECO PASS ROUTE AND EAST SIDE OF TULARE VALLEY.

	Visalia,	...	374
	To King's River,	23	397
	Fresno,	38	435
	San Luis Ranche, (Eastern Foot of Pacheco Pass,)	62	497
	Summit of Pacheco Pass	5	502
	Hollenback's, (Western Foot of Pacheco Pass,).	8	510
	Gilroy,	20	530
	San Francisco	80	610

* The line would be shorter, more cheaply constructed, and less liable to interruption from floods on *west* side of Tulare Valley, but would not develop local resources as well—he west side being dry and unattractive to settlement.

TABLE No. 5.

SAN DIEGO BRANCH.

Elevations above Tide. Feet.	From	Local Distances Miles.	Distances from Colorado River. Miles.
675	*Chemeuevis Pass, Cal.*, (Junction of San Francisco line,)	...	76
530	To Crater, (Sink of Perry Basin,)	12	88
*600	*Mouth of San Diego Pass*,	8	96
*1,140	Porphyry Butte,	6	102
*1,500	Lucky Gap,	4	106
	Quartz Point,	1	107
*2,000	*Summit of Bullion Range*, (*San Diego Pass*,)	6	113
*1,500	Morongo Basin, (Morongo Sink, estimated elev. 1,300 to 1,500 ft.)	10	123
	Antelope Ridge,	8	131
	Bunch Grass Mountain,	4	135
*2,327	*Morongo Pass*, (Summit,)	10	145
*1,677	Head of Morongo Canon,	3	148
*1,201	Foot of Morongo Canon, (Coahuilla Valley,)	7	155
1,101	Mouth of San Gorgonia Pass,	10	165
2,808	*San Gorgonia Pass*, (Summit,)	22	187
Tide-water.	*San Diego*, (distance, estimated on straight line, is 80 miles,)	100	287

Distance from Colorado River to San Bernardino, 213 miles; elevation 1,118 feet above tide. (Valley of Santa Ana)

* Estimated.

SUMMARY OF ROUTES.

The grades and other characteristics, including the resources of the country on the principal lines above described, as far as they have been ascertained, are given in the ensuing chapters. It is not the purpose here, more than has already been done, to go into a discussion of their comparative merits. At certain points, as has been stated, additional reconnoissance is needed; and in a few others, detailed surveys, such as are impracticable on a preliminary exploration, must be made, to determine which are best among the lines; and the selection must at last depend largely upon questions of general policy. All the facts that have any important bearing are given in this report, as far as known, and, where additional data is necessary, it has been so stated.

The following general table will exhibit the distances from Kansas City and Sheridan, and from New York, St. Louis and Chicago to the Pacific Ocean, both at San Francisco and San Diego, and to prominent intervening points upon the route of the 35th parallel by the several principal lines that have been referred to.*

* For detailed table of stations and elevations on Route of 35th parallel, from Kansas City to San Francisco and San Diego, see page 243.

General Table of Distances, New York to San Francisco and San Diego, by Kansas Pacific R. W. and 35th Parallel.

ROUTE.	FROM	To Kansas City.	To Sheridan, end of Track K. P. R. W. 1868.	To Denver.	To Pecos River, near Anton Chico.	To Canon Blanco, Summit of Rocky Mountains.	To crossing of Rio Grande.	To Navajo Pass, Continental Divide.	To Colorado River, near Fort Mojave.	To Tehachapa Pass, (Summit Sierra Nevada.)	To Gilroy, (end of Track Southern Pacific R. R.) 1868.	To San Francisco.	To San Diego.
							Isletta.						Miles.
1. Via Raton Mountain, Tijeras Canon and Partridge Creek.	Kansas City,	.....	405	630	781	811	871	993	1451	1701	1946	2026	1738
	St. Louis,	275	680	905	1056	1086	1146	1268	1726	1976	2221	2301	2013
	Chicago,	488	893	1118	1269	1299	1359	1481	1939	2189	2434	2514	2226
	New York	1318	1723	1948	2099	2129	2189	2311	2769	3019	3264	3344	3056
							Isletta.						
2. Via Raton Mountain, Tijeras Canon, Isletta and Mesa Gap.	Kansas City,	.....	405	630	781	811	871	993	1419	1669	1914	1994	1706
	St. Louis,	275	680	905	1056	1086	1146	1268	1694	1944	2189	2269	1981
	Chicago,	488	893	1118	1269	1299	1359	1481	1907	2157	2402	2482	2194
	New York,	1318	1723	1948	2099	2129	2189	2311	2737	2987	3232	3312	3024
							San Felipe.						
3. Via Raton Mountain, San Felipe, San Mateo and Mesa Gap.	Kansas City	.....	405	630	781	811	868	968	1394	1644	1889	1969	1681
	St. Louis,	275	680	905	1056	1086	1143	1243	1669	1919	2164	2244	1956
	Chicago,	488	893	1118	1269	1299	1356	1456	1882	2132	2377	2457	2169
	New York,	1318	1723	1948	2099	2129	2186	2286	2712	2962	3207	3287	2999
							Isletta.						
4. Via Puntia Pass, Isletta and Mesa Gap.	Kansas City,	.....	.....	.....	.....	.....	945	1067	1493	1743	1988	2068	1780
	St. Louis,	.....	.....	.....	.....	.....	1220	1342	1768	2018	2263	2343	2055
	Chicago,	.....	.....	.....	.....	.....	1433	1555	1981	2231	2476	2556	2268
	New York,	.....	.....	.....	.....	.....	2263	2385	2811	3061	3306	3386	3098
							San Felipe.						
5. Via Puntia Pass, San Felipe, San Mateo and Mesa Gap.	Kansas City,	.....	405	630	.....	.....	903	1003	1429	1679	1924	2004	1716
	St. Louis,	275	680	905	.....	.....	1178	1278	1704	1954	2199	2279	1991
	Chicago,	488	893	1118	.....	.....	1391	1491	1917	2167	2412	2492	2204
	New York,	1318	1723	1948	.....	.....	2221	2321	2747	2997	3242	3322	3034
							San Felipe						
6. Via Aubrey Route, San Felipe, San Mateo and Mesa Gap.	Kansas City,	.....	.....	.....	746	776	833	933	1359	1609	1854	1934	1646
	St. Louis,	.....	.....	.....	1021	1051	1108	1208	1634	1874	2129	2209	1921
	Chicago,	.....	.....	.....	1234	1264	1321	1421	1847	2097	2342	2422	2134
	New York,	.....	.....	.....	2064	2094	2151	2251	2677	2927	3172	3252	2964
							San Felipe.						
7. Via Cimarron, San Felipe, San Mateo and Mesa Gap.	Kansas City,	.....	.....	.....	709	739	796	896	1322	1572	1817	1897	1609
	St. Louis,	.....	.....	.....	984	1014	1071	1171	1597	1847	2092	2172	1884
	Chicago,	.....	.....	.....	1197	1227	1282	1384	1810	2060	2305	2385	2099
	New York,	.....	.....	.....	2027	2057	2114	2214	2640	2890	3135	3215	2927

GRADES.

Even on the hasty preliminary line these nowhere exceeded the maximum limit fixed by Congress, of 116 feet per mile; and with the exception of 18 miles in descending the western slope of the Sierra Nevada in California, may all be reduced on careful location to 90 feet. It is, indeed, quite practicable to descend *this range* with a 90 feet grade, or less, by winding along the northern slope of the Sierras at the head of Tulare Valley, and without increasing the distance if the valleys west of the crest of the Coast Range be selected for the route to San Francisco; but the work would be much more expensive, and it may be deemed better to employ a shorter length of the maximum grade. Heavy work, including a long tunnel, would also be required at the head of Cañon Blanco on summit of the Spanish Range of the Rocky Mountains, to avoid the use of the maximum gradient for from 3 to 5 miles in attaining that summit, on a line to the Galisteo Valley.

There is no point on the route where a curve exceeding 6 degrees per 100 feet will be necessary.

The following approximate table, prepared by Col. Greenwood, will show at a glance the general character of the line in reference to gradient:

Approximate Table of Grades from End of Track at Sheridan, Kansas, to San Francisco, by Route of 35th Parallel.

Ascending.		Level.	Descending		Maximum Curvature, 6 deg.
Feet per Mile.	Miles.	Miles.	Feet per Mile.	Miles.	
0 to 20	336	115	0 to 20	243	No grade over 90 feet required by avoiding Raton Mountain using Valley of Galisteo for descent to Rio Grande, and following northern slope of Sierra Nevada, at head of Tulare Valley, Cal., and following down Tulare Valley, instead of crossing Coast Range.
20 to 40	216		20 to 40	198	
40 to 60	119		40 to 60	169	
60 to 80	68		60 to 80	51	
80 to 100	36		80 to 100	49	
100 to 116	3		100 to 116	18	
	778	115		728	Total distance, 1,621 miles.

The above is on the least favorable of the routes examined.

In other words, in a total distance of over 1,600 miles, there are, in going west, but 226 miles that have a grade exceeding 40 feet per mile; and going east, 287 miles, which exceed that rate; or 107 miles going west, and 118 going east, that exceed 60 feet per mile. Farther along, it will be seen, that the heavy grades are favorably distributed for economical transportation.

1st.—GRADES EAST OF THE RIO GRANDE.

On the line in operation from Kansas City to Sheridan, 405 miles, the principal grade is 30 feet per mile; there are 50 miles of level, and 9 miles exceeding 60 feet—the maximum being 75 feet. The company has commenced the reduction of all grades to $52\frac{8}{10}$ feet per mile. There are 329 miles of straight line on this section.

From Sheridan to the Arkansas River, at Fort Lyon, 120 miles, the grades are usually light—maximum being $52\frac{8}{10}$ feet. This section is common to the "Raton Mountain," the "Huerfano," and the "Puntia Pass" routes.

Raton Mountain Line.—From Fort Lyon, up the Purgatory, to the mouth of Chequaco Valley, 50 miles, the grade does not exceed 15 feet per mile.

Thence to the northern foot of the Raton Mountain, at Cimarron Pass, 36 miles, the average grade is 42 feet per mile—the maximum, $52\frac{8}{10}$ feet, except for about 6 miles in approaching the mountain, where it will gradually rise from 52 to 90.

In crossing the eastern point of the Raton Mountain Range, for 25 miles, the grades on General Wright's preliminary line, as reported by Mr. Eicholtz, the Division Engineer who ran it, were as follows:

From northern foot of mountain to summit of Cimarron Pass, ascending grade of 95 to 100 feet per mile for..	4 miles.
From summit to the Valley of "Cimarron," undulating grades of from 60 to 75 feet per mile for.....	13 "
Thence to northern foot of Capulline Hills, ascending grade of 95 to 100 feet per mile for.....	4 "

Ascent to summit of Capulline Hills, grade of 100 feet per mile for	2	miles.
Descent to Hay-marsh, grade of 75 feet per mile for	2	"
Total	25	"

General Wright reports that no grade exceeding 95 feet per mile will, in his opinion, be required in crossing this range.

From the southern base of the Raton Mountain Range, to the crossing of the Pecos River, above *Anton Chico,* 140 miles, the grades are light—maximum $52\frac{8}{10}$ feet.

This is the foot of the first or "Spanish Range" of the Rocky Mountain, from which to the summit in Cañon Blanco Pass, 30 miles, an ascent must be made of 1,511 feet. It is accomplished by a grade of 90 feet per mile for 4 miles in rising from the Pecos to the table land east of the Capoté, and by the use of the maximum grade (116 feet) for about 5 miles in rising out of Cañon Blanco to the summit, which is 6,917 feet above the ocean. The intervening grades are light, and at considerable expense the summit grade may be reduced to 90 feet.

In making the descent of 2,084 feet from Cañon Blanco summit to the Rio Grande, a distance of 60 miles, Gen Wright reports that it will be necessary to use the maximum grade for about 3 or 4 miles in getting down to the plateau lying south of the Galisteo, and for about 15 miles in descending the San Dia Mountains by the Tijeras Cañon.

Galisteo Route.—By using the valley of the Galisteo, a southerly branch of which heads within 4 miles of Cañon Blanco summit, to descend to the Rio Grande, a vast improvement is made on the above grades. As reported by Mr. Holbrook, Division Engineer, they will not exceed 75 or 80 feet per mile, and that for only 3 miles; the remaining grades decreasing gradually from 60 to 25 feet, and the average for the whole distance of 57 miles, from the summit to the Rio Grande, (as shown by actual levels at each end of the line,) being less than 36 feet per mile.

The Cimarron Route.—From the general level character of the country on this route across the Great Plains, and what was ascertained by Col. Greenwood's reconnoissance, although it has not been instrumentally examined, it is pretty certain that no grade exceeding $52\frac{8}{10}$ feet per mile will be required, and that but for limited distances. Maximum curvature on this line 6°, (between the Pecos and Rio Grande.) In connection with the Galisteo Valley, there is every reason to believe that this route would enable the eastern range of the Rocky Mountains to be crossed, and the Rio Grande to be reached from Kansas City, without resorting to any grade over $52\frac{8}{10}$ feet, except for 15 miles of the common line between the Pecos River and the head of the south branch of the Galisteo, and where from 80 to 90 feet would be required, and possibly for a very short distance between the Arkansas and Red River, between Cold Spring and Cedar Creek, where an 80 feet grade may be necessary.

On the *Aubrey Route,* as far as it is a divergence from the "Cimarron," the grades are estimated to be slightly heavier than on the latter.

Huerfano Route.—From Fort Lyon, on the Arkansas, to the Summit in Sangre de Christo Pass, 141 miles, the grades for 13 miles of the distance were light, varying from 8 feet to 55 feet, with 11 miles of 65 feet per mile.

Thence, for $10\frac{8}{10}$ miles to the summit, Mr. Miller, Division Engineer, reports the grades as follows:

For 1.9 miles		105.3	feet	per miles.
" 4.7 "		170.2	"	" "
" 4.2 "		260.9	"	" "

The summit being 9,186 feet above tide.

In the Mosca Pass, about 20 miles north of Sangre de Christo, the grades ascending from the east were as follows:

3.79 miles of	90	feet	per mile.
8.52 "	148	"	" "
1.42 "	239	"	" "
0.95 "	576	"	" "

Reaching a summit of 9,577 feet. Neither of these Passes

was considered practicable, within the Congressional maximum of grade, at any reasonable cost.

Puntia Pass Route.—By barometrical observation made by Col. Greenwood, during the last summer, the elevation of the summit at this Pass (agreeing closely with that of Gunnison) was ascertained to be about 8,600 feet above the sea

On this assumption, his instrumental survey through the Pass made the elevation, at the forks of the Arkansas, 6,500 feet, which is 2,775 feet higher than our surveyed line at Fort Lyon: as the distance is 180 miles, this gives an average inclination to the Arkansas Valley of less than 16 feet per mile. Col. Greenwood reports that no grade exceeding 25 feet per mile will probably be required on this division of the line.

From the forks of the Arkansas to the summit of Puntia Pass, 25 miles, a grade of about 80 feet per mile will be required for the first 10 miles, and not exceeding 100 feet per mile for the remaining fifteen miles, with heavy work. By increasing distance, it could be reduced to 90 feet.

From this summit southward to Albuquerque, 200 miles, the average descent, following the San Luis Park and the Rio Grande, is less than 19 feet per mile, without an intervening summit. The first 5 miles will require a grade of 75 feet, which may be reduced to $52\frac{8}{10}$, (if found sufficiently important to the economical operation of the line,) by increasing the distance and supporting the grade along the mountain slopes at the head of San Luis Park.

Across this Park, for 100 miles, the line may be straight, and the grades exceedingly light, and the valley of the Rio Grande may thence be followed to Albuquerque, probably at the natural grade of the stream—about 17 feet per mile.

Tables showing Approximate Grades on Different Routes of Survey of Kansas Pacific Railway, east of Rio Grande.

No. 1. From End of Track at Sheridan to the Arkansas River, at Fort Lyon.

Level.	Ascending Westward.	Grade	Descending Westward.	Maximum Curvature, 5 deg.
Miles.	Miles.	Feet per Mile.	Miles.	
8	20	0 to 20	12	Maximum grade not to exceed 52 8-10 feet per mile.
	33	20 to 40	15	
	17	40 to 60	15	
8	70		42	Total distance, 120 miles.

No. 2. Raton Mountain Route, from the Arkansas River at Fort Lyon, to the Rio Grande at Isletta.

Level.	Ascending Westward.	Grade.	Descending Westward.	Maximum Curvature, 9 deg.
Miles.	Miles.	Feet per Mile.	Miles.	
26	67	0 to 20	26	By using Galisteo Valley, all grades may be avoided that exceed 95 feet per mile.
	39	20 to 40	25	
	37	40 to 60	24	
	37	60 to 80	22	
	19	80 to 100	24	
26	199		121	Total distance, 346 miles.

No. 3. Puntia Pass Route, from the Arkansas River at Fort Lyon, to the Rio Grande at Isletta.

Level.	Ascending Westward.	Grade.	Descending Westward.	Maximum Curvature, 9 deg.
Miles.	Miles.	Feet per Mile.	Miles.	
30	150	0 to 40	195	All grades exceeding 52 8-10 feet per mile, are concentrated at Puntia Pass.
	15	40 to 60	5	
	5	60 to 80	0	
	15	80 to 100	5	
30	185		205	Total distance, 420 miles.

GRADES FROM THE RIO GRANDE TO THE GREAT COLORADO.

In crossing the low divide between the Rio Grande at Isletta and the Puerco River, (a distance of 21 miles,) the maximum grade on the preliminary line was 60 feet per mile on the eastern slope, and 50 feet on the western. Mr. Miller, who ran the line, reports that it need not exceed 50 on either.

From the junction of the El Rito and Puerco, to the summit of the Sierra Madre, at Navajo Pass, a distance of 95 miles, the average ascent is 22 feet per mile, and very uniform. The grade of the railroad, following the valley of the El Rito for the whole distance, need not exceed this rate, except at two or three points, where, for very short distances, in crossing bends of the creek, and avoiding streams of lava, it rises to 50 feet. For 20 miles east of the summit of this range, the grade is at the rate of 31 feet per mile, rising in the last mile at the summit to 50 feet.

From the summit of the Sierra Madre, (water shed of the continent,) to the Little Colorado River, 118 miles, the average grade is that of the descending valley of Navajo Creek, 18 feet per mile. For the first 14 miles west of the summit it is at the rate of 34 feet per mile; one mile at the summit being 70 feet. In the lower course of the valley, the grade does not exceed 13 feet per mile.

From the mouth of Navajo Creek, down the Little Colorado River, to Sunset Crossing, 35 miles, the grade is that of the valley—about 7 feet per mile. Thence to Cañon Diablo, 28 miles, the maximum grade is 52 feet per mile.

We have thus reached a point on the 35th parallel, 303 miles west of the Rio Grande, without encountering a grade over 52 feet per mile. As far as Sunset Crossing, 275 miles, Col. Greenwood reports that it need not, on location, exceed 40 feet; yet on this section we have crossed the crest of the continent.

In crossing the Mogoyon Range from Cañon Diablo to its western base in the Val de Chino, heavier grades are met.

The ascent of the eastern slope to Leroux Summit, 39 miles, is effected within 90 feet per mile. The average ascent is 57 feet per mile, the elevation at Cañon Diablo being 5,294 feet, and that at Leroux Summit, 7,510 feet. On the rapid preliminary line, one intervening summit, "San Francisco Ridge," was encountered 5 miles east of Leroux, but it is merely a spur from Mount Agassiz, and the line can turn it, or, by a tunnel of 2,000 or 3,000 feet, cut through it.

On the route to the north of Mount Agassiz the reconnoissance would indicate that no grade exceeding 75 feet per mile will be required.

From Leroux Summit, descending westward to the Val de Chino, at the mouth of Partridge Creek Valley, 78 miles, the fall is 2,422 feet, which, after allowing for the two low intervening summits, (150 feet at Whipple's Pass, and 100 feet at the divide between Cedar and Partridge Creeks,) gives an average descent of 35 feet per mile. That portion between Whipple's Pass and the forks of Partridge Creek, 32 miles, has an average fall of 56 feet per mile; and from the forks of Partridge Creek to the mouth of the same valley, it is under 20. The grade nowhere exceeds 90 feet per mile, except at two points, viz: For 7 miles descending westward from Whipple's Summit, where it is 100 feet per mile; and at the mouth of Partridge Creek Valley, where for one mile it is 105 feet. The latter is clearly unnecessary in a line intended for Beale's Pass, and the former, with heavy work, may be reduced to 90 feet, should the general route by Partridge Creek be adhered to, by changing the line to the vicinity of the "Park Creek Route" of Mr. Miller.

From the mouth of Partridge Creek Valley, a further descent of 338 feet is made in 8 or 10 miles northwestwardly to a lower slope of the Val de Chino, at an elevation of 4,750 feet. The grade may be made nearly uniform throughout. Thence up the Val de Chino, 18 miles, to the summit of Beale's Pass, at the head of a west fork of that valley, the average ascent is about 20 feet per mile. The grade will be uniform, rising at

the rate of $24\frac{6}{10}$ feet per mile in the six miles nearest the summit; that of the last mile being 34 feet.

From Beale's Pass to Yampa Gap, at the entrance of the cañon of Yampa Creek, 22 miles, the line, following along the slope of the Juniper and Aquarius Ranges, on the west side of and overlooking the Aubrey Valley, has an undulating grade, which rises at a few points to $52\frac{8}{10}$ feet per mile. The slope of the surface for the first mile west of Beale's Summit was 65 feet.

From this summit down the Yampa and its cañon, for 47 miles, (of which distance the Yampa is followed for 37 miles,) to the Wallapi Valley at Peacock Spring, the fall is 2,071 feet, equivalent to 44 feet per mile. On the preliminary line the grade did not exceed 60 feet per mile, except for 8 miles, on which, for 6 miles, it was between 60 and 80 feet, and for the remaining 2 miles 90 feet per mile. On location, the latter will be reduced to 80.

From Peacock Springs to Wallapi Pass, at the head of the Wallapi Valley, 14 miles, the valley is followed with an average ascent of about 22 feet per mile. By diverging from the Yampa line before reaching Peacock Springs, a level grade, or one nearly so, may evidently be attained between these points to no very great increase of distance and cost.

A cut of 40 feet at the summit, gives a descent from Wallapi Pass to the bridge-seat, at the crossing of the Colorado River, of 3,005 feet. The distance being 49 miles, the average fall is, therefore, about 61 feet per mile. On the preliminary line there was no grade exceeding 60 feet, except for a distance of 14 miles, and on these, for 9 miles, it was less than 90 feet, and for 5 miles between 90 and $105\frac{6}{10}$. For the 22 miles nearest the river the grade was 50 feet per mile. In the descent of this remarkably uniform slope, all grades over 70 feet per mile are concentrated at the summit, and the maximum may be reduced to 90 feet by heavy work, if found best for the convenient operation of the road.

This brings us to the Great Colorado, 580 miles from the Rio Grande, having passed the most broken part of the route of the 35th parallel without encountering any necessary gradient over 90 feet per mile, in either direction; and, except for 17 miles of the entire distance going west, and 42 miles going east, no grade exceeding 60 feet, while on over one-half the line it is less than 30 feet per mile.

The following tables, prepared by Col. Greenwood, will show these gradients in a condensed form.

Approximate Tables of Grades on Route of 35th Parallel, between Rio Grande and Colorado Rivers, 580 Miles.

No. 1. General Statement from Rio Grande, at Isletta, to Colorado River.

Level.	Ascending Westward.	Grade.	Descending Westward.	Curvature. Maximum, 6°.
Miles.	Miles.	Feet per mile.	Miles.	No grade over 90 ascending westward, and those going eastward can be reduced to 90 feet per mile on careful location.
31	86	0 to 20	124	
	64	20 to 40	79	
	49	40 to 60	88	
	9	60 to 80	22	
	8	80 to 105 6-10	20	
31	216		333	Total distance, 580 miles.

No. 2. Detailed Statement from Rio Grande to Sunset Crossing, Arizona.

Level.	Ascending Westward.	Grade.	Descending Westward.	
Miles.	Miles.	Feet per mile.	Miles.	All grades can be reduced to 40 feet per mile, without heavy mountain work.
12	8	0 to 10	49	
	44	10 to 20	56	
	23	20 to 30	37	
	8	30 to 40	1	
	22	40 to 52 8-10	15	
12	105		158	Total distance, 275 miles.

From Sunset Crossing to Forks of Partridge Creek, across Mogoyon Range, of Arizona.

Level.	Ascending Westward	Grade.	Descending Westward.	
Miles.	Miles.	Feet per mile.	Miles.	All grades can be reduced to 90 feet per mile, if desired. By taking route north of Mt. Agassiz, no ascending grade over 75 feet probably required.
8	13	0 to 20	9	
	14	20 to 40	12	
	18	40 to 60	12	
	9	60 to 80	4	
	8	80 to 100	11	
8	62		48	Total distance, 118 miles.

FROM FORKS OF PARTRIDGE CREEK TO TRUXTON SPRINGS, ARIZONA.

Level.	Ascending Westward.	Grade.	Descending Westward.	
Miles.	Miles.	Feet per mile.	Miles.	All grades above 52 8-10 are e
7	15	0 to 20	8	near Truxton Springs.
	14	20 to 40	20	
	6	40 to 60	19	
	0	60 to 80	11	
	0	80 to 100	4	
7	35		62	Total distance, 103 miles.

FROM TRUXTON SPRINGS TO CROSSING OF COLORADO RIVER.

Level.	Ascending Westward.	Grade.	Descending. Westward.	
Miles.	Miles.	Feet per mile	Miles.	All grades above 70 feet are e
2	6	0 to 20	2	concentrated at Wallapi Pass
	5	20 to 40	9	and can be reduced to 90 feet,
	3	40 to 60	42	if deemed advisable.
	0	60 to 80	7	
	0	80 to 105 6-10		
2	14		67	Total distance. 83 miles.

On the "*White Mesa line*," 80 miles long, there are undulating grades for 60 miles s from Cradlebaugh's tank westward to the Mesa Gap, mainly light, but rising at some points to 80 and 85 feet per mile. At the Mesa Gap, a grade descending west, of 105 6-10 feet per mile for over 7 miles, with a tunnel nearly 5,000 feet long, will be required. Thence to the connection with Partridge Creek line, near Yampa Gap, 11½ miles, a very light ascending grade is had, except for 1½ miles, of 80 feet, in crossing a ridge 7 miles west of mouth of Mesa Gap.

On the "*Laja Gap line*" the grades are same as above, except east of Mesa Gap where they are estimated by Mr. Schuyler, in crossing Val de Chino, at not over 45 feet per mile, and in crossing the Laja Range, not over 75 feet, with a tunnel of 3,000 feet, thence eastward not to exceed 50 feet per mile to intersection with Partridge Creek line at Cradlebaugh's tank.

GRADES FROM THE COLORADO RIVER TO SAN FRANCISCO, 575 MILES.

We now enter the State of California, and find before us, to the base of the Sierra Nevada, a stretch of 235 miles of desert country, not very unlike the State of Nevada, and filled, like it, with mineral-bearing mountains.

The ascent of 2,151 feet from the level of the bridge-seat at the river to Piute Summit, a distance of 40 miles, was made on the preliminary line with a nearly level grade for 12 miles, following the west bank of the river, thence up the Piute "Wash," with a uniform grade of 75 feet, for 10 miles, to Sacramento Springs, and thence up the west fork of Piute to the

summit, 18 miles, with grades rising from 75 to 90. The surface being very smooth, and the pass 5 miles wide, no grade exceeding 75 feet is necessary in making this ascent.

From Piute Summit, the descent of 1,902 feet westward, to the inlet of Perry Basin, a distance of 36 miles, is made by a straight line at the natural inclination of the valley, which is followed, viz:

For the first 2 miles about..... 20 feet per mile.
For the next 26 " " ..... 50 " " "
And the remaining 8 miles from.....60 to 65 feet per mile.
The average for the whole distance being 53 feet.

Thence, for 34 miles, in skirting the northern margin of this basin to Volcanic Point, in which distance a total rise is made of 522 feet, the grades are from level to 40 feet, ascending west.

In the next 25 miles, rising out of Perry Basin to the summit of "Crater Pass," (2,100 feet above tide,) the maximum is 50 feet per mile.

From Crater Summit to the crossing of Mojave River, 35 miles, the descent in the first 10 miles to the level of "Malpais Sink" is 300 feet, and the maximum grade $52\frac{8}{10}$; thence to the river crossing the grade is level, or gently ascending, at no point exceeding 25 feet per mile.

On reaching the Mojave River we are pretty much out of the region of detached ranges, and have nearly a straight line presented to the eastern foot of the Sierra Nevada, 65 miles, in which an ascent is made of about 700 feet. The grades are light, the maximum being $52\frac{8}{10}$.

A careful survey was made of Tehachapa Pass, from the eastern to the western base of the Sierra Nevada, a distance of 50 miles. The ascent from the Great Basin, on the east, made in 15 miles, was found to be only 928 feet; the descent, on the west, into Tulare Valley, in 35 miles, was 3,215 feet.

The summit is 4,008 feet above tide, 250 miles from the Colorado River, 325 miles from San Francisco, and nearly on the 35th parallel.

The following are the grades on the line as run by Mr. Runk, Division Engineer:

TEHACHAPA PASS OF THE SIERRA NEVADA.

ASCENDING GRADES.

For 8 miles from eastern base, through a deep ravine, ½ mile wide, to Tehachapa Sinks, grade from..... 80 to 83 feet per mile.*
(Which can be reduced on location to 75 feet.)
For 3.5 miles from Tehachapa Sinks, over a plateau from 1 to 3 miles in width, grade of..... 19 feet per mile.
For 1.13 miles over same plateau, grade of. 51 3-10 " " "
" 0.89 " " " " " 23.6 " " "
" 1.00 " across the summit of the pass. Level.
Average grade ascending, 65 feet per mile.

DESCENDING GRADES.

For 1.4 miles over wide plateau, grade of.... 34.6 feet per mile.
" 1.0 " " " " .... 55 " " "
" 0.9 " " " " .... 72 " " "
" 2.6 " " " " ....116 " " "
" 11.6 " on mountain slope, (South Side,) overlooking narrow and precipitous gorge, grade of.....116 " " "
For 0.5 miles on mountain slope, (South Side,) overlooking narrow and precipitous gorge, grade of..... 39 " " "
For 3.9 miles on bench of mountain to Bird Point, grade of..... 39 " " "
For 9.53 miles from Bird Point, following outer side of North Spur, grade of.....116 " " "
For 0.7 miles crossing Allen's Creek.....Level.
" 0.7 miles along the foot hills, north of Pass, grade of..... 14 feet per mile.
" 1.23 miles crossing Walker's Creek.....Level.
" 1.5 " ———— grade of..... 30 feet per mile.
" 1 3 " ———— " ..... 51 " " "
reaching the Tulare Plain at an elevation of 795 feet above tide-water.

Average grade descending from summit to Tulare Plain, 80 feet per mile.

Instead of using in the westward descent from the head of ravine, the grade of 116 feet per mile for.....11.6 miles,
And that of 39 feet per mile for..... ..... 4.4 "
There may be substituted 116 feet per mile for... 8.7 "
And 75 feet per mile for..... 6.8 "

* And on the eastern slope the grade may be improved, and the distance shortened by tunneling from a point near the head of ravine, east of Salt Lake, through to Oak Creek, where the elevation at the eastern base is much higher than at the mouth of the pass on the line surveyed, and the approach from the desert more gradual.

By this excellent Pass the formidable Sierras are crossed, with only $18\frac{2}{10}$ miles of the maximum gradient, the remaining grades being within 75 feet per mile. It is deemed practicable to reduce this maximum to 90 feet, by following the northern slope of the range around the head of Tulare Valley, toward the mouth of Tejon Pass, but the work would be considerably more expensive and the distance greater.

The proper adjustment of the grades, in crossing this range, involves the consideration of routes thence to San Francisco, whether by Tulare Valley or Gilroy; of the character and direction of the traffic, including the relative magnitude of local and through trade; of the proper division of the general line into sections for convenient operation; and other questions that need not here be discussed.

From the western foot of the Sierra Nevada, at Tehachapa Pass, by the line of easiest grades to San Francisco, the Tulare Valley would be followed, the average descent of which is less than 2 feet per mile, and probably no grade exceeding 30 feet would be required.

By the *direct* route to San Francisco, the Tulare Valley is first crossed from the foot of Tehachapa to the eastern base of the Coast Range, with grades from level to 25 feet per mile. On the line to "Chalama Pass" this distance is 62 miles, striking the range at a point about half way between the Buena Vista Oil Works and Alamo Solo, from which the ascent of the mountain is reported by Mr. Eicholtz, who made the reconnoissance of this route, to be very gradual, following a broad and smooth cañada at a rise of 40 feet per mile, until within 4 miles of the summit. From this point across the summit, which is a smooth and easy divide, to the western foot of the

range in the Valley of the Chalama, a distance of 7½ miles, the surface grade is about 100 feet per mile.

Thence, down Chalama Creek to the Estrella, 11 miles, the grade does not exceed 40 feet; and along the Estrella, for 18 miles, to the Valley of the Salinas, 30 feet per mile. The fall of this valley, which is followed for 88 miles, appears to be about 15 or 20 feet per mile.

Leaving it, the line passes by the San Miguel Cañon into Pajaro Valley, 12 miles, with grades estimated as follows:

50 feet per mile for.....6 miles.
80 " " " " .....3 "
And light, undulating grades for.....3 "
To the Pajaro Valley.

Thence it is 13 miles, with light grades, to Gilroy, the present terminus of the Southern Pacific Railroad, 80 miles from San Francisco. The grades on the other routes examined across the Coast Range will be shown in the annexed tables.

GRADES ON THE SAN DIEGO BRANCH, 211 MILES.

From the junction with main line at Chemeuevis Pass, California, across Perry Basin, to San Diego Pass; 20 miles, level to 40 feet per mile.

From mouth of San Diego Pass to summit of Bullion Range.....	17 miles—	80 to 90 feet per mile.
Summit of San Diego Pass to southern foot, in Morongo Basin....	10 " —	50 " " "
Thence westward, along Morongo Basin, to eastern foot of Morongo Pass.....	24 " —	level to 25 ft. per mile.
Eastern foot to summit of Morongo Pass.....	1 " —	80 to 90 " " "
(Slope of surface.....		175 feet in 1¼ miles.)
* Summit of Pass, descending to head of Morongo Cañon.....	3 to 4 miles—	90 feet per mile.

* With tunnel of 1 mile at summit, and heavy cutting.

Head to foot of Morongo Cañon.....7 miles.

Descending—4 miles of 60 feet
1 " " 70 "
½ " " 65 " } Average, 68 feet per mile.
½ " " 85 "
1½ " " 90 "

Foot of Cañon to eastern foot of San Gorgonia Pass..... 10 miles—level to 40 ft. per mile.

Eastern foot to summit of Sierras, San Gorgonia Pass..... 22 " —60 to 90 feet per mile; average 78.

Western descent of Sierras..... 18 " —72 to 80 feet per mile; average 78.

Thence, for 82 miles, to San Diego, —nothing over 80 feet.

The above grades are estimated across Perry and Morongo Basins, and from western base of Sierras to San Diego. Those at San Gorgonia were instrumentally ascertained,* and those at the San Diego Pass and the Morongo Pass and Cañon, were taken with pocket level.

* By Lieut. Williamson.

Table of Grades from Crossing of Colorado River to San Francisco, (Route of 35th Parallel.)

No. 1. CONSOLIDATED TABLE BY CHALAMA PASS ROUTE, APPROXIMATE.

Level.	Ascending Westward.	Grade.	Descending Westward	From Colorado River to San Francisco.
Miles.	Miles.	Feet per mile.	Miles.	Maximum curvature, 6°.
45	144	0 to 20	100	
	67	20 to 40	109	
	21	40 to 60	40	
	22	60 to 80	3	
	16	80 to 100	3	
		100 to 116	*23	* Reduced to 18¼ miles.
45	270		278	Total distance, 593 miles.

No. 2. FROM COLORADO RIVER TO PIUTE SUMMIT.

Level.	Ascending Westward.	Grade.	Descending Westward.	
Miles.	Miles.	Feet per mile.	Miles.	All grades can be reduced to 75 feet.
0	12	0 to 20	4	
	1	20 to 40	6	There should be no descending grade.
	2	40 to 60	0	
	21	60 to 80	0	
	5	80 to 90	0	
0	41		4	Total distance. 45 miles.

No. 3. FROM PIUTE SUMMIT TO EASTERN FOOT OF SIERRA NEVADA.

Level.	Ascending Westward.	Grade.	Descending Westward.	Approximate.
Miles.	Miles.	Feet per mile	Miles.	
12	88	0 to 20	6	
	29	20 to 40	13	
	12	40 to 60	33	
12	129		52	Total distance, 193 miles.

No. 4. ACROSS THE SIERRA NEVADA AT TEHACHAPA PASS.

Level.	Ascending Westward.	Grade.	Descending Westward.	
Miles.	Miles.	Feet per mile.	Miles.	All grades can be reduced to 90 feet, if found advisable.
3	4	0 to 20	1	
	1	20 to 40	7	
	1	40 to 60	2	
	0	60 to 80	1	* May be reduced to 18 2-10 miles of 116 feet, and 6.8 miles of 75 feet.
	7	80 to 100	0	
	0	100 to 116	23 *	
3	13		34	Total distance, 50 miles.

No. 5. From Western Foot of Sierra Nevada across Tulare Valley to Eastern Foot of Coast Range, Approximate.

Level.	Ascending Westward.	Grade.	Descending Westward.	
Miles.	Miles.	Feet per mile	Miles.	On San Benito line grades about the same. Distance, 112 miles.
10	20	0 to 20	22	
	10	20 to 40		
10	30		22	Total distance, 62 miles.

No. 6. Across Coast Range at Chalama Pass, Approximate.

Level.	Ascending Westward.	Grade.	Descending Westward.	
Miles.	Miles.	Feet per mile.	Miles.	On San Benito line the grades are somewhat heavier, and work more expensive, with long tunnel at summit.
	16	20 to 40	11	
	4	80 to 100	3¼	
	20		14	Total distance 34 miles.

No. 7. From Western Base of Coast Range at Chalama Pass to San Francisco, approximate, (by Salinas and Pajaro.)

Level.	Ascending Westward.	Grade.	Descending Westward.	
Miles.	Miles.	Feet per mile.	Miles.	Grades are a little better on this section of San Benito line. Distance 175 miles.
20	20	0 to 20	70	
	10	20 to 40	78	
	6	40 to 60	5	
	1	60 to 80	2	
20	37		155	Total distance 212 miles.

The Grand Panoche Pass had on the 38 miles, from Tulare Plain across the Coast Range to Tres Pinos Valley, 7 miles of 106 feet per mile, (ascending westward,) and 6 miles of 116 feet per mile, (descending westward,) and the remaining 25 miles varying from 50 to 85 feet; the work heavy for 20 miles, remainder light.

RISE AND FALL.

Counting all undulations that exceed in altitude 200 feet, gives a total rise and fall upon the entire route by the 35th parallel to San Francisco, of 41,113 feet.

This estimate will be increased 1,000 feet if the Raton Mountain be crossed, and diminished about as much to reach tide-water, if the Coast Range be avoided.

The rise and fall is about the same, in proportion to the length of the line, as on the Baltimore and Ohio Railroad, on which the cost of transportation for last year is stated to have been but little over one cent per ton per mile.

The rise and fall from Kansas City to San Francisco, on our line of survey and exploration, by the route of the 32*d parallel*, including only the undulations over 200 feet, was found to be 41,538 feet, which is very nearly the same as by the 35th parallel, although the distance is 263 miles longer. The amount of rise and fall due to the minor undulations would probably not differ materially on the two routes. Should it be found practicable, of which I have little doubt, to reach the Sierra Nevada at Tehachapa Pass, from Fort Yuma, by a "Desert line," avoiding the two crossings of the Cordilleras into and out of the Los Angelos Valley, the rise and fall on the route of the 32d parallel to San Francisco would be reduced probably from 3,000 to 5,000 feet, but the waterless and timberless character of the country, for 300 or 400 miles on such a modified route, would not offer many temptations to railroad construction.

To the Pacific Ocean, at *San Diego*, the rise and fall from Kansas City, by the route of the 35th parallel, is very nearly as great as to San Francisco; but by the 32d parallel it is one-fourth less.

While the total rise and fall on the route from Kansas City to San Francisco somewhat exceeds that from Omaha to San

Francisco, by the line of the Union Pacific and Central Pacific Railroad, the working grades are not believed to be heavier. Reference may be had to the following table; in which the grades on the line from Omaha have been derived from Gen. Dodge's official report of surveys and the known grades on the Central Pacific line. The former have no doubt been considerably dimished on location, as those on the Kansas Pacific Route will undoubtedly be.

PACIFIC RAILROAD LINES.	ASCENDING AND DESCENDING.		
	Grade exceeding 100 feet per mile.	Grade exceeding 80 feet per mile	Grade exceeding 60 feet per mile.
Omaha to San Francisco,.....	51 miles.	198 miles.	304 miles.
Kansas City to San Francisco,	21 "	106 "	225 "

The increased *rise and fall* on the 35th parallel is due to the interposition of the deep Valley of the Colorado, in the heart of the mountains of Arizona and California. It may be deemed a compensating advantage, however, to strike a navigable river nearly 600 miles east of the Pacific terminus. If it were concluded to waive this benefit, by bridging the cañon of the Colorado,* the total rise and fall would probably approximate pretty closely to that on the Union Pacific line.

The inequality caused by the Coast Range is probably nearly as great on the northern line as the southern; although the pass is much lower, the eastern base is about 700 feet higher on the latter.

The practical effect of the grades upon the cost of transporting passengers and tonnage will, of course, depend very materially upon their distribution over the line. This is quite favorable on the route under consideration.

Without discussing this question in detail, a general idea may be given by stating the fact that, upon the line from Kan-

*Ives reported the Grand Canon, where he visited it, near the mouth of Diamond River, to be only 50 yards wide at the bottom, and about 3,000 feet deep, with *very steep walls.*

sas City to San Francisco, the heaviest passenger train may be run with the same sized engines as those in use on the east and west trunk lines, at an average rate of 30 miles per hour, from the Missouri River to San Francisco, with assistant locomotive power at four points, to wit:

1st. In ascending the Spanish Range of the Rocky Mountains, from the Pecos River to the summit, 30 miles, of which 11 miles will have a 90 feet grade.

2d. In ascending the Mogoyon Range in Arizona, from Cañon Diablo to the summit, 39 miles, of which ten miles will have a grade as high as 90 feet. If the route to the north of Mt. Agassiz be adopted, this grade may not exceed 75 feet.

3d. In ascending from the Colorado River to Piute Summit, in California, 30 miles, where the grade will be from 70 to 75 feet per mile continuous.

4th. In ascending the eastern slope of the Sierra Nevada to Tehachapa Sinks, where, for 10 miles, the grade (on Oak Creek Route,) will be 70 feet.

