

EXPLORATIONS AND SURVEYS FOR A RAILROAD ROUTE FROM THE MISSISSIPPI RIVER TO THE PACIFIC OCEAN.  
WAR DEPARTMENT.

REPORT

OF

EXPLORATIONS FOR A RAILWAY ROUTE,

NEAR THE THIRTY-FIFTH PARALLEL OF NORTH LATITUDE,

FROM

THE MISSISSIPPI RIVER TO THE PACIFIC OCEAN:

BY

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CORPS OF TOPOGRAPHICAL ENGINEERS

ASSISTED BY

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CORPS OF TOPOGRAPHICAL ENGINEERS.

1853-4.

## LETTER TO THE SECRETARY OF WAR.

WASHINGTON, D. C., June 30, 1855.

SIR: In conformity with your instructions, the accompanying report of explorations for "a railway route from the Mississippi river to the Pacific ocean" is hereby submitted to the department. As in many respects it differs from my previous communication upon this subject, I beg leave to make the following brief explanation. Upon my return from field duty, at the end of May, 1854, Congress, then in session, desired to obtain the principal results of the survey; and I was directed to furnish them before its adjournment. The mass of material collected was too great to be carefully looked over within the time specified, and it became necessary to make up a trace of the route by a superficial inspection of the notes and field computations. The remarks accompanying it were sketched in the same hasty manner. As for some months afterward no further information was called for, the assistants were discharged, and the work partially suspended. At the succeeding session of Congress, the Pacific railroad reports were ordered to be reprinted; and it was then suggested as proper to make a revision of the material, provided it might be done without delaying its publication. The astronomical positions, therefore, were revised, and the general maps reconstructed. Accurate profiles being of primary importance, the barometric observations, upon which they depend, were re-examined, and the altitudes of numerous additional points determined. These have been united with the field topography, making, for a portion of the route, a series of sketches, upon a scale of  $\frac{1}{62,500}$ ; thus delineating the proposed location for a railway, and giving approximately the natural inclination of the surface upon that line. Profiles have been constructed upon the same horizontal scale, showing the grades, and, roughly, the cutting and filling required to obtain them. These exhibit, upon certain sections, fewer difficulties than superficial examinations had led me to expect. The length of the line, determined by this trace, is less than that measured by the odometer, which followed many sinuosities and large deflections that, for a railroad, would be unnecessary. A barometric profile has been constructed through Campbell's Pass of the Sierra Madre, by which that mountain range may be crossed without a tunnel or deep excavation, with a maximum grade of fifty feet per mile, the summit level being 6,952 feet above the sea. This avoids the sharp crest where a tunnel was proposed, upon the direct route to Zuñi by the way of the Camino del Obispo.

The summit of Aztec Pass is found to be only 6,058 feet above the sea. With moderate excavation and embankment it can easily be surmounted.

The connexion with Lieutenant Williamson's survey, from Tah-ee-chay-pah Pass to Rio Mojave, shortens the length of the route to San Francisco, and avoids the Cajon Pass, with the expensive tunnel which it would require.

The above are some of the considerations which have led to a modification of nearly all of the approximate results previously submitted.

The material gathered upon the survey has required a diffusive report. It has, therefore, been divided into distinct parts, in order that the various subjects it embraces—each having its obvious and appropriate bearing upon the main purpose of the expedition—may be directly referred to.

In conclusion, permit me briefly to refer to the officers and assistants, to whose energy and scientific ability the government is mainly indebted for whatever there is of value in the information afforded by the exploration.

Lieutenant J. C. Ives, of the corps of topographical engineers, who was placed in charge of a separate party, devoted himself with great assiduity to the duties with which he was intrusted. His field labors in the magnetic and astronomical departments were unusually arduous, frequently, after a fatiguing march, occupying the greater portion of the night. Upon our return to Washington, with zeal and ability he aided in various branches of the scientific operations until selected to assist Captain Humphreys in the supervision of the work in the office of Pacific railroad explorations and surveys.

The scientific collectors, the civil engineer, and assistants, whose names are mentioned in the Itinerary, deserve great praise for the faithful and able manner in which their duties were performed.

The officers of the escort to the expedition were 1st Lieutenant John M. Jones, 7th infantry; Lieutenant J. C. Tidball, 1st artillery; and Lieutenant D. S. Stanley, 2d dragoons. Each, in his appropriate sphere, contributed greatly toward the success of our operations. The quiet and peaceful manner in which we passed through the various tribes of Indians, usually hostile toward Americans, is a proof of the sound discretion of those officers, and the good discipline of the men composing their command.

I have the honor to be, very respectfully, your obedient servant.

A. W. WHIPPLE,

*1st Lieutenant Corps of Topographical Engineers.*

Hon. JEFFERSON DAVIS,  
*Secretary of War.*

# GENERAL TABLE OF CONTENTS.

---

## PART I.

ITINERARY.

## PART II.

REPORT ON THE TOPOGRAPHICAL FEATURES AND CHARACTER OF THE COUNTRY.

## PART III.

REPORT UPON THE INDIAN TRIBES:

By Lieutenant A. W. WHIPPLE, THOMAS EWBANK, Esq., and Prof. WILLIAM W. TURNER.

## PART IV.

REPORT ON THE GEOLOGY OF THE ROUTE.

- 1.—General Report upon the Geological Collections, with a Geological Map, Section, &c., by W. P. BLAKE, *Geologist of the office of the Pacific Railroad Explorations and Surveys.*
- 2.—Résumé and Field Notes, with a Geological Section, and other Illustrations, by JULIUS MARCOU, *Geologist and Mining Engineer to the Expedition.*

## PART V.

REPORT ON THE BOTANY OF THE EXPEDITION.

- 1.—General Description of the Botanical Character of the Country, with a Botanical Map and Profile, by JOHN M. BIGELOW, M. D., *Surgeon and Botanist to the Expedition.*
- 2.—Description of the Forest Trees, by JOHN M. BIGELOW, M. D.
- 3.—Description of the Cactaceæ, with Illustrations, by GEORGE ENGELMANN, M. D., of St. Louis, and JOHN M. BIGELOW, M. D.
- 4.—Description of the general botanical collections, with Illustrations, by Prof. JOHN TORREY, M. D., L. L. D., and Prof. ASA GRAY, M. D., L. L. D.
- 5.—Description of the Mosses and Liverworts, with Illustrations, by W. E. SULLIVANT, Esq.

## PART VI

## REPORT ON THE ZOOLOGY OF THE EXPEDITION.

- 1.—Field Notes, and Explanations, by C. B. R. KENNERLY, M. D., Physician and Naturalist to the Expedition.  
 2.—General Description of the Zoological Collections, by Prof. S. F. BAIRD and C. GIRARD, M. D., Smithsonian Institution.

## APPENDICES.

## APPENDIX A.

ASTRONOMICAL OBSERVATIONS WITH SEXTANT.

## APPENDIX B.

ASTRONOMICAL OBSERVATIONS WITH TRANSIT.

## APPENDIX C.

COMPARISON OF CHRONOMETERS.

## APPENDIX D.

LIST OF CAMPS, WITH DISTANCES, ALTITUDES, ASTRONOMICAL POSITIONS, &amp;c.

## APPENDIX E.

MAGNETIC OBSERVATIONS.

## APPENDIX F.

TABLE OF COMPUTATIONS FOR MAGNETIC INTENSITY.

## APPENDIX G.

TABLE OF RESULTS FOR MAGNETIC INCLINATION AND INTENSITY.

## APPENDIX H.

PSYCHROMETRIC AND CLIMATOLOGICAL OBSERVATIONS.

## APPENDIX I.

BAROMETRIC AND METEOROLOGICAL OBSERVATIONS.

## APPENDIX K.

TABLES OF INSTRUMENTAL ERRORS AND HOURLY CORRECTIONS, TO BE APPLIED TO THE BAROMETRIC OBSERVATIONS, WITH CLIMATOLOGICAL REMARKS AND CHART, PREPARED BY MR. LORIN BLODGET.

## APPENDIX L.

TABLE OF RESULTS FOR ABNORMAL VARIATIONS OF ATMOSPHERIC PRESSURE, AS DETERMINED FROM BAROMETRIC RECORDS KEPT AT VARIOUS MILITARY POSTS.

## APPENDIX M.

TABLE OF BAROMETRIC HEIGHTS.

## APPENDIX N.

TABLE OF GRADES.

6

PART I.

# INTRODUCTION.

## INSTRUCTIONS FROM THE WAR DEPARTMENT.

“WAR DEPARTMENT, *Washington, May 14, 1853.*”

“Under the 10th and 11th sections of the Military Appropriation act, approved March 3, 1853, directing ‘such explorations and surveys’ to be made as might be deemed necessary to ‘ascertain the most practicable and economical route for a railroad from the Mississippi river to the Pacific ocean,’ the War Department directs such explorations and surveys to be made as will develop the availability for this purpose of that portion of our territory which lies near the parallel of 35° north latitude. The following instructions with reference thereto are issued for the government of the different branches of the public service:

“1. The party for this exploration and survey will be commanded by First Lieutenant A. W. Whipple, of the topographical engineers, who will be assisted by brevet Second Lieutenant J. C. Ives, topographical engineers, and such civil assistants as may be required and the Secretary of War approve.

“2. The Adjutant General will detail the necessary escort, transportation for the provisions and equipage of which shall be furnished by the Quartermaster General. Second Lieutenant D. S. Stanley, second dragoons, will act as quartermaster and commissary to this expedition.

“3. Upon the proper requisitions, officers on duty in the quartermaster and commissary departments at the various military posts upon the route will furnish, as far as possible, all necessary supplies, which will be paid for at cost prices from the appropriation for the survey.

“4. Medical stores will be furnished by requisitions upon the Surgeon General.

“5. Ammunition and arms may be obtained from the Ordnance department.

“This party being organized, will collect the necessary instruments and equipments. It will then repair to the field with the utmost despatch, and proceed with the survey and reconnaissance in question. The main party will rendezvous at some convenient point on the Mississippi river, and thence proceed by the most favorable route westward towards Rio del Norte. From hasty reconnaissances, and from such information as can be obtained from other sources, it may be determined from what point upon the river Mississippi the proposed railway should commence, and whether it may be advantageously connected with any railway already projected by States or companies westward from that river.

“The reconnaissance will continue along the headwaters of the Canadian, cross the Rio Pecos, turn the mountains east of the Rio del Norte, and enter the valley of that river at some available point near Albuquerque. From thence westward, extensive explorations must determine the most practicable pass for a railway through the Sierra Madre, and the mountains west of the Zuni and Moquis countries, to the Colorado. In these explorations Fort Defiance can be made a depot for supplies, and may furnish subsistence and transportation thence for the remainder of the route. From Walker's Pass it would be advisable to pursue the most direct and practicable line to the Pacific ocean, which will probably lead to San Pedro, the port of Los Angeles, or San Diego.

“Lieutenant Whipple will immediately detail an officer, with a small party, to proceed

directly to Albuquerque, in New Mexico, in order to make that place a cardinal astronomical point in the survey, and to hasten preparations for the necessary explorations in the mountainous regions of New Mexico before the approach of winter.

"Over such portions of the route as evidently afford no material obstacle to the construction of a railway, a rapid reconnaissance will suffice. This work, however, must be checked by numerous geographical points determined by astronomical observations.

"Through mountain passes greater accuracy will be necessary, in order to determine (roughly) the grades and curves to be adopted, and the probable expense of their construction. Great attention will be given to those collateral branches of science which more or less directly affect the solution of the question of location for the proposed railway: the nature of the rocks and soils; the means of obtaining water upon arid plains—whether by tanks or artesian wells; the products of the country, animal, mineral and vegetable; its population and resources; its supply of timber and other materials for the construction of a railway; the location, character, habits, tradition, and language of the Indian tribes.

"Meteorological and magnetic observations will be attended to; the hygrometrical and electrical states of the atmosphere will be noticed; and all practicable measures will be adopted in order to develop the character of the country through which the party is to pass.

"On or before the first Monday of February next Lieutenant Whipple will report the result of his investigations.

"After the completion of the field-work, the party will be disbanded in California; the soldiers no longer required will be placed at the disposal of the commanding officer of that department; and Lieutenant Whipple, with such officers and assistants as he may deem necessary, will proceed to prepare for Congress a detailed report of the operations of the survey.

"The sum of forty thousand dollars will be set apart to defray the expenses of the survey intrusted to Lieutenant Whipple.

"JEFFERSON DAVIS,  
"Secretary of War."

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"WAR DEPARTMENT, *Washington, July 25, 1854.*

"1st. You will, with as little delay as possible, furnish this department with a report of your operations, embracing—

"1st. A map exhibiting the actual line or lines surveyed by yourself and your assistants, on your late explorations to ascertain the most practicable route for a railway to the Pacific; and also a table showing the astronomical points determined for checking the lineal surveys, and the data upon which these determinations are founded.

"2d. A profile of the route traversed, marking each station where a height was ascertained, and a table of the results of the observations made with the barometer or other instruments, by which the relative heights of different points were determined.

"3d. A condensed statement of the character of the soil, the timber, the supply of water, and, as far as ascertained, the depth of snow in winter, for every section of the line traversed.

"For the immediate use of the government, the relative longitude and the relative heights of points along any given line are required. A discussion of the absolute longitude and heights, also the preparation of the natural history, geology, &c., may be deferred, without injury to the object now in view.

"The map and profile should indicate new routes or lines to be surveyed, and those heretofore surveyed, by which obstacles on the line followed may be avoided.

"Very respectfully, your obedient servant,

"JEFFERSON DAVIS,  
"Secretary of War."

