ANNUAL REPORT

UPON THE

GEOGRAPHICAL SURVEYS WEST OF THE ONE-HUNDREDTH MERIDIAN IN THE STATES AND TERRITORIES OF CALIFORNIA, OREGON, NEVADA, TEXAS, ARIZONA, COLORADO, IDAHO, MONTANA, NEW MEXICO, UTAH, AND WYOMING,

BY

GEORGE M. WHEELER,

FIRST LIEUTENANT CORPS OF ENGINEERS, U. S. A.;

BEING

APPENDIX N N

OF THE

ANNUAL REPORT OF THE CHIEF OF ENGINEERS FOR 1877.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1877.

With the Compliments of
Geo. M. Wheeler
Lieut of Engineers.

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NOTE.

The following topographical atlas maps, published during the year, accompany the copies of Appendix NN of the Annual Report of the Chief of Engineers, being annual report of Lieut. Geo. M. Wheeler, Corps of Engineers, in charge of United States Geographical Surveys for 1877, and are in continuation of the series, ninety-five in number, on a scale of 1 inch to 8 miles, embracing the territory of the United States lying west of the 100th meridian. (See Progress Map.)

1. Atlas sheet 53 C, embracing portions of Central Colorado, and lying principally in the drainage-basin of the South Platte River.

2. Atlas sheet 61 B, embracing portions of Central Colorado, and showing portions of the drainage-basins of the Rio Grande, Arkansas, Gunnison, and South Platte Rivers, indicating economical features.

3. Atlas sheet 61 C sub, embracing a portion of Southwest Colorado, and drainage-basins of the Gunnison, Rio Grande, Animas, Miguel, and Uncompahgre Rivers, representing economical features.

4. Atlas sheet 61 D, embracing portions of Southern Colorado, and lying principally in the drainage-basin of the Rio Grande.

5. Atlas sheet 65 D, embracing a portion of Southeastern California, and showing the interior basin of Panamint and Death Valleys, Amargosa River and Owen's Lake drainage, indicating economical features.

6. Atlas sheet 69 B, embracing portions of Southern Colorado and Northern New Mexico, and lying principally in the drainage-basins of the Rio Grande, Conejos, Chama, and Navajo, indicating economical features.

7. Atlas sheet 70 A, embracing portions of Southern Colorado and Northern New Mexico, and showing the drainage-basins of the Purgatory and Canadian Rivers, and Costilla and Culebra Creeks, indicating economical features.

8. Atlas sheet 70 C, embracing a portion of Northern New Mexico, and showing the drainage-basins of the Canadian and Mora Rivers, indicating economical features.

9. Atlas sheet 77 B, embracing portions of Central New Mexico, and lying in the drainage-basins of the Rio Grande and Pecos River, indicating economical features.

[EXTRACT FROM THE ANNUAL REPORT OF THE CHIEF OF ENGINEERS TO THE SECRETARY OF WAR.]

OFFICE OF THE CHIEF OF ENGINEERS,
Washington, D. C., October 12, 1877.

* * * * * * *

GEOGRAPHICAL SURVEYS OF THE TERRITORY WEST OF THE ONE HUNDREDTH MERIDIAN.

Officer in charge, First Lieut. George M. Wheeler, Corps of Engineers, having under his orders First Lieuts. Eric Bergland and Samuel E. Tillman, and Second Lieut. Thomas W. Symons, Corps of Engineers; First Lieut. Rogers Birnie, jr., Thirteenth Infantry; First Lieut. Charles C. Morrison, Sixth Cavalry; and Second Lieut. M. M. Macomb, Fourth Artillery.

The following gentlemen have been engaged in special scientific investigations during the year: Dr. F. Kampf, astronomical and triangulation observer and computer; A. R. Conkling, geologist; H. W. Henshaw, ornithologist; Dr. J. T. Rothrock, botanist; and Prof. F. W. Putnam, ethnologist.

Owing to the lateness of the appropriation act, the expedition of 1876 was only enabled to take the field in August, and was disbanded at Fort Lyon, Colo., and Carson City, Nev., during the latter part of November. The expedition of 1877, in three sections, took the field at Fort Lyon, Colo., Ogden, Utah, and Carson City, Nev., during the month of May. The number of small parties organized prosecuted their labors in parts of California, Oregon, Nevada, Utah, Idaho, Montana, Wyoming, Colorado, and New Mexico, and with the prospect of a long field-season only to be closed by the inclemency of the incoming winter at the high altitudes visited.

The areas surveyed by the expedition of 1876 lie in California, Nevada, Colorado, and New Mexico, and come within the limits of atlas sheets 47, 48, 56, 61, 62, 70, 77, and 78. (See progress map.)

The basins of drainage entered comprise portions of the "great interior basin," the Arkansas, Rio Grande, Gunnison, and several of the streams along the western slopes of the Sierra Nevada.

The astronomical stations at which latitude-determinations were made were those necessary to the checking of the measured lines of survey through the mountain defiles.

Two bases were measured; 194 triangulation, 765 three-point, and 5,115 minor stations were occupied; 4,379 miles of survey were run; 168 monuments were built; 4,553 sets of altitude-observations were made; 15 mining camps were visited.

Of the quarto volumes authorized by Congress to be published, the one numbered IV has appeared during the year, and Vol. II is passing through the press.

The tables of declinations of 2,018 latitude-stars, prepared by Prof. T. H. Safford, are in the hands of the printer.

With slight exceptions the MSS. for Vols. I, VI, and VII of the series are ready to be placed in the hands of the printer; and the illustrations have all been prepared, and are now being engraved and printed.

Seven topographical sheets have been added to the atlas, and a number of others are being completed and in various stages of progress.

The edition of colored maps published with the extra copies of the report exhibit the natural resources of the country, and are of value in connection with the settlement of the western region. In the areas given, the land branch of the Government may be able to see at a glance the adaptability of the surface for agriculture or grazing, and the area of timber, position of mines, &c. The special surveys of the Lake Tahoe region, and about the Comstock mines, the maps from both of which are to be shown on scales larger than those usually employed, will illustrate some of the best topographical efforts of the survey, and prove useful to the mining and lumber interests of that section.

The topographical maps which are the main results of the labors of the officers and assistants, and regularly issued as material is collected, are at once available to the War Department for its purposes, and reach the public in the regular course of publication, and through map publishers at home and abroad.

The continuation of this useful work in its present satisfactory stage of organization will, it is hoped, commend itself to the favorable consideration of Congress.

The amounts estimated by Lieutenant Wheeler for the continuation of the survey are recommended, viz:

For continuing the geographical survey of the territory of the United States west of the one-hundredth meridian, the supply branches of the War Department assisting as heretofore, being for field and office work, and for the preparation, engraving, and printing of the maps, charts, plates, cuts, photographic plate, and other illustrations for reports; for temporary office-room at points remote from Washington, D. C., and the purchase at nominal rates of sites for field observations, for the fiscal year ending June 30, 1877 ..... $120,000 00

(His annual report, with appendixes and estimates, is appended.)

(See Appendix N N.)

* * * * * * *

ERRATA.

Page 1221, in last column of first table, for "1.0784" read "1.0084."
Page 1233, ninth line from top, for "Fort Lyon, Colo.," read "Emory's, N. Mex."
Page 1233, fifteenth line from bottom, for "Anton Chico" read "Emory's, N. Mex."
Page 1268, fourth line from top, for "Slate" read "State."
Page 1271, twenty-third line from bottom, for "30 inch" read "1 minute."
Page 1271, twenty-sixth line from bottom, for "10 inch or 20 inch" read "10 sec. or 20 sec."
Page 1299, eighteenth line from top, for "northwest" read "northeast."
Page 1315, second line from top, for "Æcmophorus" read "Æchmophorus."
Page 1323, sixth line from bottom, for "serous" read "servus."
Page 1324, thirteenth line from top, for "Cinex" read "Cimex."
Page 1330, second line from top, for "Apiomerina" read "Apiomerinus."
Page 1330, tenth and eleventh lines from top, for "liguttatus" read "biguttatus."
Page 1333, twenty-second line from top, for "Darius" read "Darnius."

APPENDIX N N.

ANNUAL REPORT OF LIEUTENANT GEORGE M. WHEELER, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1877.

GEOGRAPHICAL SURVEYS WEST OF THE ONE-HUNDREDTH MERIDIAN IN THE STATES AND TERRITORIES OF CALIFORNIA, OREGON, NEVADA, TEXAS, ARIZONA, COLORADO, IDAHO, MONTANA, NEW MEXICO, UTAH, AND WYOMING.

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REPORT.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Washington, D. C., June 30, 1877.

SIR: I have the honor to submit the following report for the fiscal year ending June 30, 1877:

Including the expeditions of 1876-'77, the fields occupied will have embraced parts of the States and Territories of California, Oregon, Nevada, Texas, Arizona, Colorado, Idaho, Montana, New Mexico, Utah, and Wyoming.

The remaining political divisions of the area west of the one-hundredth meridian, into which parties of this expedition have not entered for its survey, are the State of Kansas and the Territories of Washington and Dakota. The work so far has been directed to the most rugged and thinly-settled portions of the western mountain region. As time and means permit, the areas occupied will adjoin the sections of territory already entered and continue toward completion the topographical survey of the entire region.

SUMMARY OF FIELD AND OFFICE OPERATIONS.

The expedition of 1876, in two sections, (Colorado and California,) took the field during the month of August from Fort Lyon, Col., and Carson, Nev., respectively. Two parties were organized at Fort Lyon and four at Carson.

The expedition of 1877 took the field during the early part of May, resuming the labors as left by parties of 1876 in the Colorado and California sections of the survey, and organizing a third division to operate in portions of Utah, Idaho, and Montana, to be known as the "Utah section" of the survey.

The disbandment of the parties of the 1876 expedition was concluded at Fort Lyon, Col., and Carson, Nev., respectively, during the latter days of November, closing a season of a little less than four months, made short by want of necessary appropriations with which to enter the field during May, as is most economical and satisfactory, and marked by an activity on the part of parties that has afforded favorable results.

The following changes in the *personnel* have occurred during the year:

Lieut. William L. Marshall, Corps of Engineers, relieved from duty August 8, 1876.

Lieut. Samuel E. Tillman, Corps of Engineers, reported for duty August 10, 1876.