To these must be added, if the Raton Mountain be crossed at Cimarron Pass, 23 miles, of which 12 will have a grade of 95 feet, and if the Coast Range Route be adopted, 4 miles at Chalama Pass, of 90 to 100 feet grade. The latter may possibly be reduced to 75 feet.

Over the whole of the same line westward, with assistance at the points named, a thirty ton engine can draw 20 freight cars, each loaded with 10 tons, at the rate of 12 miles per hour; and on five unbroken divisions of the line, each from 150 to 200 miles long, respectively, it can draw 50 loaded cars.

Going *eastward*, such a passenger train would require help at the following points:

1st. In ascending the western slope of the Sierra Nevada, at Tehachapa Pass, for 33 miles; where, for 25 miles, the grade will be from 75 to 116 feet per mile.

2d. In crossing the neck of the Cerbat Range, immediately east of the Colorado River, at Wallapi Pass, where, for 10 miles, there will be a grade of from 70 to 100 feet.

3d. In ascending the Cañon of the Yampa, in Arizona, where the grade is from 70 to 80 feet for 8 miles.*

4th. In ascending the western slope of the Mogoyon Range, Arizona, from the valley of Partridge Creek to Whipple Pass, 24 miles, where the grade for about 12 miles is from 70 to 100.

5th. In ascending from the head of Galisteo Valley to the summit of the Rocky Mountains east of the Rio Grande, where, for 4 miles, the grade is from 70 to 80.

On the Coast Range Route, assistant power would probably also be needed at Chalama Pass, where the surface grade for 3 miles is 100 feet per mile. But this grade may possibly be reduced to 75 feet.

The size of the freight train would have to be reduced going eastward to 12 or 15 loaded cars on three of the four operating divisions of the line between the Sierra Nevada, of California, and the Mogoyon Summit, in Arizona. East of that summit, 50 cars could be hauled on three long divisions; 20 to 40 cars on the remainder, with assistance for 4 miles, from the head of the Galisteo to the summit of the Rocky Mountains.

CHARACTER OF THE WORK.

Over the larger portion of the line which has been described, the work of construction would not be called heavy, in a *settled* country. Its cost will be due rather to the remoteness and wildness of the country, the absence of supplies, high cost of labor and risk from Indians, than to any serious engineering obstacles. The latter are confined to a comparatively few points in crossing the more formidable ranges of mountains, and in following the natural drainage of the country through certain rocky and tortuous cañons.

Fortunately, the great extent of comparatively light work will enable large sums to be expended at these points in order to obtain a short line of favorable grades and curvature. With heavy grades and sharp curves, (even within the limit fixed by Congress,) a line could be built much more cheaply—but at the expense of a future tax upon every ton and passenger transported over it. The traffic of the road will undoubtedly be so large that it would be very unwise to economize in the first construction, which, in the particulars named, at all events, should have the highest standard of which the topography of the country will admit.

A general idea of the character of the work may be obtained from the description which has been given of the topography of the route, and the summary here appended of the more difficult points.

EAST OF THE RIO GRANDE.

On the "*Raton Route*"—1st. Very difficult and costly work will be encountered for twenty-five miles at Cimarron Pass, in crossing the point of the Raton Mountain, the deep breaks of the Cimarron River, and the detached mountains between this and Red River.

2d. For five miles, in rising from the Pecos River, above Anton Chico, to the table land of the Spanish Range, some difficult rock cutting will be met.

3d. For six or eight miles, in crossing the summit of this range, at Cañon Blanco Pass, the work will be very difficult, to obtain grades within the limit of 90 feet.

4th. In descending the San Dia Mountains by the Tijeras Cañon, to the Rio Grande—fifteen miles of very difficult and expensive work.

5th. There are three important bridges on this section. That over the Arkansas will be 800 feet long by 25 feet high; bed, quicksand; although the rock may probably be found within a depth of 20 feet. That over the Pecos will be 300 feet long, crossing a rocky cañon 75 or 100 feet high. The bridge over the Rio Grande, if at Isletta, will be 1,000 feet long, between bluffs of hard cemented drift, 20 to 40 feet high, and probably similar foundation. If at San Felipe, it can be crossed with two spans of 140 feet each, with excellent banks and foundation. If crossed elsewhere, it must be much longer, and require special provision for protection of the low banks—and the bed is quicksand.

On the *Galisteo Route*, the extraordinary difficulties in Tijeras Cañon are avoided, and the descent made to the Rio Grande, with the much lighter expense due to following the side of the Galisteo Bluffs for 21 miles, or turning the stream to avoid bridging.

The "*San Miguel Cut-off*" is more expensive than the Cañon Blanco line, requiring heavy work for one mile east of Bernal, a deep cut or tunnel of three-fourths of a mile at the Rocky Mountain Summit, and a tunnel of 1,500 feet in the cañon of the Galisteo, six miles west of Summit; also, more or less difficult work for 28 miles, in cutting through spurs between San Miguel and the Summit.

On the *Cimarron Route* the difficult points would be the same as the above, except that the Raton Mountain is avoided. One hundred and fifteen miles more of road would have to be constructed, however, to connect at the most favorable point with the Company's track in Kansas.

On the *Aubrey Route* the work would be more expensive than the "Cimarron," but the distance to build about 75 miles less, and 40 miles more than by the "Raton Route." The Raton Mountain is also avoided—the remaining difficulties being the same.

Col. Greenwood reports that on the *Puntia Pass Line* the difficulties are found at the following points:

1st. In traversing the "Big Cañon" of the Arkansas River, 8½

miles long. For the first 3½ miles the walls are sloping, and the line can wind along their face without particularly heavy work. In the next mile the walls are nearly perpendicular, and the cañon so crooked that the line cannot be kept on the slopes, and a tunnel of 1,200 to 1,500 feet is necessary at the big bend, and some deep cuts at other projecting points. The next 4 miles are about like the first. This cañon could be avoided, but only at the expense of heavier grades and a longer line.

2d. From upper end of Big Cañon to forks of the Arkansas are a number of smaller cañons, or other points where some heavy work will be required, and several crossings of the river may be necessary; at these, single spans of truss bridge will answer.

3d. At Puntia Pass there will be pretty costly work for 20 miles, in crossing from the Valley of the Arkansas to San Luis Park.

4th. In descending the Rio Grande three cañons of that river are followed. 1st. The "Taôs Cañon," 10 miles long; the line can be carried along the slopes within about 15 feet of the usual stage of water, and crossing the river at the sharp bends, where truss bridges of 150 feet span each will answer. The work will be expensive and curves sharp, but the grade only 20 feet per mile. 2d. The "Embuda Cañon," of same character as the Taôs, but 15 miles long. Both these cañons may be avoided by crossing the Rio Grande above the upper one, and passing along the broad smooth slope on the west side, returning to the river near mouth of Ojo Caliente. The work would be much easier and the alignment improved, but the grades not near as good. 3d. The "Sante Fé Cañon," 14 miles long and very rugged; the line can be laid on the slopes with no very heavy cutting, and no fill of over 10 feet. The river will be crossed once, or it may be better to cross it three times; single span of 150 feet truss. This cañon cannot be avoided; it will cost more to go around it.

Although exceedingly heavy work is encountered at the points named on the "Puntia Pass" route, such a large proportion of the whole distance may be so very cheaply constructed that Col. Greenwood estimates it to cost less per mile than the Raton Mountain route, even with the Galisteo modification of the latter. There are, however, from 35 to 68 miles more to build, (depending on route adopted for western descent from Cañon Blanco.)

BETWEEN THE RIO GRANDE AND THE COLORADO.

With the exception of some heavy cutting, to obtain 50 feet grades in crossing the summit of the volcanic ridge, immediately west of the Rio Grande, the work may be called light to the base of the Mogoyon Range, in Arizona. Here, within a distance of 114 miles, from Cañon Diablo to the Val de Chino, occurs, perhaps, the most expensive work on the whole route.

1st. In making the ascent of the eastern slope there are four cañons to cross, three of which may be spanned by a single truss of 150 feet, but the fourth, Padre Cañon, will require a suspension bridge of 800 feet span, which will cost about $250,000. A tunnel of 2,500 feet will also probably be required through the San Francisco Ridge, and some heavy rock cutting for nearly half a mile at the summit. The *Cosnino line* is more costly than the "Cañon line," besides being longer and with heavier grades. The line north of Mount Agassiz will probably be found cheaper than either.

2d. Descending the western slope we find, on the "*Whipple Pass line*," very difficult work for 25 miles from the summit of Whipple Pass, in descending the waters of Cedar Creek, crossing its branches and reaching the Valley of Partridge Creek, including two bad cañons which are followed. The first of these is 4,800 feet long, and the second 1½ miles; both so crooked that short tunnels from 100 to 500 feet long will be required through some of the projecting points. On the "*Park Creek line*" the work on the line run would be even heavier to reach a common point at the forks of Partridge Creek, but can be improved by modifying the location so as to cross the cañon of Cedar Creek below the junction of one of its branches, and following up that branch to the summit.

3d. At mouth of Partridge Creek, to obtain good grades into the Val de Chino, heavy work will be required for from three to five miles, where the line must be supported on slopes of the Laja foot hills.

On "*White Mesa line*," although the country is pretty badly cut up for eighteen miles by branches of Cedar Creek, most of the heavy work is concentrated at "Mesa Gap," where, for eleven miles, it is very expensive—involving a tunnel of 5,000 feet, a summit cut averaging 75 feet for 1,200 feet, and some heavy cuts and fills in crossing branches of Val de Chino, east of summit. This route is less

expensive, however, than the Partridge Creek Route, besides saving seventeen miles.

The "*Laja Gap line*" has the same heavy work, from summit to western base of Mesa Gap, as the White Mesa line, but is probably cheaper than the latter, considering that it saves seventeen or eighteen miles. It requires a crossing of Cedar Creek 700 feet long, at a point where it is 150 feet deep, and a heavy cut or tunnel of 3,000 feet at the summit of Laja Range.

On the common line west of the junction, from Yampa Gap to the Colorado River, the only difficult work is—

1st. In traversing the cañon of the Yampa, which is crooked, and for two miles will require heavy work, with some short tunnels through projecting points: two miles more of heavy work near Truxton's Springs.

2d. At "Wallapi Pass," where the immediate descent to the Colorado begins. Here, for five miles the work will be heavy—extremely so, if the grade should be supported on the foot hills of the Cerbat Range, so as to get down on a grade of eighty-five or ninety feet.

BETWEEN THE COLORADO RIVER AND THE PACIFIC.

1st. The bridge over the Colorado, above the Needles, will be 1,000 feet long, and 75 feet above usual stage of water. Banks and foundation both favorable. The water rises 21 feet here in the summer. Some heavy work will be required west of the crossing.

2d. The Mojave River will require a truss bridge 300 feet long, for which there will probably be no difficulty in finding a good foundation.

3d. *The Sierra Nevada at Tehachapa Pass.*—Nearly all the difficult work between the Colorado and San Francisco is found in descending the west slope of this range. A tunnel through from Oak Creek at the eastern base would, however, much improve the grades in *ascending* from the desert.

Mr. Runk, who surveyed this Pass, reports that on the western slope—1st. From the head of gorge for twelve miles in following down the slopes of the mountain on west side of Tehachapa Creek, and crossing the spurs that put out from the main range, the work will be expensive—requiring high embankments, deep cuts, one tunnel of 1,600 feet, 3,100 feet of trestling, and several small culverts.

2d. That a tunnel of 2,200 feet will be required east of Bird Point to modify the grade to 75 feet on that portion of the line, and,

3d. That for 15 miles from Bird Point, descending to the Tulare Plain, the line winding along the foot hills that close in the mouth of the Pass, and crossing Allen's Creek, (at 50 feet above low water,) and Walker's Creek, will be very expensive—consisting of alternate cuts and fills, with much rock excavation; one tunnel of 2,000 feet and another of 1,000 feet; 750 feet of permanent bridging and 8,400 feet of trestling. The replacement of the latter by permanent structures will make this portion of the line costly.

4th. From the base of this range to San Francisco, the line could be constructed much more cheaply down the west than the east side of the Tulare Valley, by reason of the numerous streams which put out on the latter from the Sierra Nevada, and in the rainy season, or when the snow melts rapidly on the mountains, are much swollen. This is much the best side, however, for local traffic, and the work is nowhere expensive.

5th. On the Coast Range Route, by Chalama Pass, the only difficult work required is for four miles in the cañon of the Salinas, where there is heavy side cutting; in following the San Miguel Cañon for six miles through the Gavilan Range, where some heavy cutting, (50 feet deep at summit,) is required through the sand ridges, and for several miles in the cañon of the Pajaro, below the mouth of the San Benito.

Col. Greenwood reports the route from Tehachapa Pass to San Francisco, by the *San Benito Pass*, to be an easy one throughout, excepting that a long tunnel is required to obtain favorable grades at the summit of the Coast Range.

(The Panoche Grande Pass was unfavorable, Mr. Eicholtz reporting very heavy work for 3 miles in the Panoche Cañon, besides 5 miles additional of very heavy work in ascending the east slope, and 6 miles in descending the Tres Pinos on the west slope.)

SAN DIEGO BRANCH.

1st. In crossing the sink of Perry Basin, California, for a few miles some precautions may be necessary, as the bottom is alkaline.

2d. A heavy cut through gravel drift will be required in crossing the crest of the Bullion Range, and perhaps some rock cutting

through a point of the mountain putting out south into Morongo Basin.

3. A tunnel of one mile, with a heavy cut at western portal, will be required in Morongo Pass, with six short tunnels from 60 to 250 feet long, amounting in all to 1,135 feet through projecting points of rock in the Morongo Cañon, and three crossings of the creek in the same canon, each of 50 feet span.

From the point of divergence, near Perry Crater, to the Los Angelos Valley, including the crossing of the Sierras at San Gorgonia Pass, where the trestling or bridging of the water-courses is about the only work required—most of the San Diego line is so cheap that the Company could afford to expend a large sum at Morongo Pass and in the Morongo Cañon to avoid heavy grades and curvatures. But from the San Gorgonia Pass, for 100 miles to San Diego, more or less difficult work will be encountered almost continuously in crossing the streams that flow from the Cordilleras into the Pacific and the intervening ridges.

These obstacles will probably force the line near to the coast to obtain favorable grades within a reasonable cost.

It remains to speak of the other characteristics affecting the construction or operation of the line, and the resources of the country available for its support.

TIMBER.

EAST OF THE RIO GRANDE.

The *Raton Mountain Route* is perhaps the best timbered of all the route close to the line of road.

At the crossing of the Arkansas, during the warm months of the year, all the timber needed for cross-ties and bridging can be floated down very cheaply from the Pinery, near Cañon City. Otherwise, in the valley of the Purgatoire, cedar and pignon of sufficient size can be obtained to tie this portion of the road in its first construction, and an abundance for fuel. Near the head of the Purgatoire, above Trinidad, and adjoining the Spanish Peaks, there is a large extent of fine pine timber, but this will scarcely be available for construction.

The Raton Mountain has no timber fit for ties where it is crossed, but thence to Fort Union, the line is sufficiently close to the foot hills of the Rocky Mountains on the west, to obtain all that is needed.

From Fort Union to the Rio Grande, 140 miles, the route is well timbered, the supply being either directly on the line, or within easy access. It approaches to within 15 miles of the Rio Grande, in Tijeras Cañon; and in the Placer and San Dia Mountains occurs in the greatest abundance, extending southward for the whole extent of the Organ Range. The timber, pine, Douglass spruce, oak and cedar, is of fine quality. It will furnish a large traffic to the road.

On the *Galisteo Route*, for 50 miles, there is no timber fit for construction, although there is enough cedar and pignon for fuel, if wanted, but pine can be obtained in abundance from Cañon Blanco Pass, and also from the Placer and San Dia Mountains, by hauling some 10 to 15 miles. This maintains the supply nearly to the Rio Grande.

In the Sante Fe Mountains, 25 miles north of the Galisteo Valley, the timber is of large size and abundant.

On the Cimarron Route, there is very little timber as far as Fort Union, and it must either be transported along the road from the eastern end in Kansas, or floated down the Arkansas from the Rocky Mountains. The last would probably prove the cheapest and speediest method.

The *Puntia Pass Route*, while not possessing as many localities where timber lies in immediate proximity to the road, as the "Raton Mountain Route," is, perhaps, the most advantageously situated of all, in reference both to an immediate and future timber supply.

It has along it, near Cañon City, the nearest important pinery to the end of the track in Kansas, (250 miles distant.) Thence to the head of the Arkansas, Col. Greenwood reports the timber exceedingly fine and abundant, and a fair amount is found adjacent to the Puntia Pass.

For 100 miles, in following the San Luis Park, good timber can be reached at any point on one side or the other of the valley, at distances varying from 5 to 30 miles, and thence southward along the Rio Grande, it may be obtained very cheaply, and in any desired quantities, by floating it down this river, and its branch—the Chama—from the splendid pineries at the mountain sources of these streams.

If the line should follow the Rio Grande below San Felipe, it can also be obtained by floating it down the Jemez, at the proper season, and by hauling it from the San Dia Mountains which bound the Rio Grande on the east, south of the Galisteo.

On the whole, this route opens up a more extensive supply of timber, than the Raton Mountain line, and has, besides, the very great advantage of admitting, for most of its length, of the use of large streams, for the economical transportation of timber to the points at which it may be required.

In the valley of the Rio Grande south of Albuquerque, the only timber consists of occasional scanty groves of cottonwood. There is timber in the Manzano or Organ Range on the east side of the river, and in Mount Madelaine, 10 miles west of

Socorro. The latter range bears thence southwestward, and contains large pine and pignoreal.

TIMBER BETWEEN THE RIO GRANDE AND THE GREAT COLORADO.

From Isletta to El Rito, 48 miles, there is no timber except some cedar brushes on the Puerco. The cedar thickets that Whipple found on the Puerco, in 1853, have all been swept away for fuel, by the Rio Grande settlements. The construction timber for this section, must come by rail from the San Dia Mountains east of Albuquerque, an average haul of 45 miles. For fuel, the coal of Sarocino Cañon exists close to the line.

From El Rito to the "Remances," (30 miles,) an abundance of large pine timber can be obtained from the spurs of the San Mateo, a wagon haul of 12 or 15 miles. Near the Remances it is but 4 miles distant in the cañons.

And from the Remances, to Navajo Pass, (44 miles,) parallel with the Sierra Madre, the splendid forests of that range are only from 4 to 12 miles distant. This timber is pine and spruce, of fine quality and apparently inexhaustible. The whole of this range south, nearly to the route of the 32d parallel, is believed to be covered with a dense growth of large timber. In connection with the supply on the San Mateo spurs, it will furnish all the construction wants of the road as far west as the Little Colorado, and give it a large commercial traffic.

On the "Zuñi Route," Miller's line ran through or closely adjacent to timber, from Fort Wingate nearly to Zuñi village, a distance of 65 miles, west of which, cedar and pinon continued the supply for fuel purposes to Farewell Ridge, 25 miles further.

On the San Felipe Line, Schuyler found pine abundant and large enough for ties, a few miles north and west of "Moquino," and a good growth of pine in the mountains, within 6 to 10 miles of Zia, (14 miles from the Rio Grande,) on the Jemez River. So that on this route the timber supply begins much nearer the Rio Grande than on the Isletta line. At San

Felipe an abundance of timber can be got by floating it down the Jemez or Rio Grande during the high water of early summer.

On or near the proposed line, north of San Mateo Mountain, good pine is undoubtedly abundant.

West of the Sierra Madre along Navajo Creek, there is enough piñon and cedar for fuel, but it will not be needed, as coal will be used here. Construction timber will come from the slopes of the Sierra Madre.

The valley of the Little Colorado has nothing but groves of cottonwood, but an abundance of large pine can be floated down this stream and the intersecting cañons on the south side, from the continuous forests of the Mogoyon Range. We saw much drift pine along its banks, which had made this trip. This business can be carried on upon a scale sufficient to furnish a heavy traffic to the road.

This brings us to the base of the Mogoyon Range, at Cañon Diablo, 63 miles from the junction of Navajo Creek with the Little Colorado.

Thence for 60 miles west, in crossing this range, (at the immediate base of Mt. Agassiz,) we find the best timbered portion of the entire route. The trees are of immense proportions; some of them 200 feet high and 10 feet in diameter; pine and Douglass spruce, in forests which will furnish a permanently large traffic to the road. There is certainly no pinery in the interior portion of the continent superior to this. For the supply of the mining districts of Arizona and western New Mexico, and the arable plains and valleys east and west of this range, it will be invaluable. The line on the north side of Mt. Agassiz would not run so completely through this timber as that on the south side, (Tonto Pass.)

Descending the western slope of the Mogoyon, 10 miles beyond Park Spring we leave the main body of pine, and enter thickets of cedar and piñon, (with some pine on the higher ridges,) which are scattered thence to the Yampa, a distance of 130 miles. Sufficient of the piñon is large enough for cross-

ties, and the cedar will furnish an inexhaustible supply of cheap fuel.

The "Black Forest" occurs on this section, and the Aztec, or Juniper Range, whose slopes are covered with thickets of juniper, and the summits with pine.

On the "White Mesa" and "Laja Gap" lines, cedar and piñon are equally abundant.

From near Truxton's Springs, on the Yampa, to the Colorado River, about 100 miles, timber does not occur on the immediate line of the road, but the extreme summits of the Peacock, Wallapi, and Cerbat Ranges are covered with timber, which, on the latter, is abundant and of good quality, and extends the supply to Wallapi Pass, within 50 miles of the Colorado.

The Valley of the Colorado contains, near where the line strikes it, an extensive growth of cotton-wood and mesquite trees, both of which will furnish an excellent supply of fuel until *coal*, from the cañons near Callville, is substituted. This cotton-wood is said to be superior to that of colder climates, and grows very rapidly from the warmth and length of the season, so that in four years it is fit to cut again. Enough cross-ties can be obtained here, without difficulty, for the first construction of the road eastward to the Wallapi Pass, where the supplies of the Cerbat Range will be met. Drift timber comes down the Colorado from the distant sources of Green and Grand Rivers, but it is so bruised in passing through the Great Cañon, that it is not available for purposes of construction.

TIMBER FROM THE GREAT COLORADO TO THE PACIFIC.

In crossing the Great Basin no timber is found, except a scanty growth of piñon on Mt. Edgar, of the Providence Range. Some scattering cotton-wood grows along the Mojave, and small mesquite, willow and paloverde trees in the long "washes," which are so characteristic of the desert. Timber for this section must come from the Cerbat Range, 50 miles east of the

Colorado, and from the Sierra Nevada, 235 miles west of the river—Enough good cotton-wood, however, can be obtained in the Colorado Valley to tie the road, if desired, for 50 miles west of the river (in addition to the same distance eastward.)

It will depend on whether this division is built entirely from the coast end, or also from the Colorado westward—which of these sources of supply will be used. It will probably all come from the Sierra Nevada, which is covered with the finest timber, in inexhaustible quantities, extending along its entire course; chiefly pine and large red cedar, that will furnish an extensive traffic to the road, for transportation into the Tulare Valley, and to the mines of the desert eastward.

Covering the summit and the western slope at Tehachapa Pass, is an abundance of large sized oak, which may be preferred for ties, &c.

On the direct route to San Francisco there is pine on the Coast Range, and excellent forests of red-wood on its spurs, extending to the vicinity of Gilroy. On the Chalama Pass Route the Coast Range supply is much less than it is farther north, on the routes by Panoche Grande and San Benito.

There is no timber in the Tulare Valley, except oak, of which there is a great abundance near Visalia, and south thereof—of large-size, but inferior quality. An abundance of good pine and large red cedar can readily be obtained by floating it, in the winter and spring, down the Kern, Tule, Posey, Deer, and other rivers, from the inexhaustible supplies in the Sierra Nevada—parallel to whose base the Tulare line would run. Early in February of this year I saw very large pine and cedar trees in Kern River, within a few miles of Tulare Lake, that had recently drifted down from the mountains. I believe a large timber business may be furnished to the railroad in this way.

On the *San Diego line* there is no timber, except the desert willow, small mesquite, &c., from Perry Basin to the San Gorgonia Pass. Here there is an abundance on the San

Jacinto and San Bernardino Mountains, which will maintain the supply to San Diego.

Thus it will be seen that one of the most noticeable features of the route we have surveyed is the amount of timber which is found at numerous convenient distributing points along it. Whipple and Beale have dwelt especially on this feature, both pronouncing it to be the best supplied of any route across the continent. The language of our geologist, Dr. Parry, may most fittingly sum up the case:

"It would be difficult to conceive of a more convenient distribution of these pine forests for railroad construction, or transportation, than that presented on the line of the 35th parallel. Along the entire route, located at convenient distances for transportation, and directly available for the supply of adjoining treeless districts, is an abundant source of this necessary article, not only amply sufficient for all prospective needs of railroad construction, but also furnishing a material for profitable transportation to adjoining mineral and agricultural districts."

COAL.

Coal exists in great abundance on both the "Raton Mountain" and "Puntia Routes," and probably also on the "Cimarron."

In the Raton Mountain, and on both sides of it, in company with Dr. Leconte, geologist, I saw as many as twenty exposures of coal in at least a dozen different veins, the best of which, in reference to the purposes of the road, was found in the cañons of the Vermejo and its branches, about 20 miles from the line, where were two beds of ten feet thickness, each admirably situated for cheap mining, and of great purity in respect of slate and sulphur. This coal, which is bituminous, is hauled in wagons 70 miles, for the use of the Government, for blacksmithing purposes at Fort Union. Apparently, it is as good as the Westmoreland Coal of Pennsylvania. The distance from Sheridan to this coal is 260 miles. It is more particularly described in Dr. Leconte's report.

In the Valley of the Galisteo, 4 miles from the "Old Placer Mines," two veins of anthracite coal, each from 3 to 4 feet thick, occur. This deposit lies within a short distance of our line, should it follow the Galisteo Valley.

In the Tijeras Cañon, 1½ mile northeast of the town of Tijeras, a vein of bituminous coal, 4½ feet thick, was seen and traced by Mr. Holbrook, Division Engineer, for a distance of 2,000 feet, by sinking small shafts along the vein.

It seems highly probable that the anthracite near the "Old Placer Mines" will be found to be bituminous coal, at some distance from the porphyritic dyke which adjoins it at the mine, and that this and other beds will be found elsewhere in the Galisteo Valley. A valuable seam has, indeed, been recently discovered near San Felipe, within 12 miles of the Rio Grande.

Many small or otherwise inferior veins of coal were also found by our parties at different points along the line sufficient

to indicate the wide-spread diffusion of this mineral, and to tempt further exploration. But having traced the existence of enough coal of good quality to operate the road and furnish it a large traffic, for hundreds of years, we left the subject for future prospectors. We have reports of coal on the Purgatoire, 30 miles south of the Arkansas, which is represented as being of workable size and good quality; and there is said to be a vein on the first tributary south of Fort Lyon. It is, of course, of the greatest importance to obtain good coal as near as possible to the end of track in Kansas; and these points, as well as the northern base of the Raton Mountains, should be examined for the company, to ascertain whether coal cannot be had before crossing that spur.

Coal is also reported in the Pecos Valley, 5 miles above Anton Chico, and on the eastern slopes of Chupaynas Ridge, near Las Vegas.

On the *Cimarron Route* Dr. Steck states that with Gen. Carleton, he saw on Rabbit Ear Creek, 4 miles below the wagon crossing, a large vein of coal, apparently 14 feet thick. Should this deposit, of which I have heard from other sources, prove satisfactory, it will go far to offset a serious drawback in the almost entire absence of timber along this route.

On the *Huerfano Route*, Dr. Parry reports that he met with no workable coal.

On the route by "*Puntia Pass*," coal quite equal to, if not superior to that of the Vermejo, was seen by Col. Greenwood at Cañon City. It occurs in two veins, from 4 to 10 feet thick, and the deposit extends at least 20 miles down the Arkansas Valley, below Cañon City. This brings it to within 90 miles of Fort Lyon, or 204 miles from Sheridan, being the nearest certain supply of good coal to the present end of track that we know of. The quality is admirable, and the quantity apparently inexhaustible. Major Calhoun, of our party, estimated the size of the deposit between Hard Scrabble and Cañon City to be 100 square miles. In the Wet Mountain Park the deposits are represented as equally good.

Major Calhoun also discovered a thin vein in the Puntia Pass, near the head of Puntia Creek, of no value except as indicating that such veins exist in that vicinity. It may perhaps lead to the discovery of larger beds. Accessible to this route, in the mountains west of the Rio Grande, coal is also reported to have been found.

Accessible to the Rio Grande valley, from the mouth of the Galisteo southward to El Paso, a large amount of coal is found. The following are the localities reported, of which those on the Puerco, in Tijeras Cañon, and near Don Pedro, are the only ones that have been actually examined by any of our parties.

1st. Near San Felipe, thickness and quality reported good.

2d. 6 miles east of Algodones, reported very good.

3d. In Tijeras Cañon, already referred to, 4½ feet thick, quality at outcrop not very good; expected to improve when opened.

4th. West of Las Lunas on the Puerco, of fair quality—has been used in Government shops.

5th. Near La Joya, on east side of river.

6th. In the Sierra Madalena, west of Socorro.

7th. North of Fort Craig, 8 miles east of Don Pedro, vein 5½ feet thick. Dr. Leconte, geologist of the expedition, examined this bed, and reports it of good quality, and that it may be worked for many years.

8th In the Caballo Mountains, on east side below Craig.

9th At Robelodo.

10th. Abundantly near Donna Anna and Mesilla, on both sides of Rio Grande, 3 feet thick of good bituminous coal.

In reference to the branch from Albuquerque to El Paso and Chihuahua these deposits along the Rio Grande assume great importance. They will furnish a large traffic to the road, besides enabling it to be operated cheaply. They are also invaluable to the mines of silver, gold, copper, lead and iron, which line both sides of the Rio Grande almost continuously, enabling these ores to be cheaply produced and smelted; and they will furnish fuel to the large agricultural population which will before long fill up this unwooded valley.

COAL WEST OF THE RIO GRANDE.

Deposits of coal are known to extend as far west as the Moqui villages, more than 300 miles from Albuquerque, where Newberry saw a bed 12 feet thick. This is some 50 miles north of our surveyed route on the Little Colorado.

The most westerly deposit reported by our geologist, Dr. Parry, was on the Zuñi Pass line, 15 miles east of the Indian town of Zuni, where he saw a bed 4 feet thick, near Pescado Springs, at a good elevation in the bluffs for mining, and to all appearances sufficiently extensive to be valuable: in quality rather slaty at outcrop, but likely to improve as opened. There were also other beds, the outcrop showing along the bluff for several miles. This is 140 miles west of the Rio Grande.

In the Sarocino Canon, about 30 miles west of the Rio Grande, and within 3 miles of our surveyed line on the El Rito, aré 3 distinct seams of coal, averaging 3 to 4 feet in thickness; one of these is 4 feet thick and apparantly without any included slate veins. It dips about 40° and the quality is not very good at the outcrop, but it may improve at greater depth. The extent of the deposit remains to be proven, but as we hear of coal existing north, south and west of this locality at intervals over long distances, there is a reasonable prospect of finding an abundance of fair coal.

The localities referred to are:—

1st. On the Puerco near Pueblazion, 15 miles north of Hubbel's Ranch, (thought to be Cannel.)

2d. In Cañada of Ojo Hedionda, 8 miles northwest of Hubbel's bridge.

3d. At Ciboleta.

4th. Near Le Xara Springs, 50 miles south of the El Rito.

Dr. Parry found near Accoma, 60 miles from the Rio Grande, and 8 miles south of our line, cannel coal in veins as thick as 20 inches, which the Indians use for jet ornaments, and very good coal at San Jose, 7 miles west of Cubero, in three veins, of which the total thickness was three feet—the thickest seam being 20 inches.

On the *San Felipe* line, near the Gavilan Pass, 20 miles from the town of El Rito, our engineers found a good vein of coal of workable thickness. And on the same line, near San Pedro, on the divide between the Puerco and the Jemez, Mr. Holbrook reports having seen a vein of fine cannel coal, two feet thick, and nearly everywhere indications of an abundance of cannel coal; this was 60 miles west of the Rio Grande by his line. We were informed of numerous veins of coal, two to four feet thick, and covering an area of 40 miles, existing about 18 miles north from our line at Agua Azul, but did not see them. Dr. Wizlezenus saw coal near the village of Jemez. Good coal is found immediately west of the Sierra Madre, near Fort Defiance, and is reported to extend to within a few miles of our surveyed line at Campbell's Pass.

The proposed line from San Felipe, north of San Mateo Mountain, will probably lie nearer to extensive deposits of good coal than those farther south. Several localities of coal, in thick beds, are reported in that country, between Jemez and the Sierra Madre; and Simpson saw coal in the Cañon de Chaco, near the 36th parallel, almost due north of San Mateo.

Nearly 450 miles west of Zuñi, coal is found on the Great Colorado River, about 40 miles below Callville, and 150 miles north of Fort Mojave. We did not see it, but heard, on good authority, of its occurring in a vein of workable size, and of its having been used by the miners at El Dorado Cañon. Its position along the immediate bank of the river, enabling it to be boated down cheaply to all points below, will make this deposit exceedingly valuable, should it prove of good quality.

From the Colorado River westward to San Francisco, we met no coal and heard of none. The only deposit actually known in this distance is the rather inferior one at Monte Diablo—not far from the last named city.

On the *San Diego line* I heard of coal on the Rio Santa Ana, 20 miles above Anaheim, reported to be a good workable vein, but did not see it. At San Diego, Captain Colton, of our party, reports the probable existence of good

coal. "On the shore, just west of the light-house, indications were observed about 12 years ago by the Mormons, and some work was done, but before this was completed, the invasion of Utah by the United States troops took place, and Brigham Young ordered all the faithful to Salt Lake City—so the work was abandoned and has not since been resumed. A blacksmith, who had used the coal, pronounced it of good quality, burning freely with no sulphur, (something rare on the Pacific coast;) that it welded well and left a very little (white) ash. The stratum was 4½ feet thick at the bottom of a shaft 86 feet deep."

Several veins of coal are also reported on the coast at the mouth of the Soledâd Creek, 12 miles north from San Diego.

Enough has been shown to prove that a large amount of good coal is found on this route between the Arkansas River and the Pacific, sufficient not only to answer all the purposes of the road and the resident mining, manufacturing and farming population, but to furnish a large traffic for transportation to less favored districts.

The coal trade will, in all likelihood, be one of the largest sources of business the road will have. It remains to be ascertained whether the varieties found are as well adapted to the reduction of iron, as they undoubtedly are to locomotive use. If so, the supplies at Cañon City, on the Vermejo, near the Placer Mountains, and along the Rio Grande, will prove of the greatest value, in consequence of their occurring in connection with rich beds of iron ore, and close to limestone. And, before long, we may expect this country to be filled with furnaces and rolling mills like the rugged mountains of Wales.

WATER.

EAST OF THE RIO GRANDE.

From Sheridan, the end of track in Kansas, to the Arkansas, at Fort Lyon, water can be obtained in abundance in the Smoky Hill River and its tributaries, Pond Creek and Goose Creek, as far as Cheyenne Wells, 55 miles. Thence for 65 miles, to Fort Lyon, the following are the only permanent supplies of water: 1st. The Big Sandy, (15 miles,) where the water runs in the sand and can always be obtained by sinking a few feet. 2d. *Colton's Spring*, (15 miles from Big Sandy,) which appears to be permanent, and will afford a sufficient amount for railroad purposes.

Thence to Fort Lyon, (35 miles,) water can only be obtained from wells; but, as the Santa Fé Stage Company have found water (although poor in quality) on this divide, by sinking from 35 to 75 feet, no practical difficulty to a railroad need be anticipated from this source.

The water of the Arkansas River is sweet and abundant.

Between Fort Lyon and Albuqurque, on the "*Raton Mountain route*," there is no scarcity of water, except from the mouth of the Chequaco to the northern foot of the Raton Mountains, (36 miles,) where there is no surface water in the dry season; and between Cañon Blanco and Tijeras Cañon, (40 miles,) on the high plateau of the Rocky Mountains, south of Santa Fé.

In the Chequaco Valley, water will be obtained either by sinking or by leading it down five to eight miles from the foot of the Mesa del Maie, on the east, where there is permanent water.

From the Raton Mountains to the Pecos River, there is an abundance of good and permanent water in the frequent branches of the Cimarron, Canadian and Pecos, which the line crosses not far from where they emerge, sweet and copious, from the cañons of the Rocky Mountains.

After crossing the Pecos, the supply is less reliable. How-

ever, in the Canada de los Diegos, 15 miles from the Pecos, is a permanent spring, or, should it fail, an abundance of water can be had by sinking in this deep valley. For most of the year, there is also a natural reservoir filled with water on the summit of the Capoté Mountain, above the line, called "Lake Escobel," from which the water can be led down. It can readily be made permanent by a little care.

Thence for 17 miles across the summit of the Rocky Mountains to the "Lagunas," we saw no water in September when we passed over this country; but in the Cañon Blanco, for 10 miles of this distance, no difficulty will be found in obtaining a good supply either by wells or tanks.

At the "Lagunas" water is found in six or seven small lakes, and is permanent, except in very dry seasons. The supply can readily be increased, artificially, to meet any demands. From the best information, these lakes have not been known to go entirely dry but once in the last 12 years.

West of the Lagunas, 17 miles on the same elevated plateau, is the Chorro Spring, which is called permanent. Should it not prove so, it will be necessary to form an artificial tank or basin, like the Lagunas, into which the water can be drained in the wet season and stored for use. The conformation of the surface on this plateau, favors the cheap construction of such basins.

From Chorro to permanent water in the Tijeras Cañon, or "Carnouille Pass," is 17 miles. Thence to the Rio Grande, there is sufficient water.

It will be seen that almost the sole important water scarcity on this route exists betwcen Cañon Blanco Summit and the Rio Grande. This can be avoided entirely by taking the *Galisteo Route*, on which there is an abundant supply in the south branch of the Galisteo, 15 miles from that summit, and thence the line follows a small stream of running water to within 15 miles of the mouth. From this point to the Rio Grande, water can at any time be readily had by sinking a few feet, and occasionally it rises to the surface. The Galisteo water is some-

what alkaline in places and in dry seasons, but not to a serious extent.

The *Cimarron Route* is sufficiently well watered between Harker and the point of leaving the Arkansas, 153 miles, but thence to Fort Union, 300 miles, it is poorly watered. However, from the best information, there are springs or creeks along it, from 6 to 15 miles apart, where sufficient water can be had for railroad purposes, except at two points, to wit: from the "lower" to the "middle Cimarron" spring, 28 miles, and from the Arkansas River to Sand Creek, 52 miles. The first is probably not too great a distance to run a train (over light grades), if it be found difficult to obtain water in the interval by wells or artificial reservoirs. On the second Jornada, a supply may be retained by proper appliances at the "Old Battle ground," 20 miles from the Arkansas, or other similar depression, where it accumulates in wet seasons. Elsewhere on the Jornada, wells or tanks must be adopted.

The *Puntia Pass Route* is well watered *all the way*, the only portion of the line not occupied by the Arkansas or its tributaries and the Rio Grande, being the San Luis Park, which is occupied by numerous streams whose sources are in the mountains on either side.

WATER BETWEEN THE RIO GRANDE AND COLORADO.

We passed over this section, including western New Mexico and the whole of Arizona, from the middle of October to the middle of January, the dryest season of the year.

From the Rio Grande to the Puerco, 21 miles, there is no surface water; but it can be had at the eastern foot of the ridge by sinking, and also on the summit, where Mr. Miller reports that a large area of country has its drainage into lakes, which, if properly excavated and lined with cement, would furnish a never failing supply.

In the Puerco water is permanent about eight months of the year, and can be made permanent by sinking or damming.

From the Puerco to the summit of the Sierra Madre, the

valley of the El Rito from its mouth, 73 miles, to the Agua Azul, (a fine permanent spring between the Sierra Madre and San Mateo Mountain,) will afford a sufficient supply of water for railroad purposes, and at many points it is used for irrigation by the Mexicans and Pueblo Indians.

From Agua Azul it is 25 miles to a basin or laguna at Carizo, and 10 miles more to the Ojo del Oso, a spring in Navajo Pass.

From this Pass to the Little Colorado we have the valley of Navajo Creek, (Puerco of the west,) which, being dry part of the year, will require tanks or shallow wells. These will undoubtedly furnish all the supply needed.

The Little Colorado is sometimes alkaline, but furnishes abundant permanent water to the Cañon Diablo, at the base of the Mogoyon Range.

These mountains, better known here as the "San Francisco Mountains," are well watered. They have the summer rains or *temporales* of New Mexico, besides the winter rainy season of California. Even at Fort Whipple, which is much lower and dryer, there were 36 rainy days from December 1, 1866, to December 1, 1867; and 19¾ inches of rain fell in that year. The water occurs in the San Francisco mountain country in numerous springs, and is also found emerging from the base of the lava walls or beds of the cañons and valleys. Dr. Parry has shown how these lava-coated valleys thus serve the purose of covered *acequias* to convey the fertilizing water precipitated in the mountain ridges to the lower fertile valleys. By being thus covered, the water is preserved from evaporation.

These cañons, which are very numerous, and of all sizes, can be made available in the dryer region, west of Mt. Agassiz, as natural reservoirs, to increase the supply of water in the dry season. It is only necessary to construct dams across them, which can be done very cheaply, and thus the abundant supply of water with which they are filled in the rainy seasons is maintained all the year round. This can even be done to a sufficient extent for irrigation where required, and for limited water power.

In the Val de Chino, which drains long ranges of high mountains, abundant water can be obtained, without doubt, by wells of no great depth. It may also be obtained from the mountains on either side by forming reservoirs, and leading the water down therefrom.

The same in Aubrey Cove.

From Truxton's Spring there are springs at convenient distances to the Great Colorado—except between Wallapi Pass and the River, (50 miles,) on which part of the line water must be obtained from the adjacent Cerbat Range or Black Mountains, and from the Pass itself, and led down to the line.

A very different state of affairs from that on the outward march existed when our return party passed over this country in March, April and May, (1868.) Indeed, they found everywhere too much water—and nowhere a dearth. Mr. Schuyler reports that on 17th of March, Partridge Creek, at its mouth, was pouring a large stream out into the Val de Chino. On the "White Mesa," which had before been so dry, there was a great abundance, and the "ground was thoroughly saturated." On March 24th, "Stormy Hollow," instead of being a dry cañon, was a torrent, 50 feet wide and three feet deep. On the western slope of the Sierra Mogoyon "every gulch and hollow had its running stream, and the ground was everywhere full of springs. No one could easily imagine that there could be any scarcity of water at any season." Near Mt. Sitgreaves, March 26th, all the ravines contained clear running streams. In Cedar Creek, Mr. Holbrook reports "a fine running stream large enough to run a small steamboat. Leonard's Tank, near Cataract Creek, contained 1,000 barrels of water, (this was evidently permanent water.) On March 28th, the warm weather was melting the snow very rapidly, and in every ravine there was a clear, sparkling rill running down the hillsides, and in Park Creek a stream varying from 100 to 2,000 feet wide, and two feet deep. On March 31, "Leroux Park was a lake, covered with about three feet of water."

"Antelope Park, a great lake and swamp."