"Lieut. A. W. WHIPPLE,  
"Topographical Corps, *Washington.*"

## PREPARATIONS FOR THE SURVEY.

Among the first of the preliminary duties required by the preceding instructions, were the organization of a party, and the collection of the necessary surveying instruments. The former was soon effected. So great was the number of applicants to the War Department for this work, that the services of many who had been most highly recommended were necessarily declined.

The following is a list of those employed :

Name.	Residence.	Duties.
1. J. M. Bigelow, M. D.	Ohio	Surgeon and botanist.
2. Jules Marcou	Massachusetts	Geologist and mining engineer.
3. C. E. R. Kennerly, M. D.	Virginia	Physician and naturalist.
4. A. H. Campbell	Virginia	Principal assistant railroad engineer.
5. H. B. Möllhausen	District of Columbia	Topographer and artist.
6. Hugh Campbell	Texas	Assistant astronomer.
7. William White, jr.	Pennsylvania	Assistant meteorological observer and surveyor.
8. George Gibson Garner	Maryland	Assistant astronomer and secretary.
9. N. H. Hutton	District of Columbia	Assistant engineer.
10. John P. Sberburne	New Hampshire	Assistant meteorological observer and surveyor.
11. Thomas H. Parke	Pennsylvania	Assistant astronomer and computer.
*12. Walter Jones, jr.	District of Columbia	Assistant surveyor.

A portion of the instruments required for our operations it was found a matter of great difficulty to obtain, in consequence of the recent outfit of parties for scientific explorations. Commodore Perry had just gone upon his mission to Japan; Captain Ringgold was completing his preparations to explore in the North Pacific ocean; Dr. Kane was in readiness to recommence his search for the lost ship of Sir John Franklin; and Governor Stevens, in charge of a party to examine the northern route for a Pacific railroad, had secured the few instruments of the kind referred to which the others had left. Every portable transit, magnetometer, and barometer, that could have been purchased in the shops, or borrowed from scientific societies and observatories, had been already appropriated for one or the other of these expeditions. The ordinary surveying and astronomical instruments were, as usual, furnished by the Topographical Bureau; but barometers we were obliged to have made for the occasion, and it was necessary to wait until they could be completed.

The needful preparations for transportation and subsistence were meanwhile progressing. In these operations we were greatly indebted to the Quartermaster General's department, for the aid and facilities it afforded. Major Crossman, at Philadelphia, gave the matter his personal attention, and in less than two weeks our wagons, tents, &c., were constructed and delivered to the railroad company for transportation to Cincinnati. In order that no time should be lost, Lieut. Ives immediately set out for New Mexico, by the way of San Antonio, Texas, and El Paso. At the latter place were a few astronomical, magnetic, and meteorological instruments, which having been deposited there by the Mexican Boundary Commission, were placed at our disposal by the honorable Secretary of the Interior. Having obtained these, Lieut. Ives was instructed to repair to Albuquerque, and there await the arrival of the main party; making, meanwhile, astronomical, magnetic, and meteorological observations, obtaining information of the country beyond, and completing such preparations as should facilitate our progress westward from that place.

On the 29th of May, the last division of the party left Washington for the Mississippi river and the frontier; a portion going by the way of New York city, in order to obtain the instruments that were there being completed. We then hastily proceeded to Cincinnati, where Lieut.

\* Mr. Jones was taken ill soon after leaving Fort Smith, and was obliged to leave the party to return home. Mr. Abner C. Galace, of Oregon, was then appointed to the vacancy, but served only a short time, when, for the same cause, he was compelled to resign.

tenant Stanley, the acting commissary, was purchasing stores for the subsistence of the party. To these were added a few presents for the Indians, from a small fund granted by the Indian bureau for this purpose.

Unfortunately the Quartermaster's supplies, sent by railroad from Philadelphia, had not yet arrived; but as an agent had accompanied the train to attend to them, and as the rapid falling of the river created fears lest navigation might be suspended, it was not deemed prudent to delay our own departure on that account. We therefore immediately took passage for Memphis. There we learned that the State of Arkansas had already given a charter for branch railroads from Little Rock, which would connect Memphis with Fort Smith, and that no doubt was entertained of the feasibility of constructing them. Special examinations within the State seemed unnecessary, and we therefore hastened by the way of Napoleon, Little Rock, and Van Buren, to Fort Smith; acquiring such information, and taking such notes, by the way, as circumstances would admit.

We arrived at Fort Smith on the 2d of July. Capt. Montgomery, the army quartermaster at that place, had, with great promptness and energy, made the desired preparations for our departure. The escort ordered from Fort Gibson had also arrived, under the command of First Lieut. Jno. M. Jones, 7th infantry. Nothing but the Quartermaster's stores from Philadelphia were wanting to enable us to proceed with the reconnaissance. While awaiting these, astronomical and meteorological observations were made, as a basis for future operations; and the geologist, the botanist, and the zoologist employed themselves in examining the surrounding country to obtain collections in their various departments. A special expedition was made to the summit of Sugar-loaf mountain, where meteorological observations were taken, and many interesting additions made to the scientific collections.

On the 11th of July, I learned by letter from Mr. White, who was in charge of the camp equipage from Philadelphia, that the boat on which the property was being transported from Cincinnati had run aground upon a sand-bar in the Ohio river. To remedy, as far as possible, the misfortune of this delay, we borrowed tents and wagons from Capt. Montgomery, proposing to proceed with the survey so slowly as to afford the party an opportunity to become acquainted with the duties which would be required of them, and enable our own train to overtake us when it should arrive.

# PART I.

  

## ITINERARY.

### CHAPTER I.

#### *From Fort Smith to Scullyville.*

Commencement of the survey.—Tornado.—Storm.—Ring's plantation.—Scullyville.—Arrival of stores at Fort Smith.—Explorations in vicinity of the Poteau.—Visit to Fort Coffee.—Choctaw Academy.—Account of the Choctaws and their government.

July 14, 1853.—From Camp Wilson, a few hundred yards south of the fort, the survey was commenced, with chain, compass, and level. The astronomical and barometric stations were connected with the town and with the flag-staff at the barracks. The chainmen and rodmen being ignorant of their duties, little more than teaching them could this day be accomplished. The parties at present are divided as follows: Mr. Albert Campbell, surveyor; Mr. Hutton, leveller; Mr. Sherburne, barometric observer; Messrs. Jones and Gaines, signal bearers; Messrs. Garner and Parke, astronomical assistants. Our astronomical instruments consist of two sextants of 8-inch radius, divided to 10", by Gambey, of Paris; artificial horizons of Mercury; and three box chronometers, two of them old and much worn. With these, observations were made which gave for the position of Camp Wilson latitude 35° 22' 55" north, longitude 94° 29' west of Greenwich.

July 15—Camp 1.—We struck camp, and moved south-southwest 10 miles, to Ring's plantation. The survey was continued with railroad transit, chain, and spirit-level. Descending the bluff bank, we crossed the Poteau river at the ferry, and proceeded through the dense forest that covers the bottom lands of the delta between the Poteau and Arkansas rivers. Upon overtaking the surveying party, progress was found to be so slow, on account of the thick undergrowth, that it became necessary to replace the level by a barometer. Being still obliged, however, to digress from the road, the hope of bringing up the survey to camp before dark vanished, and at the approach of sunset we entered an ambulance to follow the train. We had not driven far when the tongue broke, compelling us to leave the wagon and proceed on foot. To increase our troubles a storm came up, with thunder, lightning, and a flood of rain. Mr. Albert Campbell and Mr. Jones were my companions, the latter not yet recovered from a severe attack of fever. As the last glimmering of twilight faded away we reached an Indian farmhouse where camp was to have been pitched, and found that the train had been conducted by the wagon-master to Ring's house, two and a half miles beyond. Resuming our march, the darkness, except when relieved by vivid forks of lightning, was so intense beneath the dense foliage of trees that twined their arched branches overhead, that we were obliged at every turn

Note.—The special descriptions of the topographical features of the country with regard to the construction of a railroad have been omitted from the Itinerary and appended as an appendix to the Report. The Itinerary is intended to give only a general description of the field operations.

## CHAPTER VIII.

### *From Pueblo de la Laguna to Zuñi.*

Covero.—Navajo depredations.—Disturbance at a fandango.—Mount Taylor.—Hay Camp.—Lava bed.—Division of party.—Camino del Obispo.—Forests of Sierra Madre.—Agua Fria.—Acoma Indians.—Summit of Sierra Madre.—Inscription Rock.—Ojo Pescado.—Ancient ruins.—Coal.—Rio de Zuñi.—Sacred spring.—Visit to Zuñi.—Smallpox.—Caciques.—System of government.—White Indians.—Party from Fort Defiance.—Campbell's Pass.—Tradition of the flood.—Visit to Old Zuñi.—Sacred altar.—Arch spring.

*November 14—Camp 64.*—Lieut. Ives' party overtook us soon after starting this morning, and we proceeded together for twelve miles from Laguna westwardly—the general course of the valley of San José—till opposite Covero. Then, leaving the river-side, we turned north two and a half miles to the town, where we encamped. The valley of the river was, however, examined some miles farther, to the point where the Zuñi road again strikes it. The detour by Covero appears to have been made for the convenience of the inhabitants, rather than of those travelling towards the west; but the road is so fine that the increased distance is not complained of. Most of the valley along our route is cultivated by Pueblo Indians. The stream, as we ascended, bore a greater volume of water; forming lagunas, and fertilizing some very broad bottoms. Covero is within one of the valleys that lead from San Mateo or Mount Taylor to Rio San José. It is a Mexican town, containing about sixty families, and is situated upon a sandstone ledge, on one side of which is a narrow fissure, from whence gushes a rill of clear cold water. Below this trickling stream are small cavities in the rock, from which the town draws its supply. By the side of the fountain stands a singular column of sandstone, from twelve to fifteen feet high, somewhat in the form of an uru, with a hole worn at its base so as to admit of a passage through it.

This being a frontier Mexican settlement, the people have suffered greatly from incursions of the Navajoes.\* Occasionally they have been driven from their village to take refuge among the neighboring cliffs, where are defiles and difficult passages favoring both concealment and defence. Many have been taken prisoners by the Indians, and ransomed after years of servitude. One of the men showed a Navajo shield, called "chimal," which he had won as a trophy in battle. It was of raw hide, circular, about two feet in diameter, with an image of a demon painted upon one side, and bordered with red cloth, the ends of which hung in long streamers trimmed with feathers. The Navajoes are not always hostile. They have frequently visited the village on friendly terms, and probably the inhabitants, by trade with them, have made as much in peace as they have lost in war. It was once the boast of these Indians, that, if they desired, they could exterminate the Mexicans; and that they only spared them to save themselves the trouble of cultivating corn and raising sheep. Last night two Navajoes were in our camp at Laguna. They were from Caravajal's band, which is now not far off, and were supposed to have been sent as spies. This Caravajal seems to be a man of great enterprise and cunning. It is said that, formerly, he was accustomed to hover about the settlements, till, seeing a fair chance for pillage, he would communicate the fact to some band in the vicinity prepared to improve the opportunity; and then, turning informer, put the Mexicans upon the trail of the plunderers—claiming a reward from both sides.

The fandango this evening was interrupted by a great disturbance outside. People rushed out to see what was the matter. Everybody, as is usual among Mexicans whenever there is

\* Pronounced Nah-vah-hoes.

the slightest cause, seemed to be in a high state of excitement. Menacing words were bandied, knives flourished, and pistols drawn. The whole town was in an uproar, and no one seemed to know what it was about. At length it was ascertained that one of our herders, named Torrivo, had been recognised as a peon, and a man wished to seize and imprison him till he could be restored to his original state of servitude. The Mexican had tasted freedom, and was manfully defending it. The claim was only fifteen or twenty dollars; so the money was advanced, and order immediately restored. Had it not been paid, this little debt might have kept the poor fellow bound to his master for life.\* In New Mexico the system of peonage has been abolished in law, but not in practice. Written statutes are a sealed book to the laboring classes, and nearly a dead letter to the alcaldes.

The night has been favorable for making astronomical observations.

*November 15—Camp 65.*—Preparing to start this morning, there was great delay, which, upon inquiry, was found to be due to a lack of herders and packers. It appeared that this was the home of the greater part of them, and that their female friends were begging them to stay. It seemed doubtful for awhile which would prevail—duty or love; but at length, a month's pay having been advanced for them to leave behind, their families became somewhat reconciled, and allowed them to depart.

The route passed within six or eight miles of Mount Taylor. This mountain is of volcanic origin, and rests upon sedimentary strata whose horizontality is still undisturbed. Four miles over a smooth road led us again to Rio San José, here a pretty brook rushing impetuously over a bed of lava. Having followed the edge of the valley eleven miles, we stopped at what is called by Americans "Hay Camp." It is a pleasant spot. The valley spreads out into a wide vega,† covered with an abundance of grama, which is occasionally cut to supply hay for the military posts. The whole length of the valley followed to-day has been threaded by a sinuous stream of lava. It appears as if it had rolled down a viscous semi-fluid mass, had been arrested in its course, hardened, blackened, cracked, and in places broken, so as to allow the little brook to gush out from below and gurgle along by its side. The lava bed is frequently a hundred yards in width, the cross-section being a semi-ellipse, in the centre probably thirty feet high.

*November 16—Camp 66.*—A short distance above Hay Camp the road divided—one branch, the Camino del Obispo, leading to Zuñi; the other being the new route by Ojo del Oso to Fort Defiance. There was also a trail, between the two, ascending the river to Ojo del Gallo, and thence crossing through a gap in the mountains to Zuñi. The latter is noticed by Capt. Simpson in his report of Col. Washington's Navajo expedition. In order to examine the two other routes, our party separated; Mr. Campbell taking the northern branch, while the train and main survey followed the southern. Lieut. Jones also, accompanied by Leroux and a small party, set out for Fort Defiance. An additional escort being ordered from that post, we hope it may be prepared to join us at Zuñi, or at least upon the Colorado Chiquito.