Lieut. Thomas W. Symons, Corps of Engineers, reported for duty August 9, in obedience to Special Order No. 161, paragraph 5, Headquarters of the Army, August 8, 1876.

Professor Jules Marcou, a member of the expedition of 1875, and later

connected with the office, called by private business, contributes no longer his valuable labors in western geology, having left the country for Europe for a limited period. Dr. Oscar Loew, whose industry in many fields of scientific inquiry are evidenced by his reports, returns to his home in Germany. His large enthusiasm and commendable energy justifies the hope that he may forego any prolonged professional undertaking there, and return to this country to continue his labors.

The services of Frank Carpenter terminated when he left the United States for the purpose of joining in the surveys now being prosecuted by Americans in Brazil.

Mr. George M. Lockwood, connected with the work since 1873, upon appointment to the chief clerkship of the Paten Office, concluded his service here.

The only appointments made during the year, except as to minor positions, are those of Mr. John A. Church, mining engineer, now engaged in an examination of the mining affairs about the Comstock Lode, and Mr. E. T. Gunter, who accompanies the party of Lieutenant Bergland for the field season. Dr. J. T. Rothrock has been engaged during the year in the completion of his botanical report, which, in connection with the special reports of several scientific gentlemen, will make the body of volume vi.

Prof. F. W. Putnam, without additional compensation, continues his work upon the archæological collections placed in his hands, and brings toward completion the manuscript for volume vii of the quarto reports.

Four general-service clerks have been enlisted, who are called upon, in addition to frequent clerical duty, to assist in the tracing and draughting of maps, and in the field for topographical observations.

I desire to recognize the cheerful assistance frequently extended by the officers of the supply department of the Army in facilitating the progress of the work, and to others, officers of the Government and individuals, who have shown willingness to aid, either directly in the objects sought, or by appreciation of the results obtained.

The following list notes certain of the more prominent features of the field and office work:

FIELD.

Sextant-latitude stations	74
Bases measured	2
Triangles about bases measured	50
Main triangulation-stations occupied	64
Secondary triangulation-stations	80
Station on meanders	5,115
Three-point stations occupied	765
Camps made	317
Miles meandered	4,379.48
Magnetic variations observed	208
Monuments built	168
Cistern-barometer stations occupied	749
Aneroid-stations occupied	3,804
Mining-camps visited	15
Mineral and thermal springs noted	16
Mammals, specimens collected	13
Birds, specimens collected	109
Reptiles, lots collected	10
Fishes, lots collected	9
Insects, lots collected	31
Shells, lots collected	2

OFFICE.

Astronomical positions computed	46
Stations adjusted by method of least squares	93

Triangles computed	279
Distances computed	186
Latitudes and longitudes computed	186
Azimuths computed	186
Sheets and parts of sheets plotted, (1 inch to 2 miles)	17
Special sheets drawn, (various scales)	16
Cistern-barometer altitudes computed	709
Aneroid-barometer altitudes computed	3,709
Atlas-maps (1 inch to 4 miles) published	7
Atlas-maps (1 inch to 4 miles) nearly ready for publication	4
Atlas-maps (1 inch to 4 miles) partially completed	2
Reports published: Volume iv.	
Reports distributed	1,533
Reports in course of publication: Volumes i, vi, vii; Star Catalogue, and table of distances.	
Maps distributed	8,133

ASTRONOMICAL.

The latitudes of a number of points, as determined by the officers of the survey for the season, are herewith given, viz:

Geographical positions, from sextant observations, &c., for the year 1876.

Stations.	Atlas-sheet number.	Objects observed.	Latitude.	Altitude above sea-level.	Variation of needle.	Observer.	Computer.	Remarks.
			° ′ ″	*Feet.*	° ′ ″			
Antoines' Ranch, Nev.....	48 D	α Coronæ.....W. α Pegasi.....E. α Aquilæ.....S. Polaris.....N.	39 22 56.5	6,517	17 00 17 E.	Lieutenant Birnie.....	Lieutenant Birnie	On Smith's Creek.
Anton Chico Road, N. Mex.	77 B	Polaris.....N. α Pegasi.....S. α Aquilæ.....W.	35 04 18.7	6,592	13 46 00	Lieutenant Morrison..	Lieutenant Birnie.....	Near Camp No. 67, party 2, Colorado.
Bench Creek, Nev	48 C	Polaris.....N. ε Pegasi.....S. α Andromedæ. E. α Lyræ.....W.	39 30 15.2	7,697	16 45 20	Lieutenant Birnie.....	Lieutenant Birnie	Southwest of Grant Peak.
Birchim's Ranch, Nev	48 D	Polaris.....N. ε Pegasi.....S. α Lyræ.....W.	39 25 28.7	5,743	.....	Lieutenant Birnie.....	Lieutenant Birnie.....	Reese River Valley.
Buckland's Ranch, Nev....	48 C	Polaris.....N. ε Pegasi.....S. β Andromedæ. E. α Lyræ.....W.	39 17 48.6	4,151	16 16 37	Lieutenant Birnie.....	Lieutenant Birnie.....	On Carson River.
Cañon del Agua, N. Mex...	77 B	Polaris.....N. α Pegasi.....S. α Arietis.....E. α Aquilæ.....W.	35 19 04.3	5,916	15 16 00	Lieutenant Morrison..	Lieutenant Birnie ... Lieutenant Macomb .	Near Mesa Chupaines.
Carson Lake, Nev.....	48 C	Polaris.....N. ε Pegasi.....S. α Andromedæ. E. α Lyræ.....W.	39 17 11.7	3,883	15 29 42	Lieutenant Birnie	Lieutenant Birnie	Southwest shore of.
Cerososo Creek, N. Mex ...	70 A	Polaris.....N. α Aquilæ.....S. α Coronæ.....W.	36 44 34.7	7,785	14 30 00	Lieutenant Morrison..	Lieutenant Birnie ... Lieutenant Macomb .	Camp No. 13, party 2, Colorado.
Cleaver's Ranch, Nev.....	48 C	Polaris.....N. α Pegasi.....S. α Persei.....E. α Cygni .....W.	39 07 18.7	4,337	16 42 44	Lieutenant Birnie	Lieutenant Birnie.....	On Walker River.
Chalk Well, Nev	48 D	Polaris.....N. α Aquilæ .....S. α Andromedæ. E. α Coronæ.....W.	39 06 35.0	7,604	16 27 08	Lieutenant Birnie	Lieutenant Birnie	On Wadsworth and Lodi Road.

Cherry Valley, Nev.	48 C	Polaris.....N. ε Pegasi.....S. β Andromedæ.E. α Lyræ.....W.	39 34 54.7	7,473	15 59 00	Lieutenant Birnie	Lieutenant Birnie	At head of Clan Alpine Creek.
Clover Valley, Cal.	47 B	Polaris.....N. Sun..... α Aquilæ.....S.	39 54 42.0	5,464	16 40 00	Lieutenant Tillman...	Lieutenant Birnie	Camp No. 8, party 1, California.
Dead Horse Well, Nev.	57 A	Polaris.....N. ε Pegasi.....S. α Andromedæ.E. α Lyræ.....W.	38 53 48.8	4,117	16 30 05	Lieutenant Birnie	Lieutenant Birnie	On Wadsworth and Bellville Road.
Deep Hollow, Nev	48 C	Polaris.....N. ε Pegasi.....S. β Andromedæ.E. α Lyræ.....W.	39 04 29.1	5,244	16 25 04	Lieutenant Birnie	Lieutenant Birnie	On Wadsworth and Bellville Road.
Elliott's Ranch, Cal.	47 D	Polaris.....N. ε Pegasi.....S. α Andromedæ.E. α Lyræ.....W.	39 30 14.6	6,233	16 54 53	Lieutenant Tillman...	Lieutenant Birnie	Near Little Truckee River.
Ellsworth, Nev.	57 B	Polaris .....N. ε Pegasi .....S. α Andromedæ.E. α Lyræ.....W.	38 58 24.2	6,871	.....	Lieutenant Birnie	Lieutenant Birnie	Mining town.
Florissant, Colo	62 A	Polaris.....N. α Aquilæ.....S.	38 51 34.6	8,184	14 55 08	Lieutenant Bergland..	Lieutenant Bergland..	South of Camp No. 10, party 1, Colorado.
Florissant, Colo.	62 A	Polaris.....N. Sun ..... α Aquilæ.....S.	38 56 34.7	8,184	14 55 08	Lieutenant Bergland..	Lieutenant Bergland..	
Gates' Ranch, Nev.	48 C	Polaris.....N. α Aquilæ.....S. α Pegasi.....E. α Coronæ.....W.	39 22 19.4	4,154	.....	Lieutenant Birnie	Lieutenant Birnie	On Carson River.
Glenbrook, Nev.	47 D	Polaris.....N. Sun..... β Aquarii.....S. γ Pegasi .....E. α Coronæ.....W.	39 05 06.2	6,282	15 59 00	Lieutenant Macomb ..	Lieutenant Macomb ..	
High Creek, Colo	62 A	Polaris.....N. Sun..... α Aquilæ.....S.	38 42 33.3	8,288	15 00 30	Lieutenant Bergland..	Lieutenant Bergland..	Camp No. 9, party 1, Colorado.
Ione, Nev.	57 B	Polaris.....N. ε Pegasi.....S. α Andromedæ.E. α Lyræ.....W.	38 57 05.1	6,844	15 49 13	Lieutenant Birnie	Lieutenant Birnie	Mining town.
Juan Lujan Spring, N. Mex.	77 D	Polaris.....N. α Pegasi.....S. α Arietis.....E. α Aquilæ.....W.	34 23 05.1	6,011	13 02 00	Lieutenant Morrison..	Lieutenant Birnie	2½ miles south of Camp No. 59, party 2, Colorado.
Lee's Mill, Nev.	48 C	Polaris.....N. α Pegasi.....S. α Arietis.....E. α Aquilæ.....W.	39 00 50.5	4,350	16 46 15	Lieutenant Birnie	Lieutenant Birnie	Mason Valley.

Geographical positions, from sextant observations, &c., for the year 1876—Continued.