"Antelope Creek full of water."

"Through the valley east of San Francisco Ridge a small stream of water running."

"Waterpool Cañon, filled by a stream half as large as the Kansas, rushing through it."

"Along Secretary Valley every little ravine contains a running stream, and lakes from one-fourth to two miles in diameter are frequent."

"Engineer Lake, 5 miles wide, and 7 to 10 miles long; no apparent outlet; supplied during the spring rains and thaws; apparently permanent."

"Padre Cañon, full of water, boiling, roaring, stumbling, like all the rest."

"Cañon Diablo, a torrent like every other valley and cañon in the country; water eight feet deep, and running very swift."

This was on the south side of Mt. Agassiz. On the north side "Frog Cañon" had a pool of water 75 feet long, 30 wide, and 5 feet deep; water permanent: and between Mt. Kendrick and Falls of Little Colorado, Schuyler found five or six large tanks, from 100 to 200 feet diameter, circular, and apparently 5 or 6 feet deep, constructed by the Indians. They probably contain water all the year. One in particular, sheltered by pine trees in a beautiful valley, had been enlarged by a dyke or embankment thrown up across its outlet, and appeared to be supplied by springs. Its depth was estimated at 10 to 12 feet.

"Thence to the Little Colorado, little trickling streams flowed in every ravine."

April 1, 1868. Mr. Holbrook reports "immense bodies of water running down the sides of Mount Agassiz, where, in December last, there was not a drop."

April 10. "Signal Cañon is a fine running stream."

The Mogoyon Plateau, on Sunset Gap line, was dotted over with small lakes, from one quarter to half mile in diameter, having outlets towards the Colorado River, and in nearly every ravine was a clear, sparkling rill.

April 18. "A fine stream of running water in Rancheria Cañon."

East of the San Francisco Mountain, on April 24, the "Dry Fork," a tributary of the Little Colorado, was a stream 100 feet wide and 20 feet deep. In May the Puerco had a fine stream of muddy water ten feet wide and three feet deep, where the San Felipe line crossed it.

The Jemez, May 21, was 600 to 800 feet wide, and from six inches to a foot deep, and water good.

June 7. "A stream of fine water in the main Galisteo, nearly to its head."

June 5. Tecoloté Creek now has a stream of water 75 to 100 feet wide, and the Pecos 100 feet wide, six to ten feet deep, and running at "Billendante" with extreme velocity.

Evidently, where such supplies as these exist, there will be no difficulty in a country of cañons and natural basins, in obtaining by a little care an abundance of water throughout the year. Besides these winter or spring supplies, in Central Arizona there are summer rains as in New Mexico, which begin about middle or 20th of July, and continue with showers every afternoon for perhaps a month. This rainy season lasts from about the middle of July to the last of September. With Capt. Beale, in 1859, it began about July 1st, at the Colorado River. This indefatigable and intelligent explorer, who appears to have made the trip between the Rio Grande and the Colorado, on the 35th parallel, at every season of the year, reports that he always found sufficient water; and Whipple remarks "that this route is particularly favored by rain, and that the Zuñi region, the vicinity of the San Francisco Mountains, (Mogoyon Range,) and the Aquarius Range, have evidently a large supply of precipitated moisture."

WATER WEST OF THE COLORADO RIVER.

In crossing the Great Basin, from the Colorado River to the base of the Sierra Nevada, 235 miles, there is but one permanent stream, the Mojave River, parallel to which our line runs for 25 miles. For most of this distance the level of the

river is above that of the line, which occupies a long basin, separated from the river by a low ridge of sand. There is, indeed, but one place on the entire line from the Colorado to the Mojave River, *Piute Summit*, which is as high as the last named river where our line crosses it, and the difference in this case is but 200 feet.

This suggests a plan by which, should it become necessary, water may be cheaply supplied to any point along the greater part of the line on this desert, by conveying it in pipes from the Mojave River.

The detached basins which we cross, however, constitute the drainage of such extensive mountain districts, (Perry Valley, of some 2,000 square miles,) that there is scarcely a doubt but water can be obtained in them anywhere by wells of moderate depth, especially as cemented layers, apparently impervious to water, are common in the drift, where seen on the banks of the Colorado and Mojave, and elsewhere on the desert.

This cannot be considered speculative, since, in crossing the Great Basin, further north, from Virginia City to Salt Lake, we found that the overland stage road relied, with some exceptions, for nearly 500 miles, for water on wells sunk in similar basins in a very arid country. They are about twelve miles apart, and water is usually obtained at a depth of from 10 to 100 feet. One or two wells are as deep as 400 feet, but in all cases water had been obtained except one.

Furthermore, in the high mountains which everywhere border our line in crossing the desert, we discovered, during the survey, several springs heretofore unknown, also natural tanks in the rocky cañons. And I have no doubt but that, when the desert is more fully explored, these supplies will be found sufficiently abundant to answer all necessary purposes. The Piute Indians, who occupy these mountain fastnesses, evidently have no difficulty in obtaining water, even to the extent of irrigating occasional small patches of land, where they cultivate corn and pumpkins.

We were told that it would be impossible to explore for a line on the desert because of scarcity of water, but we spent over three weeks almost entirely off the traveled route, (which crosses the highest summits,) and, although frequently pressed, eventually found water, more or less permanent, within practicable distances.

On this subject, the geologist of the survey, Dr. Parry, states that, "the same condition of things which allows the existence of natural springs would also warrant the opinion that an aqueous substratum underlies all the depressed basins or valleys; hence, by digging at sufficient depth to reach an impervious layer, water will no doubt be found in sufficient quantity for railroad purposes." Prof. Blake, of Captain Whipple's survey, expresses the same opinion.

But even if wells should fail, the line could be supplied between the Colorado and Perry Valley by leading down water from the several springs in the Providence and Piute Mountains, on the north of the line; which, in connection with the Sacramento Springs, at Iritayba Gap, would adequately supply this part of the line.

From Perry Basin to the Mojave the line could be watered in the same way from springs or cañons in the adjoining mountains, or by pipes from the Mojave River, as above suggested.

Still another plan would be, to form reservoirs in the sinks or "washes" to receive the water that drains into them at certain seasons, which must sometimes be large, as we frequently found driftwood in them.

Between the Mojave River and the base of the Sierra Nevada, 65 miles, there is no difficulty in obtaining water. The line crosses or skirts a large lake, about half way, sometimes dry, called Williamson's Lake, which is 10 miles in diameter, besides numerous small sinks, all of which contain water in the rainy season. These supplies are chiefly fed from the eastern slope of the Sierra Nevada on the left, down which an immense amount of water pours, from rain or melted snow, by numerous streams which flow a greater or less distance out into the

desert, but finally sink. In February, this whole country, for 30 miles out from the base of the Sierras, was a net-work of lagoons, and saturated with water. It is evident that these supplies may be made permanent at no great expense, or that by sinking wells, the drainage, which is underground in the dry seasons, may be tapped and brought to the surface. In crossing the Sierra Nevadas at Tehachapa Pass, there is an abundance of permanent water, and thence to San Francisco by any route, no difficulty exists on this account.

SAN DIEGO BRANCH.

The only permanent water we found in a hasty reconnoissance, until we reached the Agua Blanca, at the eastern foot of San Gorgonia Pass, was in the Morongo Cañon, about 70 miles from the point of divergence from the main line in Perry Basin. But we found two other temporary watering places, and the supply could be made permanent in the same manner as proposed for the San Francisco line, the country being favorable thereto. Through the San Gorgonia Pass and thence to San Diego, the country is sufficiently well watered.

Generally, it may be said, in regard to the water question on the line, across the California Desert, as well as on other poorly watered divisions of our route, that, at the very worst, a larger supply than is required for all possible railroad purposes may be obtained at a less cost than that of bridges and culverts, had the country been "well watered" with running streams, and the consideration of water should not be allowed to affect the location of the line across the "Great Basin" at all; or seriously anywhere along the route, except as it may affect the comparative inhabitable qualities of the country.

BUILDING MATERIAL.

Timber has already been specially noticed. There is a great abundance distributed at convenient points along the route for purposes of construction.

There is no point in the entire distance where cross-ties will require to be transported nearly as far as has been done for the existing track on the Plains of Kansas.

There is no point where cotton-wood need be used for ties, except temporarily, to facilitate construction for 50 miles east of the Rio Colorado, in order to reach the Cerbat Pinery and obtain material for the Colorado Bridge, with ties for the line across a portion of the California Desert.

The quality of the pine in New Mexico and Arizona is not always very good; but in the dry climate of this elevated plateau it will probably endure as long as the best varieties of wood in the Atlantic Slope, and will answer for bridging and all other purposes. The Douglass spruce of the San Dia[illegible] Mountain, Sierra Madre and Sierra Mogoyon is excellent.

Timber can be floated down the Arkansas and the Rio Grande, with its tributaries, during the summer rise, from the mountain supplies to the points of crossing. The experience of the Union Pacific Railroad on the Laramie and other rivers in the Rocky Mountains upon their line during the past year, has demonstrated how readily and cheaply this can be done.

Timber can likewise be floated down the Little Colorado and its tributaries from the Mogoyon Range during the spring thaw; and down the Kern and numerous other rivers in the Tulare Valley from the forests of the Sierra Nevada in winter; and possibly in winter down the Mojave from the San Bernardino Mountain, for the supply of the line on the desert. The last, at all events, could have been done at the time of our survey, in January, 1868. Drift pine comes down the Colorado, but is found to be too much injured by its long passage over rocky beds to be useful.

The whole line is well supplied with building stone, limestone, &c. *East of the Rio Grande* there is the wood-colored sandstone of Fort Wallace, the quarry at Fort Lyon, of excellent sandstone, which extends up the valley of the Purgatoire farther than our line follows it; the eruptive rocks of the Raton Mountain; good sandstone and limestone thence to the Pecos River; other sandstone not so good in crossing the Cañon Blanco Summit; granite and limestone in the San Dia Range, and extensive deposits of limestone between these and the Placer Mountains.

Between the *Rio Grande and the Colorado* occur the extensive sandstone beds which line the El Rito Valley; the superior Jemez marble; the indestructible lava rocks, which are abundant all the way to the Sierra Madre, and will be very useful for many purposes of construction and especially for ballasting; the El Rito gypsum, whose prepared material will be useful in bridging, lining of tanks, acequias, &c.; the granite and carboniferous limestone of the Sierra Madre; and the cretaceous sandstones between this range and the Mogoyon, of which Dr. Parry says: "Although mostly unfitted for the purposes of railroad construction, yet, in the arid climate where they are mainly located, they will furnish an unlimited supply of cheap material, easily worked, and sufficiently durable for storehouses and stations." Gypsum is also found in the Little Colorado Valley on this section.

In crossing the Mogoyon Range we find the greatest quantity of superior building stone—the thick beds of magnesian limestone in Cañon Diablo, Pine and Cottonwood Cañons, the granite of Padre Cañon and the Summit; and lava rock everywhere and in all varieties.

At the western base of this range, Col. Greenwood reports the lime rock of Partridge Creek and the flat sandstone of the Laja Range, bordering the Val de Chino, to be very good—the latter "as good a building stone as I ever saw."

Next we have the good limestone and sandstone of "Trux-

ton's Cañon," and Whipple's party found granite in the Aquarius Range.

We did not observe any but ordinary building stone near the Colorado River, but the facility of water transportation here throws open an extended area in which to obtain a supply from along its banks.

West of the Rio Colorado the coarse granitic and porphyritic rocks of the desert mountains will furnish a building stone that will answer for ordinary purposes. Better granite and some marble are found along the Mojave, and there is a wide-spread diffusion of lava rocks from the Colorado to the Sierra Nevada as indestructible as could be wished. There is also, on most of the route across the desert, an inexhaustible quantity of the finest gravel ballast, which will enable the road-bed, once made in this dry climate, to remain permanently in a superior condition with the slightest work. It may also be transported to other less favored sections of the line.

In the Sierra Nevada, Mr. Runk, division engineer, reports an excellent granite, easily quarried and accessible to the line, at Tehachapa Pass.

On the *San Diego line* granite occurs in the San Bernardino Mountain.

On this subject Dr. Parry, the geologist of the survey, states in general terms:

"Other crude material connected with the work of economical railroad construction, such as building stone, lime, cement, gypsum, clay, &c., are located along the line of the road, at such distances that they can be conveniently employed in processes of first construction and repairs, and also afford material for transportation. In this class is especially noticeable the superior quality and great abundance of rock suitable for buildings or heavy masonry, which, in different varieties of texture and composition, adapt them to a great variety of special uses."

CLIMATE.

The experience of our engineer parties has covered, in going and returning, nearly every season of the year, giving us a large amount of exact information on this subject; and we have, besides, the results of the experience of previous explorers—Whipple, Beale, Aubrey, Willis, Chavez, Leroux and others, who have traversed the route, or a portion of it, in different years. Altogether, these observations cover such an extended period, that we may say there is very little to learn about the climate of this route, as it may affect railroad construction or travel, or the adaptation of the country to settlement. Although a vast new region, inhabited for the most part solely by Indians and game, we have such a mass of information on this subject, including the records of the military posts, that we can feel entirely confident of the practical deductions that may be made from this data.

The route throughout is singularly favored in the matter of climate. The people of the eastern half of our continent have scarcely a conception of the physical pleasure of mere existence in the pure air and fine weather of this elevated Southern plateau. For healthfulness, it is conceded to have no superior. In our engineer parties, numbering, with attachés, some 150 young men, and exposed to numerous hardships, there was not, either going or returning, a single case of real sickness, and all came home much heartier and more robust than when they started. This covered a winter in the mountain regions of Arizona. Our experience, in this respect, agrees with that of Beale, who says: "During the entire winter (of 1858–9) my men were exposed night and day to the open atmosphere—some not using for the whole journey their tents, and others but very rarely, yet not one of them had occasion to complain of the slightest sickness during the journey."

The observations taken by Dr. Parry, and the records which he obtained from the various government posts, show a remarkable uniformity of temperature throughout most of the route.

For *railroad purposes*, the climate is unexceptionable. I am satisfied that on no portion of the line will there be any greater liability to interruption of trains from snow or other winter obstacles, than there is, for instance, on the Pennsylvania Central Railroad.

Personally, I passed over the entire mountain country west of the Rio Grande—including the Sierre Madre, two crossings of the San Francisco Mountains, (highest summit on the line,) and the Sierra Nevada—in the winter season, from the middle of October, 1867, to the middle of February, 1868, without encountering but one snow storm, or seeing any snow lying on the ground, except at one point. This was a fall of two inches, at Fort Wingate, New Mexico, which had disappeared from the summit of the Sierra Madre by noon of the following day.

During this period the days were uniformly mild and pleasant, and, although the nights were sometimes cold, I rarely used a tent on the journey.

Our wagon trains made this long winter march through the mountains without difficulty, the mules and the herd of beef cattle, which was driven along from the Rio Grande nearly to the Colorado, finding an abundance of gramma and bunch grass even on the highest summits.

Our party, on the return survey, encountered several storms of snow in Arizona and Western New Mexico, but it melted rapidly, and did not prevent the animals from thriving on the constant good grass.

CLIMATE EAST OF THE RIO GRANDE.

On the great plains of Kansas and Southern Colorado, a fall of sometimes as much as 18 inches of snow takes place about the middle of December, but is rarely troublesome. During

January and February there is generally no snow. There is apt to be a considerable storm of snow about the last of March or first of April, but it does not drift, and usually disappears in two or three days.

In the valley of the Arkansas, as high up as Fort Lyon, probably never over six inches of snow falls. Average yearly temperature at this post, about 54°. On the Raton Mountain there is more snow than at any other point on the entire route to the Pacific. It sometimes falls here in the spring to a depth of 2½ feet. Where our line crosses it at "Cimarron Pass," the elevation is not sufficient in this latitude to permit it to lie long enough to give trouble. Stock is driven in numbers to winter in the cañons intersecting this range.

On the range of the Rocky Mountains, east of the Rio Grande, (the Spanish Range,) snow is said to fall occasionally to a depth of one or two feet, but it lies but a few days, and there are no points on the line into which it can drift to cause any trouble.

At Santa Fé, twenty to forty miles north of the line, citizens say the heaviest falls of snow they have seen do not exceed fifteen inches, and these are extremely rare, and in all cases disappear rapidly, sleighing never lasting more than two or three days at a time.

In the Valley of the Rio Grande, at Albuquerque, snow rarely falls, and at Mesilla winter is scarcely known, figs being cultivated with great success.

On the "*Cimarron Route*," south of the Arkansas, very little snow falls, and that quickly melts.

On the "*Puntia Pass*" route the only snow of consequence is at the Pass itself, where, for a distance of twelve miles, in crossing the Rocky Mountain Summit, there would be much snow; but, owing to the open character of the Pass, and the fact that the storms are all from the east, and are broken by the mountains before reaching the Pass, and also owing to the fact that this neck intervenes between the deep warm Valley

of the Arkansas on one side, and the broad open Park of San Luis on the other, it is not probable that there would be as much practical obstruction to travel as on New England roads; while the distance within the snow belt is very short.

At Fort Garland, which is higher than the San Luis Park, the yearly mean temperature for five years, from 1859–'66, inclusive, was 43° 14′.

CLIMATE FROM THE RIO GRANDE TO THE COLORADO RIVER.

But little snow falls east of the Sierra Madre. On the summit of that range, at Navajo Pass, (7,177 feet,) there was no snow early in November, 1867, when our parties crossed it. There had been, on October 31, a fall of two inches, which disappeared the next day. Whipple met none there late in November, 1853. Chavez met a very little in crossing this range December 21, 1863, but it was thawing December 25. Our return party, under Mr. Holbrook, encountered a severe snow storm on the 5th of May, at Agua Fria, in this range, but it only lasted two hours, and melted almost immediately. Navajo Pass is a broad smooth plateau, from three to ten miles wide, which would not give trouble even if considerable snow should fall, which is not the case. There may be very rarely a fall as deep as eighteen inches, but it melts rapidly. At Fort Wingate, the yearly mean temperature, from 1863–'66, inclusive, was 52°.

From the Sierra Madre to the Great Colorado, the only place where snow falls in any quantity is on the Mogoyon Range, (San Francisco Mountains,) where our line finds its highest summit between the two oceans, (7,510 feet.) I crossed this summit twice, about the middle of November and again about the middle of December, without finding any snow. On the first occasion there was none even on the top of Mt. Agassiz, over 12,000 feet above the ocean. On the middle of December Mt. Agassiz had a silvery crown, which extended as far down on the slopes as a point about 2,000 feet above our heads, the

days were warm, and even the nights not unpleasantly cool for the bivouac, while our animals found the finest grazing everywhere. On the march thence westward to the Colorado River I saw no snow even on the highest mountains, and the climate was the finest I had ever experienced.

At Fort Whipple, adjoining Prescott, from December 1, 1866, to December 1, 1867, the number of snowy days were nine; the total fall of snow, in the year, 32½ inches; the mean winter temperature 41°; the mean summer temperature 78°; and the mean yearly temperature 57°.

On the San Francisco Mountains, about the first of the year (1854,) Whipple found eight inches of snow, but he states that it was nowhere drifted; did not form sufficient obstruction to prevent his mules from faring well upon the gramma grass, and that this winter was exceptionally severe. He adds that Leroux, for three previous winters, had seen these mountain peaks devoid of snow.

Col. E. W. Willis, who established Fort Whipple, informs me that he has had a personal experience in the San Francisco Mountains during three winters, 1863, '64 and '65, and a somewhat further one from reports of parties of troops under his command. That he has never seen, himself, any snow there except on the high peaks, and only knows of two occasions when his parties found any of consequence—once when he sent a party across late in January—they reported a fall of ten inches, but it did not cause them to lose their animals although they were without forage. Again, a government train was snowed in three or four days; they reported twenty inches of snow; this was an unexampled winter in New Mexico and Arizona. He adds: "I believe, from all my knowledge, that the winter fall of snow will not average more than four inches per annum, and that, at no time, does it lie long. In the summer the climate is delightful, the summer rains falling daily in showers during the hotter months, making it all that is desirable as a climate."

General E. F. Beale's testimony is even stronger. He states, in a letter to me: "I was employed by the War Department, about four years, in the exploration and location of a wagon road on that line, (35th parallel,) and passed two winters on it. During that time, I do not recall a single day in which we ceased work or travel on account of the snow, or from the rigor of the climate. I passed the latter part of the month of January about the summit of San Francisco Mountains, and the 4th of February, 1858, on it, where I found the deepest snow, and in fact almost the only snow I have ever seen on the line west of the Rocky Mountains. It was on the level about six inches deep, and up to the knees in drifts, and covering over six miles. *I traveled with my camp fully twenty miles during that day.* On all the southern exposures there was no snow, and after crossing the summit I halted my men and turned out the mules to graze for an hour before proceeding to Leroux Spring, because the grass on the southern hillsides was so good. In all my experience in that country, I repeat that I never laid up a day between Albuquerque and the Colorado on account of snow, or in fact anywhere on the line, nor have I ever seen snow deep enough on it to impede travel."

There only remains to add the experience of our return parties in the spring of 1868. The spring is evidently the only season in which snow of any consequence occurs. On the 23d of March, on the west slope, they reported that it snowed all the afternoon, but soon disappeared. On the 27th of March, at the Moqui Pass and the summit north of Mt. Agassiz, there was no snow on the ground. On March 29th, near the summit, on the south side, there was a snow storm for two hours; San Francisco Mountain was covered with snow. Early in April there was a little snow to be seen in sheltered places between Antelope and Leroux Parks, near the summit of the range. On the 4th and 5th of April, it snowed at intervals, but little fell. On April 12th, a blinding snow storm occurred in Secretary Valley, and on the Mogoyon Mesa, from six to eight inches

lying on the ground, but the next day the sun came out with a warm breeze, and all traces had disappeared by the 14th.

If there is to be the slightest particle of obstruction, even the most temporary, from snow, anywhere west of the Rio Grande, it will be in this range. Hence, the evidence in regard to it has been carefully collected, and it covers so many winters, and all seasons of the year so thoroughly, that there is no room left for the slightest apprehension on this subject.

In Western Arizona, between the Mogoyon Range and the Colorado, which was reached about the middle of January, 1868, none of our parties saw any snow on the outward march.

Whipple reports a fall several inches in depth in the Aztec Range on the 18th of January, 1854; but says four days afterwards it had disappeared; and after leaving this range, he saw no more indications, except near a few mountain summits. In the Black Forest and Val de Chino "nature had put forth spring flowers and green herbage."

Our return parties encountered, in March, 1868, several snow storms between the Wallapi Valley and Mogoyon Range, usually in the afternoons and at night, the mornings being clear and warm. These storms did not, however, prevent the mules from "picking up" on the march, the grass being fresh and green early in March. The fall never exceeded two inches, and usually melted all away the following morning or same day.

CLIMATE FROM THE COLORADO RIVER TO SAN FRANCISCO.

The Valley of the Colorado, on the thirty-fifth parallel, is very warm during the whole summer; the thermometer rising to 110°, and being rarely under 90° at night. Frost occurs only in December and January, and there have been two winters in the last four at Fort Mojave during which there was no frost at all. Snow and hail are unknown. The trees in 1867 were out in full leaf early in February, and about December 31, 1867, when we passed, their foliage was still green, as were the water-melon, cucumber and tomato vines, and the

cotton was in blossom. The Indians were selling water-melons as we passed the fort. The first frost for this winter, at Fort Mojave, was January 6, 1868.

The Mormons raise sugar and cotton 150 to 200 miles north of this, at their settlements on the Virgin and its tributaries.

The temperature of the Colorado River, on Christmas day, was 58°; of the air, 67°. On the 10th of January, on the higher summits of the Providence Mountain, there was a snow storm, which lasted an afternoon and night, some two or three inches lying on the ground; but it did not extend as low down as Piute Pass, the most elevated point on that part of our line. I met no snow thence to San Francisco, and found the weather generally very mild.

There was no snow on the summit of the Sierra Nevada, in Tehachapa Pass, the 7th of February, when I crossed this snowy range. I learned that there had been as much as six inches of snow there during the winter. There was a beautiful rich prairie, with a fine oak grove and farm houses, (Tehachapa settlement,) at the summit, and the grass and flowers were springing up. Descending westward into the Tulare Valley, the plain was covered, as far as the eye could reach, with beautiful flowers new to us, and we found ourselves in the paradise of a California spring.

On the route to San Francisco, we saw a little snow on the higher crests of the Coast Range, which is said to be extraordinary.

After I had left Tehachapa, Mr. Runk, Division Engineer, reported that two inches of snow fell, in all, on the Sierra Nevada during the month of February, lying but a few hours.

On the route of the *branch to San Diego*, there is scarcely ever any snow. Even on the summit of the Cordilleras, at San Gorgonia Pass, were fine vineyards, and orchards, and live oak trees. On the 31st of January the grass was green, and the climate like May, and in the Los Angelos Valley, two weeks before, our engineers had been luxuriating, after their long march, upon oranges which they gathered from the trees in the open air.

RICULTURAL RESOURCES.

EAST OF THE RIO GRANDE.

The rich valleys and plains of Eastern Kansas are sufficiently well known.

From the end of the track at Sheridan to the Arkansas at Fort Lyon, a distance of 120 miles, the country is adapted to grazing for migrating flocks and herds—probably worthless for any other purpose.

From the Arkansas, by the *Raton Mountain Route* to the Rio Grande, is a good grazing country all the way, the vicinity of the Raton Mountains and the Cimarron Cañons being unsurpassed in the United States. No attention is required for stock in the winter. Even the summit of the Rocky Mountains, where the line crosses it, is covered with good grass.

Throughout this entire country, cattle, sheep, and mules can be raised so abundantly and so cheaply that the road will enjoy an immense business from their transportation, and that of wool and hides. That this is not imaginary is shown by the large Texan cattle trade which the road already has, amounting recently to about 16,000 head per month.

Arable wealth of this section.—Dr. Leconte, Geologist of the Survey, sums up his report by saying: "It is, therefore, apparent that from the Arkansas River to Fort Craig, the agricultural resources of the country are not only ample for the supply of a large population, but that one of the products, *wine*, may be made a source of revenue to the road beyond the demands of local traffic."

Let us see more in detail where and what these resources are. We have—

1st. The valley of the Arkansas, cultivated by irrigation, but exceedingly fertile. It will undoubtedly furnish a large surplus of breadstuffs, fruits, &c., to be carried east, west, north and south. Fifty bushels of excellent wheat are raised to the acre in the valley above Fort Lyon.

2d. The valley of the Purgatory, which the line follows for 50 miles, and which is rich and readily irrigated. Dr. Leconte reports that it yields 80 bushels of Sonora wheat to the acre, and that 60 bushels of oats are not unusual. This valley contains good arable land, capable of irrigation for 100 miles above where the line leaves it, and produces at Trinidad, 100 miles from its mouth, good crops of corn, wheat and oats. There, it is about one mile wide, with bottom land a quarter of a mile in width.

3d. Both slopes of the Raton Mountain. Along the northern foot, from Trinidad eastward to Cimarron Pass, a distance of 50 miles, the country is rich and beautiful, and contains a number of ranches. It is exceedingly healthy, and although the land requires to be irrigated, this is very conveniently and cheaply done in consequence of the abundance of mountain creeks. I counted five of these, with valleys averaging three-quarters of a mile in width, and enclosed between long, low spurs of the Raton Mountains, in riding from Trinidad eastward to Trinchera, 35 miles. In four of these I was informed that the water never fails. In the fifth it does not fail near the source. I saw a few fields of wheat and other crops, and very large herds of cattle and sheep.

4th. From the Raton Mountain to the Pecos River, near Anton Chico, 160 miles, the numerous little valleys watered by the tributaries of the Cimarron, Canadian, and Pecos, which head in the mountains on the west, make the entire country productive and inhabitable.

Irrigation only is necessary, and this is readily accomplished by proper appliances, as for instance, at Kroenig's, near Fort Union, where the waters of the Moro are led into a large artificial lake one-eighth of a mile in diameter, and 20 feet deep, which serves to keep under cultivation 2,500 acres, on which are raised excellent crops of all kinds of grain and vegetables, (except potatoes.) The valley of the Moro is cultivated for 30 miles above Kroenig's, and 13 miles below. Along the foot of this range, (Spanish Range,) is a cordon of small Mexican

settlements, which extend from the Raton Mountain to the Pecos River, whose inhabitants cultivate the fertile valleys o the "Dry Cimarron," the Vermejo, the Ponaro, the Cimarron, the Ocaté, the Moro, the Gallinas, Spring Hollow, the Tecalote, the Pecos, and others, which the line of survey crosses.

Besides Las Vegas, which has a population of 2,300, there are Anton Chico and 18 other towns in the Valley of the Pecos alone, within 20 miles of our crossing, which contain a population ranging from 200 to 1,000 each.

This population, which lives entirely by raising sheep, cattle, horses, mules, and producing corn, wheat, oats, melons and vegetables, is kept in a state of constant alarm and uncertainty by the fears of incursions of the Navajoes and Apaches.

In the Valley of the Pecos, near Anton Chico, grapes, peaches, and other fruits are raised, and the valley is cultivable for 90 miles below to Fort Sumner, and wherever there is bottom land, for 90 miles above Anton Chico.

5th. Between the Pecos River and the Rio Grande, 90 miles—in crossing the eastern range of the Rocky Mountains, there is very little land cultivated, or perhaps cultivable, by reason of the scarcity of water—except in the narrow valleys of the San Dia and Placer Mountains.

I saw some thriving cornfields, however, in the Diegos Cañada, near the summit; and Cañon Blanco may be cultivated throughout by artificial irrigation.

6th. The valley of the Rio Grande, for 200 miles north and south of Albuquerque, has an average width of five miles, and appears to be formed of a highly productive loam, frequently covered by a drift of sand, that does not, however, seem to affect its fertility. Everything grows luxuriantly in this soil by irrigation—for which the water of the river is used cheaply and extensively. Wheat yields over 50 bushels, and corn 80 bushels to the acre, and the finest grapes are grown in the greatest abundance all along the valley, whose climate and soil are, without doubt, as specially adapted to the vine culture as the pasturage of the elevated mountain val eys

and mesas, or table lands, of New Mexico is to the cheap raising of good stock.

Of this valley, Dr. Leconte says: "It presents a belt of land rom three to ten miles in width, which by a well-contrived system of irrigation will produce most abundant crops. For vineyards it is particularly applicable. The grapes, all of which belong to European species, are superior to any of our own hot-house varieties. Fruits of the temperate zone, cereals and ordinary garden vegetables, (except potatoes,) are easily raised in the irrigated parts of the valley. Cotton is also grown to a small extent south of the Rio Puerco."

The valley is studded on both sides of the river with small villages, averaging a few hundred souls each. There are some forty or fifty such towns, from the mouth of the Galisteo southward to Fort Craig, 160 miles.

On the Cimarron Route as far as it is a divergence from the above, the agricultural resources are very limited. From the valley of the Smoky Hill to the Arkansas, 40 miles, the country is poor although it has some good grazing. For the next 100 miles along the Arkansas Valley the soil is very rich, the climate genial, water for irrigation abundant, and everything that is planted grows abundantly. The valley is broad and level with very little alkali visible. South of the Arkansas, on the creeks, there is also said to be some good country. But for 300 miles of this route, between the Arkansas near Fort Dodge and Fort Union, the only resource is grazing, and that is inferior. Thence to the Rio Grande the route is common to that by the Raton Mountain, above described.

On the *Puntia Pass Route*, we have—

1*st.* The fertile valley of the Arkansas, averaging from Lyon to Cañon City, (130 miles,) a width of two or three miles, with a great abundance of sweet water, and the mildest climate of any portion of Colorado. This, with the intersecting valleys on both sides, the Purgatory, the Apishpa, Huerfano, Cuchara, St. Charles and Greenhorn on the south, and the Fountain,

Turkey and Eight Mile Creek on the north, comprise a very large extent of rich arable land, the garden of Colorado.

2*d*. Above the Big Cañon are numerous smaller valleys and parks along the river, which, except when cut off by cañons, continue to the forks of the Arkansas, 50 miles above Cañon City; and for 40 miles above the forks, are cultivated by the miners. These are only inferior to the valley below the Big Cañon, by reason of somewhat greater altitude. South of these is the "Wet Mountain Park," 60 miles long by 30 wide.

3*d*. Crossing the range at Puntia Pass we enter the well watered San Luis Park, 5 to 40 miles in width, which the line traverses for over 100 miles, and which produces all the smaller grains, besides having superior value for pasturage, excelling the best grazing lands of Texas.

4*th*. South of the San Luis Park, are numerous branch valleys, the Taos, the Embuda, Cañada Tesique, the Chama, Ojo Caliente and others, which join the Rio Grande, and furnish in connection with the valley land immediately along that stream, between its cañons, a considerable sum total of arable district, filled with the small towns and settlements of unenterprising Mexicans and Pueblo Indians, but capable of supporting a large population of Anglo Saxons.

Below the Santa Fé Cañon to Albuquerque, the Rio Grande has a broad fertile valley, such as has been heretofore described, occupied by cornfields, vineyards and orchards.

5*th*. West of the upper Rio Grande and the San Luis Park, there is a tempting field, which will be eventually penetrated from this line, the somewhat famous San Juan country and other districts, across to which the Cochetopa, Chama and other Passes lead.

AGRICULTURAL RESOURCES BETWEEN THE RIO GRANDE AND THE GREAT COLORADO, 580 MILES.

Of this section, on the route of the 35th parallel, Dr. Parry, Naturalist to the Survey, says: "Sufficient is now known to characterize it as at least self-sustaining in an agricultural point

of view, and capable of immense production for export o animal products from the proper development of its pastora resources. A large section of this country is naturally adapte to fruit, of which the various surface exposures may be suite to different varieties."

Whipple's rough estimate of the area of cultivable soi woodland and pasture on this division of the route within 1 miles on each side, was as follows:

Cultivable soil, ...	953	square miles
Woodland, ...	2,193	"
Prairie and pasture, ...	11,008	"
Total, ...	14,154	"

There was not as much known then of the country to the right and left of the line, and I regard his estimate of cultivable soil as entirely too low; and of course a much wider belt than 15 miles would be rendered accessible by the construction of a railroad—perhaps 100 miles on each side.

But let us see what there is:

1st. The table land between the Rio Grande and the Puerco —which is nine miles wide from crest to crest; it is covered with excellent gramma grass, but without water. It makes a good sheep country.

2d. Then ensues the north and south valley of the Puerco, three miles in width, whose soil is very rich and only requires irrigating, which can be done, as there is plenty of water in the channel for eight months of the year. 30 miles above the mouth of El Rito the valley is one mile wide; our parties found it covered with luxuriant grass and the soil very fertile, a portion of which the Mexicans had under cultivation.

Several attempts have been made to cultivate the valley farther south, but the Indians drove off the men. Even stock-raising is unsafe in consequence of these incursions.

3d. Thence we have the valley of the El Rito, which the line follows for 75 miles to the base of the Sierra Madre. It is from one-half to three miles wide—above Fort Wingate much wider—and there are several fertile intersecting valleys.

It is cultivated for 4 miles below the town of El Rito by the Mexicans, and by the Accoma and Laguna Indians for 10 miles above Laguna, and at the foot of San Mateo Mountain, near Cubero, by the Mexicans. The Lagunians brought our party melons. We found an abundance of corn in this valley. The Indians raise 40 bushels to the acre, with very rude cultivation. They also raise large herds of cattle. It might be tilled for its whole length, except in the six mile cañon, if proper measures were taken to economize the water, or to increase the supply by artesian wells.

There is much to discourage farming, however, as in April, while our return party was passing, 14,000 head of sheep, and large numbers of horses and mules were driven away from the country about Cubero by a single band of Indians.

4th. Both slopes of the Sierra Madre are rich, and tolerably well watered. On the west side, north of El Moro, Beale saw a country of "uncommon beauty," with numerous springs and water courses.

Fifty miles west of the summit, we found the Zuñi Indians cultivating the soil extensively without irrigation, and having large crops of corn and wheat, while every house in the town was filled with dried peaches of excellent quality. Dr. Parry says of this Zuñi Valley: "It possesses an inexhaustible fertility, which it still maintains, after the lapse of centuries far beyond the historic period." This is at an elevation of 7,000 feet above the sea. We also saw these Indians driving up their flocks and herds, which were very large.

The slopes of this range I regard as far superior, in every way, to those of the Wahsatch Range, which the Mormons have strewn for several hundred miles with a population amounting to 100,000, converting that so-called desert into plantations and orchards.

5th. In the Valley of Navajo Creek we skirt the southern edge of the "Navajo country," where General Canby's troops found immense herds of stock, and very numerous fields of

corn, and peach orchards, the driving off and destruction of which were the only means by which these intelligent and warlike Indians were finally reduced. Colonel Willis, of the California Column, who accompanied us on the survey, states that he assisted in destroying some of these corn fields as low down as the vicinity of Navajo Springs, and that the corn was as high as his head. Even in the dry country, near Jacob's Well, we saw traces of an ancient irrigating canal.

6th. The Valley of the Little Colorado is next reached, and is followed by the line for from 25 to 60 miles, depending on the route adopted. In this distance it is from one to three miles wide, with a rich alluvial soil and plenty of water for irrigation. We found the grass in the valley excellent. The upper valley of this river, above the cañon at the mouth of the Zuñi, is said, by Colonel Willis, to be very beautiful, 50 miles long, and from 3 to 5 miles wide, and the Sierra Blanca country, in which it heads, is noted for its beauty and fertility, as well as for its attractive deposits of gold, which the Apaches have prevented all explorers from remaining long enough to develop.

The numerous little sheltered cañons leading into this river above and below "Sunset Crossing," where our line leaves it, are especially adapted to fruit culture, also to wheat. There is a vast extent of attractive country in the heavily timbered Mogoyon Mountains, south from this part of the surveyed route.

7th. For the next 100 miles, in crossing the Mogoyon Range, we have the finest country met with, perhaps, on our entire route. It is the famous San Francisco Mountain country, magnificently timbered, well watered, and covered winter and summer with the most nutritious gramma grass. Its soil, black and rich from the decomposition of the lava that has been ejected in immense quantities from the extinct crater of Mt. Agassiz, will produce, without irrigation, wheat, barley, oats and potatoes, in the heaviest crops. The summit and slopes of this range are dotted everywhere with beautiful little grassy parks, openings in the virgin forest of gigantic pines

which cover the mountain. On all sides rise tall volcanic peaks, emulating the central figure of Mt. Agassiz, whose crown, far above the timber line, seemed to be just topped with snow, as late as the middle of December, when we made the transit.

This is the country of which Beale declares: "It is the most beautiful region I ever remember to have seen in any part of the world. A vast forest of gigantic pine, intersected frequently by extensive open glades, sprinkled all over with mountain, meadows, and wide savannahs, filled with the richest grasses, was traversed by our party for many successive days."

And Dr. Parry says: "We have in these elevated districts a climate favoring the growth of trees, a more equable distribution of rain and precipitation of dew throughout the year, especially adapted to the production of nutritious grasses and the cultivation of grain without resorting to expensive processes of irrigation. These desirable climatic features are especially noticeable along the elevated slopes of San Francisco Mountain, where magnificent pine forests are agreeably interspersed with beautiful grassy valleys and parks, numerous springs, and a delightfully invigorating atmosphere."

The most attractive place of summer resort on the line of the road will be here on Mt. Agassiz. It has every attraction; health, scenery, sky, water, elevation, climate, and proximity to the greatest natural curiosity known on this continent—the "Grand Cañon" of the Colorado River, from which it is distant some 40 or 50 miles.

8th. In descending the lower slope of the Mogoyon Range on the west, we enter a drier and more sandy country, pretty well covered with thickets of cedar and piñon, to which the great pine forests give way. The soil, however, is rich, and only requires irrigation, which can be readily secured by damming the numerous cañons with which this district is filled, and thereby preserving the supply of water, of which, as our return party found, there is an infinite quantity in the spring, (as also during the summer rains.)

The grazing is perhaps equally fine on this section as higher up on the slopes of the Mogoyon, in the beautiful region which has just been described.

9th. The Val de Chino, which we now enter, is a splendid meadow, 10 miles in width, lying between the Aztec Range and Black mountains, on the south and west, and the Laja Range, Black Forest and Tonto Buttes on the east and north. It extends southeastward beyond the line of Prescott, and northward by one of its prongs to within 20 miles of the grand cañon of the Colorado. This distance is considerably over 100 miles.

Throughout it is covered with the finest gramma grass, which gives the name to the valley. On the 6th of March last, in returning, Mr. Holbrook reports that his animals were thriving on the green grass in this and other valleys. The soil is rich, and only needs water to enable the breadstuffs of an empire to be raised here. Whipple thought irrigation might no more be necessary here than in the Zuñi Valley, but it is impossible to try the experiment, as the Wallapi Indians infest the country.

The average elevation of this great valley is about 4,500 feet above tide. Tributary to it are various small but rich mountain valleys, on some of which ranches have been started. Such are Pueblo or Walnut Creek, Turkey Creek, Partridge Creek, Round Valley, Williamson's Valley, Granite Creek, &c., most of which, in the rainy season, and when the snows melt, pour down large volumes of water into the valley.

There is very little doubt but that all of the water needed, both to supply the ordinary wants of a population, and to irrigate, if found necessary, may be obtained by artesian wells of no great depth, or by forming basins in the cañons and creeks at the foot of the mountains on either side.

The Val de Chino is the proper head of the Verde River, along which, north and east of Prescott, lies much rich irrigable land, in the open valleys between the numerous impassable cañons of this stream. The "upper valley of the Verde,"

which I visited, is about 45 miles long, and an average of 5 miles in width. The soil is rich, water permanent, (without alkali,) and sufficient for all purposes of irrigation—the elevation being only 3,000 to 3,500 feet above tide. Snow is unknown, and the valley having a deep sandy soil, richer than the Rio Grande, and being, like the latter, formed chiefly of the wash of lava deposits, and being admirably sheltered by mountain walls on each side, 1,200 to 2,400 feet high, is especially adapted to producing wine and fruits.* Wild grapes are everywhere abundant. The few settlers near Camp Verde informed me they had raised 75 bushels of corn to the acre, without irrigation; also, wheat and barley. All vegetables, except potatoes, flourished in the greatest abundance.

The grazing is excellent, water clear and pure and abundant, both in the Verde and in little cañons all along the base of the Tonto Buttes, while the mountains on each side are covered with a large supply of good sized pine timber.

In this valley, even to a greater extent than in the valley of the Little Colorado, on the Mogoyon Range and in the Aztec Mountains, we met constantly the broken pottery, ruined foundations and abandoned caves which indicate the former existence of that populous semi-civilized race, which, for want of a better name, are called "Aztecs."

Below the upper valley, but separated from it by a rugged and tortuous cañon, is the lower valley of the Verde, 25 miles long, and equally rich and filled with Aztec ruins and pottery. These sheltered Verde valleys are, without doubt, well adapted to *cotton.*

There is much good arable country around Prescott also, and at the heads of the Agua Frio and other valleys leading south-

* "A soil derived from the decomposition of lava is known to be especially adapted to the growth of fruits, and the development of wine-producing grapes, the juices of which are largely impregnated with the salts of potash, which, in the process of fermentation, are deposited in the lees constituting the cream of tartar of commerce. It is therefore natural to infer that a large section of country in Central Arizona is especially adapted to this department of agriculture."—Dr. Parry.

ward to the Gila, and numerous ranches have been established here.