With the train, our course for some distance was west, till we had, not without difficulty, crossed the lava stream that has been mentioned. Having reached the base of the mountains, the road turned gradually towards the south and southwest, rising at the rate of about sixty feet per mile along the smooth slope which bounds the valley. Having travelled eighteen miles, we encamped. The average ascent for the march was fifty feet per mile. Our camp is in a grassy, park-like spot, without water, but in the midst of a forest of spruce and pines. The trees are tall, straight, and, almost without exception, appear to be perfectly sound. For railroad ties they would afford good material, and in this climate might be durable without the expense of kyanization.

Rather an amusing scene occurred when the men came into camp. The day having been warm, some of the teamsters became thirsty, and finding a keg of spirituous liquor in one of

\* Of all the Mexicans who accompanied us, no one was more efficient than Torrivo. He was killed by Indians while in the discharge of duty that had been assigned him.

† An open plain or valley.

the wagons, helped themselves to a drink. One or two of the servants were invited to join them, but they declined, knowing that the keg contained alcohol for preserving zoological specimens, and retaining also a vivid recollection of an order given at the Choctaw Agency that the spirit should be drugged with arsenic. The news was not agreeable to the drinkers, and their anxiety was increased by very soon becoming painfully sick. They entered camp, feeling that they must die, or send for the doctor and expose themselves; but love of life proving stronger than fear of punishment, they applied to him for relief. They were informed that the spirit itself was the only poison they had taken, and the ipecacuanha it contained would soon relieve them of that. The fright and subsequent jokes of their companions will probably prevent similar depredations in future.

*November 17—Camp 67.*—Started at daybreak; ascended a hill seventy feet high, and thence proceeded by a gradual rise eight miles to Agua Fria. The barometric profile gives a grade greater than that of yesterday, the mean being seventy-five feet, and the maximum ninety feet, per mile. This could be reduced by increasing the distance. The whole march has been through a beautiful pine forest, affording timber in abundance. Game is plenty. Antelope, black-tailed deer, hares, squirrels, and small birds, having been noticed. Our hunters were successful, and have added several interesting specimens to the zoological collection.

Agua Fria is a permanent spring whose waters gush from a broken bed of lava, flow about half a mile, and then hide themselves again among volcanic rocks. This is the last stream upon our route that seeks admission to the Atlantic. Its source is near the summit of Sierra Madre, 7,760 feet above the level of the sea. We met here a party of Acoma Indians. They had been hunting in the mountain forests, and the quantity of game they had killed spoke well for their archery. They wanted merely to sell us venison, of which we had plenty, and did not seem disposed to be particularly sociable. We tried to write a vocabulary of their language, but the words given were so long and so difficult to pronounce, that we gave up the task. A few flakes of snow fell to-day.

*November 18—Camp 68.*—Leaving Agua Fria, we turned around the point of a hill and ascended a ravine to the foot of a bluff ridge about two hundred feet high, leading to the summit of the Sierra. The usual odometer survey followed the road in its passage over the crest. With compass and barometer, a reconnaissance was also made by going up the cañon to its head, climbing the narrow divide, passing into a similar ravine upon the western slope of the Sierra, and rapidly descending to the level at which we commenced. By a deep cut of a few hundred yards, a railroad might be brought to the head of the cañon; thence a tunnel, with a slightly ascending grade, would open into the opposite ravine. The distance by the reconnaissance was about a mile; but, judging by the courses taken, it cannot exceed three quarters of a mile from the foot of the ridge upon one side to the corresponding point upon the other. The rock could be easily excavated, as it is a soft though compact limestone. From the mouth of the proposed tunnel, a very regular slope, averaging for eight miles fifty feet per mile, led to a wide valley in which we found "El Moro," called by Simpson Inscription Rock. Here we encamped. This side of the mountain is also covered with timber. The view towards the southeast shows an apparently unbounded forest. The mesas and valleys westward appear comparatively barren, though there are scattered clumps of trees and dwarf cedars among the ravines and upon the slopes. No water was met with till we reached our present camp, about eighteen miles from Agua Fria.

El Moro is the Inscription Rock so minutely described by Simpson, in 1849. Approaching its northeast corner, which is rectangular, the cliffs appear truly vertical and smooth to the height of nearly two hundred feet. Here are found the Spanish inscriptions and the Indian hieroglyphics. Upon the eastern face the rock projects somewhat like a bastion. At the re-entering angle there is a semi-cylindrical recess, slightly shelving, and as smooth as if a cascade had poured for ages over the top. Below is a spring or pool of water supplying the camp; but affording barely sufficient for the mules and cattle. The summit of the rock, which is of white

sandstone with a yellowish tinge, is broken, so as to present at a distance the appearance of turrets, like a Moorish castle; from which its Spanish name was derived. Desiring to see the ruins upon the top, we walked around the projecting cliff of the eastern face, and at some distance south found a point where with difficulty we accomplished the ascent. To Simpson's description of this singular place little remains to be added. The walls of the dilapidated pueblo, when not concealed by rubbish, bore evidence of having been built with considerable skill. In some places they still remain perfect to the height of six or eight feet, vertical, straight, and smooth. A pocket-compass placed upon the principal face, gave for its direction N. 75° E., which, the magnetic variation being applied, corresponds nearly with the prime vertical. I have since found that this observation disagrees with that of Simpson, who represents it as perpendicular to the magnetic meridian. The masonry is well done, the stones being of uniform size, about fourteen inches in length, and six inches wide. The layers are horizontal, and each successive stratum, with some appearance of regularity, breaks joints with that below. The beams, whose ends seem broken by a stone axe rather than cut with a sharp instrument, are of cedar, in excellent preservation. A piece was procured for a specimen. Scattered about in great profusion were fragments of pottery quite similar to those among ruins upon the Gila. Arrow-heads of obsidian were also found in the pueblo, affording another link to connect its founders with those who built the Gila cities. East of Rio del Norte, it has already been stated that, not an arrow-head of stone nor a piece of painted pottery could be discovered. Here both abound. Upon the opposite side of a deep gorge we saw another dilapidated fortress; and, by a detour to the right, climbing like goats, and sliding down the broken surface of the rock, we at length found ourselves within it. The walls were rectangular, and the one upon the north side—which was near the edge of the precipice—in good preservation, at one or two points, to the height of eight feet. Its direction did not correspond to the cardinal points. The question arises as to how people could subsist thus upon a naked rock. Two pools of water have been discovered at its base, beneath overhanging cliffs. They are doubtless springs; and, if freed from the sediment they contain, would afford sufficient water for the ordinary uses of the inhabitants, but none for irrigation. It seems probable, therefore, that they were a pastoral people, or that game was abundant, and that they built here for protection from powerful tribes of roving Apaches. As we passed the Sierra to-day a light cloud scudded across the sky, bearing a momentary squall. It soon passed away, and the weather became delightful as before. The nights, however, are cool. New specimens of mistletoe, cactus, and lichens were found. Astronomical observations have been made this evening.

*November 19—Camp 69.*—The wind last night blew for a while violently. The morning was cold, with a stiff breeze from the west, but the sun's rays soon created a pleasant temperature. Ever since leaving Albuquerque, by day, and frequently at night, there has been a westwardly wind. We had expected to find, upon this side of the Sierra, a change in this respect.

There was a little time, before starting, to examine the inscriptions. We passed by the more modern records of Spanish origin, from 1620 to 1736, which have been so well represented by Simpson. Many of them are beautifully carved, and though doubtless faithful in their statement of date, seem but slightly affected by atmospheric action upon the rock. The Indian hieroglyphics, which we examined more carefully, are, however, much time-worn and defaced—some scarcely traceable. Comparing the freshest of those with Spanish inscriptions dated about 1690, the obliteration of age upon the former seems at least twice as great as upon the latter. The place must have been a ruin since the Spaniards first commenced to record upon the rock their passage to and from Zuñi. The inscriptions do not refer to it; neither do the relations of old Spanish explorers, back to the expedition of Coronado in 1540, describe any such pueblo, unless indeed it be included among the seven cities of Cevola. Some of the sculptured hieroglyphics are just discernible, almost wiped out by the finger of time. The plainest were copied; but, on subsequent comparison, proved identical with those figured by Simpson.

Upon leaving camp the train passed over a low ridge, which might have been avoided by a

detour to the right; and, entering a long valley whose bed was upon lava, now mostly covered with a grassy soil, rolled along fourteen miles to the charming valley of Ojo Pescado, where we encamped. This spring bursts from a broken point of the lava bed, and at once becomes a pretty stream, glittering with great numbers of the finny tribe which gives name to it. The circular wall which once enclosed the fountain head is now partly broken down. Upon either side, and almost tangent, are ruins of pueblos so ancient that the traditions of present races do not reach them. Probably at the conquest they formed a portion of Cevola, the seven towns of which, Coronado says, "all stand within four leagues of each other." Below, there is a deserted town of more modern date. Even now it is occasionally occupied in summer by Zuñi Indians, while cultivating the well watered valley. The two old pueblos of the spring are nearly circular in form, and of equal dimensions. One measured three hundred and fifteen short paces, about eight hundred feet, in circumference. They were of stone; but the walls have crumbled, leaving only a heap of rubbish. The pottery is similar to that found at the Moro; painted with bright colors, in checks, bands, and wavy stripes. Many fragments show a beautiful polish. A few pieces were discovered of larger size, inferior in color and quality, but indicating a more fanciful taste. United, they formed an urn with a curious handle; a frog painted upon the outside, and a butterfly represented upon the inner surface. This is supposed to be of Zuñi manufacture. It is a singular fact, that, although some of the most time-worn carvings upon rocks are of animals and men, ancient pottery contains no such representations. Upon one fragment, indeed, found upon Rio Gila, was pictured a turtle, and a piece of pottery picked up near the same place was moulded into the form of a monkey's head. Those appeared to be ancient, and afforded exceptions to the rule. These remains having been examined, we followed a footpath which led to another fissure of the lava bed, where a sparkling stream, somewhat similar to the one described, leaped from its subterranean chasm into life. The lava cliff rises twenty feet above the fissure, and a vertical wall joining two points of it, served to enclose the fountain. Upon the summit stood the ruins of another pueblo, strongly walled around. Near the centre was a mound, with evidences of a circular tower upon the top. Crossing the valley, we explored among the sandstone bluffs and boulders for hieroglyphics. Upon one rock were quite a number of inscriptions and figures, some of which were copied.

By penetrating to the foot of the lava bed, water may probably be found throughout the valley we have traversed to-day. A few thin veins of bituminous coal were discovered, cropping out from the bluffs near camp. The specimens seem good, but the quantity is probably small. Salts, believed to be potassa, effloresce in considerable abundance from seams in the rocks. The soil watered by the springs is a black loam, very fertile. The Indians of Zuñi come hither every year to cultivate vegetables or grain.

In one of the old pueblos were found four nicely cut sticks, three and a half inches in length, stuck into the ground, and united by a cord, forming a square. Feathers of various colors were tied by thongs of bark to the top of each. This had been evidently the scene of some mystic rite, but whether of Zuñians or Navajoes we could not learn. At 8 p. m. the strong west wind suddenly veered round, becoming milder and more pleasant. A gentle breeze now fans the camp fires. The sky is cloudless, and the atmosphere so pure that stars gleam with a brilliancy unknown upon the Atlantic coast.

The fish caught in Ojo Pescado prove to be of a new species. Dr. Kennerly, of late, has been quite successful in collections of birds, fishes, and quadrupeds.

November 20—Camp 70.—Morning broke upon us bright, clear, and cold, the thermometer at sunrise reading 39° Fahrenheit.

Following Rio Pescado, about two miles from camp the recent ruins, before referred to, appeared upon our right. Allowing the survey to pass on, two of us crossed the rapid stream, and ascended stone steps that led to the plaza. The village was compactly built, but the houses were of ruder construction than any before seen, being composed of loose stones piled up singly without mortar. Some were yet entire, and evidently used by herders and laborers of the

valley. The plaza was converted into numerous corrals\* for sheep and goats. The entrance to the dwellings was by a ladder, or rather post, cut into steps, and inclined to rest upon the roof. From thence, through a hole, a similar stair led down to the interior. Some of the contiguous buildings contained a second story, having a door to communicate with the neighboring azotea,† and a fireplace above, the room below being for the stores of grain, &c. The walls were thin, the vigas (rafters) small; and the pueblo, though perhaps containing a hundred houses, showed nothing of the labor and skill displayed in the construction of the ancient strongholds at the springs and at the Moro. Fragments of pottery were strewn around, differing but little from those previously described. A piece of volcanic scoria was found, ground into a symmetrical form, probably a metate—the first seen among the ruins; also an axe made of greenstone, nicely grooved and beautifully polished, like those found at Chichilticale and the Casas Montezuma, on Rio Salinas. These had doubtless been gathered from the ancient ruins, and seemed, like the pottery, to link the wanderers of this region to those who journeyed farther south.

Leaving this place, we descended the valley of Rio Pescado—which was soon lost beneath the lava—eight miles, to where it reissued as Rio de Zuñi, augmented by Rio Nutria from the north. Passing a fertile basin, we encamped at its entrance into a gorge; where, twelve miles from Ojo Pescado, spurs from the mesas came down to the river. The descent was four hundred and twenty feet, averaging thirty-five feet per mile. For the last two days no timber has made its appearance. Scrub cedars and piñons upon the mesa slopes have furnished sufficient fuel.