Stations.	Atlas-sheet number.	Objects observed.	Latitude.	Altitude above sea-level.	Variation of needle.	Observer.	Computer.	Remarks.
			° ′ ″	*Feet.*	° ′ ″			
Log Cabin, Nev	48 C	Polaris.....N. ε Pegasi.....S. α Andromedæ E. α Lyræ.....W.	39 26 23.4	4,070	16 49 48	Lieutenant Birnie.....	Lieutenant Birnie	On Carson River.
Marlett's Ranch, Nev.....	47 D	Polaris.....N. γ Pegasi .....E. α Coronæ.....W. α Lyræ.....W.	39 11 26.7	8,074	16 54 00	Lieutenant Macomb ..	Lieutenant Macomb ..	
McMahon's Ranch, Nev....	57 B	Polaris.....N. α Pegasi.....S. α Arietis.....E. α Aquilæ.....W.	38 59 33.6	6,552	15 41 17	Lieutenant Birnie.....	Lieutenant Birnie	On Reese River.
McLaughlin's Ranch, Colo.	53 C	Polaris.....N. Sun.....	39 04 35.3	8,226	14 47 30	Lieutenant Bergland..	Lieutenant Bergland..	
Patterson's Ranch, Nev....	48 D	Polaris..... α Aquilæ..... α Andromedæ ... α Coronæ.....	39 31 06.1	5,213	16 27 24	Lieutenant Birnie.....	Lieutenant Birnie.....	On Edward's Creek.
Ponil Creek, N. Mex	70	Polaris.....N. α Aquilæ .....S. α Pegasi.....E. α Coronæ.....W.	36 41 42.5	8,333	14 57 00	Lieutenant Morrison .	Lieutenant Birnie.... Lieutenant Macomb .	South Fork.
Purgatory River, Colo.....	70 A	Polaris.....N. α Aquilæ .....S. α Coronæ ....W.	37 14 17.9	6,194	14 50 00	Lieutenant Morrison..	Lieutenant Birnie ... Lieutenant Macomb .	Camp No. 8, party 2, Colorado.
Ragtown, Nev	48 C	Polaris.....N. α Aquilæ .....S. α Pegasi .....E. α Coronæ ....W.	39 30 01.7	4,002	17 06 00	Lieutenant Birnie ...	Lieutenant Birnie	On Carson River.
Rendezvous Camp, Nev ...	47 D	Polaris.....N. α Aquilæ .....S. Sun..... α Pegasi.....E. γ Pegasi.....E. α Coronæ.....W. α Ophiuchi ...W.	39 10 14.0	4,700	16 46 43	Lieutenant Macomb . Lieutenant Birnie ...	Lieutenant Macomb .. Lieutenant Birnie	Near Carson City, Nev.
Rito Alto, Colo.....	61 B	Polaris.....N. Sun..... ε Pegasi.....S.	38 10 46.5	8,169	14 38 00	Lieutenant Bergland..	Lieutenant Bergland..	Foot of.

Rio Grande River, N. Mex..	84 B	Polaris.....N. α Pegasi.....S. α Arietis.....E. α Aquilæ.....W.	33 45 19.1	4,576	13 09 00	Lieutenant Morrison..	Lieutenant Birnie ... Lieutenant Macomb .	Above Fort Craig.
Rosita, Colo.....	62 C	Polaris.....N. Sun..... α Pegasi.....S.	38 05 10.7	8,717	14 20 00	Lieutenant Bergland..	Lieutenant Bergland..	
Rowland's, Cal.....	56 B	Polaris.....N. Sun..... α Pegasi.....S. α Persei.....E. α Aquilæ....W.	38 56 19.4	6,222	15 51 00	Lieutenant Macomb ..	Lieutenant Macomb ..	
Sierra Valley, Cal.....	47 D	Polaris.....N. Sun..... α Aquilæ.....S. α Pegasi.....E. α Coronæ....W.	39 47 58.1	4,910	16 55 53	Lieutenant Tillman...	Lieutenant Birnie	Camp No. 6, party 1, California.
Sierraville, Cal.....	47 D	Polaris.....N. ε Pegasi.....S. α Andromedæ.E. α Lyræ.....W.	39 34 58.1	4,904	.....	Lieutenant Tillman ..	Lieutenant Birnie	
Silver Age, Nev.....	48 D	Polaris.....N. ε Pegasi.....S. α Andromedæ.E. α Lyræ.....W.	39 24 42.8	6,014	16 31 52	Lieutenant Birnie.....	Lieutenant Birnie	On Big Creek.
Sulphur Spring, Nev.....	48 C	Polaris.....N. ε Pegasi.....S. α Andromedæ.E. α Lyræ.....W.	39 17 58.1	3,972	16 55 30	Lieutenant Birnie.....	Lieutenant Birnie	Sand Spring, Alkali Flat.
Tissapok Spring, Nev.....	48 C	Polaris.....N. ε Pegasi.....S. α Andromedæ.E. α Lyræ.....W.	39 08 05.2	5,832	16 43 04	Lieutenant Birnie	Lieutenant Birnie	
Vermejo, N. Mex.....	70 A	Polaris.....N. α Aquilæ.....S. α Coronæ.....W.	36 50 58.8	7,823	14 34 00	Lieutenant Morrison..	Lieutenant Birnie ... Lieutenant Macomb	
Washington, Nev.....	48 D	Polaris.....N. α Pegasi.....S. α Arietis.....E. α Aquilæ.....W.	39 09 34.5	6,992	16 40 24	Lieutenant Birnie	Lieutenant Birnie	
West Gate, Nev.....	48 C	Polaris.....N. ε Pegasi.....S. α Andromedæ.E. α Lyræ.....W.	39 17 19.4	4,504	17 03 14	Lieutenant Birnie	Lieutenant Birnie	
Welch's Spring, Nev.....	57 B	Polaris.....N. ε Pegasi.....S. α Andromedæ.E. α Lyræ.....W.	38 59 16.1	5,235	16 06 00	Lieutenant Birnie	Lieutenant Birnie	Lodi Valley.

The latitude and longitude and altitude of the main astronomical stations will be given in volume II of the quarto reports, now passing through the press.

It has not been found necessary to occupy further main astronomical stations for the purpose of checking positions determined by other means in the prosecution of work of 1877; but upon the completion of the observatory at Ogden and those contemplated—one at Denver, Col., another on the western slope of the Sierras, a number of points to the north and south of the present line of the Pacific Railroad, *i. e.*, in Oregon, Idaho, Montana, Texas, New Mexico, and Arizona—may be occupied.

GEODETIC AND TOPOGRAPHICAL.

The sketches showing the triangulation in the Colorado, Utah, and California sections are added to as computations progress, and from time to time, as it covers a number of the regular atlas sheets, will be published, as well as the geographical positions, obtained by triangulation, of prominent points. The number of triangulation stations of the highest grade increases each year, and especially in areas where more numerous observations become necessary in order to gather data for delineation on maps of the larger scales. As usual, the areas occupied in the expeditions of 1876 and 1877 follow strictly those authorized by the Chief of Engineers and the honorable the Secretary of War, in pursuance of projects submitted by the officer in charge, and are all laid within that part of the territory of the United States lying west of the one-hundredth meridian, as shown upon the progress map, and over which it is contemplated that topographical surveys in detail commensurate with the character and development of the various sections shall be prosecuted to completion.

The topographical assistants are now required to add to their notes careful data showing the natural resources of the region traversed, in order to collect information as to the general character and value of the areas still belonging to the Government, and it appears that the relative areas of arable, timber, grazing, mineral, and arid lands may be described and delineated.

The noticeable topographical results inaugurated during the year are about Lake Tahoe, in the Sierra Nevada, the topography of which, from data now gathered, warrant a projection on a scale of 1 inch to 1 mile, which has been completed at the hands of a special party engaged upon the high peaks and along the divides of the water courses of this peculiarly interesting lake region.

The plane-table sheets covering the entire Comstock mining district are drawn upon a scale of 1 inch to 500 feet, and will, after reduction, serve as a complete and connected contour map of this region so abundant in the precious metals.

As usual, when practicable, connections have been made with main and minor points of the land survey and monuments built in all cases of due importance. The areas covered by the expedition of 1876 are noted upon the progress map as parts of atlas sheets 47, 48, 56, 61, 62, 70, 77, and 78. Portions of the following basins are embraced, the "Great Interior Basin," and those of the Arkansas and Rio Grande Rivers, as well as the headwaters of a number of streams lining the western slopes of the Sierra Nevada between the latitudinal limits noted on the progress sheet. The gauge of the success of the expedition is better shown by the number and character of the observations made at the main geo-

graphical stations than by the area covered, although the latter is not inconsiderable for so short a season.

A measured and developed base was laid out in the Carson Valley, and connected with the astronomical station established in 1873 at Virginia City, Nev. A description of the apparatus and method employed, by Dr. Kampf, being somewhat typical of that adopted for use upon the survey, is herewith given.

DESCRIPTION OF MEASURING-ROD.

The rod was decided upon by the officer in charge in the winter of 1875–'76, upon consultation with Dr. Kampf, and constructed by Mr. Edward Kahler. It was made of wood, 20 feet in length, strengthened by a vertical cross-piece. Each end of the rod is provided with a scale 8 inches long, subdivided to $\frac{1}{100}$ of an inch, so that by a magnifier it can be read to thousandths. At a point near the center an arc of a circle of 30° extension is fastened. An arm attached to the center of the circle, and movable by a micrometer-screw, carries a level, so that after determining the zero-point on the face of the circle the inclination of the rod can be easily read to 5 minutes. The rod is placed for measurement on two iron-plates, weighing about 30 pounds each, and provided with three strong iron pins 2 inches long. In the center of the plate, on an elevated silver plane, is drawn a cross-line, which acts in the nature of the zero-point of the line.

METHOD OF COMPARISON.

The rod was compared daily, both before and after its use, with two steel standard rods, constructed by the United States Coast Survey, and of a normal length of 5 feet, at the temperature of 61°.6 F. In place of the rod constructed by Mr. Kahler, a similar one, not quite 20 feet long, politely furnished by Mr. Adolf Sutro, of Sutro, Nev., consisting of very well seasoned and varnished wood, was used. A very simple apparatus was used, constructed for comparison, the standard steel rods being supported on two wooden blocks, and therefore elevated by the thickness of this support from the plane of measurement, two knife-blades were driven in a wooden board, 22 by $1\frac{1}{2}$ feet by 4 inches, being as much above the surface of the board as the polished plane at the end of the normal rod. The center of the sharp blade and the plane of the normal rod were brought into the same vertical plane, and by an assistant is kept in this position until the second rod is brought in contact with the first. Thus continuing, the fourth rod was found to reach over the knife-blade about $1\frac{1}{2}$ inches. A square block of wood was placed at the end, in contact with the normal rod, and by means of a small measure, 3 inches long, and divided to hundredths, the distance from the square block of wood to the blade of the knife was read, the temperature being always carefully noted and the measurement repeated.