10th. Crossing the divide at "Beale's Pass," we find in Aubrey Cove, a similar valley to the Val de Chino, but much dryer, and with poorer grass, although it was green and good, and there was an abundance of water in March as our party returned. We found thrifty peach trees on the Yampa.

Thence by Truxton's Springs to Wallapi Pass, the slopes of the Aztec and Aquarius Ranges, and of the Peacock, Cerbat and Wallapi Mountains contain occasional spots adapted to cultivation. Farther south along the western slope of the Aztec Range, and enclosed between that and the Aquarius Range, along various tributaries of the "Bill Williams," the good land is quite extensive, and sufficiently well watered. Crops of wheat, barley, oats and all vegetables, can be raised here in abundance.

Whipple speaks of the marl bottoms of the Big Sandy Fork as luxuriant with vegetation in January. On the 28th of February, as our party passed, the young grass was springing up fresh and green in Yampa Valley. The Wallapi Valley was then likewise a fine meadow, although it contained but little grass in December.

From Wallapi Pass to the crossing of the Colorado River, (50 miles,) the country is an arid, cactus desert, except for an occasional scanty growth of grass in some cañon or pass where a spring breaks out from the bare, rocky mountains.

11th. The valley of the Great Colorado, into which we now descend, is wide and fertile. Whipple pronounced the soil far superior to that of the Rio Grande. Of course, the climate has much more of a tropical character—the elevation above the sea being less than 400 feet—snow being unknown, and the winter sometimes passing without any frost. Both climate and soil fit it for cotton, tobacco, hemp, castor beans, rice, and even sugar—to which rarer semi-tropical products all the valley land will, perhaps, be devoted—leaving the cereals to be brought

down from the higher valleys of Arizona, or eastward from the slopes of the Sierra Nevada, and the Tulare and San Bernardino Valleys of California.

The Mormons raise a great deal of cotton at their settlements on the Virgin and its tributaries, 150 miles north of Fort Mojave; they have several cotton factories in operation, and are building more. They also raise some sugar.

At present the Mojaves, Chemeuevis, and other populous tribes of Indians that inhabit the valley of the Colorado, raise corn, wheat, beans, melons and squashes; and a large amount of hay is cut for Fort Mojave and the mining operations near Hardyville. Wheat ripens in April; barley harvest takes place in May. There is as yet no artificial irrigation; the valley being inundated annually by the river, which rises 25 feet in summer, from the melting of the snow at its mountain sources.

We found some stalks of fine Sea Island cotton growing here near Hardy's Mine, about 1,000 feet above the river, and melons were brought in by the Indians on Christmas week.

From the head of navigation at Callville, for 60 miles down to Cottonwood Valley, there is no bottom land. In this stretch occur "Black Cañon" and "Painted Cañon." In Cottonwood Valley, which is from 1 to 5 miles in width, there are about 20 square miles of arable land, which the Mormons talk of occupying for cotton plantations. Thence the river flows for 25 miles through "Pyramid," and other lesser cañons, to a point 3 miles above Fort Mojave, where the bottom widens out on both sides of the river, and in some places to 10 miles, and so continues to where our line crosses it 3 miles above the "Needles." This is the "Mojave Valley," and is rich, and contains about 100 square miles, of which over one-half is covered with cottonwood and mesquite trees. Below our crossing occur the "Needles," where the projecting spurs of the Mojave Mountains, that wall in the Colorado on either side, impinge for probably 6 to 8 miles directly on the river. Then comes the Chemeuevis Valley, about 5 miles wide, and

very similar to the Mojave Valley. Below the mouth of Bill Williams Fork there are occasional narrows, with wide and long stretches of bottom land; sometimes, as at La Paz, 30 miles wide. This alternation continues nearly to Fort Yuma.

Whipple estimated the Great Colorado Valley to contain, from Fort Mojave south, 1,660 square miles of arable land, without including the Southern Desert—that part of the Great Basin lying south of the Morongo Range. I do not regard it as an over estimate.

Of the section of the route under consideration, Dr. Parry says: "In point of fact, without taking into consideration the undeveloped mineral wealth locked up in her granite mountains, Central Arizona comprises as large an extent of habitable and productive country as any other section west of the agricultural basin of the Mississippi."

AGRICULTURAL RESOURCES WEST OF COLORADO RIVER.

From the Colorado River to the eastern foot of the Sierra Nevada, 235 miles by the windings of our line, we cross the Great Basin, which here, as on every other route across it, is very much of a desert. Farther north, at Salt Lake, it is three times as wide, but everywhere it is a vast, irregular plain of sand and gravel, more or less mixed with clayey sediment, lying between the Sierra Nevada on the west, and the Wahsatch Range (represented by the Providence Mountains on this Southern route) on the east. In Central Nevada the Great Basin has an average elevation of perhaps 5,000 feet above the sea—here on the 35th parallel it does not probably exceed 1,500 feet. It is filled with irregular and detached granitic and volcanic mountain ranges, of the true alpine appearance, more or less continuous, and rising from 1,000 to 5,000 feet above their bases, around the ends of which sweep long gravelly valleys, called "washes," of uniform, but variable slope. On the higher of these ranges, pignon and cedar timber occurs—sometimes abundantly.

The drainage from the Sierra Nevada on the west, the Wahsatch Range on the east, and of all these included mountains, is into detached basins or "sinks" that vary greatly in size and elevation above the sea.

Great Salt Lake is the largest of these. It is a little over 4,000 feet above the sea. Soda Lake, the sink of the Mojave River, is about 1,000 feet; Morongo sink, about 1,500 feet; Perry Basin, which drains some 2,000 square miles of these desert plains and mountains, 530 feet; Williamson's Lake, 2,388 feet; the sink of the Armagozia River, in Death Valley, north of our route, is supposed to be 275 feet *below* the sea: with the exception of Great Salt Lake, these basins are dry, except in the wet seasons.

When the snow melts on the Sierra Nevada and Wahsatch Mountains, an immense volume of water pours down their slopes, and flows by numerous rivers and channels a greater or less distance out into the Great Basin, but finally sinks. Thus the Mojave River, at the time we crossed the desert, was emptying a rapid torrent into Soda Lake, over 100 miles from the base of the Sierras.

This water and all the other drainage probably finds its way by underground channels into the Gulf of California, of which estuary the Great Basin was apparently at one time the northern continuation. The drainage has perhaps been disturbed by the eruption of the numerous mountain ranges, and the dry climate and sandy soil, the result of the interposition of high mountain ranges between this tract and the moist currents from the sea, have not favored the formation of long and continuous river channels. Agriculturally, this basin will not probably be valuable within our day. Although there are many patches of good soil, requiring nothing but water to make them productive, and although, in the mountain valleys, as for instance, on Piute Creek and elsewhere, we find good grass, and small tracts of rich soil, where the Indians have cultivated wheat and corn; yet as long as so much good land is to be found on both sides of the basin, equally accessible, this forbidding region will

not probably be sought during our generation by any but miners, the richest gold, silver and copper veins being found abundantly in these desert mountains.

There must be excepted from these remarks: 1st, The valley of the Mojave, which has a narrow fringe of rich soil, that can be irrigated from the river, and which produces well, and from its source to a point as far east as Camp Cady, is especially adapted, both from climate and soil, to the culture of cotton and other semi-tropical products. 2d. The foot-slopes of the Sierra Nevada, which can be irrigated from the mountain creeks, and possess a good soil. They are covered with grass, which extends during the wet season for 50 miles out into the desert. We saw there everywhere the well-marked paths of cattle, which had wandered out to graze, from the large herds kept at the base of the mountain.

3d. On the Virgin and its tributaries, and farther north on the slopes of the Wahsatch Range in Utah, a considerable agricultural section exists, where the Mormons are already raising cotton and sugar. This section, and a good part of Utah, will naturally have its outlet to the coast by our line, especially if the San Diego branch be made. In these southern settlements of Utah there are estimated to be 40,000 Mormons.

Dr. Parry supposes the Yucca, or Spanish bayonet, with which this desert is abundantly covered, and which is also found abundantly throughout New Mexico and Arizona, will come into value for the manufacture of ropes, mattresses, &c., for which I believe it is already considerably used in California. The manufacture of mescal and pulka will also probably be carried on in Arizona, where this plant is so abundant.

At the foot of the Sierra Nevada, coming from the Great Basin, we meet farming settlements at "Tehachapa Sinks," and Oak Creek, and on the summit of the range in Tehachapa Pass, where there is a beautiful park with groves of oak. The soil is excellent from base to base. Thence to San Francisco, about 300 miles, our route lies entirely through a productive

country, with splendid pasturage and good soil, whose value is enhanced by the mildness of the climate.

In the Tulare and San Joaquim Valleys, which are 75 miles wide, an immense body of land, half as large as Pennsylvania, will be opened up, together with the timber and mines of the Sierra Nevada. If the line follows the east, the west side will be given communication with the road by steamboats plying on Tulare Lake.

If the more direct route to San Francisco should be adopted, the road will traverse the excellent coast valleys of the Salinas, the Pajaro, San Juan and Santa Clara, where wheat and barley grow almost spontaneously, enabling the *mining State* of California, as we have seen in the past two years, *to command the breadstuff markets of the world.* The very fact that east of the Sierra Nevada lies a great stretch of *mineral desert*, only adds to the value and importance of these rich valleys, to the necessity of having a communication which shall develope the wealth of both districts and to the prospective traffic of this highway when made.

On the *San Diego line* we enter at the San Gorgonia Pass upon the charming valleys of the southern coast of Calfornia, a country of the vine, the olive, the pomegranate and the palm, where winter is only known from the crown of snow on the overlooking peaks of San Bernadino, San Gabriel and San Jacinto. Here, also, we leave behind all our old friends of the desert and the plain, the artemesia, the Spanish bayonet and the cactus, and are ushered through groves of live oak into fertile fields of wheat and barley, well watered meadows, vineyards, and orange orchards.

To sum up this branch of our subject it may be said:

1st. That while the western half of the continent is not an agricultural paradise, yet, certainly on this route, it is far from being a desert as many have ignorantly called it. That it has been shewn to be almost continuously inhabitable, and that

there are frequent and extensive districts of great attraction to the farmer; while to the grazier, except on the California Basin, it presents one vast uninterrupted belt of uniformly superior pasturage, extending from Kansas to the Pacific Ocean, on which horses, mules, cattle and sheep can be raised in countless herds, as cheaply, perhaps, as anywhere in the world.

2d. That the mildness of the climate on this parallel greatly enhances the value both of its arable and pastoral resources, enabling more than one crop to be raised in a season, permitting stock, without care, to fare as well in winter as summer, and adding the vine, cotton, and other semi-tropical fruits or products, to those of our temperate latitudes. On the survey we drove our beef cattle along in the winter season, and always found for them and for the mules of our train abundant nutritious grazing on the highest summits of the line, equally with the deepest valleys.

3d. That although, for nearly the whole of this distance, irrigation is resorted to, yet by more thorough cultivation it is likely that, at many points, this will not be necessary. Besides, irrigation is not necessarily a drawback, since it enables the farmer to a great extent, to be independent of the seasons, serves to enrich his ground by the constant sediment with which the water is charged, and with a properly organized plan is not costly, while the crops are made to yield much more bountifully, as a general thing, than in the Mississippi Valley. The quality of the wheat grown in these elevated valleys and dry atmosphere, is superior, especially for transportation.

4th. That if this country had been continuously rich in an agricultural view, there would not have been as much necessity for a channel of communication, nor as much promise of traffic as under the circumstances existing—the country being one of alternate rich and poor belts, mineral mountains and highly productive valleys.

MINERAL RESOURCES.

Coal has already been separately referred to. It is very abundant, diffused over a considerable extent of the line, and will furnish a heavy traffic for the supply of the timberless districts of the Plain, and the mines and mills in the mountains—the latter trade being in proportion to the extent of the development of the mines of precious ores and those of iron, copper, lead, &c., which we shall now proceed to consider.

EAST OF THE RIO GRANDE.

Raton Mountain Route.

1st. *Iron Ore.*—The deposits are numerous, extending from the Raton Mountains to the Placer and San Dia Mountains, overlooking the Rio Grande. It is found of excellent quality near Las Vegas, where Dr. Leconte and myself traced two viens, one of magnetic oxide, 4 feet thick and very rich, and the other of specular iron ore, also rich, and 6 feet in thickness; at the Placer mines, south of Santa Fé, where are three viens, 6 to 10 feet thick, of rich magnetic iron ore; also, on the Maxwell Grant; in the Apache Hills, north of Fort Union; and in the Raton Mountain.

Many of these deposits being quite near to coal and limestone, their value is greatly enhanced for manufacturing purposes. Such is the case in the Raton Mountain, at the Placer Mountains, and with those reported at Maxwell's. At the Placer Mountains, south of Santa Fé, there is sufficient timber, within a radius of 10 miles from the Tuerto ore, to smelt a half million of tons—even if the coal should not answer.

2*d*. *Gold, silver, copper, lead, gypsum, China clay, salt.*—All these have been developed in great abundance on this route, between the Arkansas and the Rio Grande, in the Rocky Mountains and their foot hills. The localities may be briefly named:

Placier and quartz gold at the Moreno mines, 18 miles from Maxwell's—where about 2,000 miners are at work.

Also, at the Placer Mountains, south of Sante Fé, which have been worked a long time, and are very rich. Here the New Mexican Mining Company have 40 stamps at work, and expect to take out $200,000 of gold the coming year. The number of productive veins in this Placer Mountain district is extraordinary—20 having been shafted upon in the San Lazaro Mountain alone. These mines alone will furnish a heavy traffic to a railroad, and attract a large population, but they comprise only one of the numerous similar localities in New Mexico.

Gold bearing quartz is also found in the San Dia Mountain, where Captain Colton visited two veins near Tejon. And gold dust is reported in nearly all the arroyos near this mountain.

At the base of all the Placer Mountains the drift is impregnated with gold, and it is proposed to lead water from the Pecos River, 68 miles distant, by a ditch, at an estimate cost of $250,000, for the purpose of washing it.

Gold is found in the range east of the Rio Grande, in New Mexico, to a large extent—for 100 miles south of Santa Fe, and northward for 120 miles to Sangre de Christo.

Silver and Lead.—The San Dia Range, 18 to 25 miles from the Rio Grande, which it adjoins on the east, is the great repository of argentiferous galena in New Mexico, and its mines have been extensively worked in former times by the Spaniards—using the Pueblo Indians as slaves.

Captain Colton and Dr. Bell visited a number of mines in this district, and report them apparently rich, as also the veins of argentiferous galena in the Placer Mountains. Both are described in detail in Captain Colton's report. The San Dia Mountains are the great "Organ Range" of New Mexico, which extend from the Galisteo southward for over 200 miles, and in which are found throughout lodes of silver and copper, many of which were worked by the old Spaniards before the

Pueblo Indians rose and drove them out, filling up these mines.

Silver lead is also found in the Moreno mining district on Maxwell's grant, and in Turkey Mountain, north of Fort Union, but has not been developed as yet in either locality.

Copper.—The beds of auriferous copper ore on this route, which are very numerous and rich, will probably be found to furnish the most profitable business of all to a railroad. Many of these ores in the Placer Mountain district will bear a freight charge of $50 dollars per ton, and yield a handsome profit to the miner and smelter. This would pay 6 cents per ton per mile to Kansas City. For some time, until labor becomes cheaper and capital more abundant, it is probable that a large amount of these, as well as of the silver ores, will be transported to the Missouri or Mississippi—there to be smelted—especially as the road can afford for several years, while the process of building up this country is going rapidly on, to carry ores as return freight, at a very low charge. They must eventually all be reduced here where coal abounds.

These copper ores are found on the Maxwell district; in Turkey Mountain, north of Fort Union; and on the San Dia Mountains, adjoining the Rio Grande; along the whole extent of the Organ Range; and in abundance in the Placer Mountains, south of Sante Fé, where we visited several good veins, one of which was over 20 feet thick at the Ramirez mine, and reported to contain from 15 to 26 per cent. of copper, and also to be rich in gold.

On the San Ysedro Mountain, in this district, there are numerous lodes of copper, as well as silver and gold, which were worked many years ago—before the memory of the oldest inhabitant. The ruins of numerous furnaces and arastas are to be seen.

On a rich vein, recently opened in Tijeras Cañon, on the San Dia Mountain, one mile from the town of Tijeras, and close to our surveyed line, (east of the Rio Grande, the shaft has been sunk about 200 feet—the vein being 3 feet

thick, and improving as the mine deepens. A large quantity of good ore had been taken out, as our return party passed the locality in June last, and a smelting furnace was erected close by.

We saw good veins of very pure China clay in the Placer Mountains; and gypsum, which the Mexicans use as plaster, for window lights, &c., is very abundant along the route from the Purgatory Valley to and into the San Dia Mountains, where, at the towns of Tejon and Uni de Gata, quite a business is carried on by the people, who make plaster and sell it at Santa Fé and along the Rio Grande, for $1 per bushel. It may be expected to furnish a considerable local business. Near Tejon, Captain Colton rode over an extensive bed of gypsum, crystalline and opaque, which was three miles long, 300 yards wide, and 10 feet deep, and on Tecaloté Creek it was equally abundant.

Salt.—On the great plateau of the Rocky Mountains, southwest of Cañon Blanco summit, are the Salinas, which furnish an unlimited quantity of good salt. A large part of New Mexico is supplied herefrom, it being wagoned to Sante Fé, Las Vegas, to the towns along the Rio Grande, and even to Chihuahua. The only cost is that of transportation.

A bed of alum, three to four feet thick, is also reported in the cañon of the Purgatory, eight miles above Red Rock.

ON THE CIMARRON ROUTE,

as far as it is a divergence from the above, there is no mineral wealth, unless we except the large vein of coal reported to exist on Rabbit Ear Creek.

The chief value of this line is, of course, as affording a direct and cheap avenue for transportation of "through business" and local traffic originating south and west of Fort Union; but it is proper to state that the distance which it saves, if put into branches, would tap and develope a considerable proportion of the mineral, arable and timber wealth of the Raton Mountain line.

PUNTIA PASS ROUTE.

On the "Puntia Pass" route the mineral resources are greatest of all. We have:

1st. Approaching the base of the Rocky Mountains, at Cañon City, deposits of magnetic ore, in connection with fine coal, and an unlimited amount of water-power.

Petroleum is also found in the Arkansas Valley, about three miles northeast of Cañon City, where the wells are worked to supply the local demand.

One of the richest, if not the richest, gold quartz regions of Colorado lies along the Upper Arkansas, and is tapped by this route; and at the head of this valley an excellent pass has been discovered, by which, with grades of only 75 feet per mile, and a tunnel of one half a mile, the *Rocky Mountains can be crossed at a single summit*, and whatever mineral and other wealth there may be on Grand River and in western Colorado, may be advantageously reached.

The mineral and other resources of the South Park are also best opened up by this line, with the remarkable salt deposits near the head of Trout Creek, and others 20 miles above the forks of the Arkansas.

There is coal and gold in the Puntia Pass, also rich copper ore.

In the volcanic elevations of San Luis Park are said to be deposits of good iron ore.

East of the San Luis Park and Rio Grande Valley, in the range of the Rocky Mountains, which we have called the "Spanish Range," occurs a large portion of the mineral wealth, already described in connection with the Raton Mountain route. And these deposits (as well as the timber) are nearly as accessible to the line on the Rio Grande as to that on the Plains east of this range—but the coal does not appear on the west side.

Placer mining is carried on at Sangre de Christo.

The Moreno mines are but 35 miles eastward of the line of exploration. And even the rich Placer Mountain and San Dia districts are almost as near this line as the other.

Finally, there is approached by this line, the tempting region of the Sierra Madre, west of the San Luis Park and Rio Grande, to which the Cochetopa, Conejos, Chama, and other passes lead—the San Juan district and others, as yet undeveloped, but in which enough prospecting has been done to prove the existence of great mineral wealth, the natural and best outlet of which, will be eastward into the Valley of the Rio Grande.

Accessible to the Rio Grande, *south of Albuquerque*, lying in the mountain ranges which bound this valley on either side for nearly its entire length, are extensive deposits of mineral wealth, waiting for the capital, skill and labor to develope them. This development, but just started, will begin in earnest as soon as the road reaches Albuquerque, but will be greatly accelerated by the construction of the proposed branch down this valley to El Paso and on to Chihuahua. These may be briefly itemized as follows:

1st. In the range east of the Rio Grande, known in different parts of its course as the Manzano, Jicarilla and Organ Mountains, but called generally in connection with the San Dia Mountain, the "Organ Range," are found veins of silver and copper (many of which were formerly worked by the Spaniards) almost wherever it has been explored. This range lies from 18 to 25 miles from the river.

2d. On the same side of the Rio Grande, north of Fort Craig, occur the excellent coal of Don Pedro, and veins of copper, galena, and iron ore.

3d. On the east side of the river is a range formed of spurs from the Sierra Madre, which are called at different points the Miembres, Madelaine, Ladrones, San Mateo, and (north of Albuquerque) the Jemez and Ablque Mountains. In this range, whose north and south extent is over 250 miles, rich lodes of copper are numerous. It is found at certain localities almost in its pure state, and at others combined with gold and silver. There are two copper mines at Jemez—one large, of virgin ore, and heretofore extensively worked. There is a

large mine in the Madelaine Mountains, west of Socorro, of copper, with a large per centage of silver—new developments of which, made within the last few months, are exceedingly promising. There are two mines of auriferous copper at Pinos Altos, which are extensively worked.

MINERAL RESOURCES BETWEEN THE RIO GRANDE AND THE COLORADO.

On or accessible to our surveyed route of the 35th parallel, we have,

1. The deposits of coal in the valleys of the Puerco, the El Rito, the Jemez, and north of the San Mateo Mountain, which have been already referred to.

2. A fine *marble* quarry, close to our San Felipe line, on the Rio Salada, a branch of the Jemez, about 25 miles west of the Rio Grande. Mr. Holbrook, assistant engineer, reports the quality equal to that of the celebrated Rutland quarries, and that the deposit is very large and accessible. Large quantities of gypsum were seen near this point, and also on the Jemez, south of the junction of the Salada, where our party saw more marble.

3. Near Jemez, about 30 miles west of the Rio Grande, Dr. Steck has recently found *serpentine* of great beauty, easily quarried, in any sized blocks.

4. Very extensive beds of gypsum immediately adjoin our line near El Rito, 40 miles west of Albuquerque. They are reported by the Geologist, Dr. Parry, to be of a very pure quality, lying in regular strata, presenting a continuous bluff 80 to 100 feet thick. They are amorphous and fibrous. The value of this material in its crude form as a fertilizer is well known, and may eventually give rise to an extensive demand for distant transportation. In other respects it will prove valuable in a prepared form, and can be extensively used in different processes of building, &c.

On the eastern slope of the Sierra Madre, near Agua Frio, Dr. Parry says: "The exposed granite shows occasional indi-

cations of quartz veins, traversing it from north to south, and would probably, on diligent search, exhibit gold-bearing lodes." No developments have been made yet, however.

5. On the western slope of the Sierra Madre, 18 miles northwest of El Moro, Beale found in two localities extensive deposits of rich copper ore. Sixteen miles west of El Moro is the coal of Pescado Springs; farther north, and still nearer to our line, is the coal near Navajo Pass and Fort Defiance, and 60 miles further the mineral region of the San Juan.

6. Gypsum is found abundantly in the hillsides which bound the Little Colorado.

South of this lies the Mogoyon Range, in which, near the Sierra Blanca, (50 miles distant,) and elsewhere, is found, by the united testimony of all explorers, a very rich gold district, from which the Apaches have as yet succeeded in excluding the miners. It was here that Aubrey reported meeting Indians with golden bullets. "They are of different sizes, and each Indian has a pouch of them. We saw an Indian load his gun with one large and three small gold bullets to shoot a rabbit. They proposed exchanging them for lead, but I preferred trading other articles."

7. In crossing the Mogoyon Range, at the base of the extinct crater known as Mt. Agassiz, the slopes and basins are covered over a great area with volcanic debris, ashes and scoria; in reference to which, both as occurring here and elsewhere, Dr. Parry says: "An interesting question arises, whether, in certain forms, they may not be utilized as fertilizers, and thus be rendered fit for profitable transportation. It has been generally noticed that where this class of rocks occupy the surface, the natural grass product is most abundant, and of the most nutritious quality. Might it not therefore be profitable to transport the loose scoriaceous material, so abundant on the volcanic slopes, to the lower sandy valleys as a fertilizer?

"Still further, and connected with the same general subject, it is known that the fertilizing character of recent lavas is due mainly to the presence of salts of potash, the supply of which

article for commerce has been heretofore mainly derived from wood ashes by the wasteful process of wood burning, rendering this article continually scarcer and more costly. Could, then, some cheap process be devised for extracting potash from lava and volcanic ashes, an inexhaustible supply might be here obtained."

On the western slope of the Mogoyon Range, our surveying parties found traces of gold in all the cañons on Upper Cedar Creek, and some silver. The Indians have prevented any miners from visiting this region.

8. From the San Francisco Mountains to the Aquarius Range, 75 miles east of the Colorado River, our line lies north of the ascertained and developed mineral wealth which is abundant in that extensive section of Central Arizona, of which Prescott is the mining capital. This is, however, readily reached by a branch of easy grades, 60 miles in length, that can be cheaply built down the Val de Chino, and a fork can be extended therefrom to the Wickenburgh mining region. Both these districts were visited by Dr. Parry, whose report upon them is appended hereto.

9. Near the surveyed line in the three ranges of mountains lying east, and within 75 miles of the Colorado River, the Aquarius, Wallapi, Cerbat, and the Black Mountain Ranges, valuable lodes of gold, silver, lead and copper have been found—silver, however, principally. They are included in the "San Francisco," "Sacramento" and Wauba Yuma" districts, in all of which some mining has been done, but the Indians having recently killed several parties of miners, we found all operations stopped except, at the "Southern Cross" mine of Mr. Hardy, 9 miles east of Fort Mojave, which is rich in silver. Of this section Dr. Parry reports: "All the geological indications point to it as a natural extension of the rich silver lodes of Nevada, in their prolongation southward into Mexico. Recent discoveries to the north, (Belmont and White Pine,) giving results of almost fabulous richness, show that

this entire region only needs the facilities afforded by railroads to develope a vast and permanent mining interest."

South of this line, the geologist of Whipples' party, reports having found veins of iron ore in "Striped Cañon" of Bill Williams Fork; also of the specular variety in the Cerbat Range, and on Walnut Creek in the Aztec Pass.

10. On both sides of the Colorado River, north and south of Fort Mojave, are mines of gold, silver and copper, the value of which is greatly enhanced by their proximity to this stream, which will thus serve as a most valuable feeder to the railroad. Of these, the best known are the copper mines of the Bill Williams, of which Ross Brown says: "There are 50 good mines of rich copper, black and red oxides, siliates and carbonates, all of a character that can be readily smelted by heat alone. The ores average 40 per cent. Many of these ores are also rich in gold, for which mills have been erected."

These mines were visited by Dr. Parry in December, who reports that they were shipping all ores of 40 per cent. and over to San Francisco, by an uncertain and circuitous water channel nearly 2500 miles long, and that the main bulk was thence transported by way of Cape Horn to Swansea, Wales.

Dr. Parry also visited the mining region in western Arizona, south of the Bill Williams, of which he reports: "At several points gold has been successfully worked, yielding in a few instances rich returns from the rudest processes of *dry washing.* Quartz viens crop out in wonderful abundance in several isolated localities, especially noted 10 to 15 miles west of Le Paz. Rich deposits of silver and copper ores are also known to exist, and have been partially worked, but in nearly every instance mining enterprise has been forced to succumb to insurmountable difficulties, and in not a few cases to actual loss of life."

11th. From 10 to 40 miles north of Callville, which is 100 miles above Fort Mojave, on the Colorado, are the famous Salt Mountains, where there is an inexhaustible quantity of pure rock salt very accessible. At one point there is a face of

70 feet, clear as a crystal. For several miles square the formation is reported as being almost exclusively of this crystalline salt. There is a little sloop of 25 tons running from Mojave to Callville, which takes up merchandize, and brings back salt, potatoes, and other produce.

Between Fort Mojave and Callville, near the mouth of Yampa Creek, Aubrey reports finding rich gold placers.

MINERAL RESOURCES BETWEEN THE COLORADO RIVER AND THE PACIFIC OCEAN.

1st. In the outliers of the Piute Range, lying immediately west of the Colorado, and through or close to which our line passes, are several copper and silver mining districts—the Iritayba, Silver Hill, Rock Spring, &c. For the usual reasons, mining is not now carried on in any of them. The steamboat company charges $60 per ton transportation from San Francisco to Fort Mojave. A railroad could carry freight between the same points for $28.

In the Rat-tail Mountain, 40 miles west of the river, adjoining the line, our party found specimens of silver ore, which looked favorable, and traced the lead 50 or 60 feet on the side of the mountain.

2d. Entering the Great Basin, we found that promising mines had been discovered in the Providence Range, but that the Piute Indians had driven off the miners before they could do more than *prospect.*

Twenty-five miles southwest of Perry Basin, Mr. Spears and myself saw a quartz lode containing gold, in the Bullion Range, which looked well.

North of the Mojave River, on the Mormon Road, the "Armagosa mine" was formerly worked by a California Company, and a considerable amount of rich ore taken out; but distance was against it. Various mines of the precious metals are also known in the "Slate Range," north of our line, between the Mojave and Sierra Nevada, and at various other points on the desert. The well-known and rich "Pahranagut"

district of southern Nevada would also have its outlet to our road; and eventually, by a longer branch, the recently discovered "White Pine" mining region—probably the richest depository of silver yet known in the United States. In fact there can scarcely be a doubt but that the silver region of southern Nevada extends at least as far south as the portion of the Great Basin crossed by our line. And, although the hostility of the Piute Indians, lack of water, and remoteness from fuel and supplies, have, as yet, prevented any successful mining, it is certain the mineral wealth is here, and will be developed when these difficulties are overcome by a railroad, cheapening transportation, driving out the Indians, and affording facilities for the construction of reservoirs and the sinking of wells.

It may even be found that this desert, requiring the transportation to its mines of almost everything necessary to existence, from the Sierra Nevada, the western valleys of California, and from the Colorado Valley, paying for the same in its rich subterranean treasures, may prove to be a more valuable contributor to the business of the road than those districts externally most favored by nature.

3d. We have now reached the Sierra Nevada—the great mineral-bearing range of California. At Tehachapa Pass, where we cross it, the mountain abounds in gold, silver and copper. Gold placers are worked here.

On the Tulare side, not far distant, is the Kern River Mining District. From this, northward, as far as the range extends, mining operations are carried on, more or less extensively, on both slopes of the Sierra Nevada. Those on the east side, with the Owens River and Mono Lake Districts, will be tapped by a branch line from the foot of Tehachapa Pass, running along the margin of the desert northward until it meets a similar branch extended southward from the Central Pacific Railroad on the Truckee. The two roads are here about 400 miles apart.

The mines of the western slope will be supplied from the main line on its way to San Francisco—if it follows the Tulare Valley—otherwise by a branch.

4th. Near the summit of the Sierra Nevada, in Tehachapa Pass, is a salt lake, about three miles in length by one mile wide, from which more or less salt is taken annually, of a pearly-white color and excellent quality.

South of Tehachapa Pass, mines of the precious metals are worked, in the Cordillera Range, at the San Francisquito Pass, in the Soledâd Cañon, on Mt. San Gabriel, and in the San Bernardino Mountain, and there is magnetic iron ore in the Soledâd Cañon and tin ore in the Temescal Mountain, south of San Bernardino; all these mines, with the coal at Anaheim and San Diego will be developed by the main line and the San Diego branch.

5th. The only mineral deposits that remain to be mentioned are on the direct route from Tehachapa Pass to San Francisco, as follows: *First:* The supply of bitumen at Buena Vista Lake, in Tulare Valley, of which there seems to be an extraordinary quantity, as it crops out for a distance of 20 miles. There are works erected here for its utilization. It will apparently yield a considerable traffic to a railroad. *Second.* The quicksilver mines of New Idria, at the eastern base of the Coast Range, near our surveyed line, and those of New Almaden, overlooking the Santa Clara Valley, near San Jose, at each of which about 1,000 men are employed.

From the above necessarily hasty repertoire, which follows consecutively along the route, it is clear that the hills and mountains over this extended range contain an amount of mineral wealth of all kinds, the useful as well as the precious, which may be considered practically inexhaustible. Further-

more, that these subterranean treasures are not confined to a few localities far apart, but have a remarkable diffusion along the route. Indeed, from the Arkansas River to the western spurs of the Coast Range, near San Francisco, a distance of 1,500 miles, the mountains, which one is never out of sight of, may almost be said to possess continuous deposits of one kind or another of valuable mineral, which, beginning with the coal and iron of Colorado, end only with the quicksilver of New Almaden.

When it is remembered how little and how carelessly this vast territory, the home of savage Indians, has been explored by white men, and that, even in the small and old-settled district of Cornwall, where mining was carried on before the Christian era, and where the earth has been burrowed for ages at a great depth, new discoveries are still made of tin and copper lodes, we may well wonder at the amount of hidden treasures which the few disclosures above enumerated would indicate.

MANUFACTURING RESOURCES.

Along the route there are numerous points where water power can be used to great advantage for the manufacture of wool, the stamping and reduction of ores, &c.

In the cañons of the Arkansas River, by which this stream breaks through the easterly wall of the Rocky Mountains and obtains an outlet to the great plains, there is an unlimited amount of water power, fully equal to the best in New England, and which will create at these points, especially near Cañon City, very large manufacturing and metal reducing works. The Purgatory and Pecos Rivers also furnish, where they *canon*, admirable positions for water power; and the three cañons of the Rio Grande, between the mouth of the Santa Fé River and the San Luis Park, can scarcely be surpassed for this purpose.

The woolen mill at Kroenig's, near Fort Union, is highly successful.

West of the Rio Grande, as well as east, there are numerous smaller cañons in the Rocky Mountains, the Sierra Madre, the Mogoyon range, the Sierra Nevada and Coast range, where, by the construction of dams, a portion of the immense volumes of water which pour down these mountains in the rainy season, and during the melting of the snow, may be economized and applied to running, on a limited scale, grist and saw mills, stamping machinery, &c. The cañons of the Little Colorado and the Verde, may be used on a much larger scale, while the grand cañon of the Colorado probably presents facilities that are without limit, if they can be made available.

If our line should follow one of the routes suggested, north of Mount Agassiz, it will skirt the falls of the Little Colorado, where this river enters a cañon 100 feet deep and 200 feet wide, affording, it is estimated, from 4,000 to 6,000 horse-

power in low water, and suggesting the site for a considerable manufacturing place. There is the greatest abundance and variety of mountain timber adjacent; the altitude is medium, say 4,500 feet above the ocean; the valley above the falls fertile and extensive; the climate exceedingly healthy, and the position otherwise advantageous as being immediately at the base of the highest range on the route. Here may be the great cabinet shop of the plains.

Manufacturing will also be carried on at various points along or accessible to the line, where *coal* is found abundantly, or in connection with desirable accessories. For instance, on the Arkansas, below the Great Cañon; south of the Raton Mountain, near Maxwell; near Las Vegas, in New Mexico—if the beds of coal should prove to be thick enough; at the eastern base of the Rocky Mountains, near Anton Chico; at numerous localities on the Rio Grande, on the slopes of the Sierra Madre, and most probably on the Great Colorado River. At such points, in addition to coal, we find attractive positions for settlement—good land, abundance of water, timber, and a healthful and genial climate.

Several of these localities appear to offer superior inducements for the manufacture of iron for the many purposes of a mining country, and to supply the wants of the railroad at central points, that will save the burthen of the present lengthy transportation.

ROUTE OF THE THIRTY-SECOND PARALLEL, AND HOW IT COMPARES WITH THE THIRTY-FIFTH.

The surveys upon this route were made by John Runk and Leonard H. Eicholtz, division engineers. Their reports, in connection with those of Capt. W. F. Colton and Dr. Bell, upon the characteristics and resources of the country traversed by the line, and of the adjoining Mexican State of Sonora, have given the Company very full information. The results can only be referred to here in the most general manner.

As far as topography was concerned, an excellent route was found from the valley of the Rio Grande to the western side of the California Cordilleras, in the Los Angelos Valley. There was no grade encountered exceeding 65 feet per mile to the eastern base of the Cordilleras, except in passing through Cook's Mountain at Cook's Spring, in New Mexico, where an 80 feet grade is required for three miles on each side of the summit; in crossing the Santa Catarina Mountains from the San Pedro via *Granite Spring* to Saccaton, (to avoid the detour of 40 miles by the mouth of the San Pedro, and the very heavy work throughout the "12 mile cañon,") where a long grade of at least 75 feet per mile will be required; and in crossing the Maricopa Mountain, at the great bend of the Gila and the spurs of the Sierra Colorado along the lower Gila, where grades of 70 feet per mile are necessary. A 60 feet grade for 12 miles was found necessary in ascending the western slope of the Peloncillo Mountains, and a 65 feet grade for $20\frac{8}{10}$ miles in descending the western slope of the Calitro Mountains to the San Pedro Valley.

The grades in this distance of 850 miles, from Isletta (near Albuquerque) to the foot of San Gorgonia Pass, are uniformly lower than on the 35th parallel. The tables annexed will show the route of exploration* that was followed, and the elevation

* See also page 246.

of ruling points thereupon, with a summary of the grades on this route. The passage of the Cordilleras is made at "San Gorgonia," the best Pass in the whole range, with no grade exeeeding 90 feet and scarcely any work. Indeed, from the point of divergence near Albuquerque through to the Los Angelos Valley, the amount of excavation and embankment required is comparatively light. But here the troubles begin. To reach San Francisco, the coast route being exceedingly difficult, and objectionable in other respects, the Cordilleras have to be recrossed to the eastward, which is done by the San Fernando Pass and the Soledâd Cañon to the Great Basin, and a third time crossed, westward, at Tehachapa Pass, in order to reach the great valley which divides the Sierra Nevada from the Coast Range.

By the necessity of these three passages of the great mountain chain of California to reach San Francisco, the topographical superiority of the route of the 32d parallel is done away with, while it is from 263 to 281 miles longer than the 35th.

It has not heretofore been deemed possible to reach Tehachapa Pass from Fort Yuma without first crossing the range near San Bernardino to the coast slope. During our reconnoissance for a San Diego Branch from the line on the 35th parallel, however, we discovered a good pass, with a grade of 60 feet per mile, in the Morongo Range, about 60 miles west of the Colorado River, by which I believe the desert can be followed from Yuma to Tehachapa. After crossing the Morongo Range at the "Yuma Pass" northward into the Morongo Basin, such a line would continue northwestward across the Mojave River to Tehachapa Pass. Or it is entirely practicable to cross from the Colorado desert northward to the Morongo Basin at the *Morongo Pass*, and thence, I believe, to reach the Mojave River, and, of course, Tehachapa Pass.

The distance from Fort Yuma to the eastern foot of Tehachapa Pass might thus be reduced probably about 50 miles. But the entire route would lie in the great desert, through a timberless, unwatered waste, presenting so few attractions for a

railroad, that even at the expense of the increased distance, it would, in all probability, be preferred to carry it by the Los Angelos Valley.

As a *through line merely* to San Diego, the route of the 32d parallel has decided advantages in gradient, particularly if a detour be made by San Gorgonia Pass, (both Warner's and Jacumba Pass, on the more direct route across the Cordilleras, being very difficult, and requiring long stretches of very heavy grade.) From San Gorgonia Pass the line would follow probably near the coast for 100 miles southward to San Diego. But by this circuitous route, San Diego is made from 108 to 147 miles longer from a common point, Isletta or San Felipe, near Albuquerque, by the 32d parallel, than by the 35th.

Even by the shortest line across the Cordilleras—the Jacum, or Jacumba Pass, near the Mexican boundary—which we have not examined, but which Lieut. Williamson, who did, pronounces "utterly impracticable," the route is no shorter than by the 35th parallel to San Diego, while, of course, this would entirely rule out San Francisco. By Warner's Pass it would be from 40 to 79 miles longer than by the 35th parallel, but the grades would be so much lighter on a great part of the distance by the 32d parallel, that this might be considered the best route from Albuquerque to San Diego *merely*, but for the inferior character of the country, climate and timber supply.

The relative distances by the two routes are shown by the following table:

By 35th Parallel. (on Shortest Proposed Route.)		By 32d Parallel, (on Shortest Proposed Route.)		Saving by 35th Parallel.
	Miles.		Miles.	Miles.
From Kansas City to San Francisco,.....	1897	From Kansas City *via* San Gorgonia Pass, to San Francisco,.....	2160	263
To San Diego,.....	1609	To San Diego, *via* San Gorgonia Pass.....	1717	108
		To San Diego, *via* Warner's Pass,.....	1649	40
		To San Diego, *via* Jacumba Pass, if practicable,.....	1601	— 8

Our surveys show, moreover, that the 32d parallel, beside the fact that it is so poor a route to San Francisco, bein probably 281 miles longer thereto; and at the very best n shorter, and in all probability 108 miles longer to San Diego has relatively the following additional disadvantages.

1st. It runs through a country in which, for nearly 900 mile from Albuquerque to the summit of the Cordilleras, in Californi *timber*, either for construction or fuel, is exceedingly scarc According to the reports of our engineers, a limited quantit of cottonwood can be procured at intervals from the banks the Rio Grande, San Pedro and Gila, and perhaps enoug mesquite in Arizona to tie 20 miles of road altogether. B for most of that distance the supply of cross-ties and oth timber necessary both for original construction and subseque repair and improvement, can only be kept up at great co by transporting it over the railroad itself, upon which such ca riage would constitute a serious and permanent tax.

Between the Rio Grande and the San Pedro, 209 miles, M Runk reports such a complete absence of timber that the would not be sufficient for the working parties during the co struction of the road. The Valley of the San Pedro woul perhaps, furnish enough cottonwood for first temporary co struction, and the mesquite and ironwood on the sides of t adjoining mesa might answer for fuel for a few years. T Gila Valley has a slender growth of cottonwood, only fit f tieing the roadway in a temporary manner. The timber f trestling, bridging, and permanently for tieing being requir to be carried by rail, (or, if found practicable,) floated do from Central Arizona by the Hassayampa and other strea On the desert, from Fort Yuma to the Cordilleras, there no construction timber.

The great dearth of timber upon this route is not only serious drawback as increasing the first cost, and cost of ma tenance of a railway, but chiefly because it *discourages sett ment*, upon which a railroad depends for business.

2d. Again, the amount of arable land, from the Rio Grande to the mountains in California, on this route, is very small, and even along the Gila, where most of it lies, the climate is too hot to suit an Anglo-Saxon population.