Upon the brow of the northern mesa, which terminates in cliffs of black metamorphic rock, with large masses of the same piled up in the valley below, stand what are called the ranchos of Zuñi. In construction and appearance they resemble the deserted town upon Ojo Pescado. Nothing of interest was found there. They seem to be used merely as a watch-tower, and a shelter for shepherds and their flocks. The view is extensive; overlooking the table-lands in every direction. Westward sweeps the wide valley of the river, and at the distance of about a league is seen the dark pueblo of Zuñi. Towards the south a lofty mesa, with precipitous cliffs apparently encompassing it, lifts itself proudly from the plain to the height of a thousand feet. There, it is said, are the ruins of old Zuñi.

Below the ranchos, upon both sides of the valley, springs issue from the rocks, and water numerous patches of cultivated gardens. A few hundred yards above, a singular fountain was discovered: it was from ten to twelve feet in diameter, and of a greater depth than we had the means of measuring. Enclosing it was an adobe wall, about four feet high, upon the top of which were ranged a row of inverted jars; that, glistening in the sunlight, first attracted our attention some half a mile distant. Many of them were white, well proportioned, and of elegant forms. Upon their inner and outward surfaces they were curiously painted to represent frogs, tadpoles, tortoises, butterflies, and rattlesnakes. All were brittle from age; some being divested of the plaster ornaments which they had possessed, and others covered with a coating of lime that nearly concealed the painting. The artist made a sketch of the place, and some of the vases were taken to be preserved as specimens.‡

November 21—Camp 70.—It being necessary to await the arrival of Licut. Jones and Mr. Campbell from Fort Defiance, the computations and plots have been recommenced. The botanist and geologist employ the time in making explorations in the vicinity, though little of interest seems to reward their labors. The surrounding mesas are of new red sandstone. It is not the season for flowers, and even the cactaceæ droop. The naturalist, however, is reaping a rich harvest, finding new varieties both of birds and fishes.

The governor of Zuñi has paid us a ceremonial visit. We made inquiries regarding the country west from Zuñi, and towards the Moqui nation; telling him that our government

\* Enclosures for animals.

† Flat roof of a house.

‡ We afterwards learned that the Indians considered this spring sacred.

desired them to furnish us a guide, and such information as might be in their power. He listened attentively to the explanations of the object of our expedition, of the general course we proposed to follow, and of the requisites necessary to make the exploration satisfactory. Then, with dignified reserve, he replied that he would communicate this request to the caciques, and afterwards make known their decision upon it.

*November 22—Camp 70.*—Savendra has been sent with a party to explore the route towards Moqui, in order to ascertain whether water can be obtained in that direction. He has been in that region before and professes to know it well.

*November 23—Camp 70.*—This morning the thermometer at sunrise read 16° Fahrenheit; while the sacred spring gave a temperature of 10° Centigrade, equal to 50° Fahrenheit, which is probably the mean temperature of the year at this place. In order to learn the oscillations of the barometer, and also whether the hourly changes in magnetism are so great as to allow them to be read upon the vernier of our instrument, Lieut. Ives has been occupied in making a series of meteorological and magnetic observations—a complete set of readings having been taken by him once in every fifteen minutes during the last twenty-four hours.

A small party visited the pueblo to-day. The road passed over a ridge, but we preferred keeping along the stream. Threading an opening between rocky bluffs, we passed the rancho gardens; and, a few hundred yards below, entered the valley, several miles in width, which leads to Zuñi. The soil seemed light; but where cultivated, it produces fine crops without the aid of irrigation. Not an acéquia was seen; and an Indian, who accompanied us, said they were not resorted to, as sufficient moisture for the fields was derived from rain. Within the valley appeared occasionally towers, where herders and laborers watch to prevent a surprise from Apaches. Near the centre of this apparent plain stood, upon an eminence, the compact city of Zuñi. By its side flowed the river which bears the same name. It is now but a rivulet of humble dimensions, though sometimes said to be a large stream. The Zuñian was very communicative by the way, and pointed out the various places where he had displayed valor in skirmishes with Navajoes. Of the ruined pueblo upon the mesa, called by Simpson "old Zuñi," he told a tradition which he said had been handed down by the caciques from time immemorial. In the most ancient times, ("tiempo quanto hai,") their fathers came from the west, and built the present town. There they lived till, one "noche triste" at midnight, there came a flood of water rolling in from the west. The people fled in terror; some to the mesa, and escaped; the rest perished in the deluge. The water rose to near the top of the mesa, and there remained. During this time the pueblo was built crowning the hill. To appease the angry spirit that had brought this calamity upon them, a man and a maid were thrown from the cliff into the sea, which then subsided, leaving the individuals sacrificed statues of stone, as they remain to this day. The people then returned to the valley.\*

Upon reaching the town of Zuñi, a most revolting spectacle met our view. Smallpox had been making terrible ravages among the people, and we were soon surrounded by great numbers—men, women, and children—exhibiting this loathsome disease in various stages of its progress. Passing beneath an arch we entered a court, which they said was consecrated to Montezuma dances. This ceremony is described as being of a most singular character. The performers dress in costume; some imitating beasts with horns, all as wild and fantastic as their ideas of the subject of these orgies. The corn-dance also is a very curious annual festival. This court was entirely surrounded by houses of several receding stories, which were attained by means of ladders leading from one to another. Pointing to a house three stories in height, the governor said it was the dwelling of a cacique, where frequently met at night all the officers of the government in consultation. The caciques are the chief of these. They are four in number, and their offices hereditary. Son succeeds father whenever the latter dies or becomes too infirm to perform the duties of his station. These have a general superintendence over all that pertains to the public welfare, and have the power of making war and peace. They appoint

\* For further remarks upon Zuñi traditions see Indian report.

two chief captains, whom they consult upon all occasions: one is the war-chief; the other, a sort of superintendent of police. The latter, mixing intimately among the people, selects the most active and intelligent, whom he nominates to the caciques for the appointments of governor and subordinate officers. Should any one of these prove avaricious and exacting, the people complain to the higher powers, and the offender is displaced. The caciques are supreme; although deferring upon occasions to the will of the people. The present governor, Pedro Pino, however, seems to have things pretty much his own way. He is probably the most cunning, if not the most intelligent, among them, and exercises control by an iron will. Ancient relics being asked for, they brought us several of the "hachas" (stone axes), such as are frequently found at Chichilticale, and among other ruins. We ascended to the house-tops, climbing ladder after ladder, and encountering successive groups of miserable wretches, bearing unmistakable signs of incipient or waning disease. Here were many tamed eagles. They are caught in the cliffs when young, and become quite domesticated. The people are not willing to part with them. From the top the pueblo reminds one of an immense ant-hill, from its similar form and dense population. The number of inhabitants is estimated at 2,000. Going down from the outer side into the street, we encountered five stories of descent. There are said to be in Zuñi white Indians, with fair complexions, blue eyes, and light hair. The prevalence of the smallpox prevented us from seeing them. A sort of tradition among the New Mexicans, too vague to be worthy of credence, accounts for this phenomenon, by a story that many years ago—centuries perhaps—a company of Welsh miners, with their wives and children, emigrated hither; and that the Zuñians killed the men and married the women. There is a striking similarity between some of the words of the Zuñi language and the English. "Eat-a" is to eat. "Eat-on-o-way" signifies *eaten enough*. To express admiration of a thing they exclaim, "Look ye!" or sometimes "Look ye here!" These facts, known by the Americans of the country, are probably the cause of the origin or the revival of the Welsh legend. But the Zuñians deny that it has any foundation in truth.

*November 24—Camp 70.*—Lieut. Jones and Mr. Campbell have joined us; having completed the reconnaissance through the northern pass of the Sierra Madre to Cañon Bonito (Fort Defiance), and thence to this place. Mr. Campbell reports the route from Ojo de Gallo—the head of Rio San José—by the way of Ojo Azul to Ojo del Oso, which empties into Rio Puerco of the west, quite favorable for a railroad. Indeed, so gradual was the ascent and descent on either side of the pass, not exceeding thirty feet to the mile, that without a careful survey the summit might be passed unperceived. Thence to follow Rio Puerco of the west, seemed to him perfectly practicable. The only obstacle to apprehend is a scarcity of water upon the surface, as the stream soon sinks. Savedra has also returned, reporting that he has found a level route to La Jarra, and water at Carriso, thirty miles distant. But the country is covered with such dense thickets that much labor will be required to cut a road through them.

*November 25—Camp 70.*—The repair of our wagons is to be completed to-day. A hasty report of our operations has been prepared for the department, and a profile of the route from Fort Smith to Albuquerque enclosed; the principal object being to duplicate the work already performed; so that, in case by any unforeseen accident our notes should be lost during the march westward, this much may be preserved.

*November 26—Camp 71.*—As the train unwound itself, stretching along in the direction of Zuñi, some of us cast our eyes wishfully towards the legendary table-land that stood about a league upon our left. The Zuñi captain, who had promised to conduct us thither, not appearing, Dr. Bigelow, Mr. Parke, and myself, determined to go by ourselves and trust to good fortune for success in finding the path leading to the top. We took a trail and proceeded two miles south, to a deep cañon, where were springs of water. Thence, by a zigzag course, we led our mules up to the first bench of the ascent. Here, hollowed from the rock, was an Indian cave, and looking down into it, we saw lying in the centre six small birds ranged side by side in two rows. As nothing else was visible within the apartment, some superstitious rite was probably being

enacted. Beyond this place, upon the sandy slope, were orchards of peach trees. Although the soil appeared dry, and there was no means of irrigation, they looked flourishing. Above, the projecting summit of the cliffs seemed inaccessible, and as Indians were here gathering fuel, we endeavored to engage their services. They were young men, and evidently fearful of showing us the way, lest they might offend their elders. At length an old man, crippled by age, took our money and pointed to the road. The young Indians then led, and leaving our mules we followed a trail which, with great labor, had been hammered out from seam to seam of the rocks along the side of the precipice. At various points of the ascent, where a projecting rock permitted, were barricades of stone walls, from which, the old man told us, they had hurled rocks upon the invading Spaniards. Having ascended, according to our estimate, one thousand feet, we found ourselves upon a level surface, covered with thick cedars. The old man had been left far behind. Our young guide, who understood no Spanish, led us to the opposite side of the mesa, and pointed to the stone pillars, which we recognised as the reputed statues of the pair that had been sacrificed at the flood. They were isolated columns of sandstone, about five hundred feet in height, and remarkable enough in appearance to perpetuate a legend among this singular people. Imagination could easily trace a resemblance to human beings of colossal size. The top of the mesa was of an irregular figure, a mile in width, and bounded upon all sides by perpendicular bluffs. Three times we crossed it, searching in vain for the trace of a ruin. Not even a fragment of pottery could be found, and we were about to give up the vaunted pueblo as a fable, when the old Indian, to our surprise, made his appearance at the top of the cliff. He probably gave the guide permission to conduct us, for he led us immediately to a spot which, on inspection, showed traces of art. A few very small fragments of pottery were lying upon the ground, and with some difficulty we could distinguish the remains of a thick wall in the figure of a V. But the guide hurried us on half a mile farther, where appeared the ruins of a city indeed. Crumbling walls, from two to twelve feet high, were crowded together in confused heaps over several acres of ground. Covering every mass of rubbish were vast quantities of tall cacti, *opuntia arborescens*, tipped with bright yellow fruit, that gave the place, at a little distance, the appearance of a flower garden. The Doctor was particularly delighted, as this *opuntia* had not been seen before west of the Del Norte; and, by a direct comparison with it, he has proved another variety growing in the valley to be new. Upon examining the pueblo, we found that the standing walls rested upon ruins of greater antiquity. The primitive masonry, as well as we could judge, must have been about six feet thick. The more recent was not more than a foot, or a foot and a half, but the small sandstone blocks had been laid in mud mortar with considerable care. Having taken a few specimens of painted pottery, abundant as usual in such places, and an obsidian arrow-head that was found, we again followed the guide. Entering a forest of cedars, a secluded nook presented a scene the most interesting of all. It was a Zuñi altar, such as Pedro Pino had previously described to us. An oval basin had been scooped from the ground, seven feet in length. Near one end stood a vertical shaft, two feet high, neatly trimmed with feathers, and a circular net-work of cord. Symmetrically placed upon the other side was a cedar post, about two and a half feet high, quaintly carved, as represented in the accompanying sketch. Shells were suspended from the centre, and below was inserted a grooved horizontal piece, decorated with beads and shells. Between and around them was a forest of feathered sticks, ranged generally in rows, and united by twine. Behind these stood a thin board, two or three inches wide and three feet in height, with seven angular notches at the top; while in regular order below were representations of a star, the moon, the sun, a T, and two parallel lines. Back of all lay a flat rock, apparently intended for an altar, though there were no appearances either of a fire or a sacrifice. Upon this rock were piled a great number of sticks, cut precisely like those before described, all partially decayed, and some in the last stage of decomposition. It was evident that they had once in their turn occupied places in the basin. Judging from the soundness of cedar ties at El Moro, some of these remnants of carved pieces of wood indicated great antiquity. Although many sea-shells and

other ornaments were lying around, the guide would not allow us to take away the slightest thing. When we had left, he took from his pouch a white powder, and muttering a prayer, blew it three times towards the altar. He then followed us, intimating by signs that upon other table-lands east, south, and west, there were similar consecrated spots. The white powder he had used we found to be pinole, the flour of parched corn. The object he said was "pidiendo fortuna," asking a blessing from Montezuma and the sun, and praying for his "daily bread." Passing through Zúñi, we pursued the train eight miles to Arch spring, where it was encamped.

## CHAPTER IX.

### *From Zuñi to the Little Colorado.*

Council of Caciques.—Offers of guides and assistance.—Mexican deserter.—Ancient manuscripts.—Cultivation of corn.—Departure from Zuñi.—Jacob's well.—Estimates of population.—Navajo spring.—Messengers to Moqui.—Carriso creek.—Lithohead-iron creek.—Petrified forest.—Adaptation of the country for raising sheep.—Colorado Chiquito.—Return of Zuñi guides.—Accounts of the Navajo Indians.—Proposed reconnaissance to San Francisco mountain.—Ruins.—Stampede of the animals.—Arrival of Lieut. Tidball and escort from Fort Defiance.