The readings were made by Dr. Kampf and his assistant. After determining the distance between two points on the edges of the knife-blades, the measuring-rod was placed on top of the blades with the utmost care, and the scale on both ends read. In this manner the amount of over-lapping of the rod was obtained.

Observation made October 11, 1876, between knife-blades, 20 feet 1.537 inches, 55°.8 Fahrenheit; reading of scales on rod, east end, 0.420 inch; west end, 0.140 inch; therefore the length of the rod was determined to be 20 feet + 0.997 inch, at 55°.8 Fahrenheit.

DESCRIPTION OF METHOD OF MEASUREMENT.

Dr. Kampf was aided in the measurement by Mr. Louis Seckels and two laborers. The work was divided among the party as follows: The line was laid out in advance for one day's work, marked by iron pins 2 feet in length and about 180 feet apart. The base was measured on an old road, laid out about ten years ago, and running in a straight line for a distance of $3\frac{3}{4}$ miles. A fine line was tied to one pin and fastened to the next one. Two plates were laid down within the distance of 20 feet 2 inches, approximately, so that they were parallel with the line and tangent to it. One laborer takes the measuring-rod, bringing it near the plates, and the assistant being at the rear end, the laborer on the other, both grasp the rod at the same time and put it on top of the plates $\frac{5}{100}$ of an inch distant from the cross on the ridge of the plates. Mr. Seckels reads the rear end of the scales at the same time that Dr. Kampf reads at the front end by means of a common magnifying-glass. The readings are then at once recorded. After that the level was read by Dr. Kampf and simultaneously with Mr. Seckels, who is now at the front end. He reads the rear end of the scales, and the readings are recorded by both. Then the readings are called out and in case of disagreement repeated. In the meanwhile the other laborer puts an auxiliary rod of 20 feet 2 inches in the position, so that the rear end may be in line with the mark on the plate driving the third plate in the ground. When the readings are finished the new plate is found in its proper position, the laborer brings the rods in front of both plates, and the operation is repeated. The other laborer takes meanwhile the first plate put down and brings it to the front, as No. 4. The thermometer is read from time to time on the shady and sunny side of the rod, to obtain its temperature. After a reasonable practice the rate of measurement may be assumed as 20 feet for each interval of one and one-half minutes.

CO-EFFICIENT OF EXPANSION.

The steel rods of the United States Coast Survey are of normal length at the temperature of 61°.6 F. By means of the co-efficient of expansion for one degree, as given in Lee's tables, the distance of 20 feet is reduced by applying the temperature of the time of comparison, and thereby the distance between both knife-blades is obtained. To this is added the readings of the scales of the rod, and the length of the rod for the observed temperature is found. The mean of the observations at low and high temperatures are taken, and from the difference of both lengths the factor of expansion is derived, as shown in the next table. The rod having been heavily saturated in a rain and snow storm on October 11, the observations taken afterward are not used for determination of expansion. The length of the rod was found from the comparisons to be $20^{ft}\ 0^{in}.9408$ for 61°.6 F.

Comparisons at low temperature.

Date.	Thermometer reads 61°.6.	Knife-blades distant by reading, 20 feet.	Corrections for expansion of 20-foot steel rod.	Actual distance of knife-blades, 20 feet.	Sum of readings of wooden rod.	Wooden rod equal to 20 feet.
1876.	°	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
September 23	—14.1	—1.4950	—0.0215	—1.5165	0.4950	—1.0215
24	— 6.6	—1.4950	—0.0101	—1.5051	0.4940	—1.0111
25	—10.3	—1.4960	—0.0157	—1.5117	0.4980	—1.0137
26	— 7.6	—1.5150	—0.0116	—1.5266	0.5050	—1.0216
27	—10.6	—1.5000	—0.0162	—1.5162	0.5070	—1.0092
28	— 3.1	—1.5150	—0.0047	—1.5197	0.5170	—1.0027
29	— 8.8	—1.5100	—0.0134	—1.5234	0.5270	—0.9964
30	— 6.6	—1.5230	—0.0101	—1.5331	0.5320	—1.0011
October 1	— 7.8	—1.5260	—0.0119	—1.5379	0.5390	—1.0079
2	— 2.4	—1.5340	—0.0037	—1.5377	0.5390	—0.9987
3	— 9.6	—1.5180	—0.0146	—1.5326	0.5350	—0.9976
4	— 9.6	—1.5350	—0.0146	—1.5496	0.5410	—1.0086
5	— 9.6	—1.5330	—0.0146	—1.5476	0.5390	—1.0086
6	—10.2	—1.5330	—0.0156	—1.5486	0.5410	—1.0076
7	— 5.6	—1.5440	—0.0085	—1.5525	0.5410	—1.0115
8	+ 0.4	—1.5580	+0.0006	—1.5574	0.5490	—1.0784
10	—13.0	—1.5450	—0.0198	—1.5648	0.5590	—1.0058
11	— 5.8	—1.5370	—0.0088	—1.5458	0.5600	—0.9858
11	— 2.6	—1.5370	—0.0040	—1.5410	0.5410	—1.0000

Mean length of rod at 54° 5 F. = 20 feet — 1 0062 inch.

Comparisons at high temperature.

Date.	Thermometer reads 61°.6.	Knife-blades distant by reading, 20 feet.	Correction for expansion of 20-foot steel rod.	Actual distance of knife-blades, 20 feet.	Sum of readings of wooden rod.	Wooden rod equal to 20 feet.
1876.	°	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
September 23	+51.4	—1.5500	+0.0784	—1.4716	0.5110	—0.9606
24	+36.4	—1.5450	+0.0555	—1.4895	0.5050	—0.9845
25	+39.4	—1.5540	+0.0601	—1.4939	0.5200	—0.9739
26	+48.4	—1.5320	+0.0739	—1.4581	0.5180	—0.9401
27	+23.4	—1.5350	+0.0357	—1.4993	0.5220	—0.9773
28	+11.4	—1.5480	+0.0220	—1.5260	0.5280	—0.9980
29	+22.0	—1.5390	+0.0336	—1.5054	0.5320	—0.9734
30	+47.9	—1.5650	+0.0731	—1.4919	0.5390	—0.9529
October 1	+11.4	—1.5410	+0.0174	—1.5236	0.5410	—0.9826
2	+60.4	—1.5640	+0.0922	—1.4718	0.5540	—0.9178
3	+44.4	—1.5750	+0.0677	—1.5073	0.5420	—0.9653
4	+52.4	—1.5750	+0.0800	—1.4950	0.5450	—0.9500
5	+60.4	—1.5880	+0.0922	—1.4958	0.5510	—0.9448
6	+56.4	—1.5740	+0.0861	—1.4879	0.5360	—0.9419
7	+18.4	—1.5730	+0.0281	—1.5449	0.5420	—1.0029
8	+17.4	—1.5740	+0.0266	—1.5476	0.5510	—0.9966
10	+33.4	—1.5750	+0.0509	—1.5241	0.5620	—0.9621

Mean length of rod at 99°.0 F. = 20 feet — 0.96616 inch.

Expansion of rod for 44°.5 F. = 0.04004 inch.
Expansion of rod for 1°.0 F. = 0.00090 inch.

REDUCTION OF OBSERVATIONS.

The following corrections are applied to the number of rods multiplied by 20 feet:

(1) Difference of rod from 20 feet at mean temperature of all observations multiplied by the number of rods measured.

(2) Readings of both ends of wooden rod when lying on the plates.

(3) Correction for inclination.

The following table contains the corrections for (1):

First measurement.

Date.	Mean temperature.	Number of rods measured.	Equivalent number of rods of 20 feet.
			Inches.
September 23	88	104	−101.5487
24	89	104	−102.1987
25	89	54	− 52.6305
26	86	109	−106.5279
27	65	102	−101.6022
28	81	104	−102.1061
29	89	111	−108.2337
30	84	105	−102.9000
October 1	92	98	− 95.3392
2	94	108	−104.8724
3	93	110	−106.8146
4	85	72	− 70.4318

First measurement, 1,181 rods − 1,155.2558 inches.

Second measurement.

Date.	Mean temperature.	Number of rods measured.	Equivalent number of rods of 20 feet.
			Inches.
October 5	92	144	144.8357
6	97	151	146.1710
7	92.5	152	147.7516
8	83	150	151.9837
10	88	145	141.5302
11	58	129	129.3945
17	63	148	139.4297
18	57	150	141.7125

Second measurement, 1,179 rods − 1,142.4090 inches.

DEDUCTION OF RESULTS OF LENGTHS OF BASE NEAR SUTRO, NEV.

	First measurement.	Second measurement.
Sum of corrections for (1)	— 96.2713	— 95.2007
Sum of corrections for (2)	—101.2506	— 62.2997
Sum of corrections for (3)	— 1.1624	— 1.1492
Sum of corrections	—198.6843	—158.6496
Number of rods multiplied by 20 feet	23620.0000	23580.0000
Length of base	23421.3157	23421.3504
Mean		23421.333
Reduction to level of the sea		— 4.946
Resulting length, (feet)		23416.387

ROUTES OF COMMUNICATION.

A small number of tables of distances taken from the road-measurements of 1876 are herewith given.

In each subsequent annual report the routes joining the main terminal points of lines of present or prospective importance will be given, and the consolidated table mentioned in my last annual report will soon be made more complete and forwarded for publication.

During the year a number of distances between military posts, principally in the departments of the Missouri and Arizona, have been furnished to the Paymaster-General, United States Army.

LIST OF ROAD-DISTANCES BETWEEN PROMINENT POINTS MEANDERED BY PARTY NO. 1, COLORADO SECTION, 1876.

La Junta to Pueblo.
Pueblo to Cañon and Florissant.
Florissant to Fair Play.
Fair Play to South Arkansas Post Office.
South Arkansas Post Office to Mosca Creek Forks.
Mosca Creek to Rosita.
Rosita to Cañon City.
Cañon City to Colorado Springs.