3d. To put the Southern States in connection with the Pacific, this route, descending the Rio Grande from Albuquerque, would require the junction (with a line across Texas,) to be made near El Paso, making a longer and more costly separate line, through a part of Texas, topographically and agriculturally inferior, with one more crossing of the Rocky Mountains, (represented here by the Guadaloupe and Huecos Mountains,) at an elevation of 2,000 feet above the Rio Grande, and an additional bridge over the Rio Grande, than if said connection were made on the 35th parallel. In the last event the junction would be on the plains, near Anton Chico, at the eastern base of the Rocky Mountains, *west of which one trunk road* would answer for all sections across the mountains. The last named junction would also avoid the necessity of a great southerly detour to reach San Francisco for that important belt of Southern States represented by the Memphis system of railroads, while even from New Orleans, by a branch northwestward from Shreveport it would give the Gulf States by far the shortest and best communication with San Francisco, and a not much longer one to San Diego.

Rightfully considered, it is to the interest of the Southern States, to as great an extent as the middle and northern, that the 35th parallel should be selected. This is true, whether San Diego or *San Francisco—the New York of the Pacific coast*—be the objective point, but especially if it be desired to reach both termini with the least sacrifice in distance to one to gain the other.

It has been seen that the 35th parallel has the advantage of being comparatively well wooded, there being, from the Rio Grande nearly to the Great Colorado, 580 miles, supplies of pine or spruce, with piñon, cedar, juniper, and cottonwood,

either close to the line or within reach, almost continuously, (besides the forests of pine, cedar and red-wood on the Sierra Nevada and Coast Range, and on spurs of the latter on the route to San Francisco.) These supplies are valuable, not only as furnishing the requirements of the railroad permanently, and at cheap rates, but also because they will meet all the wants of a large population, and furnish an extensive and profitable *traffic* to the road.

From Fort Mojave to the Sierra Nevada, timber is, of course, very scarce, as on the Great Basin, wherever crossed.

It has also been seen that there is a large amount of *arable and* inhabitable country on the 35th parallel, west of Albuquerque—with a genial and remarkably healthy climate, which, while free from any liability to cause winter obstructions to travel, is much better adapted to attract a vigorous American emigration than the almost tropical belt of lower altitude, nearly three degrees southward. As Dr. Parry has shown, the general surface being much more elevated, a larger amount of moisture is precipitated from the condensation of the warm southern currents against the higher slopes, favoring not only the growth of trees, but especially of nutritious grasses and the cultivation of grain, without resorting to irrigation. Here, for instance, we see the Zuñi Indians of New Mexico cultivating all the cereals, and many fruits, for 40 miles out from the base of the Sierra Madre, without irrigation. And at Prescott, Arizona, the register at the military post of Fort Whipple, shows a rainfall of 20 inches in the year, while even this is exceeded in the San Francisco Mountains.

All explorers have dwelt upon these characteristic features of the 35th parallel. Whipple, one of the most careful and conscientious observers, sums up, "among the advantages of this route," "its temperate and salubrious climate; its freedom from heavy snows; the large amount of timber and fuel upon its extremities and interior portions; the convenient distribution of stone for construction; the general plentiful supply of

water; the comparatively great extent of arable valleys along the route, and frequency of spots adapted to settlements."

"It will be perceived that the parallel of 35 degrees is particularly favored by rain. The valley of the Canadian, the Zuñi region, the vicinity of the San Francisco Mountains, and the Aquarius Range, have evidently a large amount of precipitated moisture. The arid deserts, between the Mississippi and the Pacific coast, are here contracted to their narrowest limits; consequently upon this route there are more springs, more streams, and more woodland than *can be found upon lines I have traversed further south.*"

"Fuel is believed to be more abundant upon this route than upon any other known from the Mississippi to the Pacific."

And Beale, who has been a dozen times on various routes across the continent, and is remarkably well acquainted with the great interior plateau, says of the 35th parallel: "It is the shortest, the best timbered, the best grassed, the best watered, * * * * of any line between the two oceans with which I am acquainted." "It is well watered; our greatest distance without water at any time being 20 miles; it is well timbered, and in many places the growth is far beyond that of any part of the world I have ever seen; it is temperate in climate, passing for the most part over an elevated region; it is salubrious; it is well grassed, my command never having made a bad grass camp during the entire distance until near the Colorado; it crosses the great desert (which must be crossed by any road to California) at its narrowest point; it passes through a country abounding in game; it is passable alike in winter and summer." "The country over which we passed was one of the most attractive description. Nature has supplied it most bountifully with the great requisites for an overland road—wood, grass and water. Our work, although arduous, has been rendered pleasant by the beautiful character of country through which we have passed, and the salubrious nature of the climate. I rely upon the concurrent testimony

of all who have traveled the road, and compared it with other trans-continental routes, who agree with me that it is habitable throughout."*

In a word, all those features which we recognize as making a country attractive to a population, exist to a much greater extent on this route, between the Rio Grande and the Sierras, than on the 32d parallel, and there is no comparison between them in this respect west of the Great Basin; from the eastern foot of the Sierra Nevada to San Francisco, 335 miles, the Tulare and Coast Valleys will support a dense population, and furnish a large surplus of agricultural products to supply the barren mining districts of the desert.

In regard to *mineral wealth*, there is as much already developed east of the Colorado, along one route as the other; and the great bulk of the precious ores yet discovered, lying between the two routes, is at least as accessible either by wagon road or cheap railroad branches, with easy gradients, from the 35th parallel as from the 32d. But *west* of the Colorado River the advantage is overwhelmingly in favor of the 35th, because of the extension southward through this part of the Great Basin, of the mineral bearing ranges of Nevada, and because of the gold placers, and leads of the Sierra Nevada, and the quicksilver mines of the Coast Range. I believe every other source of local traffic exists also to a greater extent on the route of the 35th parallel.

Several claims of another character are made, however, on behalf of the 32d parallel—

1st. That it affords a better opportunity for a branch to Guaymas.

* See Dr. Parry's report on this subject, page 229.

This is true; but Guaymas is not a large enough harbor—possessing an area of only one-half square mile of water over four fathoms in depth, and is, besides, at too great a distance from the real Pacific Coast, (1,500 miles around to San Francisco, and nearly 1,000 to San Diego,) to permit it to be an entrêpot for a great *through trade;* while, for local purposes, a line from the neighborhood of the San Pedro or Tucson, (apparently the only way of reaching Guaymas from the north, because of formidable mountains,) would pass through the worst instead of the best part of Sonora; one in fact in which there is very little to develop.

If a railroad be required to open up Sonora—a province almost entirely cut off from the remaining States of Mexico by the high range and spurs of the Sierra Madre—the best way, is to build it from Guaymas inland through the rich districts of southern and eastern Sonora. It is true, such a line, by reason of mountains, might not be able to penetrate to the United States; but there would probably be nothing lost by delay in constructing a long line of road through an unproductive part of Sonora, the only effect of which would be to take a certain amount of trade a short instead of a long distance over the road, away from our own country and harbors to a port now foreign, and even if otherwise, not valuable enough for great results.

The idea of the superiority of Guaymas, in respect of distance, is greatly exaggerated. The reconnoissance—made for this Company by Dr. W. A. Bell—showed that the length of a branch from a point near the San Pedro, Arizona, (east of which no good route was presented,) on Runk's surveyed line of the 32d parallel, by the most practicable route to Guaymas, via Tubac, Calabasas, Los Nogdales, Imuris, La Magdalena and Hermosilla, would be 335 miles, making the distance from New York to Guaymas 2,812 miles, against 2,935 from New York to San Diego by the route of the 35th parallel, a difference of but 123 miles in favor of Guaymas.

The following table will give the distances in detail by shortest routes:

By 32d parallel to Guaymas—

	Miles.
New York to Kansas City,.....	1,318
Kansas City to Rio Grande, (between Albuquerque and Isletta,).....	799
To Fort Craig,.....	102
Railroad Pass,.....	204
San Pedro Crossing,.....	46
Tubac,.....	58
Calabasas,.....	13
Los Nagdales,.....	8
Imuris,.....	49
La Magdalena,.....	11
Hermosilla,.....	110
Guaymas,.....	86
	——2,804

By 35th parallel from New York to San Diego,* 2,927.

2d. In the case of Chihuahua the circumstances are different. This city is the Capital and entrêpot of the rich Northern States of Mexico—Durango, Chihuahua, &c.,—cut off by the mountain chain from the sea coast, but *most easily reached from New Mexico* by a railroad line of easy gradients and cheap cost. The natural market and outlet of this section is the Mississippi Valley, as it actually was in former times—(by wagon trains from St. Louis.) It is not shut off by high ranges, over which the only communication is by pack-mule, from the rest of the Mexican Republic, as is the case with Sonora. The branch referred to can be extended whenever the trade will warrant it, so as to penetrate and open up the larger part of Mexico, producing many desirable commercial and political results, and this in a far greater degree than if the main line had been deflected to run for nearly 700 miles close to and parallel with the frontier of two isolated Mexican States, whose productions naturally tend to their own coasts, on which they have good local harbors. But this Chihuahua connection is readily made from the 35th parallel, the branch down the

* See table on page 53.

Rio Grande from near Albuquerque being only 175 miles longer than from the 32d route, for the same branch, without requiring a sacrifice of 260 to 280 miles of distance on the main line to San Francisco, and of the other important features that have been mentioned, to effect it.

3d. It is claimed that Fort Yuma is the natural and actual distributing point for all Arizona and contiguous parts of Utah, Nevada and New Mexico. If this be true, there is not as much use or inducement for a railroad to cross the Colorado at that point as farther north, where the water navigation is not as good. But it is not true, since the military posts at Tucson and elsewhere in southern Arizona are partially supplied from Guaymas or Libertad, and those of middle and northern Arizona from Fort Mojave and Le Paz.

The truth is: 1st. That from Fort Yuma around the California Peninsula to San Francisco is nearly 2,000 miles, or farther than from the Missouri River, overland, to San Francisco, and freights are higher by that long route than they would be by a railroad even from San Francisco to Yuma, 727 miles. And 2d. While the Colorado is navigable even for 100 miles above where the route of the 35th parallel crosses, I do not think it will prove a valuable and extensive outlet to tide-water for Arizona, Utah and Nevada. It is shallow and irregular, and enters the Grand Cañon which has been recently proven to be impracticable before arriving within striking distance of Utah or Nevada. The mineral and other resources of the southern and central parts of the *Great Basin* can be much more readily and cheaply tapped by means of branch lines from the route of the 35th parallel in California and Arizona, whence direct transportation can be had to the coast at San Diego or San Francisco than by any practicable improvements of this long water route.

The river will, however, prove valuable as a local feeder, conveying mineral and agricultural products from hundreds of points along its shores to the railroad, and supplies of all kinds in return to the mines and plantations. For cheap development

of the country, both in Arizona and in southern and central Nevada and Utah, and the basin in California, it is evidently better that the road should cross the Colorado on a line as central as possible to these resources, which would take it as far north as the "Bill Williams" or Fort Mojave. Thus, the mines and cultivable lands of the Great Basin, which cannot be reached by water because of the Colorado cañons, are approached and benefited, while those of Arizona and southern California, between the 32d and 35th parallels, are attainable by river, which will convey their products cheaply to the railroad, or in some cases to the sea.

4th. It is claimed that there is an excellent bridging point at Fort Yuma. Both having been examined by our engineers, it is found that this crossing, taking everything into consideration, is no better than that near the Needles, where our surveyed line of the 35th parallel crosses the Colorado.

5th. It has been claimed further, that this route "affords decided advantages for the delivery of railroad material at several points on the line, thus expediting and cheapening the work of construction, and, while through business is going on, enables the road to consult all interests in its location through the State to San Francisco." The points referred to are, San Diego and Fort Yuma. Iron rails and other supplies are delivered at San Francisco much more cheaply than at San Diego, because of the certainty of return freight, while it is not likely they would cost at Fort Mojave, on the 35th parallel, more than $10 or $15 above the cost at Fort Yuma, 280 miles lower on the same river.

It is highly improbable that a Pacific Railroad would be built to San Francisco by way of San Diego.

6th. It is also urged that, "were a road built on the 35th parallel, a route on the 32d would be only a question of time and means—(the interests demanding it already exist)—whereas, if the latter route be adopted, its grandeur and success will defy competition."

As far as this is concerned the interests demanding a route

n the 35th parallel really exists to a greater extent than for he 32d, and were the trunk line now to be built on the atter, a line from Memphis, by the valley of the Canadian, crossing at Albuquerque, and continuing westward by the 35th parallel to San Francisco and to San Diego, is not only a question of time and of means, but it would have such advantages in distance, profitable local trade, &c., that the other would, I think, be unable to compete for the transportation of through traffic—even from the Southern States. It most certainly would not be able to compete to San Francisco. If the route of the 35th parallel be now adopted, the construction of a road down the Rio Grande and along the 32d, will be a gradual process to more fully open up and supply the mineral districts of southern Arizona, the rapidity of which will depend on the character of these developments; and, finally, it will reach the Pacific when the through trade demands an additional southern route.

Lastly, it has been urged that the line should go to San Diego, and leave San Francisco out. There is no question as to the value of the harbor of San Diego. It is admirably sheltered; will admit vessels drawing 22½ feet of water; has two square miles of water over four fathoms in depth, and is, next to San Francisco, the best harbor on the California coast. *It is four times as large as Guaymas.* By turning San Diego River, the sand of which is encroaching upon the excellent entrance of the harbor, into "False Bay," which can be done at no very great cost, a permanently valuable harbor may be insured. There is also a favorable site, with ample space at the "New Town"—the hills rising gradually for an indefinite distance to the eastward—to build a large city. The country back of San Diego is capable of furnishing an ample supply of fruits and vegetables, and meat of all kinds, while the cereals can come in by railroad from the San Bernardino Valley, and the valleys south of that. Water, adequate to the wants of a very large population, can readily be obtained by bringing in the San Diego River, from a point 10 or 12 miles

above its mouth, where it is sweet and permanent; and the exceedingly healthy and equable character of the climate, the temperature never falling below 40° or rising above 82°, as shown by the register kept at the military post for a number of years, adds an additional attraction.

The fact that this harbor is almost 300 miles nearer by railroad, to New York, than San Francisco is, either by the 35th parallel or by Omaha, is so important, especially in its bearing upon the question of the oriental trade, that if the Gila route were the only one by which San Diego could be advantageously reached—one might hestitate before giving preference to the 35th parallel. It has been shown, however, that the latter affords a good route to San Diego, 106 miles shorter than by the 32d parallel, and requiring the construction of a branch of but 211 miles in length, from a point west of the Colorado River, by the Morongo Basin and Pass and the San Gorgonia Pass, skirting the rich valley of San Bernardino, and thence extending to San Diego.

This branch could be built in 18 months, whenever the interest demanding it should *prove* sufficiently important to warrant its construction by private capital, a result that might occur even before the completion of the main line, and it is not impossible that its shortness and cheapness of transportation to the Pacific may eventually cause it to become the main line. But at present this is all mere speculation. San Francisco is already the New York of the Pacific coast, with such a headway, that, as far as we can see, within our life-time trade and travel will tend to its wharves as naturally as they do to its great exemplar on the Atlantic, while it should be remembered that even if the general route of the 32d parallel were selected, a branch of at least 100 miles in length, from San Gorgonia Pass, would still be necessary to reach San Diego, unless (the idea of building to San Francisco being abandoned entirely) the difficult passes of Warner's or Jacumba should prove practicable. The only difference in this respect, therefore, is, that a branch 111 *miles longer* would be required

from the main line of the 35th parallel to reach San Diego, than from the 32d.

Evidently what is wanted is, as far as it can be done, to get the best line for through traffic without sacrificing the local; to enjoy the advantages of a mild climate without the infliction of intense heat; to consult economy of first construction without impairing the future usefulness of the line; to have favorable gradients and curves, so that tonnage may be transported cheaply without overlooking the distance that it will be neces- to carry it; the important elements of fuel and timber, and the vital question of whether there will be as much freight and as many people to carry on one route as the other; to accommodate the interests of the Gulf States, without losing sight of those of the middle or central South; to be near to the Mexican border without sacrificing thereto any of those more important considerations for which this railroad is wanted; and finally, if possible, in the matter of terminus, to gain present certainties without giving up the possibilities of the future; in other words, to reach both San Francisco and San Diego.

The route which approaches nearest to this standard I believe to be that by the 35th parallel.*

* See, also, Report on this subject by Dr. Parry, Naturalist to the Survey, who has been over both routes. Page 196.

SOURCES OF TRAFFIC.

What business will the road have when built?

This is one of the most interesting questions in reference to existing or proposed lines across the Continent. It is admitted generally that they are of great economy to the Government in the transportation of troops and mails, and in doing away, to a great extent, with the necessity for any military transportation; that they virtually solve the Indian problem; that they assume great national importance by binding more closely together widely separated portions of the country, protecting our borders and Pacific States and Territories from foreign aggression, and peacefully working out our "destiny" in reference to the rest of the Continent without filibustering. But many people have doubts in regard to the extent of the *commercial* traffic, and think the Government may have to maintain the lines for the sake of these important national advantages.

A glance at the chapters of this report, which describe, in general terms, some of the mineral, arable, pastoral, timber and manufacturing resources of the country immediately along this surveyed route and accessible thereto, will convince those who have seen the marvelous growth of once wild and inaccessible regions of country east of the Missouri River, that the traffic of a railroad traversing the territory surveyed by this Company between Kansas and the Pacific Ocean must undoubtedly be large at first, and increase with wonderful rapidity.

Indeed, it may happen that the western half of this Continent, differing in so many respects from the eastern, and as yet barely touched and scarcely known, will, nevertheless, within the period of a single generation in this busy age, exhibit a *rapidity of growth* exceeding anything heretofore seen, even in the United States.

California affords an index. Had it remained a Mexican colony, it would doubtless have been to-day like Chihuahua or Sonora, which there is every reason to believe surpass it greatly in resources of mineral wealth, and are not far behind it agriculturally. But, thrown open to the energy and industrial improvements of Americans, it has, in 20 years, become a rich, powerful and populous State. No one in the early history of California would have conceived that it would become famous for the possession of anything but mines of the precious metals, yet now it exports breadstuffs to New York, and its production of mineral is inferior to that of its agricultural wealth. I believe that results equally surprising may be had in New Mexico, Colorado and Arizona, if the Indians be controlled, and cheap and ready access furnished.

The building up of 1500 miles of country, which, within 3½ years on this route, may be penetrated by a railroad, and made known and accessible, cannot fail to afford a heavy immediate traffic to the road. The experience of the Company on the finished part of the line in Kansas, where, during the last year, the business amounted to nearly $5,000 per mile, per annum, most of the country being perfectly new, is a sufficient demonstration of this fact. But this is in a purely agricultural district. In a mixed agricultural and mineral region the results would be much greater; a mining population has more wants, is more migratory, more luxurious, besides requiring more appurtenances for carrying on its business. All this requires more transportation per capita, and more in proportion to the amount of wealth produced.

The character of the country from the Missouri River to the Pacific Ocean on this route is especially favorable to a large railroad traffic for the above, but also for another reason. *There is a much greater inequality and variety in the distribution of the different elements of industry and wealth, than there is in the Eastern half of the continent.*

There are vast stretches of unwooded prairie, and there are

mountains at intervals covered with dense forests of timber there are rich mines in rocky ranges, and elsewhere extensive fertile valleys and numerous rich but scattered basins and cañadas. There are deep valleys adapted especially to corn melons and vineyards; and elevated parks where wheat, barley and the other small grains thrive abundantly. There are so-called deserts, like Southern Nevada, filled with rich mineral mountains, but otherwise valueless; and slopes and valleys like those of California, which can raise all the breadstuffs needed, besides semi-tropical fruits; extended rolling plains covered with the most nutritious grasses, where horses, cattle and sheep may be raised wonderfully cheap and in wonderful abundance; and cañons whose water-power is available to reduce the ores to metal and convert the wool into clothing. Perhaps the largest portion of the country is badly off for fuel; but, at points, there are beds of very pure coal, practically inexhaustible, and, at many more, large pineries and stretches of cedar forest. There are some sections, especially in the Great Basin, west of the Colorado River, that are very badly watered, but, until this is remedied by improved artificial means, suggested by experience, the ores of those mountains will be carried to water.

Now these are precisely the conditions which are most favorable to the business of transportation. A railroad thrives in the proportion that one portion of its line lacks that which another has a great facility for supplying. As has been stated, if the whole line from the Missouri to the Pacific had traversed a good agricultural country, there would evidently be neither the same necessity for a railroad, nor the same promise of traffic, as under existing circumstances.

In this connection, it is a noticeable feature that on this route the line penetrates one latitude from another, and along the 35th parallel itself the differences in elevation between the valleys and mountain plateaus, and of climate between the Pacific and Atlantic slopes, produce all the effect of a

variation in latitude, which, by favoring the growth of variable products, promotes still further this exchange, upon which railroads live. Thus, we pass from the middle state productions of Kansas to the country of the vine and of semi-tropical fruits, from the bracing summits of the Rocky Mountains, Sierra Nevada and Mount Agassiz, to where winter is rarely known, in the Valley of the Rio Grande, and never in the Valley of the Colorado, to cotton and sugar in the latter, and oranges and pomegranates on the western foot-hills of the Sierra Nevada. It may be repeated that the value of the grazing, and of general agriculture is greatly enhanced by the *mildness of the climate.* The grass is nearly as good in winter as in summer, and the animals of our surveying party were taken through and returned over the most elevated and mountainous part of the route from October till May, finding everywhere an abundance of the best grazing.

But this remote country has been carelessly charged with being a desert, and unfit for extensive settlement. It has been said that the western tide of emigration in the United States must stop somewhere in the vicinity of the 100th meridian, and make one leap across to the coast of California. This was natural when the country was so little known. The question of its future capabilities, as deduced from a scientific view of its characteristics, is so ably treated by the geologist of the expedition, Dr. Parry, in his report attached hereto,* that it is scarcely necessary to add anything thereto. It may be pointed out, however, that it so happens that nearly all the tribes of Indians on this route, the Navajoes, Zunians, Moquis, Mojaves, and even the Piutes and Apaches, to a greater or less extent, *cultivate the soil.* The Zuni Indians had plenty of corn and dried fruits to sell us as we passed their town.

The country has looked with wonder on what has been

* See page 196.

done by the Mormons in Salt Lake Basin on the slopes of the Wahsatch Range. But the slopes of the Sierra Madre will, when this line crosses it, build up numerous larger settlements than those of Utah, within five years after the completion of the road; and the parks of Mt. Agassiz, to which the Mormons are already talking of emigrating from Southern Utah, will, independently of any mining interest, attract and support a very large agricultural and mining population. We have, indeed, on this route, a continuous extent of comparatively elevated country, which affords the moisture that makes the country inhabitable and attractive, and gives timber growth, and when the line descends it is into great valleys with large streams like the Rio Grande, the Great Colorado, Little Colorado and Tulare Valleys.

It should also be remembered, in connection with this question, that on a portion of this route, and accessible thereto, a considerable population already exists—110,000 in New Mexico, over a 1,000,000 in the Northern States of Old Mexico, which will be supplied from this line, 50,000 in Colorado, without mentioning the smaller but energetic Indian-harrassed settlements of Arizona, and the rapidly increasing population of Southern California. The Santa Fé trade is already large, and even on the present basis, a railroad would find considerable business in supplying the wants of this population.

The mere fact that mining can be carried on at all in New Mexico and Arizona, under all the discouragements of costly transportation, Indian attacks and remoteness from the conveniences of life is, to the thinking mind, strong evidence that, with these drawbacks removed, through the agency of a railroad, the development of mining industry would be enlarged in an extraordinary degree. While only the larger and richer veins can now be profitably worked, when the cost of transportation is reduced to one-fifth and the risk to property and life removed by the settlement of the Indian question, capital

will find it advantageous to open up the smaller and less productive veins; and as these are much more abundant and widespread than the richer ones, the field of mining industry will thus at once be much more than proportionably enlarged.

It is not alone the resources of the country immediately traversed that will contribute to the trade of the road, but those of districts even somewhat remote from the line, which will be immediately rendered greatly more accessible than at present, and will gradually be put into *direct* communication by branches. Thus, as a legitimate and certain effect of the construction of the trunk line, without further aid from the government, private capital will hasten to use various points along the route, each as a new base from which to strike in order to tap new and distant sources of wealth and trade. Thus, almost immediately a branch will be constructed from Cheyenne Wells to Denver, reaching, by the shortest practicable route, the gold and silver mines of the Clear Creek region—the farthest north of any discovered mineral wealth in Colorado—and the coal, iron ore, and manufacturing facilities at Golden City and Boulder.

Another branch will, at an early day, be extended up the easy grade—less than 20 feet per mile—of the Arkansas Valley to the coal, timber and iron ore at the base of the Rocky Mountains, to the unexampled manufacturing facilities at the Big Cañon, to the mines of gold and silver, and the arable parks and valleys, and the unrivaled pastures of Southern Colorado, and to that most promising reservoir of the precious metals near the head of the Arkansas, and in the South Park. As mining developments advance, this line will be pushed on westward over the great Continental Divide at Arkansas Pass, (which can be crossed with a grade of 75 feet per mile) to the waters of Grand River, and so on eventually through Western Colorado into Utah. A southward prong of this line will be extended from the Arkansas across Puntia Pass to the San Luis Park, traversing that beautiful basin for its whole length, and open-

ing up an extensive mining region in the Spanish Range, o
the east, and the San Juan Mountains, on the west. This lin
by gradual extension, southward along the Rio Grande, tappi
the Abique and Jemez Copper Mines en route, will finally aga
intersect the trunk road near Albuquerque—the whole rou
being through a country with good resources, and, except
crossing the Puntia Pass, the grade nowhere exceeding 20 fe
per mile.

A third branch will be very early constructed from Albuquerque down the Valley of the Rio Grande, 250 miles to El Paso, traversing all the way, by a grade from 5 to 10 feet per mile, a broad, productive valley and vineyard, (where enough good wine can be raised to supply the United States;) and opening up the mines of argentiferous galena and copper in the Organ Range, which encloses the valley on the east for the whole distance, and of gold and silver and copper in the Ladrones, Socorro, San Mateo and Miembres Mountains on the west; the coal near Fort Craig; and the extraordinary rich deposits of copper and gold at Pinos Altos, with the agricultural wealth of the Mesilla Valley. This branch will be extended from El Paso, 200 miles more across a gentle mesa to the City of Chihuahua, the capital of the rich Northern States of Mexico, which have produced an amount of gold and silver compared with which the production of California and all our other mineral States and Territories is, as yet, but a trifle; where in a single small mining district, that of "Santa Eulalia," more than 200 mines were formerly worked in a space of two square leagues, 50 of them to a depth of 600 feet, and where a census, taken in 1833, showed that 430 millions of dollars had, up to that time, been taken from the mines in this *single limited district.* But, although the population of the City of Chihuahua, adjoining Santa Eulalia, then 76,000, has dwindled to 12,000, and very few of the mines are now, by reason of bad government, and its result, insecurity from the Indians, worked at all; yet great wealth is still there to reward those

who are to extract it under the new and stimulating influences of railroad communication.

This Chihuahua branch may be extended to Durango, and eventually to the City of Mexico, opening up a trade with 7,000,000 of our neighbors from the best direction to benefit the people of the United States.

This is, in many respects, perhaps, the most important branch of all, and the rich traffic that it promises will induce its construction promptly after the main line reaches the Rio Grande. The supplies of Chihuahua, Durango, Zacatecas, and other Mexican States which are cut off from the ocean by high mountain barriers, are now wagoned from the coast in Texas, and were formerly wagoned from Missouri. This trade will be at once restored to its ancient channel, and vastly enlarged when the track reaches Albuquerque. The people of Chicago and St. Louis, and of the cities of the Mississippi Valley, south of the latter, will then be found competing for the supply of clothing, machinery, groceries, &c., to the Mexican States as they now are to the miners and rancheros of Colorado, Montana and New Mexico. The silent but certain political effect of this influence is not less notable than the stimulus to trade.

The ores of Pinos Altos, west of the Rio Grande, in Southern New Mexico, are very rich, and now pay for wagoning supplies over 900 miles from the Gulf of Mexico at Indianola. What a development will be seen in such a region with the railroad finished to Albuquerque, or, still better, with the Rio Grande branch constructed, and the Apaches *fully* disposed of.

In Western New Mexico, branches will be constructed from the thirty-fifth parallel northwestward and southeastward along the slopes of the Sierra Madre.

There will be two important branches in Arizona: the first from Mt. Agassiz along the Mogoyon Range southeastward, (or from the mouth of Navajo Creek up the Valley of Little Colorado) to the rich mining district and beautiful parks of the

Sierra Blanca; the second (unless the main line should itself take that general course) from the mouth of Partridge Creek or other point of striking the Val de Chino, southward, with one prong to the mines, ranches and timber of the Prescott and Verde country and Central Arizona, and the other following the low country between the Aztec Range and the Black Mountains to Wickenburg, with an ultimate extension to the Gila and the mines of Southern Arizona.

The banks of the Great Colorado being interrupted by occasional precipitous cañons, it is not likely that railroad branches will soon be constructed up and down that valley, nor will they be so necessary as elsewhere. The river, although not a superior navigable stream, will at all seasons of the year act as a valuable feeder to the business of a railroad crossing it, carrying cheaply thereto the products of the mines and plantations along its course, and taking back the necessary supplies. Thus, both up and down, but especially from above, (for 200 miles,) as far as the mouth of the Grand Cañon, the Salt Mountains and the gold and silver mines of the rugged ranges, which line this valley on each side, will be afforded an outlet much cheaper than by the present long, inferior and uncertain water circuit, by way of the Gulf of California, to San Francisco. Thus the rich auriferous copper ores of the Valley of Bill Williams, (if the main line does not follow that route,) will be reached, and supplies for these mines furnished from the railroad.

There will be three principal branches in California, and perhaps a fourth.

The first, to San Diego, has already been referred to. It is rather an extension of the main line from the Colorado River westward to another terminus, than a branch, and should be built very soon. It will open up the mines of the Bullion Range and other mountains in the Great Basin, also of San Bernardino Mountain and the Cordilleras, the tin mines of Temescal, the charming semi-tropical Valleys of San Bernardino

and Los Angelos, with their fine vineyards and orange groves; and reach, by crossing the best pass in the whole range of the Sierra Nevada, the second best port on the coast of California, (with water for vessels drawing 22½ feet,) in 300 miles less distance than to San Francisco.

The second branch is from the eastern base of Tehachapa Pass northward along the foot of the Sierra Nevada, and the margin of the Great Basin, to Owens River, and as far north as may be required to develop the almost continuous mines of the Sierra, which are the most readily reached from the eastern slope. A prong from this branch may be extended through the valleys dividing the silver-bearing Mountains of Nevada to Reese River, Austin and Belmont, giving this productive mining region a connection with the coast, and with the agricultural valleys west of the Sierra Nevada, by a line of easier gradients than the Central Pacific, and free from snow. A branch may also be extended southward from Tehachapa Pass along the easterly foot of the Sierra Nevada to the Cajon as mining developments advance.

The third branch will deflect at the western foot of Tehachapa Pass, and follow down the eastern side of Tulare Valley and the San Joaquim Valley, traversing a good agricultural and pastoral country of immense extent, and affording access for over 200 miles to the mines and pineries of the Sierra Nevada, which are the most easily reached from the western slope.

If the main line should take this route, then the branch will cross the Coast Range to the Salinas Valley and so on to the Pajaro and Gilroy, opening up the good valleys and the forests of red wood between that range and the coast.

Perhaps a fourth branch may be constructed from the vicinity of the Piute Pass, the Mojave River, (or from the Yampa Valley, in Arizona, northward by the Virgin,) into Utah and Western Nevada to the Pahranagut Mines, the White Pine Region, and along the line of Mormon settlements. The *existing* principal outlet and route of supplies for the Mormons is southwestward to the Mojave, and thence to the coast at Los

Angelos, to and from which they wagon their goods and surplus products, in order to avoid the passage of the snow-covered Sierras.

By these various branches which, with one or two exceptions, all follow strongly-marked natural routes, great lines of drainage, long mountain plateaus, extended basins or lines of depression, or the base of mountain ranges, a vast extent of territory, rich in natural resources, is opened up and made to pay tribute to the Continental line. The system thus indicated would develop nearly everything of value in our own territories, (and in the Border States of Mexico,) south of Denver, and the southern boundary of Nebraska; and this is done without material divergence of the main line from that which is the shortest, and cheapest, and most reliable route of transportation between the Middle States and San Francisco.

Can a doubt remain that there will be a paying traffic? The road is successful already, and yet it is running through what may be regarded by itself as the least productive section of the whole line, and it is without a pound of through traffic, or a single through passenger. One coal company in Western Pennsylvania, the Westmoreland Coal Company, pays the Pennsylvania Central Railroad nearly one million of dollars yearly freight upon its mineral product alone, without including the freight upon the supplies for the miners and the business that is created by the mines. This may afford some slight indication of what the *mineral traffic merely* of this continental line will be, when the mines of coal, iron, copper, lead, salt, gypsum, besides gold, silver and quick-silver, which have been described, are fairly opened up.

But let us itemize the different sources of traffic in general terms and see what they are.

There will be to carry:

1st. From the Mississippi Valley westward as far as the Colorado River, all the mining and other emigration which will flock to

these Territories, with the supplies, machinery and plant of all kinds, including certain kinds of lumber, required for this increase of population, and for that already existing.

2d. From the Pacific Coast and the valleys of California eastward, as far, probably, as the Sierra Madre in New Mexico, there will be a similar emigration, with manufactured articles and supplies of all kinds to carry.

3d. There will be the Northern States of Old Mexico to fill up and to supply in the same way from the Mississippi Valley.

4th. There will be a very large health and pleasure travel, from the cities of the Mississippi Valley to the elevated plateau, the numerous hot and other medicinal springs, and the magnificent scenery of the Rocky Mountains. The favorite places of summer resort for the people west of Ohio will undoubtedly be in these ranges, and this trade is large and profitable. There will be a similar travel eastward from the California cities, but there the mountains approach much nearer to the coast.

5th. The transportation of the mails, troops and munitions, and Indian goods and supplies for the Government westward and eastward. Although this will be greatly reduced by the construction of the road, it must continue to a greater or less extent for many years, and the mails, of course permanently.

The *return traffic* from the interior outward to the Mississippi Valley, and to the California Coast, will be—

1st. Bullion.

2d. The richer and more refractory silver and copper ores and "mat" from Colorado and New Mexico, eastward to the Mississippi; the same from Arizona and Southern California westward to the Pacific. I have seen, during the last summer, the silver ores from Black Hawk, in Colorado, loaded for shipment by wagon 160 miles to Cheyenne, thence to go by railroad nearly 2000 miles to New York, from which they were to be carried by ocean to Swansea, in Wales.

3d. Wool and hides, horses, mules, cattle and sheep, (especially when breeds are improved,) in enormous quantities, and the furs and skins of wild animals, game, &c.

4th. Wines and semi-tropical fruits from the Rio Grande and other valleys, eastward; cotton and sugar from the Valleys of the Colorado, the Mojave, the Gila and the Verde westward.

5th. Coal and certain kinds of lumber from the Rocky Mountains eastward to supply the great plains as far as the Missouri River.

Then, *locally*, there will be transported both ways along the line largely—

1st. Passengers—no population being so nomadic as a mining one.

2d. Fuel, both wood and coal, to the mines, reducing works and ranches. This will be a very large trade, as there is no general diffusion of fuel in the western half of the Continent.

3d. Timber, lumber, iron, &c., to the mines and mills; fabrics of clothing, pottery, &c., as soon as the native manufacturing resources are utilized, which will be very soon. In the face of all existing discouragements, they have, indeed, already been started—witness the pottery works at Golden City, the blanket mills near Fort Union, and the numerous manufactories of the Mormons.

4th. Ores in large quantities to favorable local points where they will be reduced by water power or steam. The product of placer mines (where rich) from dry localities to water.

5th. Live stock from the pastoral uplands to the mines and arable valleys; breadstuffs, vegetables and fruits from the valleys and parks to the mines and table lands; volcanic ash and tufa for manures; gypsum for the same and for plaster; cement, moulds, &c.; marble, serpentine, granite and other building material; coal oil from Cañon City and the head of Tulare Valley; even the yucca for ropes and mattresses, now extensively used in California; mescal and pulka, and innumerable other materials that enter into the necessities or luxuries

of American life, and new products peculiar to the combination of latitude and elevation.

Lastly, the "through trade," whatever it may prove to be. It is not as reliable as the local traffic, but we can be certain, at all events, of—

1st. The through passenger travel, because this is already large by steamer, and very few people will take three weeks to go by Panama to New York, when they can go in six days by railroad with so much greater safety, and at a less cost, than is now paid by water. Besides, it must be remembered that a large proportion of the travel, both to and from California, is from or to the Western States, and St. Louis is but four days removed by rail from San Francisco, while it is twenty-three or twenty-four days distant *via.* New York and Panama.

It is estimated that, during the year 1868, the passenger business between California and our eastern seaboard, by steamer, both ways, has been at the rate of 70,000 per annum, and that the number overland, and by sailing vessels, will increase it to 100,000, or about 300 daily; so that this through passenger trade already amounts to an averaged sized train load each way daily, and it will be *almost immediately* doubled by emigration, tourist travel, and by the visits to their old homes in the States of a large number of Californians who have never yet been able to spare the time for an ocean trip, and of their friends to them in return. This large and profitable source of travel is therefore certain.

2d. Of course the mails and expresses will be certain and permanent, and a greater or less amount of troop and other transportation for the government.

3d. What the "through freight" will be, is as yet a matter of speculation. It is estimated at present, both ways, at 400,000 tons. A large proportion of this will probably continue to go by water, but all the lighter, and more valuable articles, that can bear a high freight, will go by rail; and the tendency of modern business is to attach so great importance to the element

of time, that every day the ability of water communication to compete with rail, even for heavy goods, is diminishing. It must be remembered also that the Mississippi Valley, which is rapidly becoming the centre of population and wealth in this country, is already one-third of the way across the Continent, and is proportionately removed from the effect of ocean competition. It can scarcely be doubted also that the construction of the Pacific Railroads will create many sources of through freight traffic, which are now unthought of.

4th. Finally, there is the wonderful Oriental trade, of which so much has been expected. The teas, drugs, silks, cloths, the many natural products peculiar to that climate and longitude, and the innumerable fabricated articles of taste and fancy which will start new sources of trade when our communication with this distant and busy people, numbering over one-third of the entire population of the globe, becomes more intimate.

Then, in return, the supply of machinery, and all the articles and fabrications peculiar to our civilization, which must follow the opening up of close commercial relations with these Oriental hives, may be expected to swell the traffic of the road to a very round number of tons.

But all this is speculative. While we believe the course of trade around the world will be changed, it will not do to build upon such a fancy. The *local trade* is that of which we can feel sure, and enough has been shown to prove that this will be very large and very remunerative. It is chiefly for this, apart from political and military considerations, to build up our interior territories—the whole western half of the Continent—and add this vast new trade to that which our people already have, that Pacific Railroads should be built. Then the "through Continental traffic" and the Oriental trade, whatever they may turn out to be, will be so much clear gain; the profits of which will permit the reduction of the charges of transportation on *all* tonnage to a minimum.

CONCLUSION.

What has been demonstrated may be summed up as follows:

1st. That four practicable and good general routes exist from the completed track of this railroad in Kansas, southwestwardly to the Rio Grande in New Mexico, in the vicinity of Albuquerque, to wit: the "Puntia Pass," "Raton Mountain," "Cimarron" and "Aubrey" routes; of which, the Puntia Pass route goes through the best country for local traffic, and, next to the "Cimarron," has the best grades, uses the completed line in Kansas for its entire length, but is the longest of all as a through route from Kansas City to Albuquerque. The "Raton Mountain route" starts also from the present terminus, has the shortest distance to build, and ranks second in reference to local trade, but has the heaviest grades, will cost the most per mile, and, next to the Puntia Pass route, is the longest between Kansas City and the Rio Grande; the "Cimarron route" gives the shortest line, the best grades cost the least per mile, and is altogether the most advantageous for *through business*, but it goes through the least productive country, and has the most new track to build, using the finished road only as far as Fort Harker; the Aubrey route uses the completed line in Kansas as far as Fort Hayes or the 100th meridian, has but little more distance to build than by the "Raton Mountain," ranks next to the "Cimarron" in through distance, gradient and cost per mile, while it goes through a better country than the latter.

2d. That westward from the Rio Grande a good route exists to *San Francisco*, lying, as far as the Sierra Nevada, between the 34th and 36th parallels, and after crossing that range (at "Tehachapa," the best pass known in its whole extent,) following the great valley which divides the Coast Range from the

e fertile valleys west of the Coast

hat, diverging from this line at a

point in California, on the Colorado or between the Colora- and Mojave Rivers, a good route exists thence to Los Ange- and San Diego, crossing the Cordilleras at "San Gorgoni- the best pass in that range.

3d. That the summit of the eastern range of the Ro-ky Mountains (Spanish Range) is crossed at Cañon Blanco P-ss, southeast of Sante Fe, at an altitude of 6,917 feet above *the* ocean; the Sierra Madre, or water shed of the continent, *at* Navajo Pass, northeast of Zuni, New Mexico, at an elevation of 7,177 feet; the Mogoyon Range, or *divide* between the waters of the Gila and Little Colorado, at Tonto Pass in Arizona, northeast of Prescott, at an elevation of 7,510 feet; the Providence Range (southern extension of the Wahsatch,) at Piute Pass, 40 miles west of the Colorado River, at an elevation of 2,579 feet, and the Sierra Nevada of California, at Tehachapa Pass, north of Tejon, at an altitude of 4,008 feet. That on the least favorable route examined the grades were found to be approximately as follows: For three-fourths of the whole line, from the present end of the track, in Kansas, to San Francisco, less than $52\frac{8}{10}$ feet per mile; 119 miles between 60 and 80 feet per mile; 85 miles between 80 and 100 feet per mile, and 21 miles from 100 to 116 feet per mile; which last, on location, may be reduced, if desired, to 90 feet per mile.

4th. The distances, as measured, (*via* the Raton Mountain line,) were found to be as follows:

From Kansas City, on the Missouri River, to San Francisco	2,026 miles.
To San Diego	1,738 "

Of which 405 miles, from Kansas City to Sheridan, are completed and in operation.

The more recent surveys and examinations of alternate lines at various points, made during the past year, indicate that, with a considerable improvement in grades, these distances on location will, most probably, be reduced to the following:

From Kansas City to San Francisco	1,934	miles
From Kansas City to San Diego	1,646	"
As the distance from New York to Kansas City, by railroad, is	1,318	"
The total from New York to San Fancisco is	3,252	"
And from New York to San Diego	2,964	"

San Francisco is thus reached from New York in a less distance than by way of Omaha: and the ocean (at San Diego) in over 300 miles less distance than from New York, by way of Omaha to San Francisco.

5th. That the climate is unexceptionable for railroad transit, as shown by the fact that our surveying parties crossed all the high mountain ranges in the fall and mid-winter, and again in the early spring, without encountering any snow sufficient to prevent their animals from obtaining, at all times, an abundance of good grass; and from the additional facts cited out of the experience of Whipple, Beale, and other explorers, covering a period of some ten winters, and showing that the season was not an exceptional one with us.