*November 27—Camp 71.*—A cold storm commenced last evening, and showers continued during the night. About ten this morning the rain ceased, and a party was sent out on Savedra's route to cut away the low cedars sufficiently to allow the train to follow.

Arch spring issues from the foot of a red sandstone cliff. Upon the smooth faces of the rock are great numbers of hieroglyphics, evidently old, and as much like symbols of connected ideas as any we have seen. There is a vaulted recess near the spring which gives name to the place. The high table-lands adjoining are covered with ruins. This, at the time of the Spanish conquest, must have been another of the seven towns of Cibola.

At noon the Zuñi war chief arrived to inform us that a council upon our affairs had been held the preceding night by the caciques and governor. They approved of the objects of our expedition, and determined to afford all the aid in their power. They knew of a better route to the Colorado Chiquito than that which Savedra proposed, and offered to send guides to show it to us. No recompense was asked. This illustrates a trait in Indian character—to act with deliberation, and not from impulse.

*November 28—Camp 72.*—The Indian guides arrived, according to promise, to pilot us by the new route to Rio Colorado Chiquito, and the train turned back, by their direction, to follow a short distance the Zuñi river. Last night a Mexican herder deserted, and as the survey was being retraced, we returned to Zuñi in search of him.

We could not well spare his services; and, besides, should he escape, his example might be followed by others. No trace of him could be found till the governor was requested to search the town. The church-bells were sounded, and the chiefs of police then passed through the streets proclaiming the order. The fugitive was soon dragged from his hiding-place, and sent under escort to the train, where he was delivered to the safe-keeping of the guard. The promptness and success with which the governor performed the duties of his office, spoke well for his power of maintaining discipline among the people. Having heard that some curious manuscripts were in possession of the chief cacique, we went to his house to see them. Climbing a ladder, we entered a comfortable room where the old man and his family were seated by a fire. The papers were sent for, and after a long delay brought in by a very good-looking boy about twelve years old, with auburn hair, blue eyes, and a fair complexion. He was a son of the cacique, and claimed to be of pure Indian blood. Glancing at the manuscripts, they were found to contain a correspondence between the governor of New Mexico and certain priests that had officiated at Zuñi. One was dated 1757. The old man declined giving them to us, saying, that a long time ago they had been found in a corner of the old church, and had since been handed down from generation to generation, till now they were considered as insignia of the cacique's office. Besides, they were sacred, and to part with them would bring evil upon the pueblo. He consented that they might be copied, but time for that could not be spared, as it was necessary to join the train.

We descended the valley of Zuñi a league, and then, turning from the river, entered a wide and fertile ravine which led westward to our present camp, about twelve miles from the pueblo. Lieut. Jones had encamped thus early in order to allow the mules to be driven back to the Rio Zuñi for water. The grass is excellent throughout the valley, and even upon the mesas and hill-sides adjoining. Upon each side are quite extensive forests of small cedars and piñons. As an indication of the fertility of the Zuñi country, it may be mentioned that the corn produced there by Indians without the labor of irrigation is sufficient not only to support a large population, but to supply Fort Defiance. Besides, we have been furnished with seven or eight hundred bushels, and there still seems to be plenty remaining in town.

José Maria, Juan Septimo, and José Hacha, were the guides sent to us by the caciques. They described the country to the Colorado Chiquito as being nearly a level plain, with springs of permanent water at convenient distances. This is their hunting ground. Of the country west of that river they know nothing. Moqui Indians are, however, supposed to have a knowledge of the region, and we intend to seek among them for a guide. José and Juan are to go as bearers of despatches to the Moqui nation, with the understanding that, after having accomplished their mission, they will report to us upon the Colorado Chiquito.

We have now passed through the ancient country of Cibola, described by Marco de Niça in 1539, and by Vasquez de Coronado in 1540. We have seen much to verify the accuracy of their journals. The relation of Coronado regarding the people of Cibola is for the most part applicable to the Zuñians of the present day. The city which he calls Granada is Zuñi itself.

The astronomical observations to-night have been rendered less satisfactory than usual, by the condensation of moisture upon the artificial horizon. This is the first time dew has been observed since leaving Albuquerque.

November 29—Camp 73.—This morning, Captain Ker, the sutler at Fort Defiance, who had accompanied our party thus far, took leave of us. He returns to Albuquerque, doing us the favor to forward our letters for the States. We have now broken away from all communication with the civilized world; and, for the first time upon the trip, have entered a region over which no white man is supposed to have passed. Rising gradually to the plain, we traversed a country moderately level to the crest of a sandstone ridge, where we abruptly descended some forty feet. Thence, with a gradual fall of nearly four hundred feet in six miles, we entered a fine large valley, and encamped at Jacob's well. The Indian name for it is "*Wah-nuk-ai-tin-ai-è.*" This spring is a curiosity. In the midst of the valley, which resembles several we have passed during the day, is a conical pit, about three hundred feet wide at top, and one hundred and twenty-five feet deep. At bottom lies the pool of water, some thirty yards in diameter, and apparently quite deep. It is bordered by a fringe of tall rushes. An old and well beaten path leads spirally along the side of the tunnel down to the water. Navajo trails radiate from it in various directions. We are now twenty-three miles from the last watering place on Rio de Zuñi, and the firm road seems to the eye, except at the previously mentioned sandstone ridge, nearly level. The soil passed over is good, and grass abundant. On each side extensive thickets of cedar may furnish a plentiful supply of fuel. Water could probably be obtained at various points we have passed by sinking common wells to the depth of about one hundred and thirty feet. A finer grazing country could scarcely be desired. Grama-grass is luxuriant and nutritious during the whole year. The climate is excellent. For raising cattle and sheep, and producing wool, this region seems peculiarly adapted.

To-morrow, José Maria and Juan Septimo leave our trail, and proceed to Moqui. At our request they traced a sketch of the Moqui country and the route they propose to travel. They say that the population of the seven towns of Moqui has been greatly diminished lately, and now is about the same as that of Zuñi; that is, according to our previous estimate, 2,000 persons. But it is a difficult matter to determine satisfactorily the population of an Indian pueblo, without an examination more minute than would have been agreeable to us in Zuñi during the prevalence of the smallpox. The houses are so piled upon each other that they cannot be

counted, nor does any one seem to know how many families occupy the same dwelling. Different authors, therefore, vary in their estimates for this place from 1,000 to 6,000 persons. Mexicans say that in joining them in expeditions against the Navajoes, there have been known to turn out 1,000 warriors. Leroux agrees with me that this is doubtless an exaggeration. Navajoes are said to be more numerous. José Hacha thinks they number five to one of the Zuñians. Gregg and Simpson estimate their number from 8,000 to 10,000; but by Leroux's standard there are less than 1,000 warriors, and not more than 5,000 persons in all. Speaking of Navajoes reminded our Zuñian warriors of their battles, which they recounted with great spirit. Five years ago their pueblo was threatened by a large body of Navajoes from the east. The Zuñians met them at the ranchos near our Camp 69, and fought from sunrise to near sunset. But the crafty enemy had laid a snare to destroy the pueblo, and while the braves were engaged at a distance, a stronger force approached by the Moqui trail, thinking to enter the town without resistance. But our war-chief told us, with pride, that the women and children successfully defended their homes until the return of the men at night.

*November 30—Camp 74.*—Leaving Jacob's well, we proceeded about 5° north of west, eight miles to Navajo spring, a fine pool of water which breaks out at the surface of a valley. The Indian guide had no trail to follow, but pursued a course so straight as to pass over several small ridges that might as well have been avoided by a very slight detour to the right. But the country was good, and the road for wagons excellent. Two of the guides left, as was arranged, this morning, to convey our message to the caciques of Moqui. They seemed highly impressed with the importance of their mission, and it is hoped that they may succeed in obtaining for us a guide. At camp are relics of extensive ruins. Pottery, painted in stripes, broken into very small fragments, and much decayed, is strewn about the spring. Upon the first hill is a circular depression, forty paces in diameter, like one seen last year at the junction of Rio San Pedro with Rio Gila. Around it are pieces of glazed pottery, and arrow-heads of obsidian, agate, and jasper. The structures were probably of adobes, which would be likely to leave only faint traces of their existence.

At sunset a smoke was seen in the distance, and, soon after, two Navajo Indians rode into camp. They said they were hunters from the Cañon de Chelly; but, learning that we were lately from Zuñi, they were afraid of taking the smallpox, and soon left.

*December 1—Camp 75.*—The first day of winter opened bright, with an elastic exhilarating air, though it was the coldest morning we have had. Since leaving the base of Sierra Madre, disagreeable winds have ceased to annoy us; the atmosphere has generally been clear, and the temperature charming during the latter part of the day and in the evening.

Our course has been nearly west. Five miles from Navajo springs we crossed the wide valley of Rio Puerco of the west, and an arroyo dry except in pools. Thence, passing another ravine and prairie, we entered the valley of Carriso creek; where, twelve miles from our last camp, we halted. The bed of the river contains pools, but the water does not flow above the surface. The road has crossed two prairie ridges about one hundred and thirty feet above the sandy bed of the arroyo. By deflecting the course they may be passed with light grades. Thus far we are agreeably impressed with the character of the country on the Pacific slope of Sierra Madre. We have not yet encountered waterless deserts such as have been supposed to exist in this region. The distant peaks of Jemez, northeast, and of Sierra Magoyon, south, appear to be tipped with snow. There are no indications of a cold climate elsewhere within view.

*December 2—Camp 76.*—Leaving Carriso creek we proceeded nearly west, over a prairie intersected by open valleys from the northeast, to bluffs bounding Lithodendron creek. Here the steep sandstone rocks were difficult to descend, and the ascent westward looked still more formidable. We therefore turned towards the south, and after following the mesa about five miles encamped upon the ridge separating two valleys; Lithodendron upon the right, and a smaller valley a short distance to the left. The banks of Lithodendron creek are forty feet in height, and composed of red sandy marl. The width between the bluffs seems nearly a mile. The

country westward still looks rough. Near camp are found ruins of stone houses, and fragments of painted pottery. Half a jar curiously indented was shown to Savedra, who pronounced it more ancient than the rest. In one place the crumbling banks expose a well-built wall that must have been founded several feet below the present surface. Quite a forest of petrified trees was discovered to-day, prostrate and partly buried in deposits of red marl. They are converted into beautiful specimens of variegated jasper. One trunk was measured ten feet in diameter, and more than one hundred feet in length. Some of the stumps appear as if they had been charred by fire before being converted to stone. The main portions of the trees have a dark brown color; the smaller branches are of a reddish hue. Fragments are strewn over the surface for miles.



Petrified tree near Lithodendron creek.

Now the soil produces no timber; the scrub cedars even have disappeared. For the last three days dry twigs of chamisa have been the only fuel available for camp fires.

*December 3—Camp 77.*—Having passed about three miles farther along the crest, the banks of Lithodendron creek afforded a passage into its wide sandy bed. For about half a mile we followed the stream, which flowed beneath a surface of wet quicksands, in which our wagons often sunk to the hub. This was the most fatiguing part of the journey. Some distance below there were indications of a more favorable crossing. Should it be required to bridge the creek there are plenty of sandstone slabs, quarried as it were, and fit for use. Following the right bank for half a mile we emerged from the sandstone cañon, and found ourselves upon the edge of an immense valley—that of the Colorado Chiquito—extending towards the south and southwest apparently twenty or thirty miles. The soil appeared of dark loam, covered with grass. A few miles below was seen a line of alamos, indicating the junction of a stream from the northeast, which we supposed to be Rio Puerco of the west. Doubtless this should have been followed from the place where we crossed it, although Savedra says that it passes through a cañon. For a railroad it appears that, from this point eastward, the route should ascend the Puerco to near its head at Ojo del Oso; thence, turning the heights of Sierra Madre by Campbell's pass, pursue Agua Azul to Rio San José. The country we have travelled is probably superior in richness of soil and abundance of water; but, as regards the grades, the other would be preferable.

From the entrance to the wide valley referred to we turned westward, and eight miles beyond the crossing of Lithodendron creek, finding numerous lagunas of fresh water and good grama, we encamped. With water for irrigation, such as in this region artesian wells might afford, the soil would yield abundantly. This valley is at the same altitude as that of Rio Grande at Albuquerque. Hence there is probably less rain here than at Zuni, and crops would require artificial watering. The advantages of this country for grazing, however, cannot well be surpassed. With two hundred mules, besides beef-cattle and sheep, we are able to camp where

we please, without fear of the want of grass. Formerly New Mexico, according to Gregg, exported annually 500,000 sheep for mutton alone. Twice that number could doubtless have been sheared. The wool, allowing two pounds per fleece, and that it is worth forty cents per pound, would be worth \$800,000, and would pay every year to a railroad company a handsome freight. An improved breed of sheep would produce wool of more value, and there scarcely need be a limit to the number that may graze upon this region. Nature has furnished grass, sufficient water, and a climate most favorable to this purpose.

Many petrified trees have been seen to-day, their woody texture faithfully preserved in silex, producing jasper variegated with rich and bright colors. Many specimens have been collected by members of the party for seal rings.