From La Junta, Colo., to Pueblo Post Office, Colo.—Atlas-sheet No. 62.

	Distance in miles. Between consecutive points.	Distance in miles. From La Junta.	Distance in miles. From Pueblo.	Altitude in feet above sea-level.	Remarks.
La Junta, Colo		.....	65.05	4,094	No wood or grass near town.
Texas Bend	4.78	4.78	60.27	4,169	
Rocky Ford	6.76	11.54	53.51	.....	
Apishpa Creek	13.49	25.03	40.02	4,266	
Huerfano River	19.19	44.22	20.83	4,324	
Old Fort Reynolds	2.60	46.82	18.23	.....	
Fork of road to Pueblo and South Pueblo.	12.27	59.09	5.96	.....	
South Pueblo, lower bridge	5.36	64.45	0.60	4,584	
Pueblo Post Office	0.60	65.05	.....	.....	

Road along south bank of Arkansas River.

From Pueblo, Colo., to Cañon and Florissant.—Atlas-sheet No. 62.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Pueblo.	From Cañon City and Florissant.		
Pueblo Post-Office	12.64	.....	90.65	4,584	Grass and fuel along river-bottom.
Big Turkey Creek	8.26	12.64	78.01	4,947	
Beaver Creek	10.17	20.90	69.75	5,148	
Ute Creek	1.46	31.07	59.58	.....	
Eight-mile Creek	3.75	32.53	58.12	.....	
Oil Creek	3.05	36.28	54.37	5,241	
Cañon City Post Office	8.25	39.33	51.32	5,325	
Forks of road, (Pleasant Valley)	3.90	47.58	43.07	6,271	
Currant Creek, (12-mile ranch)	5.57	51.48	39.17	6,019	
Eighteen-mile Ranch, forks of road to Fair Play.	5.13	57.05	33.60	7,161	
South Fork Wilson Creek	3.10	62.18	28.47	7,401	
Divide between Wilson and High Creek.	3.80	65.28	25.37	8,439	
Crossing High Creek	3.84	69.08	21.57	8,401	Good grass, fuel, and water.
Settlement on west fork Oil Creek	4.50	72.92	17.73	8,259	Valley fenced in.
Down west fork to near mouth	8.73	77.42	13.23	7,924	Do.
Up Oil Creek to Summit, Twin Creek Pass.		86.15	4.50	8,790	Good grass and water.
Florissant Post Office	4.50	90.65	.....	8,184	Good grass, water, and fuel.

From Florissant, Colo., to Fair Play, Colo., via Tarryall Creek.—Atlas-sheet Nos. 62, 53, and 52.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Florissant.	From Fair Play.		
Florissant Post-Office	4.97	.....	60.80	8,184	
South Platte Bridge	7.47	4.97	55.83	7,978	
McLaughlin's ranch	15.23	12.44	48.36	8,226	Camp. Grass, wood, and water.
Duck Lake	7.90	27.67	33.13	8,807	Do.
Fork of road to Fair Play	3.67	35.57	25.24	9,035	
Up Rock Creek to the point where the road leaves the creek.	4.90	39.24	21.56	9,239	
Confluence Michigan and Jefferson Creek.	5.16	44.14	16.66	9,298	
Tarryall River bridge below Hamilton, (by the shortest trail.)	7.26	49.30	11.50	9,713	No wood near road.
Summit road	4.24	56.56	4.24	9,958	
Fair Play Post Office		60.80	.....	9,929	Wood scarce, grass medium, water good. Hay and grain for sale in town.

The above road is not the shortest road between Florissant and Fair Play. The stage-road leaves it near the South Platte bridge.

From Fair Play, Colo., to South Arkansas Post Office.—Atlas-sheet Nos. 52 and 61.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fair Play.	From South Arkansas Post Office.		
Fair Play Post Office		.....	59.07	9,928	
Four-mile Creek	3.77	3.77	55.30	9,670	
Ranch on Dry Creek	5.55	9.32	49.75	9,317	
South Fork South Platte River	2.65	11.97	47.10	9,161	
Buffalo Springs	4.41	16.38	42.69	8,952	
Salt-Works	4.16	20.54	38.53	8,969	Camp. Grass and water, but no wood. Hill moderate.
Divide between Platte and Arkansas Rivers.	3.47	24.01	35.06	9,464	
Riverside Post Office	2.14	26.15	32.92	9,144	
Springs, Trout Creek	2.18	28.33	30.74	8,963	
Fork of roads up and down Arkansas River.	8.18	36.51	22.56	7,937	
Arkansas Bridge	3.15	39.66	19.41	7,741	Good bridge.
Chalk Creek	2.16	41.82	17.25	7,729	Grass and wood scarce.
Centreville Post Office	2.38	44.20	14.87	7,690	
Brown's Creek	1.40	45.60	13.47	7,828	
Three-mile Creek	2.29	47.89	11.18	7,926	
Squan Creek	5.70	53.59	5.48	7,279	
South Arkansas Post Office	5.48	59.07	.....	7,383	Wood and water good. Poor grass.

From South Arkansas Post Office to Mosca Creek, fork of roads.—Atlas-sheet No. 61.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From South Arkansas post-office.	From Mosca Creek.		
South Arkansas Post-Office		.....	65.11	7,383	
Toll-gate	3.42	3.42	61.69	8,216	Puncho Pass.
Summit Puncho Pass	4.63	8.05	57.06	8,945	
Round Mountain Ranch PostOffice	2.67	10.72	54.39	8,732	
Hall's, Kerber Creek	11.81	22.53	42.58	7,900	
Bismarck Post Office	8.10	30.63	34.48	7,736	
Major Creek	2.46	33.09	32.02	7,686	
Wild Cherry Creek	3.24	36.33	28.78	7,431	
Rito Alto Post Office	2.08	38.41	26.70	7,484	
San Irabel Post Office	3.74	42.15	22.96	7,537	
Crestones Creek	3.12	45.27	19.84	7,517	
Willow Creek	2.75	48.02	17.09	.....	
Cottonwood Creek	2.00	50.02	15.09	7,566	
Deadman Creek	2.30	52.32	12.79	.....	
Sandhill Creek, (old Star ranch)	9.60	61.92	3.19	7,587	Road very sandy.
Spring Creek	1.55	63.47	1.64	7,560	
Mosca Creek	1.64	65.11	.....	7,549	

Grass poor and wood scarce near road; better grass and wood in abundance found in the foot-hills of Sangre de Cristo Range.

Road through Puncho Pass is kept in good condition.

From Mosca Creek to Rosita, Colo.—Atlas-sheets No. 61 and 62.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Mosca Creek.	From Rosita.		
Mosca Creek, fork of roads	7.73	.....	43.01	7,549	
Ranch, western entrance to Mosca Pass.	3.22	7.73	35.28	8,172	Camp. Grass poor; wood and water good.
Summit Mosca Pass	5.13	10.95	32.06	9,787	Road good through pass.
Fork of roads to Gardner's	6.90	16.08	26.93	8,805	
Intersection, creek and cross-road	2.52	22.98	20.03	7,977	
Muddy River, forks of road	4.43	25.50	17.51	7,916	
Divide between Arkansas and Huerfano Rivers.	4.82	29.93	13.08	8,428	
Forks of road to Colfax	2.64	34.75	8.26	8,223	
Forks, U-la road	2.76	37.39	5.62	8,174	
Rosita and U-la road	2.86	40.15	2.86	8,327	
Rosita		43.01	.....	8,717	Good wood, grass, and water near town; hay and grain for sale.

This is the old road from Mosca Pass to Rosita, and is now practicable only for lightly-loaded wagons

From Rosita, Colo., to Cañon City, Colo.—Atlas-sheet No. 62.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Rosita.	From Cañon City.		
Rosita	13.56	.....	30.76	8,717	
Oak Creek, (blacksmith-shop)	2.51	13.56	17.20	7,987	
Yorkville	5.11	16.07	14.69	7,727	Post Office.
Point where road leaves Oak Creek	0.91	21.18	9.58	6,105	
Summit road	0.44	22.09	8.67	6,829	
Forks of road, Cañon City and Labran	3.27	22.53	8.23	6,678	
Crossing Milk Creek	4.45	25.80	4.96	5,939	
Arkansas River bridge	0.51	30.25	0.51	5,302	
Cañon City Post Office		30.76	.....	5,325	

This is the stage-road between Cañon City and Rosita. Grades are easy and road in good condition.

From Cañon City, Colo., to Colorado Springs.—Atlas-sheet No. 62.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Cañon City.	From Colorado Springs.		
Cañon City Post Office	2.24	.....	45.39	5,325	Corrals in town; no wood or grass near town.
Railroad-crossing		2.24	43.15	.....	
Oil Creek	0.81	3.05	42.34	5,241	No bridge.
Eight-mile Creek	4.48	7.53	37.86	5,540	
Ute Creek	2.14	9.67	35.72	.....	
Beaver Creek Crossing	6.61	16.28	29.11	5,930	Camp. Grass scarce; wood and water in abundance.
Fork Big Turkey Creek	9.33	25.61	19.78	6,480	
Big Turkey Creek	2.50	28.11	17.28	6,519	
West Fork Little Fountain Creek	2.61	30.72	14.67	6,180	
Confluence, east and west forks	1.13	31.85	13.54	6,109	
Bend of road	2.21	34.06	11.33	6,000	
Railroad-crossing	10.39	44.45	0.94	5,875	
Colorado Springs, center of town	0.94	45.39	.....	5,946	Animals in corrals; grain and feed purchased.

This is not the usually-traveled road between Cañon City and Colorado Springs; it is called the "short cut," but is impracticable for heavily-loaded wagons between Beaver Creek Crossing and Big Turkey Creek.

LIST OF ROAD-DISTANCES BETWEEN PROMINENT POINTS, MEANDERED BY PARTY NO. 2 COLORADO SECTION, 1876.

Trinidad to Santa Fé.
Fort Lyon to Trinidad.
Santa Fé to Tejique.
Socorro to Las Lunas.
Valencia to Socorro.
Socorro to Fort Craig.
Socorro to Guinisa.
Ojo de las Casas to Las Lunas.
Pedernal to Manzano.
Tejique to Pedernal.
Pedernal to Anton Chico.
Antelope Spring to Los Pesos.
Tangues de Juan Lojair to Cienega de Tula.
Anton Chico to Fort Lyon.