6th. That the route is unusually well timbered; has along it large deposits of coal, much of which is of superior quality, extending at intervals from the Arkansas River to the eastern border of California, with deposits also at San Francisco and San Diego; that it has an abundance of good stone and other building material, and although, as in the case of every route across the western half of the continent, not abundantly provided with surface water, yet it is sufficiently well watered to meet all the requirements of a railroad, and to supply the wants of a large population.

7th. That while thus reaching the Pacific by a line quite favorable in respect of distance, gradients, climate, fuel, and other important characteristics, for cheap and reliable transportation of through passengers and traffic, the line occupies for the most part a country rich in the elements of a great local trade, which will be stimulated by the fact of its possessing a climate attractive to population. That for a distance of 1,500 miles from the spurs of the Rocky Mountains, in

southern Colorado, to the western base of the Coast Range near San Francisco, the line is immediately contiguous to or within easy access of mineral-bearing mountains—in which veins of gold, silver, copper, lead, iron, quicksilver, or other mineral products of some kind and value, have actually been opened, and are worked by the miner or have been traced by the prospector, and that in many localities these deposits are known to be exceedingly rich.

That with the exception of a belt of 100 miles between the Smoky Hill and the Arkansas, and of 280 miles from the summit east of the Colorado River, in crossing the Great Basin, to the foot of the Sierra Nevada, (and even here intervene the fertile valleys of the Colorado and the Mojave,) the country occupied by the surveyed route, for its whole extent, is excellent grazing land; and that besides this, *five-eighths* of the entire line has a rich soil, and sufficient water to make it productive and inhabitable for *arable* purposes, the mildness of the climate greatly increasing its value in these respects, and adding in the lower valleys numerous semi-tropical products and fruits to the grains and vegetables of the temperate zone. That as a result of the great diffusion of coal, iron and timber, and still more of the existence of fine water-power, cheaply available in the numerous confined cañons of Southern Colorado, New Mexico and Arizona, manufactories will spring up and be extensively carried on along the route as soon as labor and capital can be introduced.

8th. That in all the respects, and for all of the purposes above enumerated, including gradients, the route of the 32d parallel was demonstrated to be decidedly inferior to that by the "thirty-fifth," to reach San Francisco, and the superiority of the former in gradients as a line to San Diego was not so marked as to offset these other drawbacks.

9th. That while the surveyed route of the 35th parallel thus presents great inducements to the middle and northern States of the Union *thereby* to seek communication with the Pacific, and with our rich southwestern mineral territories, and the ad

joining States of Mexico, through the extension of the Kansas Pacific Railroad, it has the important additional feature of enabling the "South" to realize the same advantages by a connection of her lines from Fort Smith, Arkansas, and Shreveport, Louisiana, with the trunk line at the eastern base of the Rocky Mountains, near Anton Chico, in New Mexico. That there is hereby insured to this section of our country an early communication with the Pacific Ocean by a route which is by far the best for all of her people and all of her trade to reach San Francisco; and for most of them the shortest and best to reach San Diego; and that the general system thus indicated occupies the best route to open up and develop all the resources of the western half of our continent, south and west of Central Kansas, together with those of Northern Mexico.

10th. Many of the advantages above claimed for the route of the 35th parallel have long been admitted by those who have studied the subject of a Southern Pacific Railroad. They have been urged and confirmed by Whipple, Beale, and all explorers who have gone through this country. But by many it was thought that important as they were conceded to be, they could not be gained without too great a sacrifice in the particulars of gradient and cost of construction. Our instrumental surveys have established the fallacy of this notion. The worst features on the line run by Whipple, to wit, the detour from the head of the Bill Williams River to the Colorado Crossing, and the transit of the Aztec and Aquarius Ranges in Western Arizona have been entirely avoided, while west of the Colorado River a summit of 2,500 feet has been substituted for one of nearly 5,000, encountered by Whipple in crossing the Providence Mountains.* The total rise and fall on the line to San Francisco has been shown to be no greater than by the route of the 32d parallel, and about the same in proportion to distance as on the Baltimore and Ohio Railroad, while the working grades are very favorable for a greater part of the dis-

* Both of these modifications were anticipated and predicted by Whipple.

tance, and even in crossing the more formidable ranges, need not, with proper work, rise above 90 feet to the mile. These limits of gradient are only obtained at certain points, by expensive construction; but this amounts to but a small proportion of the cost of the additional length of road required by the route of the 32d parallel, while the latter traverses an inferior country.

It must be apparent, also, that the line obtained by our parties on a hasty survey for a practicable general route, without time being afforded to thoroughly explore the country, can certainly be much improved on actual location.

But the question is asked, with so many advantages and such a large promise of traffic, why should not this line be built entirely by private capital? All extensions of the railroad system anywhere throughout the country, it is admitted, benefit all sections. Why should the Government be called upon to assist in this case more than in others? For various reasons:

1st. Because the Government, as an *organization*, is interested, and is the *largest* party interested. It is both natural and in accordance with custom that a Railroad Company should apply for a loan to aid in building its line to the party which owns nearly all the land, and carries on most of the business that is done in the country traversed by that line.

2d. Because of the direct pecuniary saving to the Government in carrying on this business, which is chiefly to fight Indians, protect settlers and emigrants, guard the boundaries of the nation, transport mails and Indian goods, &c. *Large expenditures have always been, and are now, constantly being made for these purposes. They are essential and cannot be avoided, unless the whole country be abandoned.* One hundred and four companies of infantry and cavalry* are now stationed along this general route, or within such distance as to be supplied therefrom—not including those at either terminus. They are maintained at an average cost of over one million dollars per regiment.

It is certainly a proper subject of enquiry, whether the expense of maintaining this military force, of transporting the mails, &c., can be reduced. The Military Committee of the House of Representatives has considered this question, and has reported (see page 237,) that the saving in these items due to the substitution of railroad for wagon transportation in those

* See table, page 240.

remote districts, is so large that it would extinguish in a very few years the principal and interest of any loan required from the Government to aid the road, through to the Pacific, besides doing away rapidly with the necessity of maintaining any troops, in consequence "of the growth of self-protecting settlements along the line." The estimates for the erection of new buildings at the single minor post of Fort Larned, on the Arkansas, for last year, were one and a half millions. The structures at Fort Riley, Fort Union, &c., have cost heavily, and are kept up at great expense. The 1,400 Yutes and Apaches at "Maxwell's" in New Mexico, now, and for the last five years, fed by the Government, to prevent them from going to war, are no light burden. The 8,000 Navajoes, just sent back from the reservation at Fort Sumner to their own country, have cost the Government a great deal to feed them in the last four years, but they will probably cost much more in the next four years to fight them, unless they are allowed free license to steal the cattle, horses and sheep, of the settlers, and to depredate upon emigrants. Wood for fuel, at Fort Wallace, in Western Kansas, during the last year, cost the Government between $30 and $40 per cord. With a railroad to the mountains they could have coal at $8 per ton. New Mexico alone, according to Senator Sherman, has cost the Government one hundred millions of dollars to take care of it, since its acquisition. A guarantee of half the sum, not a penny of which would it ever have been necessary to pay, would have insured the construction of a railroad from the Missouri River, through this territory, to the Pacific ocean, and saved the necessity of nearly all further cost thereafter.

Is it not time to inquire whether these resultless expenditures can be stopped, and some revenue be obtained from this country, filled, as it is, with resources of wealth?

3d. Because the railroad is the only reasonable plan that has been proposed for a final settlement of the *Indian question*, which, apart from the cost, is a problem of great concern to

the nation —affecting its honor and conscience, as well as its growth. Build the road and the tribes of the Plains and mountains will give no further trouble than the Indians now do in eastern Kansas and in California. In truth, except on the Plains, they will be employed in large numbers by the road itself, in construction, and subsequently in operation, and in furnishing supplies. Not only the Pueblos, Chemeuevis and Mojaves, but the Navajoes, and even the Wallapis, for they are all more or less accustomed to labor in cultivating crops and orchards, in taking care of stock, and in digging irrigating canals. Give them the constant opportunity for labor, at fair wages, and with the deprivation of their hunting grounds, I believe they will cease roving and stealing and take to steady work.

4th. Because it will not do to give up this country, and yet this is seriously what it appears to be coming to.

All the settlements of New Mexico may be said to exist only on sufferance of the Indian. The towns along the Pecos, the Rio Grande and the El Rito, are kept in a state of constant alarm and uncertainty—thousands of head of sheep and cattle are annually driven off by the Indians; several attempts had been made to cultivate the Valley of the Puerco, but the Indians rendered it impossible. We found the miners leaving Arizona in large numbers, unable to hold their own against the Apaches. As we passed through the country we had constant evidence of the fact of this unceasing assassination and depredation. Mail riders, herders, teamsters, couriers, travelers, officers moving from post to post, mining prospectors, emigrants, rancheros, were the victims. The same story met us at every fort and settlement; some one had just been brought in dead or wounded from an Indian ambush, or a miner or farmer had recently had his animals stampeded, and was left without the means of carrying on business. At one post in New Mexico we were informed that all the horses of a company of cavalry had been driven off while grazing under guard within a stone's throw of the fort. At Prescott,

Arizona, the Indians occasionally committed their outrages so boldly as almost to enter the streets of the town. The effort to develop the silver lead mines in the Wallapi Range, east of Fort Mojave, had but recently terminated by the massacre of the Willing party. Ehrenburg had been killed in the Le Paz gold district; a party who had endeavored to open the mines in the Providence Mountains, on the desert of California, were driven away by the Piutes. Very few in the east have any idea of the extent of the drain upon a population from this persistent warfare. A reliable hunter in Arizona told me eighty of his personal acquaintances had been killed in the last four years in that Territory. Col. Lally, at the Santa Rita mines in southern Arizona, lost twenty-two of his miners and laborers, who were killed in the three years during which he was managing those mines. It is a wonder that any enterprize whatever is carried on in the face of such obstacles.

The country along the surveyed routes, for a thousand miles, was found filled with the scattered pottery, ruins and other indications of a race that had evidently been populous, and that scarcely lives, perhaps, even in the traditions of the oldest Pueblo tribes, whose towns of Zuñi, Accoma, Laguna, Moqui, and others, by or near to which the line was run, are thought to be the last strongholds of this ancient Aztec civilization. Such as the country is now, in general appearance and population, it appears very nearly to have been when the Spanish explorers, Coronado and Bazconceles, traveled over it in search of gold and adventure, nearly one hundred years before the Pilgrims landed at Plymouth Rock. The story of the semi-civilized Aztec cannot yet be told, but his experiment to effect a permanent lodgment in this country, at all events, failed—possibly from inability to cope with the fierce tribes of nomadic Indians, which then, as now, evidently roamed over it, forcing the towns to be built upon elevated and defensible sites, where most of the ruins are found.

The Spaniards, like the industrious Aztecs, found it impossi-

ble to *stand guard all the time*, and although a match for the Apaches in actual battle, were forced gradually to retire to the most accessible valleys, where their descendants are even to-day disputing every inch with the savage. Our race is now responsible for the future of this region. So far, our attempt to settle and develop it has proven a lamentable failure. The Apaches, who have waged for 200 years a relentless war against all white men, and even against the industrious tribes of Pueblo Indians, have harried our miners, and those who go to supply their wants, until steady industry has become almost impossible. The chances of life throughout New Mexico and Arizona are less than those of the operatives in a powder mill, and the risks to property are so great as simply to forbid enterprize or accumulation.

Some plan other than the present inadequate but terribly expensive military protection must be adopted, or in a few years there will not remain as many traces of American existence in the whole of that country as are now to be found of Aztec civilization within a few miles along the valleys of the Little Colorado or Verde. Just as the Mexicans have diminished, from 120,000 to 80,000 in Sonora since the "Gadsden purchase," and are gradually receding toward the coast, in consequence of the incursions of the Gila Apaches, so our hardy pioneers must utterly give way in New Mexico, Arizona and Colorado, unless some plan, founded on reason and experience, be adopted for their relief, and for the encouragement of emigration. In short, unless this country be penetrated by a railroad, it must practically be abandoned.

It will be singular if our people, ready as they are to protect the person of a single citizen abroad, if need be by a war costing hundreds of millions, should continue to gaze with indifference upon the yearly murder, by a barbarous enemy, of thousands of her hardy western pioneers, when assured by the leading military commanders that there is a way, and an economical way, to stop it—that way being the construction of a railroad

through these territories.* The incoming President has declared, as a fundamental article of his political code, that every American shall be protected in his life and rights throughout the length and breadth of this country, as well as abroad. If that pledge is to be carried out in Arizona by the use of troops, it will cost more than a foreign war. But as the same officer has declared, in his report as Secretary of War, that "the completion of the *railroads to the Pacific* will go far toward a permanent settlement of our Indian difficulties," and that it will also "materially reduce the cost of maintaining troops in that section, as well as the number of men to be kept there," it must surely be that he is in favor of redeeming his pledge in the more economical of the two ways.

5th. The Government should give its assistance, because a railroad is the cheapest and most efficient means of defence to our southern border, until Mexico becomes a part of the United States. Again, because the connection with our own Pacific States should not be allowed to depend on the vicissitudes to

* "The completion of these roads will go far towards a permanent settlement of our Indian difficulties."—Gen. U. S. GRANT.—December, 1867.

"This road (Kansas Pacific) almost substantially ends our Indian troubles, by the moral effect which it exercises over the Indians, and the facility which it gives to the military in controlling them."—Major Gen. P. H. SHERIDAN.—May 2, 1868.

"It seems to me that we can, with great propriety, recommend to Congress, at its present session, to extend their subsidy to this Company, (Kansas Pacific.) *This road is a military necessity.*"—Lieut. Gen. W. T. SHERMAN.—March 4, 1868.

"From my personal experience on the plains, I can speak in strong language as to the necessity of this road (Kansas Pacific) being extended as rapidly as practicable. I consider any assistance given by the government to this enterprise, as most wisely and advantageously applied."—Major Gen. W. S. HANCOCK.—June 4, 1868.

"I consider the extension of your road (Kansas Pacific) as of great military necessity, and productive of sufficient economy in army expenditures to fully discharge the government loan in a reasonable time."—L. C. EASTON, Acting Chief Q. M. Military Division of the Missouri.—June 8, 1868.

"The saving by this road (Kansas Pacific) would, in less than six years, reimburse the entire loan necessary to extend the road from its present terminus to the Rio Grande. The committee have had satisfactory evidence presented to them that *west of Albuquerque*, and through Arizona and Lower California, the same or even larger proportionate economy in the public service would be effected by the substitution of railways for wagon transportation, with a result of an equally certain payment of the interest and extinction of the principal of the government aid *long prior to its maturity.*"

Report of Military Committee of House of Representatives, May 25, 1868.

which one line of great length, easily cut, and traversing a wintry climate, is liable.

6th. Because the amount of capital required is too large to be obtained from private sources, and however important for the Government, it is natural that capitalists should hesitate at the idea of investing heavily in a country which is substantially at war. By the gradual westward extension of the railroad systems from the Mississippi River, they might, perhaps, in 50 years, succeed in spanning the continent. But why wait 50 when it can be done in three and a half—with a positive money gain to the Government from the day it starts.

7th. Because it will expedite the payment of the national debt by greatly stimulating the production of specie, and of all forms of taxable wealth, enlarging an hundred fold, by one act, the field of industry and production.

To achieve all these benefits, the cost—a loan of the nation's credit—seems absolutely puerile. It will be repaid every year, in direct and indirect gains to the public treasury.

This is no new policy. Nearly all other civilized nations have granted aid in much larger amounts to railroads. England has voted over 400 millions of dollars to the cotton railroads of India. France, Belgium and Russia have given or guaranteed immense subsidies. Everywhere the experience is found to be the same—that the governments are never called upon for a penny; the traffic of the railroads being sufficient to meet and repay all loans and guaranties. So far, on this Pacific Railroad, the same result has been achieved, and it will be greatly exceeded when the mineral mountains of New Mexico and Arizona are reached. The United States is but just upon the threshold. The total amount of aid to all lines it has yet authorized is less than sixty millions of dollars.

Can our Government afford to disregard the experience of European nations? This is a contest for wealth, power and prosperity; the shaping of the course of the world's trade. Can we fall behind, especially when we have so many stronger reasons than other nations? Besides those given above, there

is the fact that the vast extent of our country almost renders it imperative for the success of the fundamental principle of its institutions that the various parts should be closely bound together by lines of cheap and rapid communication, thereby preventing the growth of sectional interests and policies. No other country has such a vital concern in this matter, and none has so large an area. When, moreover, the aid of the Government is confined to cases where it has already a large and indispensable outlay, so that the requisite subsidies come rather as a *change in the form of an existing expenditure*, than the creation of a new one, it is difficult to resist the conclusion that it is wise to grant them, and to grant them immediately.

One great route to the Pacific is now nearly completed. It crosses the water shed of the continent nearly seven degrees of latitude north of the surveyed line of the 35th parallel, reaching an altitude of 8,242 feet at the summit of the "Black Hills," and 7,042 feet on the Sierra Nevadas. It in no wise benefits the vast territory whose resources have been described in this report. If the Pacific railroad is needed chiefly to insure speedy and reliable communication with the western ocean, this southern line should certainly receive favor, because of its freedom from snow, and its shorter distance by 300 miles to that coast from New York. If the main object be to open up and develop the western half of the continent, hitherto a waste, this line is a necessity, because, owing to the topographical character of the country, and the great intervening distance, New Mexico, Southern Colorado, Arizona and Southern California cannot be favorably tapped by branches from the other road. In truth, it is needed for both purposes, as well as to insure a healthful competition.

We have seen somewhat in detail what treasures lie in the extensive domain acquired by the treaty which followed the Mexican war. They have scarcely yet been touched, and even their existence is unknown to all but those whose attention has been especially attracted in that quarter. But a rich and permanent market here awaits the producers, manufacturers and

traders of the Mississippi Valley, the northwestern Lakes, and of our whole country, and it is of the highest moment to every section that it should be placed in communication with this new field of wealth within a period that will enable the present generation to enjoy its benefits. There is no reason why we should wait fifty years or a century for the realization of this picture. As has been already said, the process is not necessarily a slow one. If California had belonged to the Mexicans it would probably have been to-day in the condition of Sonora. Owing to the facility afforded by the intersection of the navigable Colorado, the mildness of the climate, in permitting work to be done throughout the winter, and by the availability of the existing population of Mexicans and Indians as laborers on its construction, this line can be completed in three and a half years, and we shall be brought face to face with what would otherwise be deemed only the possibilities of the next century. A trade of wonderful extent and richness will spring up; great States will be rapidly created out of the present Indian-ridden territories, and a third of a continent be redeemed from waste and barrenness in a single decade.

The South promised her adherents the re-opening of the African Slave Trade, and held up to the imagination of her poor men great prosperity and wealth from this source, but the restored nation may increase the real prosperity of every American citizen by a measure which will re-open the rich mines that were closed by the Pueblo slaves when they rose and drove out the Spaniards; re-populate the valleys and plains, now strewn with Aztec pottery, and open up innumerable avenues of wealth, as well in the creation of local trade as in the diversion and vast enlargement of that generous stream which, from time immemorial, has flowed by other routes from and to the Orient.

Respectfully, WM. J. PALMER.

Office of the Union Pacific Railway Co.,
Eastern Division,
St. Louis, December 1st, 1868.

PRELIMINARY REPORT OF DR. C. C. PARRY,

GEOLOGIST AND NATURALIST OF THE SURVEY.

To Gen. Wm. J. Palmer,

In Charge of Surveys, Kansas Pacific Railway:

Sir:—The extensive railroad surveys recently completed under your direction, extending to the Pacific Ocean, at San Francisco and San Diego, have furnished a large amount of reliable data for determining the natural resources and habitable character of a wide scope of country heretofore imperfectly known, and which has a direct bearing on the question of railroad extension across the continent, now so deeply interesting the public mind.

In anticipation of a more full and detailed report on the Geology and Natural History of the country covered by the surveys of the past season, and in accordance with your instructions, I submit the following condensed report of the general features and natural resources of the district, more especially that part extending from the Rio Grande to the Pacific, having particular reference to the comparative advantages of this as a continuous railroad route across the continent:

PHYSICAL GEOGRAPHY.

The gradual and continuous slope of the "*Great Plains*," as indicated by the general course of the rivers draining this wide section of country is to the east, and its comparatively smooth surface offering no obstruction to the sweep of the atmospheric currents, presents the aspect of a wide open country, covered with a fine alluvial soil, and supporting a growth of tough-rooted perennial plants and grasses, such as gives its peculiar aspect to this well-known section of country. Only in the river bottoms, where the necessary superficial moisture and shelter can be afforded, do we meet with a tree growth, confined mainly to the cottonwood and willow.

All these features are abruptly changed on reaching the great barrier constituting the eastern outlier of the Rocky Mountain Range; instead of uniform slopes, the elevations exhibit abrupt rocky declivities; the valleys are cut deeply through the rocky

strata, forming chasms and prolonged cañons; the sheltered recesses, irregular character of soil, and more abundant moisture, favor the growth of trees and shrubbery, while the variety of rock exposures, including volcanic, metamorphic and sedimentary, serve still farther to vary the general features of the country.

On crossing this first range of mountains near the line of the 35th parallel, at an elevation of about 7000 feet above the sea, we descend into the valley of the Rio Grande, 2000 feet lower, and from this point westward to the Colorado, a distance of 575 miles, the principal drainage is to the south, the intervening water-sheds between the different valleys presenting ridges of moderate elevation, as exhibited in the general profile of the surveys.

The region under special consideration comprises three very distinct sections, which may be briefly referred to in regular order, proceeding westward from the Rio Grande.

1st. From the Rio Grande to the Colorado of the West.

2d. From the Colorado to the summit of Tehachapa Pass in the Sierra Nevada.

3d. The western slope of the Sierra Nevada, descending into the Tulare Valley, and thence over the California coast range or down the Tulare and San Joaquim valleys to the Pacific.

1. *From the Rio Grande to the Colorado of the West* the country presents the character of a vast upland, crossed by a succession of mountain ridges, and basin-shaped valleys, interrupted by the product of recent volcanic eruptions in the form of extinct craters, cones, and streams of lava, which have overflowed and buried up the lower sedimentary rocks. The principal mountain axes exhibit a granitic nucleus, which, at certain points, is exposed to view in irregular mountain ranges, treading northwest and southeast, and constituting the general frame-work of the country, as exhibited in the Sierra Madre, the Mogoyon Range and the Pinaleno Mountains of Central Arizona. Intermediate to these is the great table-land or *mesa* formation of Western New Mexico and Eastern Arizona, comprising the sedimentary strata of triassic and cretaceous rocks, which spread out into broad uplands, abruptly terminated by steep mural declivities, bounding valleys of erosion, or presenting isolated butes and fantastically castellated rocks, that serve to give a peculiar aspect to the scenery. The principal foci of extinct volcanic action are represented by the elevated cones of San Mateo, and San Francisco, attaining an elevation of over 12,000 feet above the sea, whose alpine

slopes, reaching above the timber line, present in their covering of snow, the only wintery feature pertaining to this latitude.

It is in the eastern section of this district that we meet with the most populous and flourishing of the interesting tribes known as Pueblo Indians; here they secure not only defensive positions for their towns on the tabled summits of isolated hills, but also fertile valleys adjoining, suited to their rude agriculture, and a wild scope of grazing country, limited only by the necessity of protection from the thievish and roving Navajo and Apache.

What is known as the Navajo country, extending still further to the west and north, comprises a similar character of broken country with fertile valleys, grassy slopes, and deeply sheltered cañons, especially adapted to their mode of life as nomadic and at the same time partially agricultural; still better suited, however, to the wants of an energetic civilized community, who can properly appreciate the advantages of a healthful climate, combined with a useful variety of soil, and that picturesque beauty of scenery, which adds such a charm to rural life.

In passing to the valley of the Colorado, we descend by a succession of irregular mountain ranges and basin valleys, becoming more arid as they reach a lower elevation, and finally passing into the valley of the Colorado, characterized by its bare mountain ranges, desert uplands, and broad alluvial bottoms, supporting their peculiar semi-tropical vegetation.

II. *From the Colarado to the summit of Tehachapa Pass in the Sierra Nevada.*—After leaving the valley of the Colorado, and crossing the first range of mountains, bounding the valley on the west, we come upon that peculiar section of country properly characterized as the southern continuation of the Great Basin. In all its external features of isolated mountain ridges, separated by stretches of desert plain, and valleys with intermittent flowing streams, terminating in saline or fresh water lakes or sinks; in its numerous dry water-courses or *washes*, which convey the product of summer rains, in sudden floods, to the lower plains, it is an exact counterpart of the settled mining districts of Nevada, characterized, however, by milder winters and greater summer heats. It is also much narrower in its eastern and western extension, the entire desert tract being comprised within little over 200 miles, the valley of the Mojave occupying in its easterly course more than half of the distance.

On reaching the eastern slope of the Sierra Nevada, here much reduced in elevation, and affording a number of practicable railroad passes, we reach a well-watered country with frequent springs and small water-courses flowing from the adjoining mountains; and towards the dividing ridge, good grazing and agricultural lands are interspersed with groves of timber, presenting all the desirable features of an habitable country.

III. *The western slope of the Sierra Nevada, descending into the Tulare Valley, and thence across the coast range of California, or down the Tulare and San Joaquin valleys to the Pacific.*—This section of country comprising the southern extension of the great valley of California, is too well known to require any detailed description. It includes the rich mining and timbered district of the Sierra Nevada, the charming pastoral region of Tulare Valley, especially adapted to winter grazing; a fine belt of agricultural and timber lands, abundantly watered by the perennial streams flowing from the high snowy ranges; a second extensive timber district included in the Coast Range, and the Red-wood forest adjoining the coast, all combining with a delightful mild climate, to favor permanent settlement, whenever made accessible by railroad construction.

In order to arrive at certain definite views in reference to the particular items comprised under the general head of Physical Geography, it would seem advisable to present the subject under the following heads, viz:

1st. Climate.
2d. Supply of water.
3d. Native vegetable products.
4th. Adaptation to agriculture and grazing.
5th. Mineral products.
6th. Facilities for connected Railroad Extension to reach the different districts, naturally tributary to the main line.
7th. A general recapitulation comprising the habitable features and special wants of this section of country.

1st.—CLIMATE.

The general elevation of the interior district, extending from the Rio Grande to the Colorado, averaging over 5,000 feet above the sea, and rising at several points on the higher peaks to 12,000 feet, insures that purity of atmosphere and coolness, such

as characterizes all elevated regions. Another important feature is also connected with the general southerly slope of the country, which, while it serves to interrupt and weaken the force of the cold northern currents, admits the warm winds from the south to precipitate their moisture on the higher slopes in the form of summer rains and winter snows. Hence, we have in these elevated districts a climate favoring the growth of trees, a more equable distribution of rain and precipitation of dew throughout the year, especially adapted to the production of nutritious grasses and the cultivation of grain without resorting to expensive processes of irrigation. These desirable climatic features are especially noticeable along the elevated slopes of San Francisco Mountain, where magnificent pine forests are agreably interspersed with beautiful grassy valleys and parks, numerous springs, and a delightfully invigorating atmosphere. In passing south along the natural course of drainage, we encounter at lower elevations, numerous fertile valleys, interrupted by rocky ridges and deep canons, where the climate is milder, the summer heat more intense and the severities of winter, such as are experienced within short distances in the higher elevations, are unknown. There is, however, sufficient rain in these lower districts to support a rank vegetation, and the copious water-courses offer every facility needed, in the way of irrigation, to mature late-growing crops. These sheltered valleys and irregular rocky slopes, now resorted to by the murderous Apaches for hiding places, will offer to their future civilized inhabitants comfortable winter quarters, where their flocks and herds can be safely sheltered during the inclement season, and kept in good condition till the higher mountain slopes again invite them to their rich summer pasturage. In these favorable climatic conditions, we can safely determine the future location of the populous district of Central Arizona and New Mexico, which, very fortunately for railroad enterprise, occupies this central continental position, where extensive virgin forests, rich pastoral and agricultural lands are nearly connected with vast undeveloped mineral resources to complete those desirable features, that will invite and retain a permanent population.

In going westward from this elevated district, a gradual descent towards the valley of the Colorado is indicated by greater aridity in the atmosphere; the pine forests give place to cedars; instead of the uniform grassy sward of the mountain valleys, bunch grass occupies the plains and mountain slopes; the *agave* and *dasy lirion*, with their tough fibrous leaves, make their appearance, and with the singular shrubbery of the uplands of the Colorado Valley, give their peculiar aspect to the scenery.

A more rapid descent to the alluvial bed of the Colorado, after passing the last range of bare rugged mountains, brings to view the regular desert features of this section of country indicated by arid soil, stunted shrubbery, a prevalence of cacti, and other leafless plants. It is in this district that summer rains, in the form of thunder storms, bursting on the steep mountain slopes, occasion deluges which rush in sudden torrents to the lower valleys, marking their course by the dry water-beds, characteristic of all this section of country.

Along the course of the Colorado Valley, which at different points expands into wide alluvial basins, the climate is characterized by mild winters, with occasional frosts, sufficient to check growth, and intense summer heat giving a tropical character to the vegetation. Very little rain falls in this section, and the main reliance for cultivation is on the overflow of the river, which occurs with considerable regularity, being dependent on the melting of the snow at its extreme sources in the Rocky Mountains.

Westward from the Colorado, the ascent to the desert uplands is not of sufficient elevation to insure a precipitation of moisture from the warm southwesterly currents, which are mainly cut off by the continuous range of the Sierra Nevada to the west and south; hence over the greater part of this district, only scanty showers fall, mainly in the summer months, while the high mountain ridges occasionally receive a slight covering of winter snow. Along its western edge, however, the elevated mountain slopes come within the limits of the rainy season of the Pacific coast, and winter rains combine with melted snow to supply running water to limited valleys, which terminate at a greater or less distance in the basin plains below. Of these valleys the most extensive is that of the Mojave, which usually presents the character of a dry bed, while at other seasons it is a wide stream, bedded with quicksand and very difficult of passage. All this arid district is marked by mild winters, and intensely hot summers, giving it a semi-tropical character.

The western slopes of the Sierra Nevada, extending through the Tulare Valley, and across the coast range to the Pacific, comprises the district characterized by a rainy season, extending through the winter months, occurring in the form of deep snows on the high mountain ranges, and frequent rains in the lower valleys, favoring the growth of a rich winter pasturage. In the summer season the gradually melting snows continue the flow of water down the lower valleys, thus extending the supply through the dry warm season, and presenting favorable conditions for forest growth on their sheltered slopes.

2d.—Supply of Water.

The natural supply of water over the district under consideration, is essentially dependent on the climatic features above alluded to, and will necessarily vary according to the peculiar conditions of each particular section. Wherever mountain ranges reach a sufficient elevation to present a cool condensing surface on the track of moist southerly currents, there we shall invariably find a more or less copious precipitation, either in the form of rain, snow, or dew, giving origin to the numerous mountain streams, which unite to form the principal watered valleys of the lower districts.

The extent of this precipitation will necessarily depend upon a variety of circumstances, including the season of the year, (determining the general direction of winds,) the proximity or distance from the ocean, as well as the general topographical features of the country in obstructing or favoring the flow of atmospheric currents in certain directions. The high elevation of the Rocky Mountain Range, west of the great plains, necessarily insures an ample source of water to supply the extensive valleys to the east, which also passing through a district subject to summer rains, continue the supply unwasted by evaporation along their lower courses. Passing westward from the valley of the Rio Grande, the heights of the Sierra Madre, and the volcanic ridges of the San Mateo, give origin to numerous valleys which, though they do not present the character of continuous water-courses, contain water at different points along their line of drainage, either breaking out in the form of springs, or to be reached by superficial wells along their dry beds. In the recent volcanic districts, where overflows of lava have occupied the beds of valleys, we find the flowing water penetrating the deep fissures and porous rocks, to appear at sudden breaks in the lower course of the valleys, by which arrangement in following their deep subterranean courses, they are protected from loss by evaporation. The same character of hidden water-courses is also exhibited on the slopes of the San Francisco Mountain, where there are few running streams, but numerous springs at different points, and where copious supplies of water can undoubtedly be reached by boring through the superincumbent rocks. The valleys of the Puerco of the West, and the Colorado Chiquito, will also furnish abundant supplies either in the form of running water passing over shallow rocky beds, or to be reached by wells along their course.

Along certain sections of country lying south and west of San Francisco Mountain, where the volcanic eruptions have

been extensive and long-continued, covering up the underlying sedimentary strata with heavy accumulations of trap and basaltic rocks, the valleys assume at different points the character of deep canons, through which the ordinary drainage of the country is effected. It is along the course of these canons that natural caves and tanks retain the products of rain, and furnish the ordinary supplies of water. These natural supplies can be increased to any desired extent by the construction of artificial embankments, taking advantage of narrow gorges, where extensive basins might be formed, to retain the water accumulated during the rainy season, sufficient not only for the ordinary wants of travel, but also for purposes of irrigation in the lower alluvial basins, or even for limited water-power.

Westward towards the valley of the Colorado, recourse must be had to springs, or wells, located either in the lowest depressions of the basin valleys, or at the foot of inclined rocky ridges. In the latter position, artificial tanks might also be constructed to receive the drainage of the bare mountain slopes where the occasional rains are not absorbed by a depth of porous soil.

In the desert region west of the Colorado, springs are frequently met with on the steep slopes of mountain ridges, or issuing from beneath the broken ledges of metamorphic rocks. The flow of these springs is soon lost in the deep sandy layers of the lower plains, but might be extended by pipes or covered ditches to a long distance, if required to reach convenient railroad stations. The same condition of things which allows the existence of natural springs would also warrant the opinion that an aqueous substratum underlies all the depressed basins and valleys which would naturally be selected as affording the easiest grade for a railroad route. Hence by digging at sufficient depth to reach an impervious layer, water will no doubt be found in sufficient quantity for railroad purposes. Such supplies would be quite superficial along the line of such an extensive water-course as the Mojave, and would also be copious and abundant towards the base of the Sierra Nevada, where the numerous streams from the snowy range lose themselves in their deep sandy beds, or go to form the extensive "dry lakes" of that district.

The deep sandy layers here answer the same purposes as the porous lava rock of the volcanic districts, in protecting the essential supplies of water from loss by surface evaporation.

The well-watered region of the Sierra Nevada and coast valleys, does not present any practical question in reference to supplies of water for railroad purposes.

3d.—Native Vegetable Products.

The peculiar character of the natural vegetation of any region is dependent on the combined influence of soil and climate, and often affords the best means of determining their general features on a limited and imperfect view. Thus, a certain degree of moisture in the atmosphere, absence of extreme heat, and a sheltered location, combined with a coarse soil, and superficial rock exposure are most favorable to the growth of pine forests, and wherever on our route these peculiar conditions exist, there we find them exhibited in the greatest perfection. The true pine belt of this interior portion of the continent, ranges between 6,000 and 10,000 feet above the sea; here it secures the needful moisture in the form of rain, dew, or winter snow, and is also naturally associated with the protruded granite rocks that form the central nucleus of the higher ridges. *It would be difficult to conceive of a more convenient distribution of these pine forests for railroad construction or transportation, than that presented on the line of the 35th parallel.* Intercepting first the high pine clad ridges of the Rocky Mountains, it skirts for some distance their eastern base, thus rendering accessible the great bulk of timber products to supply the treeless wastes of the great plains; and by means of the passes leading to the valley of the Rio Grande, furnishes that extensive agricultural district with the material for building, bridging, and railroad construction, of which this valley is remarkably deficient.

Still further westward the high ridges of the Sierra Madre, while offering everything desired in the way of satisfactory railroad passes, presents on the higher adjoining ridges, including the elevated volcanic peaks of San Mateo, a magnificent growth of untouched forests especially adapted to the supply of treeless districts to the east and west. Beyond this again the valley of the Colorado Chiquito, with its scattering growth of cottonwood, is within accessible distance of the pine region of the Sierra Blanca or Mogoyon Range to the south; while westward on the direct line of the railroad survey, are the unequalled pine forests of the San Francisco and the elevated mountains beyond, whose timber product will continue the supply to the valley of the Colorado, to meet still further west the inexhaustible pine region of the Sierra Nevada of California, and the Pine and Redwood of the Coast Range and its spurs. Thus it will be seen that along the entire route, located at convenient distances for transportation and directly available for the supply of adjoining treeless districts, is an

abundant source of this necessary article, not only amply sufficient for all prospective needs of railroad construction, *but also furnishing a material for profitable transportation to adjoining mineral and agricultural districts.*

At certain lower elevations where the aridity of the soil and atmosphere is unfavorable to the growth of pine or oak adapted to building purposes, there is a more stunted growth of piñon and juniper, which covers extensive mountain tracts, and is especially suited for fuel. These occur over districts remote from coal deposits, and will furnish the necessary material for locomotive use, or manufacturing and domestic purposes. In certain portions of the valley of the Colorado and adjoining desert tracts, we find several varieties of hard wood, including Mesquite and iron-wood which, makes an excellent charcoal, especially adapted to smelting operations.

Besides these timber and fuel products, the desert region adjoining the Colorado and extending to the base of the Sierra Nevada, affords a variety of vegetable fibrous products, derived from the *wild flax*, the *Agave* and the *Yucca*, which will eventually come into extensive use and may furnish material for profitable transportation. Other articles in the way of dye-stuffs, or tanning material, and medicinal drugs may also be reasonably expected to enter in to the natural vegetable resources of this region, when properly examined and developed.

4th.—Adaptation to Agriculture and Grazing.

The variable conditions of climate and soil necessarily determine the character of agricultural capacity or adaptation for grazing. We have seen that a certain degree of elevation in this medium latitude of 35° is necessary to secure atmospheric moisture, favorable to the growth of trees or nutritious grasses. Districts thus elevated are especially adapted to the growth of small grain while the lower alluvial valleys deriving their main supplies of water from these higher sources, are best suited to the growth of corn, fruits, and other staples requiring a higher temperature and longer growing season. Hence, the mountain districts and higher alluvial slopes present a well-marked district adapted to the growth of timber, small grain and summer grazing, while the lower valleys supply farming lands suitable for corn, vineyards and orchards, and offer desirable locations for permanent settlement. Over all this section of country, except the more arid tracts, the uplands are occupied with a peculiar growth of grasses and shrubbery, especially adapted to stock raising. The great va-

riety of these different exposures, according to their elevation or geological structure, occasions a prominent difference in their relative capacity for supporting animal life.

Thus certain desert tracts, on which, during the greater part of the year, no animal could live on account of absence of water, and scarcity of grass, during a short rainy season may be clothed with a verdure capable of sustaining immense herds. Again the lower valleys, which in the winter season afford shelter and pasturage for stock, which can be kept in good condition on the refuse of agricultural fields, become parched and oppressively warm in the summer season, so that the fresh pasturage of the high mountain ridges is preferable. Hence, successful stock raising in this central district will naturally be more or less of a roving character and be carried on by a class of shepherds and herders adapted to the nomadic mode of life. When thus regulated, agricultural and pastoral pursuits profitably complement each other and both unite to sustain the largest population and yield the greatest amount of surplus products of which this section is capable. Sufficient is now known of the central section of country now under special consideration, to characterize it as *at least self-sustaining in an agricultural point of view, and capable of immense production for export of animal products, from the proper development of its pastoral resources.* In the valley of the Colorado the semi-tropical character of the climate adapts it to the growth of staple products pertaining to warm countries, including especially cotton, hemp, tobacco, and sub-tropical fruits, while the mild winter seasons admit the successful growth of wheat which may be harvested before the period of river overflow, to be succeeded the same season by a late maturing corn crop. A large section of this country is naturally adapted to fruit, of which the various surface exposures may be suited to different varieties. The cultivated grape has long been successfully raised in the alluvial bottoms of the Rio Grande, and also seems particularly adapted to sections where volcanic rocks are exposed on the surface, the decomposition of which, supplies a large percentage of potash, necessary to perfect the rich vinous juices adapted to wine making. Peaches are extensively raised by the Pueblo Indians in the sheltered valleys and cañons of the district they inhabit, where, without any special care or resort to irrigation, they produce abundantly and attain a great age. The native fruits, including especially the Cacti, have an agreeably acid flavor, and might by cultivation be so improved as to add an important item to the wholesome diet of this region. They are already much used and esteemed in Sonora, Sinaloa, &c.

In the California valleys west of the Sierra Nevada we encountered the moist winter climate and abundant supplies of irrigating water, which insure the successful growth of the rich agricultural products pertaining to that favored region and especially adapted to supply the more barren mining districts to the east.

5th.—Mineral Products.

The mineral products of this region in their particular relation to railroad enterprises, may be best considered under two distincts groups, viz:

1st. Such as are directly connected with the construction or operation of railroad work.

2d. Such as are calculated to yield renunerative business in the supply of local or through freight.

Under the first head of material required for direct use, in the matter of railroad construction and working, the most important are *coal* and *iron*.

These two minerals are generally associated together, or more properly stated, the widely spread ores of iron are generally met with in connection with workable coal beds, and their value depends in great measure on this connection.

After leaving the coal beds of the Missouri Valley belonging to the regular carboniferous rocks, of the geological series, a more recent formation underlies the country forming the substatum of the great plains, and reaches continuously to the Rocky Mountains, where its upturned edges are exposed in contact with metamorphic and igneous rocks. The principal thickness of this, is made up of the cretaceous formation, characterized by a succession of sandstones, marls and clays of more or less coherence, easily recognized by its peculiar fossils. Still above this, and occupying original basins of depression in the lower series, we occasionally encounter tertiary strata, with their peculiar fossils and variable lithological characters. In both of these formations, coal is found in the form of lignite beds of greater or less thickness, generally exposed in nearly horizontal layers, except where they have been subjected to dislocation by subsequent disturbance of the enclosing strata. Recent extended examinations seems to show that the largest and most valuable of these recent coal deposits are connected with the tertiary strata, such being the formation in which the thick beds of carbonaceous deposits are met with. along the eastern slope of the Rocky Mountains, extending from the vicinity of Long's Peak to the western tributaries

of the Arkansas, the Cimarron, the Canadian, and the Pecos. The coal on Hardscrabble Creek, near Cañon City, probably belongs to this formation, and on the direct line of the proposed railroad route the extensive beds of the Raton Mountains are of the same character, so that these may be regarded as the productive coal measures of the district adjoining the eastern slope of the Rocky Mountains. A description of these veins and the quality of the coal, is contained in the report of Dr. J. L. Leconte, Geogolist to the same survey, according to whose examinations the coal here met with, is much superior to the same class of coals found in Europe.

But besides these well-determined beds so conveniently located for railroad purposes, we meet with other deposits in the valley of the Rio Grande, the Puerco of the west, the San José and Ojo Pescado, *showing an extension of the coal deposits fully two hundred miles west of the Rio Grande.* The precise character of these deposits is not yet fully determined; most of the beds here exposed consist of thin irregular seams, widening out at points to a workable thickness, and at other times associated with igneous protrusions that have converted them into anthracite. The most promising of these beds are those connected with the Puerco coal basin, which may prove to be tertiary; they present a succession of beds from two to five feet in thickness, generally steeply inclined and associated with shales and sandstones, containing frequent bands of iron ore. To determine satisfactorily the precise character and actual value of these deposits would require detailed examinations and extensive excavations, which can be more advantageously effected in the process of railroad construction. In the meantime the large extent of country over which these deposits are found, warrants a reasonable expectation, that when thoroughly examined the coal product of this section will be ample to meet the requirements of railroad fuel, and afford freighting material for transportation to destitute districts.