*December 4—Camp 77.*—This has been a day of rest. Lieutenant Tidball, with the additional escort from Fort Defiance, not having yet overtaken us, it seems proper to move slowly. Mr. Campbell discovered upon the low lands near camp traces of ruins quite similar to those on Rio Gila. Among them he found an arrow-head of jasper, and a sort of earthen amulet. The buildings must have been of adobes, differing in that respect from the walled pueblos previously seen upon mesa heights. Those of Moqui are said to be upon hills more than a thousand feet above the surrounding plains. Barricaded passes, like those at old Zuñi, lead to the top. It was probably a powerful enemy that drove the people from watered valleys to arid heights, notwithstanding their strange tradition of a flood.

*December 5—Camp 78.*—Another bright morning, calm and cloudless, followed a cool night. The water in the lagunas of Lithodendron creek was abundant, though deeply colored with red marl. Taking an early start, the pack-train following the guide and the wagons as usual in rear, we proceeded about eleven miles over a slightly undulating prairie, covered with grama de china, to the bed of a river coming from the north, to which we gave the title of Leroux's fork. By a gradual descent we crossed this stream, and encamped near its junction with Colorado Chiquito. The valley of the last named river is very wide, reminding us forcibly of the bottom land upon Rio Gila. Like that, the soil is good, and, with irrigation from the river, might be cultivated to advantage. The barometer shows our present camp to be eighteen feet below Albuquerque. The day has been uncomfortably warm for travelling; the thermometer at 3 p. m. reading 65° Fahrenheit. Camp is beautifully situated in a cotton-wood grove, upon the bank of Rio Colorado Chiquito. This stream was called "Rio del Lino" (Flax river) by Coronado, in 1540. Mesquites of small growth line its banks. A porcupine of an unknown variety was secured to-day by Dr. Kennerly, our zealous naturalist. José Hacha took leave of us this morning to return to Zuñi. He had despaired of meeting those sent to Moqui, but this evening they came prancing into camp. Every one was glad to see them, and their arrival created quite an excitement. Their mission had been performed, but no Moqui guide could be obtained. The smallpox had swept off nearly every male adult from three pueblos. In one remained only the cacique and a single man from a hundred warriors. They were dying by fifties per day; and the living, unable to bury the dead, had thrown them down the steep sides of the lofty mesas upon which the pueblos are built. There wolves and ravens had congregated in myriads to devour them. The decaying bodies had even infected the streams, and the Zuñians were obliged to have recourse to melons both for food and drink. The young of the tribe had suffered less, few cases among them having proved mortal. Juan Septimo brought for us several excellent robes of wild-cat or tiger skin, such as the Moquis wear in winter.

*December 6—Camp 79.*—Our Zuñi guides left us this morning to return, and the survey proceeded along the right bank of the river for fifteen miles. Several dry ditches were crossed, the banks of which it was necessary to cut down, thus creating a few hours' detention. It was dark when camp was reached. The valley of the river continues to be several miles in width, and the soil, like that of Rio Gila, would doubtless be excellent for maize or cotton. The stream is now small, but rapid; its waters are fresh and clear, and sufficient for the irrigation of a considerable portion of the low lands that border it. Its sinuous course through the bot-

toms is marked by a line of small alamos. The gravelly prairies that bound the valley are in some places thinly spread with grama; in others, barren. Great quantities of broken pottery have been found. A portion appeared to have been water-worn, as if from a flood, and the patterns were somewhat different from any we have before noticed. Some were ribbed in parallel lines; others wavy, but not in points. Arrow-heads neatly made of jasper were found entire. The foundations of houses were also sometimes traceable.

*December 7—Camp 80.*—We pursued a course a little north of west, still traversing the wide valley, towards the snowy peaks of San Francisco, which for several days have been visible. Sand and light soil, like ashes, rendered the journey heavy for the wagons. Finding a favorable spot we encamped early, having made but 8½ miles. Mr. Marcou says we are now below the Jurassic and Lias formations, and that geological indications are in favor of the development of coal-beds south of our route.

A spur of the Mogollon mountains, which lies nearly southwest from us, is said to be peopled by warlike Yampais. Our guide, Savedra, has recounted various reminiscences of their bravery and daring. A few years since he joined a party of Moquis and Mexicans for the purpose of stealing children for slaves. Upon entering this country, they were met and attacked with such fury by the Yampais that the whole party fled.

In passing through the Navajo country the natives have kept quite aloof from us. Therefore, as one of our Mexican herders from Covero understands their language, a vocabulary of it has been obtained from him. A few years since, while he was playing at Covero spring, he was captured by Navajoes. For nine months he was a prisoner, and followed the Indians in their wanderings. He accompanied a party of one thousand warriors through the Moqui country, and afterwards spent much time among their rancherias in the famous Cañon de Chelly. Their fields are numerous, though cultivated by women alone; no man ever condescending to lend a helping hand. Their numbers, he says, no one can tell. They are thickly spread from Cañon de Chelly to Rio San Juan, and he believes them equal to the whole population of New Mexico. These statements are noted as they were given, without vouching for their accuracy. One ought to deduct an allowance for the exaggeration usual among this people. It is very probable that the size of the tribe exceeds the usual estimate. Their wealth, by his account, consists of immense flocks and herds. Some of the rich men own one thousand horses each, besides mules, cattle, and sheep.

*December 8—Camp 81.*—Plodding along through sand and light soil—sometimes threading the wide valley, at others crossing gravel ridges that bounded it—we made five miles, and encamped. We had crossed the deep bed of a well-wooded tributary flowing from the northeast, called Cotton-wood creek. Nearly opposite could be seen the junction of an affluent from the southeast. The Colorado Chiquito here branches into a net-work of channels, all bordered with alamos. Below camp is quite a forest, extending about four miles down the valley. From a high hill two miles back from camp the river can be seen making a great bend, and sweeping northward. There we propose to commence a reconnaissance westward towards the southern slope of San Francisco mountain, hoping to avoid the circuitous course by the river.

*December 9—Camp 82.*—At the usual hour we left camp, and proceeded a mile and a half, near to the great bend of the river, where we encamped. Near by is the remnant of a ruin as extensive as any yet seen. An isolated hill of sandstone is the foundation of this ancient pueblo, which was doubtless similar to those at Ojo Pescado. In few places are the faces of walls visible above the débris of stones, vigas, and pottery. The colors of the latter are black, red, white, and yellow, worked into a variety of figures, but representing no animals. The indented kind, said to be so very ancient, is here found in many patterns. A stone axe and several pretty arrow-heads of obsidian or carnelian were picked up from the ruins. The pueblo, as well as could be ascertained, was rectangular, one side nearly east and west, 120 feet in length; the other, 360 feet, nearly in the true meridian. The walls were in some places ten feet in thick-

ness, with small rooms inserted within. Scattered around were timbers of pine, which resembled rafters. Two posts, about twelve feet in height, were still standing in good preservation.

The camp-fires are bountifully supplied with fuel from piles of drift-wood of pine, such as grows in this country only upon mountain slopes. It must, therefore, have been brought by freshets from spurs of Sierra Megoyon, among which the Colorado Chiquito takes its rise.

*December 10—Camp 82.*—Last night there occurred that dreaded calamity of the prairies, a stampede of the mules. The herd was quietly grazing, when suddenly a pony took fright; and, creating a panic among the animals, all fled. Their heavy tramping awoke us; and, seizing arms, we rushed out, thinking that Indians were the cause of the disturbance. The night was so dark that nothing could be seen at a distance, and we followed the sound. At length a body of mules was overtaken and brought back. The whole herd was supposed to be recovered; but at daybreak it was found that many were missing. The ground about camp exhibited no trace of Indian footsteps; and at length it appeared that the animals had taken the back track at full run towards Zuñi. The swiftest were gone; only the tired and lazy remained. But a party, without waiting for breakfast, was quickly mounted and in pursuit, hoping to overtake them before they might fall into the hands of the Indians. If not driven, it was not supposed the mules would run far without halting, but they did; and, as time passed without tidings, party after party followed the trail. For thirty-two miles they continued the pursuit; and then, overtaking the frightened horses that led the herd, turned them back. One of the mules had broken a leg in leaping an arroyo. Another had wearied herself out. The rest were driven to camp.

*December 12—Camp 82.*—We have been obliged to await here to allow our mules to recover from the fatigue of their stampede. This has enabled Lieut. Tidball to overtake us with the escort from Fort Defiance. He arrived this afternoon, bringing letters for many of us; a favor as welcome as it was unexpected.

## CHAPTER X.

### *From the Little Colorado to New Year's Spring.*

Departure of reconnoitring party.—Cañon Diablo.—Pine forests.—San Francisco mountain.—Leroux's spring.—San Francisco springs.—Cosaino caves.—Return to the train.—Leaving the Little Colorado.—Christmas in the mountains.—Proposed routes to the Colorado.—Another reconnoissance.—Bill Williams' mountain.—New Year's spring.—Extensive view towards the west.—Black forest.—Continuance of explorations.—Return to New Year's spring.—Arrival of the train.

*December 13.*—Lieutenant Jones, Dr. Bigelow, Mr. Campbell, Mr. White, Mr. Hutton, and myself, with thirteen soldiers, started on the reconnoissance. Crossing to the left bank of the Colorado Chiquito, a course nearly west led us through a fine portion of the valley, where were groves of cotton-wood, and vestiges of an old acequia. But the river soon turned towards the north, and we passed directly over a ridge to an extensive valley, with an ill-defined bed of a stream; the water, except during freshets, passing beneath the surface. This arroyo comes from the southeast; and, according to Leroux, there is water above, and plenty of beaver. But trappers have seldom ventured to explore in that direction, on account of the great numbers of Indians in the vicinity. A short distance beyond, we came upon a broken country, generally prairie, but interspersed with dry ravines and cedar thickets. About twelve miles from camp we stopped in one of the pleasant groves, beside a horizontal ledge of sandstone, which in cavities contained water. There we took supper, and grazed our mules till dark; then continued the journey, trusting to have a bright moon for a guide. But evening produced flying clouds and showers, and the rain concealed the mountains, by which we desired to direct our course. After travelling an hour and a half as nearly west as occasional glimpses of stars would admit, the storm triumphed: so we tied our mules to bushes; and, for the night, threw our blankets upon the lee side of one of the sandstone cliffs, which form a singular feature in the landscape of this region. They are high table-rocks—like little islands in the plain, the remnants of horizontal strata—twenty to thirty feet above the general surface of the prairie.

*December 14.*—At four o'clock this morning the full moon showed the earth about us mantled with snow. The storm, however, had passed, leaving the sky clear, and the atmosphere cold. Having proceeded four miles west, over prairie, we were all surprised to find at our feet, in magnesian limestone, a chasm probably one hundred feet in depth, the sides precipitous, and about three hundred feet across at top. A thread-like rill of water could be seen below, but descent was impossible. There was not the slightest indication of a stream till we stood upon the brink and looked down into the cañon. For a railroad it could be bridged, and the banks would furnish plenty of stone for the purpose. Beyond, upon the course where we wished to explore, the country looked like a nearly level prairie, to the foot of the southern base of the San Francisco mountains. But, finding no means of crossing the cañon with our pack-mules, we followed the right bank for a passage, proceeded to its junction with Rio Colorado Chiquito, and encamped, about twenty-five miles northwest from where we left the wagons. The valley is here wide, and thickly covered with good-sized alamos. The river, which we crossed in order to find a better camp-ground, is two and a half feet deep, and from ten to twenty yards wide. It flows rapidly, furnishing plenty of water for irrigation. The cañon which interrupted our march to-day has been named Cañon Diablo. Near its junction with the river valley was seen a great quantity of dark volcanic ashes, and it is possible that the channel, seemingly cut in a level bed of dolomite, may have resulted from the decomposition of a trap-dike.

December 15.—Having sent messengers to the wagon camp, desiring Lieutenant Ives to conduct the survey by the river to this point, we recrossed Colorado Chiquito, and turned again westward, towards the peaks of San Francisco mountain. From the edge of the prairie which bounds the river bottom, by a generally gradual ascent, we passed a mesa, and at midday reached a glen, one side of which was lined with dolomite, the other by a bed of lava. Beyond we traversed a sort of tufa, sometimes nearly knee-deep to the mules. Within the next eight miles we rose in regular steps upon wave after wave of volcanic rock, and then entered a system of conical peaks, beautifully regular. One among these had a broken crest, and a stream of lava which once poured out from it had been arrested and cooled in its serpentine course. A short distance beyond, a few branching cedars furnished shelter and fuel for a bivouac. Gramagrass has been excellent and abundant over nearly the whole of the route traversed to-day. All were fatigued with the march, and as we had brought with us water for the men, and the snow covering the ground was sufficient to satisfy the mules, we felt independent of springs, and encamped.

December 16.—The largest of the volcanic hills referred to yesterday appears five hundred feet high, with a crater at top. A well-beaten Indian trail winds up the side, showing that there must be water in the basin above, or some other special attraction upon the summit. We continued our course westward for two miles, and then climbed a volcanic hill where we had a fine view of the mountains, now free from clouds. Between the southern base of San Francisco and a long spur stretching northwest from the Mogoyon, the same gap or opening that we saw from Camp 82 was again apparent. We therefore turned southwest in that direction. For some distance thickets of cedar had skirted our road; now we entered a forest of pines extending over a large tract of country from south to north. It is a species of yellow pine, called by the botanist *Pinus brachyptera*. The trees are tall, straight, and sound; from one to three feet in diameter, and from sixty to one hundred feet in height. They are the same that are used for timber throughout New Mexico. In that dry climate no complaint is made of its want of durability. Now we are evidently in a region of more moisture; and *Douglass spruce*, which is also abundant upon the sides of the mountains, would afford a better material for railroad ties. Having travelled fourteen miles, we encamped in the pine forest, near the edge of a beautiful patch of grassy prairie that swept into a valley eastward. Beyond, no hills seemed to intervene between us and the point where, three days since, we turned to descend the Cañon Diablo. The grade from thence is apparently quite regular, and would probably average from thirty-five to forty feet per mile. We have found no water since leaving Colorado Chiquito. Snow yet lies upon the ground to the depth of about an inch, and supplies the present need. A large herd of antelope was seen yesterday, and to-day we have followed the trail of at least one hundred. Upon the hill behind camp a broken jar has been found, the only recent trace of Indians yet seen. Tufa and volcanic scoria are still abundant. The rocks are metamorphic sandstone. The hills are covered with *Corrania Stansburyana*, a shrub which Mexicans call "Alusima." With them it is a valuable medicine, used particularly in complaints of hemorrhage.