From Trinidad, Colo., to Santa Fé, N. Mex., via Long's Cañon and Taos Pass.—Atlas-sheets 70A, 70C, and 69D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Trinidad.	From Santa Fé.		
Trinidad			188.46		Town; Government agency.
Junctions Long's Creek and Purgatory	6.54	6.54	181.92		Ranches.
Long's Cañon Pass	21.51	28.05	160.41	8,402	Good grazing; water in spring below summit.
Vermejo Creek, Cameron's	18.34	46.39	142.07	7,133	Ranches.
Van Brummer Park	13.66	60.05	128.41	8,557	Lakes; fair grazing.
Ponil Creek	6.00	66.05	122.41		Good grazing.
South Fork Ponil Creek	7.05	73.10	115.36	8,332	Poor grazing.
Ponil Pass	6.99	80.09	108.37	9,848	Good grazing.
Elizabethtown	4.33	84.42	104.04		Mining town.
Six-mile Creek	7.25	91.67	96.79	8,450	Good grazing; ranches.
Kennedy's Ranch	7.71	99.38	89.08		Deserted; wood, water, grass.
Taos Pass	2.06	101.44	87.02	9,282	Wood, water, grass, below summit.
Mouth of Fernandez Creek	14.43	115.87	72.59		Poor grazing.
Ranchos de Taos	4.07	119.94	68.52		Mexican town; forage.
Junction with Government road	5.34	125.28	63.18		
Cineguilla	8.28	133.56	54.90	6,011	Mexican town; wood and water.
Plaza del Alcalde	23.30	156.86	31.60	5,756	Government agency; Mexican town.
Pueblo de San Juan	2.94	159.80	28.66	5,870	Government agency.
Santa Cruz	4.22	164.02	24.44		Do.
Pojoaque	7.27	171.29	17.17		Do.
Cuyamunque	27.24	174.01	14.45		Mexican town.
Tesuque	5.096	179.11	9.35		Indian pueblo.
Santa Fé	9.348	188.46			Military post; large town.

The road is practicable for wagons. Descending to Vermejo Creek there is a steep hill for half a mile.

From Fort Lyon, Colo., to Trinidad, Colo.—Atlas-sheets Nos. 62CD and 70A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Fort Lyon.	From West Las Animas.		
Fort Lyon				3,938	Government post.
Purgatory River	3.414				Poor grazing.
West Las Animas	2.090	5.494		4,040	Town; railroad.
Sizer's Ranch	6.447	11.941		4,040	Government agency.
Alkalis Station	11.981	23.922	18.428	4,136	Deserted; poor water; little wood.
Vogel's Cañon	10.230	34.152	28.658	4,205	Deserted; poor water; poor grazing.
Bent's Cañon	15.613	49.765	44.271	4,696	Do.
Lockwood's Ranch	13.482	63.247	57.753	4,997	Do.
Hogback	16.773	80.020	74.526	5,423	No wood; little water and grass.
Chicoso Creek	14.619	94.639	89.145	5,840	Ranches; grazing generally eaten up.
El Moro	10.246	104.885	99.391		Denver and Rio Grande Railroad.
Trinidad, Colo.	5.145	110.030	104.536		Town; forage; Government agency.

Country generally worthless. River-bottom cultivated; water elsewhere scarce and alkaline. Bluffs wooded with piñon and cedar. Grazing good, but usually closely eaten.

From Santa Fé, N. Mex., to Tijeras, N. Mex.—Atlas-sheet No. 77 B and D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Santa Fé.	From Tijeras.		
Santa Fé, N. Mex.			57.35		Town; Government post.
Forks of road	9.590		47.75		
San Marcos Spring	8.951	18.541	38.80	6,056	Good water; little wood; good grass.
Galisteo Creek	3.003	21,544	35.80		Good water; wood plenty; good grass.
Old Placer	6.195	27.739	29.60		Mining town; little of anything.
Fork roads	6.339	34.078	23.27		Good grazing and wood; no water.
New Placer	2.906	36.984	20.36	6,667	Mining town; wood and water.
Fork roads	1.553	38.537	18.81		Good grazing.
San Pedro	7.384	45.921	11.43		Deserted.
San Antonito	3.759	49.680	7.67		Mexican town.
Cañoncito	3.028	52.708	4.64		Do.
San Antonio	2.541	55.249	2.10		Do.
Tijeras	2.105	57.354			Do.

Grazing in general, good; wood, cedar and piñon, abundant; water, scarce.

From Socorro, N. Mex., northwest bank Rio Grande, to Las Lunas.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Socorro.	From Las Lunas.		
Socorro			56.88	4,659	Mexican town, Government agency.
Escondida	4.96	4.96	51.92		Mexican town.
Limitar	4.23	9.19	47.69		Do.
Palvadera	2.25	11.44	45.44		Do.
Alamillo	3.42	14.86	42.02	4,693	Mexican town, Government agency.
San Geronimo	7.27	22.13	34.75		Mexican town.
San Carlos	1.61	23.74	33.14		Do.
Rio Puerco	2.42	26.16	30.72		Water.
Sabinal Agency	3.83	29.99	26.89	4,757	Mexican town, Government agency.
Pueblito	2.14	32.13	24.75		Mexican town.
Sabinal	1.07	33.20	23.68		Do.
Ranchitos	2.32	35.52	21.36		Do.
Bosque	3.05	38.57	18.31		Do.
Pueblitos de Belen	3.50	42.07	14.81		Mexican town, Government agency.
Belen	3.69	45.76	11.12	4,890	Do.
Ranchitos de Belen	1.71	47.47	9.41		Mexican town.
Los Charez	3.65	51.12	5.76		Do.
Las Lunas	5.76	56.88		4,921	Mexican town, Government agency.

From Valencia, N. Mex., northeast bank Rio Grande, to Socorro, N. Mex.—Atlas-sheet No. 77D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Valencia.	From Socorro.		
Valencia			60.78		Mexican town.
	5.28				
Tome			45.50		Do.
	1.15				
Ranchitos de Tome		6.43	54.35		Do.
	3.57				
Constancia		10.00	50.78		Do.
	8.26				
Casa Colorado		18.26	42.52		Do.
	4.80				
Vellita		23.06	37.72		Do.
	1.81				
Chihuahua		24.87	35.91		Do.
	1.15				
Las Nuetrias		26.02	34.76		Do.
	7.12				
Ranchos		33.14	27.64		Do.
	3.15				
La Joya		36.29	24.49		Do.
	6.54				
La Joyita		42.83	17.95		Do.
	7.05				
Sabina		49.88	10.90		Deserted.
	4.99				
Pueblito de la Parida		54.87	5.91		Ranch.
	1.70				
La Parida		56.57	4.21		Town, Mexican.
	4.21				
Socorro		60.78		4,659	Town.

Rio Grande Valley: arable; generally entirely taken up with ranches. No Government agencies on east bank.

From Socorro, N. Mex., to Fort Craig.—Atlas-sheets Nos. 77D and 84A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Socorro.	From Fort Craig.		
Socorro			64.64	4,659	Mexican town, Government agency.
	5.562				
San José			59.08		Do.
	5.937				
San Antonio		11.499	53.14		Do.
	19.742				
San Marcial		31.241	33.40		Do.
From Fort Craig to Bosquecito.					
	4.098				
Fort Craig		35.339	29.30	4,619	Government post.
	1.000				
Contradero		36.339	28.30		Mexican town.
	4.295				
La Mesa		40.634	24.01		Do.
	2.360				
Valverde		42.994	21.65		Do.
	21.651				
Bosquecito		64.645			Do.

No wood near the river. Grazing fair. Little inhabited.

From Socorro, N. Mex., to Ojo de la Quinsa.—Atlas-sheets Nos. 77D and 77C.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Socorro.	From Ojo de la Quinsa.		
Socorro		.....	38.88	4,659	Mexican town.
	11.198				
Ojo de la Culebra		.....	27.68	5,707	Spring, ranch, wood, water, and grass.
	8.480				
Cañon del Agua		19.678	19.20	6,833	Wood, water, and grass abundant.
	6.559				
Junction road from Socorro		26.237	12.64	.....	Partially over; no marked trail.
	3.309				
Junction road from Socorro		29.54	9.33	.....	
	1.834				
Main fork roads		31.38	7.49	.....	
	7.494				
Ojo de la Quinsa		38.88	.....	5,673	Ranch, spring, no wood, poor grazing.

From Ojo de las Casas, N. Mex., to Las Lunas.—Atlas-sheet No. 77D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Ojo de las Casas.	From Las Lunas.		
Rio de la Casa		.....	21.47	6,243	Spring; wood, and fine grazing.
	5.610				
Ojuelos		.....	15.86	.....	Ranch; no wood; grazing.
	4.864				
Junction road to Cañon Ojito		10.474	11.00	.....	
	.927				
Crossing road from Hell Cañon		11.401	10.07	.....	To Las Lunas.
	2.369				
Crossing road from Hell Cañon		13.770	7.69	.....	
	3.626				
Peralta		17.396	4.07	.....	Mexican town.
	2.082				
Valencia		19.478	1.99	.....	Do.
	1.986				
Las Lunas		21.464	.....	4,921	Mexican town, Government agency.

From Pedernal Water-hole to Manzano, New Mex.—Atlas-sheet No. 77D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Pedernal Water-hole.	From Manzano.		
Pedernal Water-hole		.....	64.66	7,140	Spring in spur of peak to south.
	1.000				
Junction road to Estancia		.....	63.66	.....	
	7.806				
Fork road to Los Posos		8.806	55.85	.....	
	12.098				
Los Cañoncitos		20.904	43.75	.....	Water-holes, permanent.
	1.775				
Junction road from Los Posos		22.679	41.98	.....	
	1.349				
Fork to Mesteñito		24.028	40.63	.....	
	4.644				
Laguna de Sol		28.674	35.99	6,041	Salt lake.
	4.989				
Fork of roads		33.663	31.00	.....	
	5.426				
Junction road from Pedernal		39.089	25.57	.....	
	3.343				
Ojo de Estañcia		42.432	22.23	6,177	Ranch; forage and grazing good.
	3.126				
Junction road to Mesteñito		45.558	19.10	.....	
	11.862				
Crossing road to Manzano		57.420	7.24	.....	
	2.173				
Punta del Agua		59.593	5.07	.....	Mexican town.
	5.071				
Manzano		64.664	.....	.....	Do.