Other crude material connected with the work of economical railroad construction, such as building-stone, lime, cement, gypsum, clay, etc., are located along the line of the road at such distances that they can be conveniently employed in processes of first construction and repairs, and also afford material for transportation. In this class is especially noticeable the superior quality and great abundance of rock suitable for buildings or heavy masonary, which in different varieties of texture and composition adapt them to a great variety of special uses.

Gold and Silver.

The precious metals which generally constitute the first objects of search in a new country, are everywhere associated with those altered rocks which in the process of metamorphism have been not only changed in structure, but are necessarily disturbed in position, and are thus brought to view in the most irregular and rough outline. Wherever this class of rocks are met with there we find the outcropping of mineral veins of greater or less richness. No section of country presents a wider extent or more favorable geological indications of rich mineral veins than that traversed along the line of the 35th parallel. From the easternmost range of the Rocky Mountains on the east to the Sierra Nevada on the west, both inclusive, this class of metalliferous rocks is more or less exposed to view, forming the high gigantic ridges of extended continental ranges, or the sharp crests of isolated desert mountains. Over all this district, prospecting reveals the presence of placer gold, which could be profitably worked whenever sufficient supplies of water can be furnished, and the outcropping quartz veins everywhere show the original source of supply available for increased production whenever the proper appliances in the way of machinery can be reasonably procured. Silver is very generally associated with the ores of lead and copper, and also occurs in the form of chloride and black oxide, associated with more or less gold. These precious metals require railroad facilities, not so much for conveying their products to market in the form of bulky ores, as the cheap transportation of supplies, heavy machinery and fuel to reduce them on the spot to small dimensions for convenient handling, or to the still more concentrated form of bullion or metal. The advantages of safe and rapid transportation for treasure will, moreover, always insure large remuneration in proportion to the actual weight carried, and by giving increased safety to regular transmission, will, to the same extent, stimulate production wherever, as in this region, the abundance and richness of mineral veins are capable of unlimited developement.

Lead and Copper.

The very extensive deposits of lead and copper met with at various points near the proposed railroad line, occur in the form of ores of variable degrees of richness, frequently associated with a small amount of gold and silver. Owing to the great cost of living and transportation, only the richer ores,

containing 30 to 50 per cent. of metal, can be profitably mined and transported to the sea-board. But with the increased facilities of transportation and the cheap procuring of supplies, thus diminishing the cost of production, the lower grade ores can be profitably mined, and will thus afford remunerative freight to a railroad, and at the same time stimulate production and mining industry, to assist materially in the development of a large scope of mining country which would otherwise lie dormant. At the present time only the rich copper deposits of Williams' Fork are successfully worked, the ore being carefully assorted and transported by the tedious and expensive route of the Colorado River and the Gulf of California to San Francisco; thence the main bulk is shipped by way of Cape Horn to Swansea, Wales, where it is finally reduced and put into a marketable form as metallic copper, the small percentage of gold and silver being also extracted for the sole benefit of the foreign metallurgist. Could the same ore, or a much poorer quality, be rapidly transported by rail to the sea-board, or to the coal district eastward and there reduced, the immense saving of time and the regularity of the supply, would soon serve to build up in our own country, this profitable branch of metallic reduction, while at the same time it would directly stimulate mining developments, not only in the original locality from which the ores are taken, but also in the coal region to which they may be transported.

In general terms it would be safe to assert as the result of our observations over this entire mineral region, extending from the eastern base of the Rocky Mountains to the Pacific coast, that the proper railroad facilities comprise *all* that is necessary to induce capital and labor to enter into this new field of mining industry, and develop to the fullest extent its productive resources.

6th.—Facilities for Connected Railroad Extension to Reach the Different Districts, Naturally Tributary to the Main Line.

Only one other examination as above stated is necessary to complete our general view of the comparative advantages of this proposed railroad route across the continent, near the 35th parallel. Its intersection, as above noted in its western extension, with a general southerly slope of the country crossing the great interior valleys of the Rio Grande and the Colorado, will naturally connect it with a subsequent extension of branches north and south, to meet the wants of these accessi-

ble districts. This will insure an ultimate connection between the mining and semi-tropical region of Northern Mexico, and the pastoral, agricultural and timbered districts of New Mexico and Arizona.

Further westward on reaching the eastern base of the Sierra Nevada, it will accommodate the trade, naturally seeking an outlet from Southern Utah and Nevada to the sea-board, by avoiding the inaccessible heights of the northern extension of the Sierra and seeking the low passes by which it is directly connected with the fertile plains of Tulare or the rich valley of Los Angelos and San Bernardino. The extension of these branches will naturally follow the building of a main trunk, and will be a process directly proportioned to the wants of the adjoining regions, and will be only limited by the complete development of the same in all their peculiar interests, as mining, agricultural or manufacturing districts.

GENERAL RECAPITULATION.

The general comparative advantages of this trans-continental route along the 35th parallel may be thus briefly summed up:

A salubrious climate favorable to health and activity, accessible to the moist southerly currents, while at the same time protected from the severe northern blasts, receiving along the higher elevations precipitation of rain and snow sufficient to favor the growth of natural forests and upland grasses, without forming any obstruction to winter travel.

A pleasant variety of atmospheric temperature, connected with differences of elevation or exposure in closely adjoining districts, which can be selected to suit the requirements of the season, or the particular taste of individuals.

An agricultural capacity that in its proper development can be made ample to supply the prospective wants of this region, and in the production of fruits and garden vegetables, can afford the delicacies that enter into the essential wants of civilized communities.

A pastoral region unequalled in the extent or quality of its grasses, which, in adjoining districts, keeps up a constant supply of nutritious fodder through the year, requiring only the light labor of herding to secure the remunerative returns of this branch of industry.

A mining region yet undeveloped but sufficiently known to be characterized as second to none on the continent in the ex-

tent and variety of its mineral products, only waiting for the facilities of railroad transportation to invite and retain permanent capital and industrious labor.

A location of route which presents the special advantages of a main trunk line in being naturally connected with adjoining rich districts that will thus seek an oulet by branch roads to central commercial points.

All these several conditions combine to present those habitable features which render the construction of a continuous railroad route not only highly desirable, but as a matter of speedy development, essentially necessary.

Respectfully submitted,

(Signed) C. C. PARRY,

Geologist and Naturalist of the Survey.

Washington, April 3d, 1868.

Extract from Dr. Parry's Detailed Report.

Botany of the region along the line of the Union Pacific Railway, Eastern Division, with a list of the Plants collected on the Surveys in 1867, through Kansas, Colorado, New Mexico, Arizona and California.

BY C. C. PARRY, M. D., NATURALIST TO THE SURVEY.

The native vegetation, which is the most prominent external feature that first attracts the eye of the observing traveler in a new country, is found, on a more careful examination, to afford the most direct means of arriving at those peculiarities of soil and climate that indicate its capacity for agricultural productiveness, as well as it adaptation for desirable civilized habitation. Hence, lists of plants, especially in regions that have not been subjected to long experience or modification in the pursuits of agriculture, are valuable as indicating the particular class of vegetable products to which they are best adapted, or whether they are unfit to reward human industry by profitable returns.

The unguarded and loose use of the term "desert," as employed not only in popular writings, but also in scientific descriptions, has given origin to wrong impressions in reference to a large portion of our Western Territories, that hold with remarkable persistence, both on the popular and scientific mind. Thus, although to a certain extent the desert wastes of our old geographies are contracted, or pushed farther west into unexplored districts, the prevalent idea remains, that much of the Continental region, beyond 100° of west longitude, is unproductive and unfitted for human habitation.

The readiest means of correcting this wrong impression would be to exhibit the plants which naturally grow on these supposed desert wastes; or, to one somewhat versed in the nomenclature of botany, a list of the native plants of such a district would serve at once to dispel this old and cherished illusion. Thus, let the intelligent traveler pass through central Kansas, in the month of September, and note the gigantic weeds and sunflowers that all but obstruct his view along the beaten road, and it will not be difficult to convince him, that where such rank annual vegetation can secure nourishment, there corn and other useful agricultural products can be raised in perfection. Or, on the great plains beyond, let him see the broad uplands, bedded with nutritious grasses, and he will not be slow in arriving at the conclusion, that, if only partially adapted to agriculture, it certainly possesses great pastoral capacities. Still farther west, where mountain slopes bound rich alluvial valleys, well watered, and displaying a luxuriant vegetation, familiar in many of its aspects to what he has been accustomed to in cultivated Eastern countries, he will have no hesitation in assuming that, with ordinary facilities for working the soil, still

greater returns will reward his toil from the virgin sod, unexhausted by protracted culture. Again, where natural forests abound, there we may reasonably expect to find all the conditions of successful tree or fruit culture; and even where many of these indications are wanting, a soil rich in mineral ingredients for the growth of plants, but exposed to the intense aridity of a rainless sky, may be restored to fertility by processes of artificial irrigation. Thus, according to past experience, the real danger to be guarded against in estimating the productive capacity of an undeveloped country, is an undue depreciation of its real value, and where definite knowledge of natural products is substituted for easy ignorance, the deserts disappear from our geographic horizon.

The list of plants herewith presented, is a contribution from one of the latest and most complete railroad surveys ever conducted on this continent, to our knowledge of the natural vegetation of the far West. Without aiming to be complete, it is at least sufficient to show, that along the entire length of the railroad survey, extending from Kansas through south-eastern Colorado, New Mexico and Arizona, to the Pacific, there is an extent of habitable country, which only needs to be made easily accessible from the populous districts of the Mississippi Valley, and the western seaboard, to support and maintain a prosperous and civilized population.

Commencing with central Kansas, we note the rank vegetation pertaining to rich alluvial districts; the bottom lands are occupied with a heavy growth of forest trees, including elm, black walnut, hackberry, ash and cottonwood; the uplands support rank prairie grasses and a variety of plants, exhibiting a strange mingling of north-western and more southern forms, corresponding to the peculiar mixed climate which characterizes this section. Proceeding westward a gradually increasing atmospheric aridity is evidenced by the gradual disappearance of forest growth, which is confined to the moist margins of constant streams, or water-courses dry during the summer season, and is represented only by the persistent cottonwood, box-elder and willow. On the uplands buffalo grass and *gramma* take the place of the rank prairie sod, and are characterized by a short curly growth and dense fibrous roots, often growing in clumps, and penetrating deeply into the dry though still nutritious soil. Still farther west we find the depressed basins and valleys, exhibiting a white saline efflorescence, due to the intense evaporation which, in the dry season, concentrates the saline ingredients derived from the washed soil of the uplands, on the saturated bottoms overflowed in the season of rains. With this peculiar condition of things we meet with a class of saline plants, many of them identical with such as are found along the seashore, or in connection with salt marshes. Here the uplands acquire more distinctly an arid feature, to which, however, the term of desert cannot be properly applied, as, although in a great measure unfit for ordinary agriculture, they still support a close growth of peculiar grasses which, in the summer rainy season, assume a dull verdure, and in the succeeding

dry season become converted into a nutritious hay, the saccharine and organized juices being concentrated in the dried perennial stem and leaves.

On the upper alluvial benches of the principal valleys we encounter dense moorish growths of "wild sage," (*artemesia,*) *sarcobatis*, and *obione*, or grease-wood, well known to all western explorers.

The conditions essential for timber growth, viz: superficial moisture, and shelter from fierce winds, are here confined to the deeper valleys and constant large water-courses, where cottonwood and willow maintain a variable existence, occasionally occurring in extensive tracts along the Arkansas and the Republican, while elsewhere the country presents a treeless and open waste.

The idea frequently suggested by those unacquainted with the true physical features of this section of country, of planting trees, and thus securing shelter and an increased precipitation of moisture, will by no means stand the test of a common sense view, when the objects to be gained are precisely such as the country does not naturally admit of; and, furthermore, its perfect adaptation to grazing is so manifest, that any other view of its application to useful production is not even to be desired.

Before reaching that point of extreme aridity, which a continuous open and level country would no doubt eventually reach, deserving the name of a true desert, (and which is actually realized further south in the staked plains of Texas,) we encounter the abrupt elevation presented by the Rocky Mountain Range, with its steep broken slopes, and irregular rocky spurs. This at once changes the whole aspect of scenery; its elevated ridges and snow-clad peaks, presenting a cool condensing surface, on which the warm moist currents of air are deposited in the form of summer rains and winter snows. These necessarily give rise to perennial streams and springs, which send their watery tributes to the arid plains below, and maintain verdure in the lower valleys, which are thus adapted to cultivation by processes of irrigation.

This obvious change from increasing aridity to sufficient moisture is at once characterized by a great profusion of vegetation, including trees, shrubbery, and a variety of plants, either identical or similar to such as are met with in well watered mountain districts to the east. Where a sufficient elevation is attained to insure a constantly cool atmosphere, forests abound, consisting mainly of evergreen pines, spruce and fir, but also including a scattering growth of scrubby oak, maple, birch, cottonwood and willow.

The principal valleys that penetrate this mountain district, including the Arkansas, with its numerous branches, as the Huerfano, Purgatory and Greenhorn, comprise sections of great natural fertility, abundantly watered, and conveniently located for supplying adjoining mining districts with their surplus agricultural products. Hence they represent the main populous districts, which, combining all the agreeable accessories of a fine salubrious climate, and conveniences for

building, and fuel, will invite and retain a permanent population, devoted to the mixed pursuits of agriculture and grazing. In the accompanying list of plants, those referred to as occurring in the valley of the Huerfano and Sangre de Christo, will serve to represent the natural vegetation of this peculiar mountain district.

In passing down into the valley of the Upper Rio Grande we encounter a flora very distinct in its general features, including a number of peculiar plants and strange shrubbery, having a Mexican type. The river here, hemmed in along a great portion of its upper course by dark igneous and basaltic rocks, flows in deep inaccessible cañons, which open out below into wide sandy basins. The San Luis Valley, lying above this cañoned portion of the valley, presents a wide alluvial basin, including extensive tracts of fertile soil lying along the course of the numerous tributary streams flowing down from the high mountain ridges on either side of the main valley. This section is particularly adapted to the growth of cereals and root crops, and in its cool atmosphere, abundance of grass and clear flowing water, is eminently a dairy region. In these respects the two portions of the main valley, designated by the Mexican population as the Upper and Lower River, maintain the natural distinction in their products—the former being adapted to small grains, potatoes, butter and cheese, the latter to corn and fruits. In this condition of things an exchange of products would prove of mutual advantage, and afford profitable business in the way of transportation in both directions.

The natural supply of fuel, for all this region, is furnished in the extensive forests of Piñon and Cedar, which occupy adjoining rocky and barren ridges, while the higher mountain ranges will supply lumber and building material to any desired extent.

The lower portion of the valley of the Rio Grande includes the district generally referred to as New Mexico. Here we find the valley spread out into wide alluvial or sandy bottoms, bounded by bluffs of gravel and occasional rocky declivities capped with basalt. The flora here includes the plants referred to in the accompanying list as New Mexican. Owing to the more porous nature of the soil, and the greater summer heat, the general aspect of vegetation is characterized as arid. There is a scarcity of tree growth, confined to the cottonwood and willow, which occupy the moist bottoms or direct margins of the river. The grass of the valley is coarse and frequently saline, and on the adjoining uplands it is scant, though of a nutritious quality. The low bottom lands, susceptible of irrigation, are well adapted to the growth of corn, vines and peaches, being subject to irregular overflows, which, when moderate in extent, and occurring at the proper season, help to maintain the natural fertility of the soil, but are occasionally very destructive, in flooding growing crops, or undermining and transporting large tracts of fertile soil, leaving in its place the coarse sandy layers of the changeable river bed. At other points of the valley the prevalent westerly winds gather up the light drifting sands of the adjoining bluffs and deposit them in changable,

ripple-marked dunes, on the fertile bottoms, thus consigning them to an hopeless sterility as well as obstructing the ordinary roads by their deep sandy beds. Still further south, in the neighborhood of Socorro, sub-tropical shrubs, including *Acacia*, *Mesquite* and *Larrea* make their appearance, marking the northern limits of the Mexican flora.

On the uplands west of the Rio Grande, near the 35th parallel, west longitude, we meet with a great variety of surface exposures. These are exhibited in extensive *mesas*, or table land, composed of light-colored porous sedimentary rocks, bounding with abrupt mural faces, valleys of erosion; these strata are interrupted at various points by igneous protrusions, and overflows of basalt and lava, serving to diversify in a remarkable manner the external features of scenery, and modify the texture and composition of the overlying soil. This is especially noticeable in the character of the native vegetation, which is directly adapted to these variable conditions. Thus, on the dry uplands and *mesas* we find a scattered growth of *gramma*, interrupted with occasional growths of cedar and *pinon*. On the more elevated mountain ridges we meet with dense forests of Rocky Mountain pines, spruce and fir, intermingled in favorable locations with oak and aspen. The lower valleys, adapted to agriculture, support a growth of coarse grass and shrubbery, interrupted by occasional bare saline flats. In certain sections of this district deep *canoned* valleys conceal from view clear running streams in which the vegetation is rank and luxuriant, while at other points the valleys expand into wide grassy basins, where, during the dry season, running water disappears from the surface, or is exhibited only in brackish springs. This character of country comprises the favorite home of the roving Navajo and Apache, and, in certain defensive positions, has been occupied since the earliest historic periods by the industrious and contented Pueblo Indians. It extends with slight variations, through western New Mexico and northern Arizona, the surveyed rail route on the 35th parallel traversing the most desirable portions. Being passed over by the surveying parties during the late fall and winter months, only an imperfect view of its botanical features could be obtained, but the faded vestiges of floral beauty were manifested on every hand to testify to the luxuriant richness of its summer dress.

The uplands of the Valley of the Colorado, and the desert stretches beyond, extending to the foot of the Sierra Navada, comprise a singular and very interesting flora, the general features of which, though not thoroughly examined, are still fairly represented in scientific collections. Here arborescent *Cacti* and *tree Yuccas* form a conspicuous feature in the landscape, and desert forms exhibit the neat evergreen *Larrea*, with its myrtle-shaped leaves, together with a host of thorny *Mimoseæ*, dull-colored *Obione*, or grease-wood, and prevalent *Artemisias*, all serving to give a faded aspect to the vegetation.

The annual growth is here exceedingly rapid and evanescent, and consists mainly of delicate grasses and tender-foliaged plants, which expand quickly with the early spring rains, and disappear as suddenly

when the scorching sun licks up the superficial moisture, leaving no trace of their previous existence, save the diminutive seeds buried from sight in the light drifting sand or gravelly soil. In the dry water-courses of this district we meet very constantly the *Cercidium floridum*, or "green-barked Acacia," the arborescent Dalea, (*Dalea spinosa*,) with its silvery leafless branches, and the valuable "Iron-wood," (*Olnega tessta.*) The *Chilopsis linearis*, allied to *Catalpa*, is also abundant, being known under the common name of the "Desert willow," its long slender branches being used by the Indians for basket work. In the river bottoms we meet with luxuriant growths of *mesquite* and "screw bean," the former furnishing a very durable wood, affording excellent fuel, occasionally of sufficient size for rail-road ties; the *screw bean* is the principal reliance for feeding mules and cattle as a substitute for grain.

Most of the plants of this district, including especially the *Artemisias* and other shrubby *compositæ*, are smeared with a resinous varnish, which gives out a pleasant stimulating aroma, noticed by nearly all desert travelers. It is quite probable that some of these plants possess valuable medicinal qualities, or are adapted for dies or varnishes, presenting a subject well worthy of investigation.

In reaching the Pacific slope of the California Mountains, the rich vegetation of this district is brought forcibly to view, in contrast with the desert forms before noticed. In the moist humid soil of the mountain valleys we here meet with those gigantic monsters of the forest met with nowhere else. Broad spreading oaks, both evergreen and deciduous, nourish in their leafy shade delicate plants and vigorous shrubbery, while the open valleys and hilly slopes present a patch-work of flowers rivaling the colors of the rainbow. This rich botanical field, which has already given many choice plants to enrich eastern gardens, is not yet exhausted, and new discoveries are being made every year by the zealous botanists connected with the California State Geological Survey. A regular flora of this region is now in course of preparation by Prof. W. H. Brewer, under the able assistance of Prof. Gray, of Cambridge, Mass.

THE FOREST TREES ON THE ROUTE OF THE SURVEY.

The importance of the tree product near the line of the surveyed railroad route, both as regards supplies of fuel and purposes of construction and repairs, are of sufficient importance to receive some special notice in a general botanical report.

After leaving the wooded district of eastern Kansas, which occupies the principal valleys with belts of timber of variable extent, which diminish rapidly to the west, we at length near the 100°, west longitude, enter upon a treeless district, extending for over 5°, and reaching to the foot of the Rocky Mountains. Here, with an increase of elevation, and condensation of moisture, we encounter the pine forests of eastern Colorado. A very remarkable outlier of this pine growth

occupies an elevated district, south-east of Denver, which, not properly pertaining to the Rocky Mountain Range, in the absence of granitic or metamorphic rocks, is comparatively smooth in its general outline and easily accessible. The forest growth is here almost exclusively confined to the Rocky Mountain yellow pine, (*Pinus ponderosa*,) which, from its durable quality, regularity of growth, and facility for working up into the different qualities of lumber, is probably the most valuable of any western pine. When growing singly this pine is apt to assume a branching shape, with an irregular oval outline; but, in extensive forests, it presents a more uniform trunk, less knotty, and better suited for boards and dimension lumber. The interior wood, being to a considerable extent impregnated with resin, renders it durable and well adapted for railroad ties. This is the prevalent pine tree which is met with on all the elevated mountain slopes extending from the eastern Rocky Mountains to the Sierra Nevada.

Farther to the south of the Denver pine region, along the different lines of the surveyed railroad route through southern Colorado and New Mexico, a very different and peculiar pine makes its appearance along the foot-hills of the Rocky Mountains, clothing the low rocky ledges with patches of dark green, as seen in a distant view. This is the nut pine, or *Pinon* of the natives, *Pinus edulis* of botanists. It is generally of a low branching habit, its short stocky trunk dividing near the surface of the ground into branching arms, giving it a globular outline. When growing in large bodies its straggling branches intertwine to form almost inextricable thickets. It is generally associated, at lower elevations, with a cedar, (*Juniperus occidentalis*,) of a similar straggling habit, which further west gives place to the Arizona Juniper, *Juniperus pachyphlœa*, Torr.) These trees are all well adapted for fuel, burning when dry, with a clear intense flame, which is prolonged and steady, especially suited for steam purposes. In some sections the *pinon* presents a more upright growth, and has short uniform trunks, suitable for railroad ties. The wood is durable but knotty, and with a twisted fibre, so that it is unfitted for other purposes of construction.

The distribution of the piñon and cedar forests are particularly favorable for convenient supplies of railroad fuel, being scattered along the line of the route, easily accessible, and in inexhaustible amount, the range extending through New Mexico, northern Arizona, and to the eastern base of the Sierra Nevada in California.

On the higher crests of the Rocky Mountains, the Sierra Madre, San Francisco, and the Sierra Nevada, we meet with other varieties of pine and spruce, occasionally forming extensive forests, and affording material for the various uses to which different tree products are adapted. Of these we may specify the *Pino real*, (*Pinus contorta*,) which is noted for its slim regular growth, particularly suited for telegraph poles and cross-ties; the Douglas spruce, or mountain hemlock, affording a very durable and tough wood; Menzies spruce and *Abies Engelmanni*, the latter furnishing a light soft wood, well adapted to inside work. Besides these, on the high alpine ridges

we meet with *Pinus flexilis* and *Pinus aristata*, which extend to the extreme limits of tree growth on the Rocky Mountains and the Sierra Nevada.

It will be noticed that hardly any mention has been made of hard wood, as oak, ash or walnut, in this central mountain region; while we have representatives of each of these, they are so comparatively rare, or of such insignificant growth, as not properly to enter into the account in any economical view of our central mountain forests. In certain sections of the Rocky Mountains, and the lower valleys of the San Francisco Mountains, we meet with a deciduous-leaved white oak, sometimes of fair size, and suitable for railroad and timber, but generally of scrubby growth, and not fit for any useful purposes of construction. The same is true of the occasional scattering growths of walnut and ash, which are rarely of sufficient size or quantity to attract attention.

But, on reaching the Sierra Nevada Range, in California, we meet not only with a great variety of peculiar pines and firs, but also large oaks, forming extensive forests, and well adapted to all the required uses of hard wood in eastern countries. Of those deserving of special notice is the white oak, (*Quercus lobata*,) found along the eastern tributaries of the Tulare Valley; these present perfect giants of vegetable growth, and cover extensive tracts of country. Besides this there are several varieties of live-oak, occupying the interior and coast ranges, which, though not generally durable, and of a stocky growth, are no doubt applicable to a variety of useful purposes. Then we have the redwood forests of the Coast Range, the timber of which is highly prized for its durability and facility for working. The peculiar qualities and distribution of the California forests would require a long special report to do justice to the subject, and will no doubt eventually receive attention when the railroad interests of that section call for definite information. For other items of information in regard to the botany of the region connected with the railroad survey, reference may be had to the following list of plants:

(This list has been compelled to be omitted.)

Extract from Dr. Parry's Geological Report

MINERAL DISTRICT OF CENTRAL AND WESTERN ARIZONA—GENERAL FEATURES.

The prolongation of the Pineleno Range of Mountains, extending from the south to the north-west, through central Arizona, exhibits, particularly in its northern extension, a well defined axis of metamorphic granite. In the mining district to the south and east of Prescott, this axis spreads out into various distinct spurs, forming a very broken water shed at the head of the Hassayampa and Agua Frio Valleys. It is particularly along the slopes of these different spurs that mineral-bearing ledges crop out, showing a very uniform direction of lodes in the separate districts, and maintaining a very similar character of mineral contents, evidently pointing to a common origin. Along the flanks of this main axis there is a more or less extensive protrusion of igneous rocks, serving to isolate the mineral formation into separate basins, some of which, as at Wickenburg and along the course of the Colorado, are quite rich over a limited area. Over all this district the placer gold washings derived from natural denudation are what are significantly termed "spotted," being at certain points quite rich, and again, in apparantly equally favorable locations, unproductive. It must, however, be constantly borne in mind, that the great natural impediments in the way of mineral exploration, arising from Indian hostilities, difficulties of transportation and scarcity of water, have prevented a proper development of mining industry, and the actual wealth of this mineral district remains yet to be brought to light.

CHARACTER OF THE MINERAL VEINS.

The different mineral veins, though varying considerably in width and extent, show considerable uniformity in direction, dip and mineral composition in the same district, so much so that an experienced person can generally determine the locality to which they belong from average hand specimens. All of these veins vary along different points of their exposure; rich mineral streaks traversing the quartz matrix, showing occasional expansions termed "pockets" and "chimneys," or again, "pinched up," and giving place to the ordinary vein material.

In the Big-bug, Hassayampa and adjoining districts the surface vein exhibits a decomposed honeycomb appearance, being stained by iron rust, and showing at certain points spangles and filaments of free gold, visible to the naked eye. At a variable depth of from 30 to 50 feet, (being below the action of atmospheric influence,) the mineral

contents assume the form of crystalized sulphurets of lead and iron, still containing, according to assays, a workable amount of precious metal, but not capable of being extracted by the ordinary stamp process. Hence, many of the best paying lodes have been abandoned after reaching the sulphurets, and a large amount of capital invested in machinery and mills now lies idle, waiting for more improved processes, by which the refractory ores can be made to yield their rich ingredients of gold and silver.

Most of the mineral veins show a well defined wall on either side, sometimes composed of clay or talc, forming a smooth lining known as "slickensides;" in many other cases the wall material is more or less intermixed with the vein, forming irregular lines of division, and occasionally reducing the original vein to unproductive dimensions. Some of these veins can be traced by the eye for a long distance on the line of outcrop, crossing over spurs and valleys of denudation, and frequently sending off small lateral spurs. The vertical depth of these mineral veins has not been as yet sufficiently tested, very few shafts or lower side tunnels having penetrated lower than 50 to 80 and 100 feet in depth. Hence, the question of permanence or change of mineral contents at great depths, remains a question that as yet can only be answered on theoretical grounds. Most of the facts in the case favor the view of mineral depositions from aqueous solution above, rather than injection from below; and, in the case of copper, the basin form of the beds, and the character of deposition as a precipitate, clearly point to this origin of their mineral contents.

As most attention has been naturally given at first to gold-producing lodes, those containing the precious metals in smaller quantities, associated with lead and copper, have been in a great measure neglected. It is probable, however, that eventually these less valued deposites will prove most profitable, and in their more bulky form, as raw or partially reduced ores, will afford materal for railroad transportation. The various specimens collected on the survey will afford the most satisfactory means of ascertaining the prospective mineral wealth of this district. I append herewith a list, as complete as my means of information furnished, of the different mineral lodes discovered and partially worked in this district, derived partly from personal observation and otherwise from the most trustworthy sources.

HASSAYAMPA DISTRICT.

Often Lode.—Width of vein, 2 feet; depth of shaft, 60 feet. Yields, by assay, $200 per ton.

Montgomery Lode.—Width of vein, 18 inches, containing a rich pay streak, 4 to 8 inches wide. Yields, by assay, $117 per ton.

Umpqua Lode.—Width of vein, 6 feet; depth of shaft, 80 feet. Ore variable in quality, containing gold, silver and copper.

Chase Lode.—Recently opened by Noyes & Co. Width of vein, 3 feet. Yields a large per cent. of free gold from picked specimens.

Senator Lode.—Width of vein, 3 feet. Worked by a tunnel 100 feet.

Chance Lode.—Width of vein, 4 feet. Contains samples of native silver.

Sterling Lode.—Width of vein, 5 feet; depth of main shaft; 50 feet; several tunnels. Yields, by assay, $100 per ton.

YAVAPAI DISTRICT.

United States Lode.—Width of vein, 4 feet; depth of shaft, 25 feet. Yields, by assay, $130 per ton.

BIG-BUG DISTRICT.

Ticonderoga Lode.—Picked ore from the surface quartz is said to have yielded $1,000 to 7 tons of ore.

Dividend Lode.—Range of vein, E. N. E. and W. S. W.; width, 4 to 5 feet; (out-crop decomposed quartz showing free gold;) depth of shaft, 50 feet. Exhibiting bright sulphurets in a hard, white quartz matrix. Now worked by Gray & Co.

Galena Lode.—Range E. N. E. and W. S. W.; width of vein, 2½ to 5 feet; dip nearly perpendicular. Yields, by assay, $196 per ton.

Eugenia Lode.—Range E. N. E. and W. S. W.; dip nearly perpendicular; width of vein, 5 to 7 feet; upper wall "slickensides." Out-crop decomposed rusty quartz, changing below to bright sulphurets, in a dense quartz matrix—vein showing along its course several distinct streaks, with rich "*pockets*" of "*pay dirt.*"

WALKER'S DISTRICT.

Accidental Lode.—Width, 2 feet. Yields, by assay, $100 per ton.

Pine Mountain Lode.—Width, 4 feet. A large percentage of silver associated with the gold. Now worked by Arastas.

Titi Lode.—Vein narrow, but rich. Now worked by Arastas.

Dead Wood Lode.—Width, 4 feet. Prospects well.

Eureka Lode.—80 feet shaft, in rich sulphurets.

TURKEY CREEK DISTRICT.

Bully Bueno Lode.—Width of vein, 4 to 7 feet; considerable work done by shafts and tunnels. Yields $20 per ton.

Goodwin Lode.—Width, 4 feet; shaft, 50 feet. Contains a large per cent. of silver.

WALNUT GROVE DISTRICT.

Wabash Lode.—Width of vein, 2½ feet. Shows free gold.

Big Rebel Lode.—Width, 4 feet; worked by tunnel, 80 feet. Rich ore.

Josephine Lode.—Width, 2 feet; shaft, 80 feet. Yields, by assay, $200 per ton.

BRADSHAW DISTRICT.

Forks Lode.—Yields, by assay, $70 per ton.

Hope Lode.—A branch of Forks Lode—vein 3 feet wide. Yields by assay, $100 per ton.

Uno Lode.—Another branch of Forks Lode.

White Swan Lode.—Prospects rich.

Black Swan Lode.— " "

Nopal Lode.—Now worked by Mexicans.

Valencia Lode.—Now " " "

AGUA FRIO DISTRICT.

Minnehaha Lode.—Width, 2 feet; worked by a shaft 80 feet in depth. Assays $80 per ton.

Clinton Lode.—Width, 2 feet; shaft 50 feet.

Silver Mountain, in this district, comprises an extensive mineral ledge, exhibiting at several points a width of 25 feet, and separating into several distinct lodes, that have only been partially prospected, but thought to indicate an exceedingly rich mineral deposit.

WICKENBURG DISTRICT.

Vulture Lode.—This mineral vein, located in the desert region near the sinks of the Hassayampa, is instructive as showing the possibility of a successful development of the mining interests of this section, under a combination of serious difficulties. It is located 15 miles east of the town of Wickenburg, where the stamp mills are located, and occupies a low, isolated knoll of rock, rising not over 75 feet above the surrounding desert plain. The crest of the ridge shows a distinct out-cropping of dark, weathered quartz, and the debris of the mining operations are scattered in the vicinity in the form of vast piles of refuse ore and wall rock. On the exposed surface we see fairly opened to daylight the mineral vein, showing two very distinct divisions, ranging in a parallel line 10° north of west, (magnetic.) This can be traced for a long distance along the line of out-crop, traversing the main ledge till it unites with a cross ridge, ranging north and south. The vein has a dip of about 60° to the north, and the lower or southern vein lies on a distinct foot-wall of talcose slate, having an average width of 8 feet. Resting upon this, on the north slope of the hill, is an irregular mass of rock, streaked with quartz veins, about 20 feet in thickness, and separating the lower from the upper vein. The latter does not exhibit a distinct wall, being irregularly mixed with the enclosing rock, and is worked on an average thickness of 10 feet.

Both of the veins, including the intervening "*horseback*," are made up of a series of veins of greater or less richness, the most productive showing a redish, rusty or greenish stain, honey-comb in texture, and often exhibiting a brilliant network of free gold.

The mining is conducted by open cuts, following down the out-crop of the vein, and sloping with the natural incline, leaving occasional

pillars of support. Shafts have been sunk outside the line of dip to reach the vein at a lower depth. The nearest of these shafts is located 30 feet north of the out-crop, on the line of working, and a second shaft, 100 feet in depth, is situated 50 feet farther—the two shafts being connected by a tunnel. Neither of these shafts appear to have fairly struck the main vein, but show, at the lowest points reached, several streaks of mineral-bearing quartz and talc partings. It is thought that the vein may have thinned out at that depth, or that the dip of the vein may have become more perpendicular, so that the main mineral deposit has not yet been reached by either shaft. A better test would be to carry down the incline on the lower vein to strike one of the shafts, and thus ascertain the variation which the vein exhibits at lower depths. They have at present (December, 1867,) about 75 men employed at the mine, (mostly Mexicans,) the amount of ore raised per day being from 40 to 50 tons. The ore is divided into two classes—the richer yielding $15 per ton in the stamping process, while the poorer quality averages about $20 per ton. Some of this second class ore is mixed with the richer in the stamp mill, so that the average yield of the ore used is $30 per ton.

The general appearance of the mine is very promising—the greatest drawback being the want of water for milling purposes, requiring the ore to be transported 15 miles to the reducing mill, involving an expense of $10 per ton—the return freight wagons bringing back all the water required at the mines.

The following is a statement of the operations of the Vulture Mine, at this place, as kindly furnished by the proprietors:

VULTURE MINE AND MILL.

Monthly Expenses.

Pay roll,	$9,000 00
Incidentals,	3,520 00
Hauling ore, 864 tons, at $10,	8,640 00
Fuel,	720 00
Interest on capital invested,	875 00
Total monthly expenses,	$22,755 00

Monthly Returns.

864 tons, yielding $30 per ton,	$25,920 00
Net monthly profit,	$3,165 00

THE MINING DISTRICT OF WESTERN ARIZONA.

In the intervening country lying west of the mining district of central Arizona, extending to the Colorado River, there are extensive tracts of desert uplands, interrupted by irregular mountain ridges, which, on account of the inhospitable character of the country, difficulties of transportation and subsistence, and especially Indian

hostilities, have been but very partially explored. At several points in this district placer gold has been successfully worked, yielding, in a few instances, rich returns from the rudest processes of *dry washing*.

Quartz veins crop out in wonderful abundance in several isolated localities especially noted, 10 to 15 miles west of La Paz. Rich deposits of silver and copper ores are also known to exist, and have been partially worked, but in nearly every instance mining enterprise has been forced to succumb to insurmountable difficulties, and, in not a few cases, to actual loss of life. Ehrenburg, the distinguished mining engineer, who had spent years in a special examination of this mining section, and to which he gave the preference over all others previously examined by him, here met with a sad fate, being killed by hostile Indians, while engaged in his researches, in 1866. His frequently published reports on the mineral wealth of this region show the views of an intelligent, educated explorer, who, having enjoyed superior advantages for extensive exploration, always expressed the most unbounded confidence in the ultimate development of the rich mineral treasures here partially brought to light.

At present the only successful working of mines in this district is that of the copper lodes on Williams' Fork, in regard to which the following items, derived from personal examination, are submitted:

COPPER MINES ON WILLIAMS' FORK.

The location of these mines is at a point on the south side of Williams' Fork Valley, about 12 miles from Aubrey City, at the junction of this stream with the Colorado, being the shipping point for ore and supplies by the circuitous route of the Colorado River and the Gulf of California to San Francisco and Europe. The lodes here worked include the *Planet* and *Ashley*, also a newly opened vein called the *Eliza*. Of these the former is best known from regular shipment of ores to the San Francisco market. Owing to the cost of transportation, and the uncertainty and length of time required for shipments, only the higher grade ores, realizing 40 per cent. of metallic copper, can be profitably shipped. These picked ores are sold in the San Francisco market according to average assays made of each cargo, and are thence mostly shipped from that point to Swansea, Wales, for final reduction. With all these drawbacks, acting directly adverse to the mining interests of this section, the great richness of the ore has secured profits that, under more favorable circumstances, would prove highly remunerative. The actual permanence and extent of the mineral veins is still a matter of dispute; but occupying, as they do, such an extensive scope of country, where the superficial deposits have proved so rich and productive, there is every reason to believe that, with proper facilities for mining and shipment, and consequent encouragement to mining enterprise, this class of ores would enter largely into the productive wealth of a wide scope of mining country, especially adapted to winter work, thus drawing on

a very extensive supply of mining industry, which, farther north, or in the high mountain regions, is obliged to suspend labor during the inclement winter season.

THE SILVER DISTRICT OF NORTH-WESTERN ARIZONA AND SOUTH-EASTERN CALIFORNIA.

In the vicinity of Fort Mojave, including the mining districts of Mojave, Sacramento and Wauba-Yuma, considerable prospecting has been done, and some extensive mining operations commenced, mainly in search of silver. The most promising ores consist of various qualities of chloride of silver, and different grades of argentiferous galena. None of these have been as yet sufficiently developed to determine their actual value, but all the geological indications point to this region as a natural extension of the rich silver lodes of Nevada in their prolongation southward into Mexico.

Recent discoveries to the north, giving results of almost fabulous richness, show that this entire region only needs the facilities afforded by railroads, to develop a vast and permanent mining interest. The experience heretofore gained in other similar districts, will here be at once available in this new field. Considerable work has been already done, especially on the *Moss* and *Parsons Lode*, in the vicinity of Hardyville, but the cost of transportation and uncertainty of supplies, has deterred all but the most sanguine from a prosecution of their costly though promising undertakings, in developing their several mining claims. All of these are now absolutely dependent on the construction of railroads, or the improvement of navigable waters, for a successful prosecution of their various enterprises. It would be a source of unfeigned regret if such energetic men as W. H. Hardy, of Hardyville, should, for want of such facilities, be forced to abandon their mining enterprises where so much has been already expended in preparing the way for valuable returns, and that this promising region should thus again revert to its native wildness.

In the isolated mountain ranges, which traverse the desert country lying between the Colorado River and the Sierra Nevada of California, there is a continuation of the geological features that elsewhere accompany the presence of productive mineral ledges. Thus the higher ridges exhibit a granitic nucleus flanked by more or less metamorphosed strata, and interrupted everywhere by igneous protrusions, either recent or more ancient, including, with fresh vesicular lavas, porphyritic rocks of every variety of texture and composition, and necessarily equally varied in their different associated minerals. The extensive collections of the California State Geological Survey over this region, exhibit, in a very striking manner, this variety of mineral constituents, and all explorations hitherto made, unite in the opinion that a vast store of mineral wealth lies here waiting development.

We can already see the natural process by which this development is being worked out in the gradual extension of mining enterprise

from the more accessible districts adjoining the Sierra Nevada, as in Holcomb Valley, extending southward on the eastern flanks of the San Bernardino range, and in the Owen River mines, lying directly east of the highest culminating points of the Sierra Nevada. From these accessible points, mining prospectors are gradually working their way eastward over the desolate region, including Death Valley, the sinks of the Mojave and Providence Mountains, till they will eventually connect with the extension of settlement from Salt Lake Valley, Central Nevada and the Colorado mining districts, thus occupying the whole of the great interior basin, and replacing on our maps the unsatisfactory title of "*unexplored*" with successful mining camps, to be succeeded by more or less permanent civilized accessories, till we know just what this whole country is capable of producing.

C. C. PARRY,
Geologist to the Survey.

Comparative Advantages of Railroad Routes along the 32d and 35th Parallels of North Latitude.*

BY DR. C. C. PARRY.

The different surveying parties along the lines of the 32d and 35th parallels, both working at the same time of year, in the late fall and winter months of 1867-'68, brought to light the comparative advantages of each route, which may here be briefly summed up from a scientific point of view. While the surveys in the matter of grade and alignment show both to be entirely practicable for a railroad route, with a reasonable outlay of expense of construction, there are other manifest differences that should be taken into the account in according a preference to either. Both routes may be safely regarded as traversing a region prospectively rich in minerals; both comprise a certain proportion of desert uninhabitable country; along both lines are to be found excellent grazing lands on the higher mountain slopes, and limited fertile valleys; both are subjected to moderate and desirable winter climate.

As far as can safely be judged from the limited mining development, we may note that the prospected mineral district on the 35th parallel is much the widest in its horizontal extension westward, stretching over the entire line from central Arizona to the Sierra Nevada of California. To compensate for this, in a certain measure, we have, on the 32d parallel, a more eastern development of mining country at Pinos Altos, in the Sierra Madre; also apparently equally rich mining indications in central southern Arizona, which, however, give place farther west to unproductive desert regions. The high mountains of the Mogoyon Range are mainly situated on the 34th parallel, and are, therefore, most accessible from the upper line. Though as yet very imperfectly explored, it is known to contain extensive forests, fine grazing lands, and undoubtedly rich mineral deposits, which would be directly tributary to the line of travel along the 35th parallel.