December 17.—At 9 a. m. leaving our bivouac upon the hill-side, we followed a wide, valley-like opening southwest, towards the southern point of the San Francisco mountain. Having gradually ascended two hundred feet in five miles, we found ourselves upon the dividing ridge separating the waters of Colorado Chiquito from those flowing into the Gila. Thence appeared a smooth, grassy valley sloping towards the south; and beyond, a magnificent view of a vast forest, covering a wide space, and extending as far as we could see, probably fifty miles distant. Towards the east were several volcanic hills, generally isolated like those we passed among yesterday. Looking back, we saw the same generally plain surface which appeared so inviting from Camp 82. At such a distance, it is true, minor depressions would be invisible; but there was every indication to warrant the belief that, in that direction, fewer difficulties would be encountered than upon our trail. In the course sought at first appeared a long valley and none of the volcanic hills around which we have wound.

San Francisco mountain, so often referred to, is a huge volcanic pile, with several conical peaks near the centre, elevated to the height of at least a mile above its base. From the east, its axis appears to extend from northwest to southeast about ten miles, where it is terminated by a gigantic mass of granite. The steep slopes are everywhere covered with a dense growth of timber, spruce and pine, extending nearly to the highest pinnacles. From the base eastward, are alternate groves and prairies broken by numerous volcanic hills. Upon old Spanish maps the San Francisco mountain is represented as belonging to the continuous Mogollon chain, which comes from the east-southeast, and was called Sierra de los Cosninos, the name of a tribe of Indians inhabiting this region. We now find a division between the two ranges affording the desired passage. To search for water, this being our third day without it, we turned the southwest point of San Francisco mountain, and, avoiding the valley on the left, kept upon the spurs close at its foot. After travelling about seven miles, we reached a permanent spring that poured from a hill-side and was lost in the grassy plain below. In honor of the guide it was called Leroux's spring. It is the same to which he conducted Captain Sitgreaves two years since, but by a different route, passing around the north and the western base of the mountain.

The grass is covered with snow, except in spots among rocks on the hill-sides, and the poor mules can scarcely satisfy their hunger. From our last bivouac we have passed through groves of magnificent pines, intermingled with cedars and dwarf oaks. Some of the latter may be large enough for railroad ties, and perhaps might be found more plenty in other parts of this extensive forest region. The spruce trees would afford a supply for this purpose. The cedars are of a new species, and are frequently two feet in diameter. They bear a sweet berry which Indians gather for food. Upon the more elevated mountain slopes, beside the Douglass spruce, there are tall pines of a species different from those that grow upon the plains below.

December 18.—Two years ago, when Leroux was here with Captain Sitgreaves, the hills were covered with savages, who occasioned them considerable annoyance by hostile demonstrations. But thus far, since leaving the Navajo country, we have not seen the fresh track of a wild Indian. The snow is untrampled, except by beasts and birds, which afford plenty of game. Antelope, deer, hares, and turkeys, are abundant; also a singular species of striped squirrel, which Dr. Woodhouse was the first to find in this region.

Well content with the results of the exploration, at 1 p. m. we turned back for the train. Following the course of the open, meadow-like valley, irrigated by the waters of Leroux's spring, we passed southeast and east about four miles, and discovered a small stream flowing towards the great southern valley, and forming probably the main branch of Rio Verde.\* It is fed by springs. The barometer indicated a descent of two hundred feet from Leroux's spring. From the San Francisco springs we passed over a spur from the hills, and encamped near the southeast point of the mountains, having travelled about six miles.

Snow upon the hill-sides is much less than yesterday, many spots now being bare. Grass is therefore not so scarce. Our bivouac is somewhat elevated upon the slope from the foot of the mountains, and looks over the dark forest before mentioned. Leroux thinks he can distinguish in the distance, south, blue peaks of mountains lying near Rio Gila.

A breeze renders the air chilly, but with a semicircle of green boughs, and a blazing fire in front, we do not feel the need of tents.

December 19.—At 9 a. m. we continued our backward march, to a point near the bivouac of December 18. Here we turned more to the right, and, from the prairie valley before mentioned, found an arroyo leading eastward towards Cañon Diablo. Turning from this, we crossed a low lava ridge and entered a grassy meadow. Skirting a forest of cedars and pines, we descended the arroyo to a sudden breaking away of the rocks, which produced a fine place for a waterfall, and a short cañon below. Water was still standing in pools above, and beneath

\* This stream was called by Leroux Rio San Francisco, from the mountain near which it takes its rise, and it is thus designated in the report of Captain Sitgreaves. The early Spanish explorers gave it the name of Rio Verde, which is still retained among the Mexicans of the present day, and appears upon modern maps. As there is another affluent to the title known as the San Francisco river, it would seem proper, if only to avoid confusion, to preserve the original appellation.

appeared to be springs. As grass and fuel were excellent, and as there were good trees for shelter, we encamped, having made ten miles.

Descending one side of the fissure which forms the cañon, we found within the rock quite a number of caves in the shape of ovens, opening towards the stream. They showed unmistakable signs of volcanic origin. The cavities were regular, and covered with a vitreous substance, hard, and brownish-black, like iron. They had been artificially plastered, and some of the largest were divided by walled partitions into separate apartments. The principal rooms were ten feet across, and where the adobe floor was not covered by débris, the height was about six feet. Within, and communicating with these, were smaller caves still more like ovens, and doubtless used as dormitories. The walls were laid with care, and the plastering of the ceiling, which remained in patches, seemed to have been done rather skilfully. Upon the rocky hill above, and in the cañon, were fragments of pottery, some painted black and white, others indented. The caves seem to have been unoccupied, except perhaps by an occasional visitor, for a long period. The entrances to several are choked by heaps of disintegrated rock. Nevertheless, we call them "Cosnino Caves," after the tribe that roams over this region. The fresh trail of a small party of them has been seen to-day.

*December 20—Camp 87.*—Taking a course about north  $60^{\circ}$  east, we crossed the arroyo, and re-crossing below at a large water-hole, passed a small ridge into a valley apparently descending, by a gradual slope, north  $50^{\circ}$  east to Rio Colorado Chiquito. We kept more to the right, and after traversing a nearly level prairie, made an abrupt descent over precipitous banks to the river, which we reached after a march of seven hours from Cosnino Caves. We struck the river at a deserted camp of our party, and were surprised to find that the trail from there turned backwards. They had returned a mile and a half to a better place for camping, and were there awaiting our arrival. Lieutenant Ives had brought the survey about thirty miles down the river, from Camp 82, where we had left the train. The party was in good spirits. Another stampede of the mules had occurred. One dark night they took fright, and ran six miles before they were stopped. In their flight, some plunged headlong over each other into Cañon Diablo, and the men in pursuit narrowly escaped breaking their necks.

We passed to-day a rocky eminence where were found stone enclosures, apparently intended for watch-towers and for defence, similar to those formerly seen near Ojo de la Vaca, between Rio del Norte and the Gila. Broken jars were also found, painted in stripes. At the wagon camp below are hieroglyphics upon the rocks, representing men and beasts—one of the former having a snake about his head. Among other symbols, is one resembling the notched stick found at the ancient Zuni altar.

*December 21—Camp 87.*—We have remained in camp to-day in order to rest the weary mules. Good grama-grass is found upon the high table-lands.

Dr. Kennerly has labored hard to catch a fish in the Little Colorado, and has at last been rewarded by a single specimen. Fortunately it is of a new species.

*December 22—Camp 88.*—Turning our backs upon Rio Colorado Chiquito, we travelled south  $60^{\circ}$  west nearly direct towards Cosnino Caves. The ascent was gradual, with a generally uniform slope, eleven miles, to a point of lava, where we encamped, having risen nearly six hundred feet above the river. Our loaded wagons passed without difficulty, and made an excellent road. Around camp grama-grass is abundant, and nutritious as usual. The decomposed black lava, called in Mexico "mal pais," affords the best soil for the production of this grass. Our camp is without water, though a few miles beyond is an arroyo with alamos and willows, generally indicative of a flowing stream.

*December 23—Camp 89.*—We continued our march in the midst of a snow-storm. It was a day of toil for the wagon mules, as snow gathered in balls upon their feet, causing them to slip and stumble badly. We passed a few small hills, and after fourteen miles' travel arrived at Cosnino Caves, which proved to be between seven and eight hundred feet above our last camp. The

road which the wagons made was very hard and good. If there were no snow, a train following could make the march from Colorado Chiquito, twenty-five miles, in one day, with ease.

*December 24—Camp 89.*—Having a sheltered spot on the edge of a forest, with plenty of water and grass, it was deemed necessary for the welfare of the mules, upon which we are so dependent, to rest till Monday. The weather in the morning was very cold, the thermometer at sunrise reading  $3^{\circ}.5$  below zero. Later in the day the sun's rays were warm and powerful, melting the snow upon the southern slopes. Several of the party went out to hunt turkeys and other game, thinking to have a feast, but were quite unsuccessful. They found plenty of tracks in the snow. One young hunter got upon the trail of a bear; but the foot-prints were so enormous that he preferred to return to camp.

Christmas eve has been celebrated with considerable éclat. The fireworks were decidedly magnificent. Tall, isolated pines surrounding camp were set on fire. The flames leaped to the tree-tops, and then, dying away, sent up innumerable brilliant sparks. An Indian dance, by some *ci-devant* Navajo prisoners, was succeeded by songs from the teamsters, and a pastoral enacted by the Mexicans, after their usual custom at this festival. Leroux's servant, a tamed Crow Indian, and a herder, then performed a duet improvisatore, in which they took the liberty of saying what they pleased of the company present—an amusement common in New Mexico and California, where this troubadour singing is much in vogue at fandangoes. These last entertainments are interesting to a stranger from their singularity. The plaintive tones of the singers, and the strange simplicity of the people, lead one's fancy back to the middle ages. In this state of society, so free from ambition for wealth or power, where the realities of life are in a great measure subject to the ideal, there is a tinge of romance that would well repay the researches of a literary explorer. Their impromptu ballads alone would make an interesting collection.

*December 25—Camp 89.*—Christmas dawned upon us with the thermometer nearly at zero; but the day has been pleasant, and the snow is rapidly disappearing. Nineteen mules strayed last night, but all have been recovered. No fresh signs of Indians appear since the late snow. Cosminos are said to roam from Sierra Mogoyon to the San Francisco, and along the valley of the Colorado Chiquito. Their number has been estimated by trappers at ten thousand—probably a great exaggeration.

*December 26—Camp 90.*—The morning was again clear and very cold. The pool of water in the cañon below the caves seems to be supplied from a spring. It has afforded sufficient for our large herd, above 200 mules, and appears to suffer little diminution. The fact of a good-sized Indian village having been established in the vicinity, is in itself a strong indication that the water is unfailling.

At  $9\frac{1}{2}$  a. m. we struck tents, and pursued our journey; the surveyors, as usual, in rear of the train. The route was nearly the same as that pursued in returning from the reconnaissance, and was quite easy, except the passage of the narrow ridge before described. Twelve miles led us to the southern base of the San Francisco mountains, where we encamped, from five to six hundred feet above Cosmino Caves. The intention was to have gone on to the San Francisco springs, some three and a half or four miles farther; but, by some mistake or misapprehension, the advanced party encamped here without water.

*December 27—Camp 91.*—Travelling through the crusted snow became so fatiguing to the mules, that it was necessary to add to the force of some of the teams. This could be done only by abandoning a wagon, and one was therefore left behind this morning. We crossed a narrow spur from the mountain some fifty feet in height, and in two hours reached the springs of San Francisco. Water there was abundant, flowing rapidly south, through an extensive grassy basin, towards the great valley of forest before mentioned. Thence we ascended a ravine, which, in one place, narrowed to a cañon, and, after travelling six miles, reached Leroux's spring. In the cañon, fallen trees and rocks obstructed the passage for wagons. To avoid them, the guide led the way over a rocky hill from sixty to seventy feet in height. In a day our party could have rolled away the rocks and made a good road. For a railway, it would be necessary to cut

through two salient points, or it might be more economical to keep nearer to the foot of the mountain, so as to avoid the cañon entirely. A short distance south the whole country looks level, and may, perhaps, be still better adapted for the location of a railway. Leroux says that we can neither proceed west nor southwest, on account of successive mountains and cañons. He desires us to follow the route by which he led Capt. Sitgreaves' party two years ago, or to go even farther to the north. There, he says, we may keep upon the dividing ridge until we reach the mountains that border the Colorado upon the west, pass thence, and enter the valley. Savedra has crossed over that country, and represents it as a barren and nearly waterless prairie. There seems to be another objection to this route—the very advantage that Leroux ascribes to it—viz: the "keeping up" for so long a distance. We must now be about three degrees of longitude east from Rio Colorado, and nearly seven thousand feet above the nearest point. A uniform slope the whole distance would require a grade of forty feet to the mile. To keep upon the ridge, as he proposes, would diminish the distance at so great an expense of grade as to be objectionable. We therefore propose to follow Bill Williams' fork, which Capt. Sitgreaves has represented as rising near this place, and flowing west-southwest into Rio Colorado.

The hill-sides are now nearly divested of snow, and there is plenty of grass for the mules.