From Tejique, N. Mex., to Pedernal Water-hole.—Atlas-sheet No. 77D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Tijigue.	From Pedernal Water-hole.		
Tejique	17.794	.....	43.62	.....	Mexican town.
Ojo de Estancia	4.550	.....	25.83	6,177	Ranch spring.
Cross-road from Antelope Spring	6.857	22.344	21.28	.....	
Road from Antelope Spring	13.419	29.201	14.42	.....	
Junction road from Los Posos	1.000	42.620	1.00	.....	
Pedernal Water-hole		43.620	.....	7,140	Spring on south spur from peak.

From Pedernal Water-hole to Anton Chico.—Atlas-sheet No. 69D and 78A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Pedernal Water-hole.	From Anton Chico.		
Pedernal Water-hole	11.78	.....	48.90	7,140	Spring on south spur from peak.
Albuquerque road	6.74	.....	37.12	.....	
Las Tanques Empedrador	11.73	18.52	30.38	.....	Water-holes, not permanent.
Cañon Blanco	18.65	30.25	18.65	.....	Water-holes.
Anton Chico		48.90	.....	.....	Mexican town.

Grazing excellent everywhere; wood occurs on highest points, but usually at some distance from water. Beyond Pedernal, wood and grass abundant.

From Antelope Spring to Los Posos del Pino.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Antelope Spring.	From Los Posos del Pino.		
Antelope Spring	8.05	.....	42.16	6,221	Ranch, Government agency.
Cross-road from Estancia	7.85	.....	34.11	.....	
Laguna de Sal	9.93	15.85	26.31	6,041	
Tanques de las Caminos	9.25	25.78	16.38	.....	Water-holes, not permanent.
Junction main road to Stanton	7.13	35.03	7.13	.....	
Los Posos del Pino		42.16	.....	6,168	Ranch, Government agency.

From Tanques de Juan Lujan to Cienega de Tula.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Tanques de Juan Lujan.	From Cienega de Tula.		
Tanques de Juan Lujan		.....	37.41	.....	
	7.55				
Abo Pueblo		.....	29.86	.....	
	12.93				
Pueblo de Quará		20.48	16.93	.....	
	0.92				
Punta de Aqua		21.40	16.01	.....	
	11.55				
Mesteñito		32.95	4.46	6,268	
	4.46				
Cienega de Tula		37.41	.....	.....	

From La Liendre, N. Mex., to Fort Lyon, Colo.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From La Liendre.	From Fort Lyon.		
La Liendre Church		.....	154.92	.....	Mexican town.
	7.37				
Head Cañon del Agua		7.37	147.55	6,353	Water-holes and springs; deserted houses.
	2.34				
Camp 71		9.71	145.21	6,736	Water-holes.
	9.90				
Las Vegas		19.61	135.31	.....	Town; Government agency.
	11.30				
Los Alamos		30.91	124.01	6,789	Town, Mexican; forage.
	18.86				
Fort Union		49.77	105.15	6,715	Post.
	5.61				
Collier's Ranch		55.38	99.54	.....	Spring, private.
	6.61				
Las Gallinas		61.99	92.93	.....	Mexican town.
	10.74				
Apache Spring		72.73	82.19	.....	No wood.
	9.62				
Ocate Creek		82.35	72.57	.....	Do.
	11.67				
Rock Ranch		94.02	60.90	5,844	Government agency.
	20.81				
Chico Spring		114.83	40.09	6,882	Do.
	13.00				
Kiowa Spring, Taylor's Ranch		127.83	27.09	7,226	Spring; no wood.
	4.25				
Camp 77 (ponds)		132.08	22.84	7,036	Water slightly brackish.
	11.91				
Pinavete Spring		143.99	10.93	.....	Wood abundant.
	6.24				
Walter's Ranch		150.23	4.69	.....	Head Dry Cimarron Cañon.
	4.69				
Emery's		154.92	.....	6,080	Government agency; Dry Cimarron.

From Anton Chico to Fort Lyon, Colo.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Anton Chico.	From Fort Lyon.		
Emery's Ranch		.....	103.27	6,080	Government agency.
	2.45				
Toll-gate, Metcalf's		2.45	100.82	.....	
	5.38				
Boundary (nearly)		7.83	95.44	.....	
	9.35				
Chaquaquo Cañon		17.18	86.09	5,932	Water-holes; grazing; little wood.
	12.65				
Fork roads		29.83	73.44	.....	
	2.56				
Pinavete Spring		32.39	70.88	.....	Wood, water, and grass.
	9.08				
Camp head Plum Cañon		41.47	62.80	5,754	Water-holes; wood; grazing.
	4.33				
Head Smith's Cañon		45.88	58.47	.....	Water.
	20.27				
Camp Smith's Cañon		66.09	38.20	4,523	Water; little grass and wood.
	8.90				
Purgatoire Ranch, Nine-mile Bottom		74.99	29.30	.....	Ranches.
	7.92				
Alkali Cañon		82.89	21.38	.....	Stage station, deserted.
	11.70				
Sizer's Ranch		94.59	9.68	4,035	Government agency.
	9.68				
Fort Lyon		104.27	.....	3,938	Post.

LIST OF ROAD-DISTANCES BETWEEN PROMINENT POINTS, MEANDERED BY PARTY NO. 1, CALIFORNIA SECTION, 1876.

Carson to Reno.
Reno to Beckwith's Store.
Reno to Milford.
Reno to Truckee.
Reno to Milton.
Truckee to Sierraville.

From Carson, Nev., to Reno, Nev.—Atlas-sheet No. 47d.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Carson.	From Reno.		
Carson		0.000	31.965	.....	State-house.
	10.080				
Franktown		10.080	21.885	.....	Railroad station.
	4.971				
Washoe City		15.051	16.814	.....	Do.
	5.501				
Steamboat Springs		20.552	11.413	.....	Do.
	4.706				
Hoffakers		25.258	6.707	.....	Do.
	6.707				
Reno		31.965	0.000	.....	Crossing C. P. R. R.

From Reno, Nev., to Beckwith's Store, Cal.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Reno.	From Beckwith's Store.		
Reno		0.000	42.621	.....	
	10.741				
Peavine Ranch		10.741	31.880	.....	
	14.048				
Junction House		24.789	17.832	.....	
	3.610				
Summit		28.399	14.222	.....	Post-Office, Sierra Valley.
	14.222				
Beckwith's Store		42.621	0.000	.....	Do.

From Reno, Nev., to Milford, Cal.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Reno.	From Milford.		
Reno		0.000	64.225	.....	
	24.789				
Junction House		24.789	39.436	.....	
	21.619				
Willow Ranch		46.408	17.817	.....	
	17.817				
Milford		64.225	0.000	.....	

From Reno, Nev., to Truckee, Cal.—Atlas-sheet No. 47 a.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Reno.	From Truckee.		
Reno	12.705	0.000	31.665	.....	
Crystal Peak	5.850	12.705	18.960	.....	Village.
Forks of Henness Pass Road	4.580	18.555	13.110	.....	
Virginia House	4.474	23.135	8.530	.....	Stage station.
Prosser Creek	4.056	27.609	4.056	.....	
Truckee		31.665	0.000	.....	

From Reno, Nev., to Milton, Cal.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Reno.	From Milton.		
Reno	18.555	0.000	49.006	.....	
Forks of Henness Pass Road	18.626	18.555	30.451	.....	
Webber Lake	11.825	37.181	11.825	.....	
Milton		49.006	0.000	.....	

From Truckee, Cal., to Sierraville, Cal.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Truckee.	From Sierraville.		
Truckee	4.056	0.000	26.140	.....	
Prosser Creek	11.413	4.056	22.084	.....	
Cory's Ranch	10.671	15.469	10.671	.....	
Sierraville		26.140	0.000	.....	

LIST OF ROAD-DISTANCES BETWEEN PROMINENT POINTS, MEANDERED BY PARTY NO. 2, CALIFORNIA SECTION, 1876.

Carson to Dayton.
Carson to Steamboat Springs.
Carson to Warm Springs.
McKinney's to Truckee.
Virginia City to Dayton.
Virginia City to Carson.
Virginia City to Steamboat Springs.
Carson City to Rowlands.
Rowland's to Genoa.

From Carson, Nev., to Dayton, Nev.—Atlas-sheet No. 47 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Carson.	From Dayton.		
Carson			11.85		At the capital.
	3.70				
Empire		3.70	8.15		
	2.55				
Half-way House		6.25	5.60		
	0.55				
Mound House		6.80	5.05		Virginia and Truckee Railroad.
	5.05				
Dayton		11.85			At the post-office.

Carson, Nev., to Steamboat Springs, (via east side Washoe Lake.)

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Carson.	From Steamboat Springs.		
Carson			19.91		At the capital.
	4.17				
Lake View		4.17	15.74		
	10.15				
Washoe		14.32	5.59		East side of lake from Lake View to Washoe.
	5.59				
Steamboat Springs		19.91			Virginia and Truckee Railroad.

Carson to Warm Springs.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Carson.	From Warm Sp'gs.		
Carson					At the capital.
	1.71				
Warm Springs					State-prison.

From McKinney's, Lake Tahoe, Cal., to Truckee, Cal.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From McKinney's.	From Truckee.		
McKinney's			24.30		North of Sugar Pine Point.
Blackwood Creek	3.48	3.48	20.82		
Saxton's Saw-Mill	3.30	6.78	17.52		
Tahoe City	2.29	9.07	15.23		At hotel.
Claraville	5.56	14.63	9.67		Deserted mining-camp.
Knoxville	4.74	19.37	4.93		Toll-house, Truckee and Tahoe turnpike road.
Truckee	4.93	24.30			Central Pacific Railroad.

From Virginia City, Nev., to Dayton, Nev.—Atlas-sheet No. 47D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Virginia City.	From Dayton.		
Virginia City			7.51		At the International Hotel.
Silver City	3.74	3.74	3.77		At the flag-staff.
Johntown	1.72	5.46	2.05		
Gold Cañon Toll-House	1.37	6.83	0.68		
Dayton	0.68	7.51			At the post-office.

From Virginia City, Nev., to Carson, Nev.—Atlas-sheet No. 47D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Virginia City.	From Carson.		
Virginia City			14.47		At the International Hotel.
Toll-House, American Flat	10.73	3.74	10.73		
Carson		14.47			At the capital.