The greater general elevation of the northern line, on 35th parallel, insures a much more desirable summer climate, cool and invigorating, in place of sultry and oppressive; a more copious precipitation of rain and dew during the growing season, extending the period of vegetable growth so as to dispense in a great measure with the necessity for irrigation in agricultural operations, and still more especially favoring the growth of pine forests, which are met with but rarely on the lower

*Dr. Parry, as Geologist and Naturalist, has accompanied surveying parties on both of these routes.

route, and in no case in sufficient abundance to afford material for extensive railroad construction or distant transportation, in which respect the 35th parallel has everything that could be desired.

The variety and natural attractions of scenery are much more conspicuous on the 35th parallel. Thus there are greater elevations and diversities of surface, giving rise to differences of climate over small areas of country, a greater display of vegetation, and more extended views. The deep cañons of the larger water-courses present some of the wildest aspects of scenery to be met with on the continent. Thus all these varied features will combine to attract pleasure travel, or afford a field for adventurous discovery.

Along the line of the 35th parallel the remains of the ancient civilization, now partially exhibited in the semi-civilized Pueblo Indians, are most abundantly represented, showing in former times a capacity for sustaining large populations, and now offering a most attractive field for antiquarian research.

The very abrupt and excessively broken character of the mountain region south of the 35th parallel, extending to the upper course of the Gila River, has afforded strongholds and places of secure retreat for the thievish and murderous Apache tribes that have, from the earliest historical records, desolated the frontiers of northern Mexico, and hindered the progress of mining, pastoral and agricultural pursuits over the entire region adjoining. This serious obstacle in the way of civilized development can only be effectually removed, and the wild Indian tribes brought under subjection, by the facilities which a through railroad route across the continent would offer in building up permanent settlements, and allowing rapid and systematic military movements. In all these respects the 35th parallel offers the most desirable and convenient location for securing these essential conditions of civilized progress.

In a geographical point of view, the line along the 35th parallel seems to combine many of the advantages both of a northern and a southern route, while at the same time, it is free from some of the most objectionable features pertaining to either of the other rival lines. Thus its lower latitude gives it a manifest advantage over any other northern route, in being unobstructed by snow, and at the same time free from those severities of winter climate that hinder permanent settlement, and put a check upon industrial out-door pursuits during a considerable portion of the year. Again, its greater general elevation gives it a superiority over a more southern and lower line in the comparative freedom from oppressive summer heats and long-continued droughts.

Still further, in its *intermediate* position, lying on the most direct line for a trans-continental route from the populous districts of the central and southern States, it can be brought to the Pacific seaboard on a shorter line than any other now projected, while it also intersects still nearer the navigable waters of the Colorado of the West, extending to the California Gulf.

It crosses the desert region bordering the Colorado at its narrowest extension, where it is conveniently intersected by the Mojave Valley, and crosses the Sierra Nevada of California at its lowest gap. Thence traversing the rich Tulare Val'ey, it is accessible to the mining and timber district of the western Pacific slope, and the redwood forests of the Coast Range, till it strikes tide-water at the great commercial emporium of San Francisco Bay.

C. C. PARRY,

Geologist U. P. R. W., Eastern Division.

DAVENPORT, IOWA, Nov. 11th, 1868.

GRAND CANON OF THE COLORADO.

Account of the Passage of the Great Canon of the Colorado, from above the mouth of Green River to the head of Steamboat Navigation at Callville, in the months of August and September, 1867, *by James White, now living at Callville.*

To Gen'l Wm. J. Palmer,
Director of Surveys, Kansas Pacific Railway.

Sir:—The railroad survey now in progress under your direction has afforded many opportunities for acquiring valuable additions to our geographical knowledge of the unexplored regions of the far West, from original sources not accessible to ordinary map compilers.

Mining prospectors within the last twenty years, more adventurous even than the noted trappers of the Rocky Mountains, have hardly left a mountain slope unvisited or a water-course unexamined over the wide expanse extending from the Mississippi River to the Pacific Ocean. Could the varied and adventurous experience of these mountain men be brought into an accessible form, we should know nearly as much of these western wilds as we now do of the old settled portions of our country.

Among the geographical problems remaining for the longest time unsolved was the actual character of the stupendous chasms or cañons through which the Colorado of the West cleaves its way from its snowy sources to its exit into the California Gulf. Within the last ten years public attention has been frequently directed to this subject, and various Government expeditions have imparted reliable information in reference to the upper and lower course of this remarkable river. Lieut. Ives, in 1857–'8, made a satisfactory exploration of the navigable portion of the Colorado, extending from its mouth to the Big Cañon, and since then a regular line of light draft boats have been successfully traversing these inland waters. Still, the Great Cañon remained a myth; its actual length, the character of the stream, the nature of its banks, and the depth of its vertical walls, were subjects for speculation, and afforded a fine field for exaggerated description, in which natural bridges, cavernous tunnels and fearful cataracts, naturally formed a prominent feature. Now, at last, we have a perfectly authentic account of the character of this *Great Canon* of the Colorado, derived from the lips of a man who actually traversed its formidable depths, and who, fortunately for science, still lives to detail his trustworthy observations of this most remarkable voyage. Happening to fall in with this man during my recent stay of a few days at Hardyville, on the Colorado, I drew from him the following connected statement, in answer to direct questions carefully written at the time.

NARRATIVE.

James White, now living at Callville, on the Colorado, formerly from Kenosha, Wisconsin, was induced to join a small prospecting party in search of gold washings, in the San Juan region, west of the Rocky Mountains. The original party was composed of four men, under the command of a Capt. Baker. This small party left Fort Dodge on the 13th of last April, and after crossing the plains, completed their outfit for the San Juan country in Colorado City, leaving that place on the 20th of May. Proceeding by the way of South Park and the Upper Arkansas, they crossed the Rocky Mountains, passing round the head waters of the Rio Grande, till they reached the *Animas* branch of the San Juan River. Here their prospecting for gold commenced, and being only partially successful, they continued still farther to the west, reaching the *Dolores* and *Mancos* branches. The latter stream was followed down to the main valley of the San Juan, when they crossed over to the left bank, and followed down the valley 200 miles. At this point the San Juan River enters a cañon, to avoid which they again crossed to the right bank, and struck across a mountain range for the Colorado. In a distance of fifty miles, over a very rugged country, they reached this latter stream, or rather its main eastern branch, *Grand River*, being still above the junction of *Green River*—the united waters of which two streams go to form the *Colorado* proper. At the point where they first struck the river, its steep rocky banks were inaccessible, and they accordingly followed up the stream in search of a place where water could be procured. At an estimated distance of twelve miles they came upon a side cañon, down which they succeeded in descending, with their animals, and procuring a supply of water. They camped at the bottom of this ravine on the night of the 23d of August, and on the morning of the 24th started to ascend the right bank to the table land above. In making this ascent they were attacked by Indians, and Captain Baker being in advance was killed at the first fire. The two remaining men, James White and Henry Strole, after ascertaining the fate of their comrade, fought their way back into the cañon, and getting beyond the reach of the Indians, hastily unpacked their animals, securing their arms and a small stock of provisions, and proceeded on foot down the cañon to the banks of the Grand River. Here they constructed a raft of dry cotton wood composed of three sticks ten feet in length and eight inches in diameter; these were securely tied together by lariat ropes, and having stowed away their provisions and arms, they embarked at midnight on their adventurous voyage. The following morning, being the 25th of August, they made a landing, repaired their raft by some additional pieces of light cedar, and continued on their course.

The river here was about 200 yards wide, flowing regularly at a rate of two and a half to three miles per hour. At this estimate they reached the mouth of Green River, and entered the main Colorado 30 miles from the point of starting. Below the junction the stream

GRAND [illegible]

Account of the [illegible] above the mouth [illegible] gation at Call[illegible] by James Wh[illegible]

To Gen'l Wm. [illegible]
Director [illegible]

Sir:—Th[illegible] has afforded [illegible] our geograj[illegible] from origin[illegible] Mining [illegible] even tha[illegible] left a mo[illegible] wide ex[illegible] Ocean. [illegible] tain no[illegible] as no[illegible] tion- [illegible] un- [illegible] th[illegible] si[illegible] y[illegible] y[illegible]

[illegible]icular rocky walls, gra[illegible]ually [illegible]ated distance of 40 miles from [illegible]ed the mouth of the San Juan, [illegible] by perpendicular walls. From [illegible] with only occasional breaks formed [illegible]essible with the main chasm. Still [illegible]ontinuing their voyage and were [illegible] reaching the settlements on the [illegible].

[illegible]n day of their journey, they encoun- [illegible]passing one of which Henry Strole was [illegible]pool below. The small stock of pro- [illegible] White emerged from the foaming rapids [illegible] any provisions, and with gloomy pros- [illegible] his adventurous journey. His course [illegible]non, and was a succession of rapids [illegible], over which his frail raft thumped and [illegible]cept the precaution of tying himself fast [illegible] passing over one of the rapids his raft [illegible] hold on to the fragments by main strength [illegible]ow in a shallow eddy where he succeeded [illegible]arted again. The mouth of the Colorado [illegible]e 4th day, in the evening, the general [illegible]rticularly noticed, as he was here entangled [illegible]l rescued, as he says, "by the direct inter- [illegible] The course of the river was noted as very [illegible]e view on every side being shut in by the [illegible] white sand rock." These walls presented [illegible]rface above the water level, and showed a [illegible]er mark 30 to 40 feet above the stream. [illegible]ge height of the cañon was 3,000 feet, the [illegible]ed out about half way from the bottom, thus [illegible]. The last two days in the cañon, dark- [illegible] the place of the white sandstone, which [illegible]reaks on either side, till he reached a more [illegible] small patches of bottom land. Here, for the [illegible]e encountered Indians, from whom he suc- [illegible] scanty supply of mesquite bread, barely [illegible] till he reached Callville, on the 8th of Sep- [illegible]om the time of starting, during seven of which [illegible] description.

[illegible]e presented a pitiful sight; emaciated and [illegible] his bare feet and legs literally flayed from [illegible]ching from water, and the scorching rays of [illegible] reason almost gone. Being, however, of a [illegible], he soon recovered his usual health, and [illegible] hearty man. His narrative throughout bears [illegible] reliability, and is sustained by collateral

evidence, so that there is no room to doubt that he actually accomplished the journey in the manner and within the time mentioned by him.

CONCLUSIONS.

The following may be summed up as some of the new facts to be derived from this remarkable voyage as additions to our previous geographical knowledge of the hydrography of the Colorado River:

1st. The actual location of the mouth of the San Juan, 40 miles below Green River junction, and its entrance by a cañon, continuous with that of the Colorado, above and below the point of junction.

2d. From the mouth of the San Juan to the Colorado Chiquito, 3 days travel in the swifest portion of the current allowing a rate of 4 miles per hour for 15 hours, or 60 miles per day, would give an estimated distance of 180 miles, including the most inaccessible portions of the great cañon.

3d. From Colorado Chiquito to Callville, 10 days travel were expended. As this portion of the route was more open, and probably comprised long stretches of still water, it would not be safe to allow a distance of more than 30 miles per day, or 300 miles for this interval. Thus the whole distance traveled would amount to 550 miles, or something over 500 miles from the Green River junction to the head of steamboat navigation on the Colorado.

4th. The absence of any distinct cataracts or perpendicular falls would seem to warrant the conclusion that in time of high water, by proper appliances in the form of boats, good resolute men, and provision secured in water-proof bags, the same passage may be safely made, and the actual course of the river mapped out, and its peculiar geological features properly examined.

5th. The construction of bridges, by a single span, would be rendered difficult of execution, on account of the usual flaring shape of the upper summit; possibly however points might be found where the high mesas come nearer together.

6th. The estimated average elevation of the cañon at 3000 feet, is less than that given on the authority of Ives & Newbery, but may be nearer the actual truth as the result of more continuous observation.

7th. The width of the river at its narrowest points, was estimated at 100 feet, and the line of high water mark, 30 to 40 feet above the average stage in August.

8th. The long continued uniformity of the geological formation, (termed "white sandstone, probably cretaceous,) is remarkable, but under this term may have been comprised some of the lower stratified formations. The contrast in reaching the dark igneous rocks was so marked that it could not fail to be noticed.

9th. Any prospect for useful navigation up or down this cañon during the season of high water, or transportation of lumber from the upper pine regions could not be regarded as feasible, considering the long distance, and the inaccessible character of the river banks.

10th. No other satisfactory method of exploration, except along the course of the river, could be adopted to determine its actual course, and peculiarly natural features, and James White, as the pioneer of this enterprise, will probably retain the honor of being the only man who has traversed through its whole course, the great cañon of the Colorado and lived to recount his observation on this perilous trip.

Respectfully yours, C. C. PARRY,
Geologist of the Survey.

HARDYVILLE, ARIZONA, January 6, 1868.

REPORT OF THE MILITARY COMMITTEE.

HOUSE OF REPRESENTATIVES, May 25, 1868.

The Committtee on Military Affairs, to whom was referred a letter from the Secretary of War, inclosing a letter of Lieutenant-General Sherman, dated March 4, 1868, recommending Government aid to extend the Union Pacific Railway, Eastern Division, as a "military necessity," and a measure of public economy, beg leave to report:

That they have carefully considered the statements therein made, and have found them confirmed by the following facts, drawn from official record:

The cost to the Government for transportation on the Union Pacific Railway, Eastern Division, in 1867, was - - - - - - - - -	$511,908 24
If the military supplies had been wagoned, and the mails carried by stage, and the troops marched, (taking the average rates at which the Government made its transportation contracts for that year, as shown by certificates of the Departments of the Quartermaster-General and Postmaster-General,) the cost would have been - - - - - - - -	1,358,291 06
Saving to the Government in 1867,	$846,382 82

At this rate of saving all the United States bonds issued in aid of this road, principal and interest, would be extinguished in less than four years.

These are the results of the use by the Government of the *finished* portion of the road in Kansas in the last year.

In regard to the extension of the road *beyond* the point in Kansas at which its subsidy ends, the committee find that *there are three regiments* of troops in New Mexico, (two of infantry

and one of cavalry,) nearly all of the supplies for which a wagoned from the end of the Kansas Pacific Railway at a c of $1.28 per 100 pounds per 100 miles. At the present freig rates of the railway, as shown by their printed schedule, t saving in transportation on these supplies to Albuquerque, the Rio Grande, a central distributing point in New Mex would be, per annum, $851,880. We have ascertained th the additional saving to the Government in the transportation to Albuquerque of the mails, troops, and Indian supplies, would be $231,992. *Total annual saving*, $1,083,872.

But there is another consideration of economy in the public expenditure as the result of constructing the road. Lieutenant-General Sherman has testified that one-half of the military force in New Mexico could be dispensed with if the road was constructed, owing to the greater mobility of the remainder, and the growth of self-protecting settlements on the line of the road. As his estimate of the cost of maintaining the two regiments of infantry and one of cavalry was about four millions of dollars a year, the committee find that *an additional saving to the Government, of two millions annually, would thus be effected by the road.* This saving, added to the saving in the transportation of the diminished military force that would be left in New Mexico, and of the supplies to maintain them, including the carriage of the mails and Indian goods and supplies, would, *in less than six years, reimburse the entire loan necessary to extend the road from its present terminus to the Rio Grande.*

The committee have had satisfactory evidence presented to them that *west of Albuquerque*, and through Arizona and Lower California, the same or even larger proportionate economy in the public service would be affected by the substitution of railway for wagon transportation, with the result of an equally certain payment of the interest and extinction of the principal of the Government aid long prior to its maturity.

The committee have also had before them the written recommendation of Major-General Philip H. Sheridan that the

Government at once continues its aid to the Kansas Pacific Railway, in the course of which he says:

"It almost substantially ends our Indian troubles, by the moral effect which it exercises over the Indians, and the facility which it gives to the military in controlling them. * * * * No one, unless he has personally visited this country, can appreciate the great assistance which this road gives to economy, security, and effectiveness in the administration of military affairs in this department."

The committee make no recommendation to the House, but merely report the facts which they have ascertained in the consideration of General Sherman's letter, and ask that the same be printed and referred to the Committee on Pacific Railroad, and that the accompanying detailed statements, documents and official certificates be referred to the same committee, without being printed.

DISTRIBUTION OF TROOPS.

Position and Distribution of Troops in the Department of the Missouri, commanded by Major General PHILIP H. SHERIDAN, *including Kansas, Colorado and New Mexico, with distances by Wagon Road, (as authorised by General Order No. 66, of Quartermaster General, November 30, 1867.)*

	Miles from Kansas City.	Miles from Leavenworth.	No Co's of Troops.	To what Regiments belonging.
Fort Leavenworth, Kansas,			1	3d Inf. and Headquarters.
Camp Hoffman, "			1	10th Cavalry.
Camp Grierson, "			1	10th Cavalry.
Fort Riley, "	139	134	1	10th Cav. & Head-quarters.
Fort Harker, "	222	217	4	10th Cav., 5th and 38th Inf., 4th Artillery & Head-qrs.
Fort Zara, "	263	258		
Fort Hays, "	294	289	6	10th Cav., 3d and 38th Inf.
Fort Larned, "	295	290	4	10th Cav. and 3d Infantry.
Downer's Station, "	335	340	1	5th Infantry.
Monument " "	387	382	1	38th Infantry.
Fort Dodge, "	356	351	4	7th Cav., 3d and 37th Inf.
End of Government aid,	400	395		
Fort Wallace, Kansas,	437	431	5	7th Cavalry, 5th Infantry.
Fort Lyon, Colorado,	561	556	4	7th Cav., 3d and 37th Inf.
Cedar Point, "	571	566	1	37th Infantry.
Trinidad, "	636	631		
Maxwell's Ranch, N. M.,	700	695		
Fort Reynolds, "			2	7th Cavalry, 5th Infantry.
Pueblo, "	621	616		
Fort Union, New Mexico,	778	773	3	3d Cavalry.
Fort Marcy, Santa Fe, N. M.,	878	873		
Fort Bascom, New Mexico,	923	918	1	3d Cavalry.
Fort Sumner, "	926	921	6	3d Cav., 5th and 37th Inf.
Fort Garland, Colorado,	931	926	1	3d Cavalry.
Albuquerque, New Mexico,	943	938		
Fort Stanton, "	985	980	1	3d Cavalry.
Fort Wingate "	1028	1023	2	3d Cavalry & 5th Infantry.
Fort Craig, "	1038	1033	1	3d Cavalry.
Fort McRae, "	1070	1065		
Fort Selden, "	1123	1118	2	3d Cavalry, 38th Infantry.
Fort Cummings, "	1174	1169		
Fort Bliss, Texas,	1185	1180		
Fort Bayard, New Mexico,	1216	1211	1	3d Cavalry.
Fort West, "				
Fort Plummer, "			1	37th Inf. & Head-quarters.
Fort Butler, "				
Fort Thorn, "				
			Total, 55 Companies.	

In the field, en route in the Department.

7	Companies	7th Cavalry and Head-quarters.
1	"	3d Infantry.
2	"	5th Infantry.
4	"	37th Infantry.
3	"	38th Infantry and Head-quarters.

Total, 17 Companies—(some of which are at the unassigned posts in the above list.)

[See next page *et seq.*]

RECAPITULATION.

Companies of troops in Kansas, at posts	29
" " Southern Colorado	8
" " New Mexico	18
Total companies of troops in this Department, at posts	55
" " " " in the field, chiefly in New Mexico	17
Total number of companies of troops in the Department of the Missouri along the general route of Kansas Pacific Railway,	72

Position and Distribution of Troops in Arizona and Southern California, with distances as authorized by Quartermaster's Department.

	Miles from San Francisco	No. Companies of Troops.	To what Regiments belonging.
Camp Wright, California,	300	1	9th Infantry.
" Cady, "	551	1	14th "
" Rock Spr'gs "		Detachment.	14th "
" Indep'dence "	551	2	1st Cav. and 9th Infantry.
Drum Barracks, "	480	Detachment.	14th Infantry and recruits.
San Diego, "	580		
Fort Mojave, Arizona,	690	4	8th Cav., 9th and 14th Inf.
Beale's Spring, "	729		
Fort Yuma, California,	750	1	14th Inf. and Headquarters.
Camp Willows, Arizona,	767		
Maricopa Wells, "	817		
Camp McDowell, "	922	4	1st Cav., 14th and 32d Inf.
Fort Whipple, "	946	2	8th Cav. and Headquarters.
Camp Grant, "	952	3	14th and 32d Infantry.
Tucson, "	961		
Camp Lincoln, "	1000	2	14th Infantry.
Tubac, "	1009	3	1st Cavalry, 32d Infantry.
Fort Barrett, "	1047		
" Lovell, "	1052	1	32d Infantry & Headquarters.
" Bowie, "	1057	1	32d "
Camp Goodwin, "	1118	3	32d "
" Wallen, "	1140		1st Cavalry and 32d Infantry.
" McPherson, "			14th Infantry.

Total number of companies of troops in the Department of California along the general route of Kansas Pacific Railway,..... 33

RÉSUMÉ

Of Troops along the general route of the Kansas Pacific Railway, December 16, 1867, *and that are, or will be, supplied therefrom.*

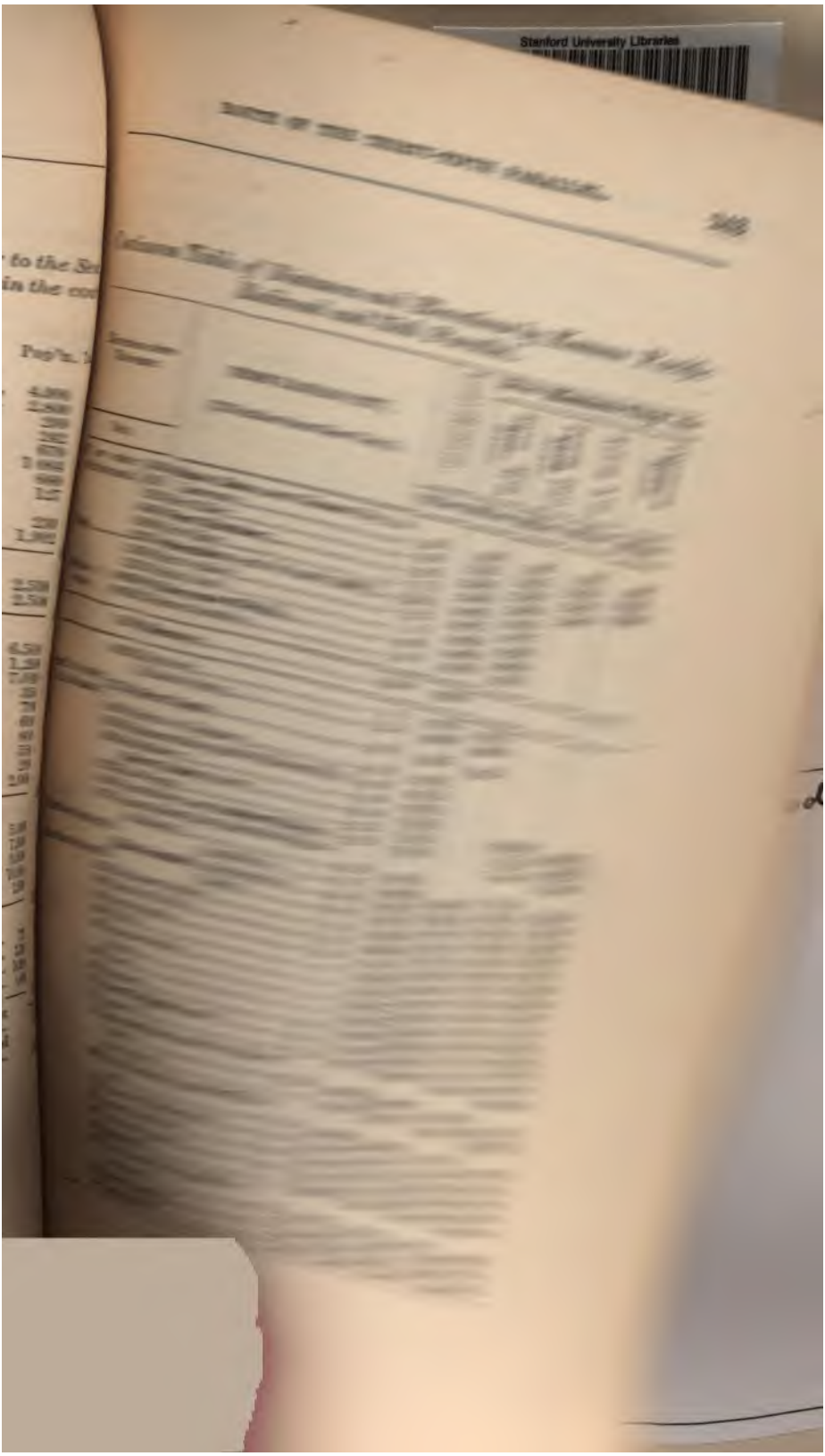
	Co's of Inf.	Co's of Cav.
Kansas,.....	15	14
Southern Colorado,.....	4	4
New Mexico,.....	8	10
In the field in Dep't of the Mo., chiefly in New Mexico,.....	10	7
Arizona,.....	19	8
Southern California,.....	5	1
Total of each class,.....	61	44

Making the whole number of companies of both infantry and cavalry,..... 105

NOTE.—The entire military force stationed between the Missouri River and the Pacific Coast inclusive, from the British Possessions south to Mexico, is two hundred and forty companies, so that it will be seen that nearly one-half of that force is along the route of this Union Pacific Railway, Eastern Division.

Extract from the Report of the Secretary of the Interior to the Sena
April 13, 1867, showing Population of Indian Tribes in the coun
penetrated by the Kansas Pacific Railway.

Superintency and Agency.	Tribes.	Pop'n.	To
CENTRAL.			
Arrapahoe, Cheyenne and Apache,	Arrapahoe, Cheyenne and Apache,	4,000	
Kiowa and Camanche,	Kiowas and Camanche,	2,800	
Ottawa,	Ottawas,	200	
Kickapoo,	Kickapoos,	242	
Kansas,	Kansas or Kaws,	670	
Delaware,	Delawares,	1 064	
Shawnee,	Shawnees,	660	
Osage River,	Miamas,	127	
	Peorias, Pinkeshaws, Kaskaskias, and Weas,	230	
Pottawatomie,	Pottawatomies,	1,992	
			11,985
COLORADO.			
Denver,	Grand River and Uintah Utes,	2,500	
Conejos,	Tabequache Utes,	2,500	
			5,000
NEW MEXICO.			
Bosque Redondo,	Navajoes at Reservation,	6,500	
	Navajoes at large,	1,200	
Pueblos,	Pueblos,	7,010	
Abiqui,	Capote Utes,	350	
	Webinoche Utes,	700	
Cimarron,	Maquache Utes,	600	
	Jicarilla Apaches,	800	
Mescalero Apaches,	Mescalero Apaches,	550	
	Mimbres Apaches,	200	
	Captives held in peonage,	2,000	
			19,910
ARIZONA.			
Papagoes,	Papagoes,	5,000	
Pimas and Maricopas,		7,500	
River Tribes,	Yumas, Mojaves, etc.,	9,500	
	Apaches,	10,000	
	Moquis,	2,500	
			34,500
SOUTHERN CALIFORNIA.			
Tule River,	Owens River and Tule River,	725	
Mission Indians,	Various bands,	3,300	
	King River and other bands,	14,900	
	Coahuillas and other tribes,	4,400	
			23,325
Total number of Indians along the general route of the Kansas Pacific Railway,			94,720
out of a total population of Indians in the United States, as estimated by Secretary of Interior, of			306,475



Elevations above Tide-water.	BY THIRTY-FIFTH PARALLEL.	*Local distances.*	*From* **Kansas City** via			
			Raton Mt'n Route.	*Pueblo Pass Route.*	*Aubrey R'te.*	*Cimarron Route.*
Feet.		Miles.	Miles.	Miles.	Miles.	Miles.
6358	Padre Canon,	21	1195	1269	1160	1123
7101	San Francisco Ridge,	13	1208	1282	1173	1136
7510	**Leroux Summit,** (Tonto Pass,)	5	1213	1287	1178	1141
7558	Bald Peak,‡	9	1222	1296	1187	1150
7199	**Park Springs,**	6	1228	1302	1193	1156
7206	**Whipple Pass,** (Summit,)	5	1233	1307	1198	1161
5521	Fork of Partridge Creek,	32	1265	1339	1230	1193
5285	Russel's Tank,	6	1271	1345	1236	1199
} 5088 } 4748	Mouth of Partridge Valley,	20	1291	1365	1256	1219
4748	**Val de Chino,** (Crossing,)	11	1302	1376	1267	1230
5127	Beale's Pass, (Summit,)	17	1319	1393	1284	1247
5241	**Yampa Gap,** (Entrance to Canon,)	22	1341	1415	1306	1269
3783	Truxton's Spring,	27	1368	1442	1333	1296
3170	Peacock Spring, (Wallapi Valley,)	20	1388	1462	1353	1316
3473	**Wallapi Pass,** (Railroad Pass,)	14	1402	1476	1367	1330
1286	Mojave Gap,	27	1429	1503	1394	1357
Low water } 353 grade, } 428	**Colorado River,** (between Fort Mojave and the "Needles,")	22	1451	1525	1416	1379
1159	Sacramento Springs,	22	1473	1547	1438	1401
2579	**Piute Pass.** (Summit.)	18	1491	1565	1456	1419
675	Chemeuevis Pass, (entrance to Perry Basin,) San Diego Junction,	36	1527	1601	1492	1455
1000	Perry Crater. (opposite.)	14	1541	1615	1506	1469
	Sink of Perry Basin, elevation 530 ft.					
1200	Volcanic Point,	20	1561	1635	1526	1489
*1700	Squaw Summit,	10	1571	1645	1536	1499
*2100	**Crater Pass,** (Summit,)	15	1586	1660	1551	1514
*1900	Malpais Sink,	10	1596	1670	1561	1524
†2375	**Mojave River,** (Crossing near Grapevine,)	25	1621	1695	1586	1549
†2388	Williamson's Lake,	30	1651	1725	1616	1579
3080	Eastern foot of Sierra Nevada,	35	1686	1760	1651	1614
†4008	**Tehachapa Pass,** (Summit of Sierra Nevada.)	15	1701	1775	1666	1629
2020	Bird Point,	20	1721	1795	1686	1649
795	Western foot of Sierra Nevada,	15	1736	1810	1701	1664
*700	Buena Vista Oil Works,	35	1771	1845	1736	1699
*700	Polvero,	75	1846	1920	1811	1774
*2100	Summit Coast Range, (San Benito Pass)	15	1861	1935	1826	1789
	Gilroy. (end of Southern Pacific Track, 1868,)	85	1946	2020	1911	1874
	San Jose,	30	1976	2050	1941	1904
Tide-water	**San Francisco,**	50	2026	2100	1991	1954
	This distance to San Francisco may be reduced, as follows:					
	1st. By using Galisteo Valley and San Mateo line to		2001	2036	1966	1929
	2d. By using Galisteo Valley, San Mateo and White Mesa line to		1984	2019	1949	1912
	3d. By using Galisteo Valley and Laja Gap line to		1969	2004	1934	1897

* Estimated. † Barometer. ‡ Unnecessary summit.

Elevations above Tide-water.	BY THIRTY-FIFTH PARALLEL.	*Local distances.*	*From Kansas City via*			
			Raton M'ns Route.	*Punta Pass Route.*	*Aubrey R'te.*	*Cimarron Route.*
Feet.		Miles.	Miles.	Miles.	Miles	Miles.
	SAN DIEGO BRANCH.					
675	**Chemeuevis Pass,** (junct'n with Main Line 76 m. west of Colorado.	.....	1527	1601	1492	1455
600	Mouth San Diego Pass,	20	1547	1621	1512	1475
*2000	Summit San Diego Pass,	17	1564	1638	1529	1492
*1500	Morongo Basin,	10	1574	1648	1539	1502
*2327	**Summit Morongo Pass,**	22	1596	1670	1561	1524
*1201	Mouth of Morongo Canon,	10	1506	1680	1571	1534
1101	Eastern foot San Gorgonia Pass,	10	1616	1690	1581	1544
†2808	**Summit San Gorgonia Pass,**	22	1638	1712	1603	1566
1118	**San Bernardino,**	26	1664	1738	1629	1592
	Los Angelos,					
Tide-water	**San Diego,**	100	1738	1812	1703	1666
	This distance to San Diego may be reduced, as follows:					
	1st. By using Galisteo Valley and San Mateo line to	.....	1713	1748	1678	1641
	2d. By using Galisteo Valley, San Mateo and White Mesa line to.	.....	1696	1731	1661	1624
	3d. By using Galisteo Valley, San Mateo and Laja Gap line to	.....	1681	1716	1646	1609

* Estimated. † Barometer.

DISTANCES AND ELEVATIONS

By Kansas Pacific Railroad and Thirty-second Parallel.

Elevations above Tide-water.	FROM STATE LINE NEAR KANSAS CITY, MO. (1318 miles from New York) TO	Local distances.	Raton Mountain Route.	Raton Mountain and Galisteo.	Puntia Pass Route.	Aubrey Route.	Cimarron Route.
Feet.		*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Mls.*
4803	**Isletta,** (below Albuquerque,)		871	910	945	836	799
4349	**Fort Craig,**	102	973	1012	1047	938	901
3896	**Mouth of Santa Barbara Canon**	73	1046	1085	1120	1011	974
4853	Summit West of Rio Grande,	17	1063	1102	1137	1028	991
4585	East foot of Cook's Mountain,	14	1077	1116	1151	1042	1005
4876	**Summit of Cook's Mountain,**	3	1080	1119	1154	1045	1008
4538	West foot of Cook's Mountain,	4	1084	1123	1158	1049	1012
4716	North end of Sierra Redondo,	6	1090	1129	1164	1058	1018
4472	Arroyo Miembres,	9	1099	1138	1173	1064	1027
4849	**Ojo de la Vaca,**	12	1111	1150	1185	1076	1039
4944	Summit at end of Burro Mountain,	8	1119	1158	1193	1084	1047
3992	**Barney Station,**	22	1141	1180	1215	1106	1069
3955	East foot of Peloncillo Mountain,	21	1162	1201	1236	1127	1090
4148	Summit Runk's Pass,	4	1166	1205	1240	1131	1094
3438	West foot of Peloncillo Mountain,	12	1178	1217	1252	1143	1106
3816	East Foot of Railroad Pass, (Chiricahui Mountains.)	27	1205	1244	1279	1170	1133
4192	**Summit of Chiricahui Mountains,**	7	1212	1251	1286	1177	1140
3998	West foot of Chiricahui Mountains,	6	1218	1257	1292	1183	1146
3985	East foot of Calitro Mountains,	6	1224	1263	1298	1189	1152
4522	Summit of Calitro Mountains,	10	1234	1273	1308	1199	1162
3256	Mouth of Nugent's Pass, (**Tres Alamos,**)	21	1255	1294	1329	1220	1183
1985	**Fort Grant,**	63	1318	1357	1392	1283	1246
1602	Mouth of San Pedro,	11½	1330	1368	1403	1294	1257
1594	Head of Canon of Gila,	9	1339	1377	1412	1303	1266
1202	White's Rancho	44	1383	1421	1456	1347	1310
1066	**Saccaton,**	15½	1398	1437	1472	1363	1326
	Pima Villages,	11	1409	1448	1483	1374	1337
	Maricopa Wells,	12	1421	1460	1495	1386	1349
*108	**Fort Yuma,** (75 feet above the river,)	167	1588	1627	1662	1553	1516
*1101	East foot of San Gorgonia Pass,	154	1742	1781	1816	1707	1670
*2808	**Summit of San Gorgonia Pass,**	22	1764	1803	1838	1729	1692
1118	West foot of San Gorgonia Pass,	24	1788	1827	1862	1753	1716
*1118	**San Bernardino,**	2	1780	1820	1864	1755	1718
*1048	San Fernando Mission,	75	1865	1904	1939	1830	1793
*3164	Summit of **Soledad** Pass,	43	1908	1947	1982	1873	1836
2889	Desert,	8	1916	1955	1990	1881	1844
	Willow Springs,	34	1950	1989	2024	1915	1878
*3080	East foot of Tehachapa Pass,	17	1967	2006	2041	1932	1895
4008	**Summit of Tehachapa Pass,**	15	1982	2021	2056	1947	1910
795	West Foot of Tehachapa Pass,	35	2017	2056	2091	1982	1945
	Gilroy,	210	2227	2266	2301	2192	2155
Tide-water	**San Francisco,**	80	2307	2346	2381	2272	2235
	This distance from Kansas City to San Francisco may be reduced, by estimated saving, between Fort Craig and Saccaton, of 75 miles, to		2232	2271	2306	2197	2160
	N. York to San Francisco, (measured,)		3625	3664	3699	3590	3553
	" " " (shortest.)		3550	3589	3624	3515	3478

* Barometer elevations.

Barometer Elevations.	KANSAS CITY TO SAN DIEGO, BY THIRTY-SECOND PARALLEL.		Local distances.	Raton Mountain Route.	Raton Mountain and Galisteo Route.	Puntia Pass R'te.	Aubrey Route.	Cimarron Route.
Feet.			*Miles.*	*Miles.*	*Miles*	*Miles.*	*Miles.*	*Mi's*
108	**To Fort Yuma,** above the river 75 ft.			1588	1627	1662	1553	1516
70 feet below tide.	Big Laguna,		68					
Above tide. 431	Last water in Carizo Creek,		24					
2176	San Felipe		37					
3780	**Warner's Pass Summit,**		11	1728	1767	1802	1693	1656
2911	Warner's Ranche		5					
Tide-water	**To San Diego** by Warner's Pass,		63	1796	1835	1870	1761	1724
Tide-water	To San Diego by San Gorgonia Pass,	From Yuma	276	1864	1903	1938	1829	1792
	This distance from **Kansas City to San Diego** may be reduced by estimated saving between Fort Craig and Socaton of 75 miles, to	Via Warner's Pass,		1726	1760	1795	1686	1649
		Via San Gorgonia Pass,		1789	1828	1863	1754	1717
	New York to San Diego by surveyed line and San Gorgonia Pass,			3182	3222	3256	3147	3110
	Surveyed line and Warner's Pass			3114	3153	3188	3079	3042
	Shortest line and San Gorgonia Pass,			3107	3146	3181	3072	3035
	Shortest line and Warner's Pass			3039	3078	3113	3004	2967

REMARK.—On the portion of the route by the 32d parallel, not instrumentally surveyed, several important summits occur, which are not included in the above table, to wit: in crossing the Great Bend of the Gila, where the ascent is 558 feet; in crossing the dividing ridges that separate the waters west of the Sierra Bernardino—the Santa Ana, San Gabriel and Los Angelos, and elsewhere. In crossing the Colorado Desert, the line is at points below the level of the ocean.

Approximate Statement of Grades on Route of 32d Parallel.

1st. From Albuquerque down the Rio Grande to Fort Craig, 103 miles, the grade need not exceed 10 feet per mile.

2d. From Fort Craig, on Rio Grande, to Fort Grant, on the San Pedro, distance 345 miles.

No. of Miles.	Grade per Mile. Descending West.	Grade per Mile. Ascending West.
14.6	9 feet.	
6.6		35 feet.
4.7	40 "	
8.9	6 "	
1.5		60 "
8.8	24 "	
27.3	6 "	
19.1		50 "
12.1	19 "	
3.1		75 "
3.6	77 "	
6.5		27 "
8.6	28 "	
12.6		30 "
8.2		12 "
21.8	40 "	
21.0	Level.	
3.4		50 "
11.8	59 feet.	
27.1		14 "
6.9		54 "
5.8	30 "	
6.4	Level.	
10.2		50 "
20.8	60 feet.	
63.3		20 "

3d. From Fort Grant to mouth of San Pedro, 11 miles—average grade 21 feet per mile.

From mouth of San Pedro down Gila to Saccaton, 69 miles —average fall of river 12 feet per mile.

[This is through the "12 mile cañon" of the Gila, where the line could not be run because of flood. The work through this cañon would be very heavy. The line to avoid it, (from Fort Grant, by Leech's old trail to Saccaton,) saved 20 miles of distance, but required a grade for 12 miles of 150 feet per mile, ascending from Grant; then 3 miles of undulating grades to "Cottonwood Springs; thence 12 miles of descending grade to "Round Valley," and thence 9 miles, to the Gila, at 80 feet per mile, and 30 miles, of 10 feet per mile, to Saccaton. This was, of course, impracticable. In order to avoid the detour, by

the mouth of San Pedro and the "12 mile cañon" of the Gila, the only probable route is to leave the San Pedro, as suggested by Mr. Runk, about 25 miles above Fort Grant, and continue the line through the Santa Catarina Mountains *via* Granite Springs to Saccaton, on the Gila. It would undoubtedly require grades of at least 75 feet per mile for a long distance, and heavy work in crossing the Santa Catarina Mountains, but would save 40 miles on the Gila Cañon Route.]

4th. From Pima Villages to Maricopa Wells, 12 miles along the Gila, grade of 8 to 10 feet per mile.

5th. From Maricopa Wells to summit of Maricopa Mountains a rise of 280 feet in $5\frac{4}{10}$ miles; then for 14 miles comparatively level; then *ascend* 273 feet more in $2\frac{9}{10}$ miles to summit of Gila Bend Mountains; then descend 368 feet in $2\frac{6}{10}$ miles; then descend 33 feet per mile for 6 miles; then descend very gently for 6 miles to the *Gila* at its south bend. (Grades of at least 70 feet per mile are required in crossing the Great Bend of the Gila, as above shown.) Then from "Gila Bend" down the Gila, 18 miles, to Sierra Colorado, grade of 8 to 10 feet per mile.

6th. In crossing the Sierra Colorado, ($3\frac{3}{4}$ miles,) the rise is 101 feet in 1.10 miles to summit; then level for 1.1 miles, and then falls 87 feet in 1.5 miles to river bottom.

7th. Thence to Fort Yuma, 108 miles, the average fall of Gila Valley, which is followed, is about 6 to 8 feet per mile.

8th. In crossing the Colorado Desert, from Fort Yuma to base of San Gorgonia Pass, 154 miles, the grades are generally light.

9th. In ascending the Sierras at San Gorgonia Pass, 22 miles, grade is from 60 to 90 feet per mile; average, 78 feet per mile. In western descent of San Gorgonia Pass, to San Bernardino Valley, 24 miles, grade is for $6\frac{1}{4}$ miles 45 feet per mile, and for $18\frac{1}{4}$ miles average of 78 feet per mile. (No grade over 80 feet per mile required.)

10th. From western foot of San Gorgonia to eastern base

of Sierra Nevada, at Tehachapa Pass, heavy grade will be required for a considerable distance in crossing the Cordilleras by the San Fernando and Soledâd Passes, rising to 100 feet per mile. From western foot of San Gorgonia to San Diego, maximum grade 80 feet per mile for considerable distances.

11th. From Fort Yuma to San Diego, by Warner's Pass, 200 miles, a long extent of very heavy grade, probably maximum, will be required in crossing the Cordilleras.