*December 28—Camp 91.*—Our weary mules again requiring rest, we have not moved camp to-day. A small party made a reconnaissance four or five miles southwest to a volcanic peak, 706 feet by barometer above its base, from which the view was extensive. Towards the north and northeast were Mount Kendrick and Mount Sitgreaves. Southwest we saw Bill Williams' mountain, where the stream of the same name is said to take its rise. Towards the south was a range of hills, which seemed to form the western boundary of the great valley of Rio Verde. Westward were lesser hills, with plains between, and dim mountains in the distance, all white with snow. But there we are determined to explore for a passage to the Colorado. Turning back towards camp, the snowy peaks of San Francisco, towering, like spires, above a huge pile of mountains, looked grand and imposing. Dense forests of pine surrounded the base. Spruce and pine covered the slopes near to the foot of the conical spires, where appeared to be a pretty well defined curve, supposed to be the "limit of pines," found, by measurement, to be 4,169 feet above the valley at Leroux's spring.

*December 29—Camp 91.*—There being several cases of varioloid in the party, and the surgeon deeming it imprudent to remove the sick, we have remained in camp another day. This morning, the summit of San Francisco being visible, the triangulation commenced yesterday was completed. The height above Leroux's spring was found to be 4,673 feet, making it about 12,000 feet above the level of the sea. At noon, the temperature of the spring, where it issues from the hill-side, was measured. The immersed thermometer read  $48^{\circ}.4$ ;  $3^{\circ}.2$  higher than the surrounding atmosphere. That is probably the mean temperature of the place. The water pours, in several streams, down the ravine, producing a fringe of green herbage. The valley below has a dark loamy soil, luxuriant in grass. It would make a superb plantation. This spot could easily be irrigated, should not the climate prove sufficiently moist to render that process of watering unnecessary. The hill-sides are covered with excellent grama, and tufts of it are now beginning to appear above the snow on the plain. Neither last night, nor to-day, has the temperature been below the freezing point.

*December 30.*—Dr. Bigelow, Mr. A. J. Campbell, Mr. White, and myself, with Leroux for guide, and Lieut. Tidball escorting us, set out upon a reconnaissance westward. We passed from Leroux's spring, north of our reconnoitring peak, and crossing a wooded ridge 150 feet in height, descended gently into another prairie, where at the foot of a grassy hill we bivouaced for the night. Our distance from Camp 91 is eleven miles. The barometer places us eleven feet below that station. Snow covers the ground to the depth of eight inches, with a crust upon the surface, which is the only real obstacle our wagons can encounter thus far upon the march. For a railway the country is excellent. With a slight cutting at the summit of the ridge, which, near reconnoitring peak, divides two valleys—one sloping east, the other west—the road would be nearly level

for the whole distance. On the hill above us an extensive view is obtained; north-northwest, hills and plains are seen, destitute of snow.

*December 31.*—We continued our march through the long prairie that we crossed yesterday. It is surrounded by pine forests, and nearly enclosed by volcanic hills. The snow being from three to eight inches in depth, and covered with a hard crust, our mules, for several hours, made slow progress. Afterwards we entered a forest of pines and dwarf oaks, with large cedar trees bearing sweet berries. The snow becoming soft and less deep, we progressed more rapidly, and at 2½ p. m. bivouaced upon a hill-side, where abundance of bunch-grass, quite green, and cedars for shelter and for fuel, afforded a fit resting-place for the night. From the top of the hill we could distinguish the vicinity of Leroux's spring, lying due east at a distance estimated at twenty miles. The surface between is nearly level. Looking west and southwest appeared an open country, with imperfectly defined valleys, among a dense growth of cedars; but it was difficult to say in what direction was the slope. A blue mountain range some fifteen or twenty miles distant limited the view. From south to south-southwest, about ten miles from us, was Bili Williams' mountain, the highest in this vicinity. North and northwest were black volcanic hills, and a high prairie devoid of snow, and nearly destitute of trees. Below the hill where we stood was a ravine, in which were indications of water. Men were sent to explore, and soon brought the agreeable news of having found a spring. This was of service to the mules, as snow does not satisfy their thirst. This last piece of good fortune determined us to send back to Lieut. Ives, desiring him to continue the survey, and bring the train to this place. The barometer places us about four hundred feet below Leroux's spring. We therefore seem to be truly on the slope towards Rio Colorado.

*January 1.*—The morning was bright and clear. Upon leaving camp, we visited "New Year's spring," about a mile west. It was a pool ten or twelve feet in diameter, with water twenty inches deep, beneath a stratum of ice three inches thick. The amount of water was not perceptibly diminished by what the mules had drunk during the night. It therefore appeared to be a permanent spring. Proceeding southwest towards Bill Williams' mountain, we overtook our pack-train, which had been watered from another pool said to be larger than the first, about half a mile from last night's bivouac. Five miles beyond were indications of other springs to the right, with many Indian trails leading in that direction. After travelling about twelve miles, we spread our blankets beneath a cedar tree three miles west of Bill Williams' mountain. Good grass and timber are found here; but we have failed to reach the waters of Bill Williams' fork. From a hill west of camp, we saw a valley upon the right of our trail which looked like a favorable route, provided it should be necessary for the train to go down to the stream we are in search of; but the long range of mountains west, extending from north-west to southeast, still seems to be unbroken.

We are now near the trail of Capt. Sitgreaves, who passed around the southern base of Bill Williams' mountain, and thence proceeded towards the west-northwest, in the direction of Yampai creek. Lieut. Tidball has taken a sketch showing the Sierra de la Laja and Picacho, some twenty-five miles distant, between which the trail crossed. A chain of blue hills appears in the distance, and extends towards the south-southeast; its crest evidently preserving nearly the same altitude; but the descent of the valley along its foot causes the southern portion, represented in the sketch, to appear a formidable range. The drainage of the ravines is towards the Picacho, through a generally level country, containing prairies mingled with copse of piñons and cedars. The soil being of decomposed volcanic rock, is rich; and, judging from the vegetation which covers it, must be well watered. Capt. Sitgreaves, according to Leroux, found this region to be a plain intersected by numerous and difficult ravines. The country beyond proved to be an elevated prairie, considerably broken, and nearly devoid of water and wood, forming a dreary jornada. The grass, though nutritious and abundant, was parched, indicating a long drought. The soil was so light and porous, that there appeared little chance of finding water in pools. After a laborious and uncomfortable march of eighty miles, on the fourth day they

reached two small springs, to which they had been conducted by a Yampais Indian, captured by them a short time before. These springs furnished but a scanty supply of water, and no more was found till their arrival at Yampais creek, twelve miles beyond. A difficult range of mountains, besides two barren and extensive plains, were crossed, and a second range ascended, before a view of the Colorado was obtained; the descent to the river being then very abrupt. From Leroux's description, it would not appear that this route offers many facilities for a railway.



Black Forest, Pichaco, and mountains north of Aztec Pass.

The region from San Francisco mountain to this place contains much volcanic sand and scoriaceous rock, quickly absorbing rain, and melting snow. Springs doubtless exist in many places, but being now covered by snow and ice, cannot easily be found. Pine forests, interspersed with prairies, seem to extend towards the south to the blue mountains that are just visible above the horizon. The appearance is somewhat similar to the Cross Timbers upon the Canadian. Our camp is on a dry branch of Bill Williams' fork, and, according to the barometer, 400 feet below the bivouac of last night.

*January 2.*—Turning south and southeast along the channel of an arroyo, in half an hour we found pools of water. Willows growing upon the banks seemed to indicate that it was permanent, though melting snows have probably added to the usual quantity. Keeping our course three miles over a prairie which sloped from the southern base of Bill Williams' mountain, we again found water which supplied the train. We then followed Leroux in search of the main stream, to a point which he recognised as being near Capt. Sitgreaves' Camp No. 21. Here we saw the ravine in which the creek flowed south, and followed a branch about four miles to a point of hills, where we again encamped. The stream below us flows in a cañon 150 feet deep. Ascending a hill half a mile south, we saw an immense and beautiful valley, into which the creek enters from the mouth of the cañon, about four miles distant. The valley is striped with

timber and prairie, and extends from north-northwest to south-southeast. It seems to be a well-watered region, and a winter retreat of Indians for several smokes were seen there. Upon the slopes of the hills we find in the vegetation an agreeable change from that of the higher country we have left. *Agave Mexicana* is quite abundant. It is the beautiful American aloe, or Century plant, called in this country mezeal. The Apaches roast it for food; Mexicans distil from it a spirituous liquor.

The weather is warm, and the snow has nearly disappeared, but the gravelly soil is everywhere so saturated with moisture as to make travelling difficult. The mules sink in the mire at almost every step, half way to their knees.

The barometer places us a thousand feet below Leroux's spring.

*January 3.*—A stampede of the mules took place last evening, indicating the approach of Indians or wild animals; therefore, although we regained the muleda, the night was passed with watchfulness and anxiety lest our neighbors might make another attempt to leave us on foot; but we were not again disturbed.

A mile west from our bivouac No. 4, we ascended a ridge called Topographical hill, where we had a view still more extensive than that noted yesterday. We can now trace the great valley, as well as the western ridge of mountains which bounds it, far towards the north-northwest. A mesa mountain towards the southeast has been named Sierra Tonto. South-southwest is Sierra Prieta, with indication of passes upon both sides of it. From thence, northerly, extends a range with a snowy peak near the centre. Nearly west is seen "Picacho." Intervening is a low ridge, covered with a dense growth of dark cedars and piñons, which we call the "Black Forest." This seems to divide the drainage of the valley—one system of streams flowing south-southeast to Rio Verde; the other towards the west and southwest, probably to the Colorado. That upon which we encamped last night belongs to the first system, and therefore may not be Bill Williams' fork, as at first supposed. At all events, it passes far towards the south. Our bivouac No. 3 was upon a branch which appeared to flow westerly, more in the direction of our route. Therefore, to explore it, we took a course north  $70^{\circ}$  west, descended into the valley, and, after travelling about ten miles, encamped upon a creek where were large pools of water. Small alamos and willows cover the banks. Grama-grass is abundant in the vicinity. We now seem to be below the region of pines, and of the sweet-berried cedars. Red cedar is, however, abundant; larger and finer than before seen. There are also numerous piñons with esculent nuts, affording food for wild beasts as well as for Indians. We have seen to-day black-tailed deer, rabbits, and quails; also foot-prints of many antelope and bears. The barometer gives our camp nearly the same altitude as the valley of Rio Colorado Chiquito, and of Rio del Norte at Albuquerque.

*January 4.*—Proceeding in a generally northwest course, we crossed several arroyos, one of which contained deep pools of water; and, after travelling about fifteen miles, encamped near the head of a dry ravine, among hills of red sandstone. Volcanic rock, or "mal pais," as it is appropriately called by Mexicans, has entirely disappeared. Upon our left is a valley leading around these hills, and the indications seem favorable there for the passage of the wagon train, supposed now to be encamped at New Year's spring. We therefore ascended the ridge, and endeavored to communicate with the main surveying party by preconcerted signals. But hills intervened, and prevented our smokes from being seen.

*January 5.*—Leaving our dry bivouac, we passed up the valley mentioned, and ascended a higher hill to reconnoitre. From that point we had an extensive view in the direction towards New Year's spring, but saw no indication of camp-fires. We then turned eastward, followed up a long valley, crossed a low ridge, and from a ravine ascended to the hills, in order to catch, if possible, a view of smoke, which might at least direct our course to the train. Soon the forest became so dense that, not only could we not see beyond, but could scarcely make our way through. At length, having travelled about fifteen miles, we came to the end of the range, and saw Bill Williams' mountain before us. To the east-northeast were several volcanic hills,

and at the foot of one of them was New Year's spring. Here again, at sunset, we made the usual signal, but fruitlessly, as before. Unable to account for this, we had many misgivings with regard to the safety of our friends. The loss of mules by an Indian stampede is the great danger to be apprehended in a country like this. A plan for that purpose, well concerted by savages, is almost sure to succeed; and, however strong the sufferers may be, pursuit on foot is hopeless.

In a ravine at the foot of the hills we bivouaced. All the arroyos crossed to-day were dry; but as we have ascended some eight hundred feet, there is now snow upon the northern slopes, supplying water sufficient for our men. Some mules, when thirsty, eat snow readily; others will not.

*January 6.*—A cold sleet was blowing into our faces this morning, and it awoke us before daybreak. The cedars in this instance proved less comfortable quarters than tents would have been. Having again made signals from the hill, and watched in vain for smoke of camp-fires, with considerable anxiety we turned eastward. On the way, water was found in cañons of the valley; but without stopping, we travelled over broken ground, frequently strewn with pedregal, fourteen miles, to New Year's spring, where, to our delight, we found the main body encamped.

The peaks of San Francisco mountain are again white with snow. A sheet of the same also tips the summits of Mt. Kendrick and Mt. Sitgreaves. But the valley westward, with its grassy slope and border of pine and cedar forests, forms a pleasing contrast to the wintry-looking region which we are now prepared to leave behind. During the eight days we have been absent from the main party, we have travelled, according to our estimates of distances, only ninety-six miles;\* but the labor in wading through snow and soft gravel has been greatly fatiguing to the mules. We have, however, examined a large extent of country. The long mountain range that lies west of the Black Forest remains for a subsequent exploration.

*January 7—Camp 94.*—The day was passed in camp to rest the mules and have them shod. A triangulation was made to fix the positions of mountains and hills that can be seen from this place. The usual series of magnetic and astronomical observations were taken.

Savedra has returned from a three days' reconnoissance to the northwest, upon the trail that he thinks he followed when he accompanied the Moqui Indians some years ago. He reports that he has now travelled thirty miles in that direction without finding any indication of water.

\* Subsequent examinations proved our estimates about one third too small.

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PART II.

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18