From Virginia City, Nev., to Steamboat Springs, Nev.—Atlas-sheet 47D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Virginia City.	From Steamboat Springs.		
Virginia City			11.15		At International Hotel.
	2.51				
Toll-House		2.51	8.64		On Geiger grade.
	3.17				
Five-Mile House		5.68	5.47		Do.
	3.22				
Magnolia House		8.90	2.25		Foot of Geiger grade.
	2.25				
Steamboat Springs		11.15	0.00		Virginia and Truckee Rail road.

From Carson City, Nev., to Rowland's, Cal.—Atlas-sheets Nos. 47D and 56B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Carson City.	From Rowland's.		
Carson			28.49	4,665	At the capitol.
	9.41	9.41			
Swift's Station			19.08		On King's Cañon road.
	2.55				
Summit Camp		11.96	16.53		
	0.85				
Spooner's		12.81	15.68		
	2.39				
Glenbrook		15.20	13.29		
	3.32				
Cave Rock		18.52	9.97		
	2.33				
Zephyr Cove		20.85	7.64		
	4.15				
Small's Station		25.00	3.49		
	0.90				
Kearney's Station		25.90	2.59		
	2.59				
Rowland's		28.49			

From Rowland's, Cal., to Genoa, Nev., (via Kingsbury grade.)—Atlas-sheet 56B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Rowland's.	From Genoa.		
Rowland's			14.76		
	3.48	3.48			
Small's Station			11.28		
	3.22	6.70			
Summit Kingsbury grade			8.06		
	5.04	11.74			
Haines's			3.02		
	1.14	12.88			
Genoa Hot Springs			1.88		
	1.88	14.76			
Genoa					

LIST OF ROAD-DISTANCES BETWEEN PROMINENT POINTS, MEANDERED BY PARTY NO. 4, CALIFORNIA SECTION, 1876.

Carson, Nev., to Austin, Nev., routes Nos. 1, 2, and 3.
Mound House, V. & T. R. R., to Dead Horse Well.
Wadsworth, C. P. R. R., to Mason Valley.
Wadsworth, C. P. R. R., to Dead-Horse Well.
Wadsworth, C. P. R. R., to Lodi Mining District.
Wadsworth, C. P. R. R., to Elsworth and Ione.
Austin, Nevada, to Elsworth, Nev., via Lower Reese River Valley.
Austin to Elsworth, via Ione, Nev.
Austin to Schmidtlein's, Kingston Cañon,
Dead-Horse Well to Elsworth, via Old Wellington Road.

ROUTE No. 1.

From Carson City, Nev., to Austin, Nev.—Atlas-sheets Nos. 47D and 48 C & D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Carson City.	From Austin.		
Carson		.....	171.23	4,699	Capital of Nevada.
	3.66				
Empire		.....	167.57	4,553	On Carson River; number of mill.
	3.45				
Mound House		7.11	164.12	.....	Station Virginia and Truckee Railroad.
	5.06				
Dayton		12.17	159.06	4,376	On Carson River; town of.
	16.50				
Cooney's		28.67	142.56	.....	Hay Ranch; water; no wood.
	14.15				
Carson River		42.82	128.41	4,070	Log cabin; wood and water; little grazing.
	10.25				
Ragtown		53.07	118.16	4.002	Water; little wood; forage purchased.
	3.87				
Saint Clair's		56.94	114.29	3,989	Bridge; little wood; forage purchased.
	6.28				
School-house		63.22	108.01	3,920	
	6.47				
Hill & Grimes's		69.69	101.54	3,944	Ranch; no wood; good grazing.
	16.51				
Sand Spring		86.20	85.03	3.926	Water, wood, and forage all purchased.
	20.06				
West Gate		106.26	64.97	4.504	Good water; no wood; no grazing.
	3.11				
Middle Gate		109.37	61.86	4,703	Good water; no wood; little grazing.
	3.39				
White Rock		112.76	58.47	4,818	Water; no wood; little grazing.
	7.11				
Cold Spring		119.87	51.36	5,418	Good water; no wood; little grazing.
	10.86				
Patterson's		130.73	40.50	5,213	Ranch on Edwards's Creek; no wood; grazing.
	14.00				
New Pass		144.73	26.50	.....	Water in spring.
	9.25				
Mount Airy		153.98	17.25	6,786	Water; little grazing; no wood.
	10.00				
Jacobsville		163.98	7.25	.....	Reese River; no wood; little grass.
	7.25				
Austin		171.23	.....	6,594	City of.

NOTE.—The above is the usually-traveled route, and the best road between Carson and Austin, except that from Patterson's to Austin. The route via Smith's Creek (see Route No. 21) should be taken if accommodations are required en route, there being none between Patterson's and Jacobsville

ROUTE NO. 2.

From Carson City, Nev., to Austin, Nev.—Atlas-sheets Nos. 47 D and 48 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Carson City.	From Austin.		
Carson		.....	174. 16	4, 699	
	12. 17				
Dayton		.....	161. 99	4, 376	See Route No. 1.
	21. 39	33. 56	140. 60	4, 258	
Old Fort Churchill					On Carson River, (deserted.)
	1. 11	34. 67	139. 49	4, 151	
Bucklands'					Toll-bridge over Carson.
	11. 19				Ranch.
Old Well		45. 86	128. 30	.....	Houtons, (deserted,) no grass or wood.
	14. 50				
Carson Lake		60. 36	113. 80	3, 883	Little grass; poor water; no wood.
	13. 81				
Sulphur Spring		74. 17	99. 99	3, 972	Road station; wood and forage purchased.
	8. 00				
Sand Spring		82. 17	91. 99	3, 926	Road station; water, wood and forage purchased.
* * * *					
	44. 53				
Patterson's		126. 70	47. 46	5, 213	See Route No. 1.
	14. 37	141. 07	33. 09	6, 517	
Antoines					Smith Creek, Milk Ranch; forage must be purchased.
	22. 32				
Birchini's		163. 39	10. 77	5, 743	Reese River; ranch; no timber; forage must be purchased.
	5. 08				
Half-way House		168. 47	5. 69	5, 726	Well; no wood.
	5. 69				
Austin		174. 16	.....	6, 594	Wood and forage purchased.

From Buckland's to Sand Spring is a deserted road and without accommodations at present, between Bucklands' and Sulphur Springs, the first telegraph and old stage road. Also, from Buckland's, Route No. 1, can be joined *via* Gates, on Carson River, (8 miles,) and striking the first route between Coney's and Log Cabin, (10 miles from Gates,) about six miles from Log Cabin.

ROUTE NO. 3.

From Carson City, Nev., to Austin, Nev.—Atlas-sheets Nos. 47 D and 48 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Carson City.	From Austin.		
Carson		176. 34	.....	4, 699	Capital of Nevada.
* * * *					
	56. 94				
Saint Clair's Station		119. 40	.....	3, 989	See route No. 1.
	3. 72	115. 68	60. 66	3, 978	
Crossing Carson					Bridge; ranch near.
	13. 71	101. 97	74. 37	3, 954	
Stillwater					County seat of Churchill County, Nev.
	14. 55				
Mountain Well		87. 42	88. 92	.....	Poor water; wood; no grazing.
	0. 95	86. 47	89. 87	5, 882	
Summit					Wood; no water or grass.
	21. 50	64. 97	111. 37	4, 504	
West Gate					Good water; no wood; forage purchased. See Route No. 1.
* * * *					
	64. 97				
Austin		.....	176. 34	6, 594	City of.

Ranch about one-fourth mile beyond "Crossing."

Old mining town, La Plata, 3 miles from "Summit," is reached by road that turns to the north at this point.

There is a telegraph station at Stillwater, and this road follows the telegraph line to West Gate, thence to Austin the telegraph is *via* New Pass and Mount Airy. This was the last route of the Overland Stage Company.

From Stillwater there is a road (little traveled) to Sand Spring, distance 21 miles.

From Mound House to Dead-Horse Well.—Atlas-sheet No. 57 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Mound House.	From Dead-Horse Well.		
Mound House		.....	94. 49	.....	Station, Virginia and Truckee R. R.
	5. 06				
Dayton		.....	89. 43	4, 376	Town of. Carson River bridge.
	11. 02				
Toll-Gate		16. 08	78. 41	4, 269	On Carson River; ford near.
	9. 84				
Churchill Cañon		25. 92	68. 57	.....	Water and little wood; no grass.
	3. 46				
Forks of road		29. 38	65. 11	4, 272	
	6. 19				
Schwartz		35. 57	58. 92	.....	First ranch in Mason Valley.
	5. 12				
First Crossing		40. 69	53. 80	4, 345	Portion Walker River; no timber; grazing.
	6. 00				
Mason's		46. 69	47. 80	4, 348	Ranch.
	1. 40				
Geiger's		48. 09	46. 40	4, 352	Near second ford (main) Walker River.
	0. 60				
Lee's Mill		48. 69	45. 80	4, 350	Water-mill.
	17. 80				
Indian Agency		66. 49	28. 00	4, 120	Lower crossing W. R. ford.
	9. 00				
Double Spring		75. 49	19. 00	.....	Water; no wood.
	19. 00				
Dead-Horse Well		94. 49	.....	4, 117	Water; no wood or grazing.

From Dayton, a toll-road is being constructed through Mason Valley toward Bellville.

Dead-Horse Well is called 50 miles from Bellville. This road is now constructed to its junction with the road from Bucklands to Mason Valley.

From Churchill Cañon the left-hand road, making a small detour to the east, passes a well and station on the Buckland road, (also) 2 miles from Churchill Cañon. The construction of bridges, as contemplated, over the Walker River, near Lee's Mill will materially improve and shorten this toll-road.

From Wadsworth, Nev., to Mason Valley Post-Office.—Atlas-sheets Nos. 48 C & 57 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Wadsworth.	From Mason Valley Post-Office.		
Wadsworth		.....	56. 54	4, 102	Station, C. P. R. R.
	27. 08				
Bucklands		.....	29. 46	4, 151	Ranch; toll-bridge over Carson.
	7. 25				
Road from Dayton { First Fork		34. 33	22. 21	4, 259	Well of good water; station.
	2. 00				
Road from Dayton { Second Fork		36. 33	20. 21	4, 272	
	6. 19				
Schwartz		42. 52	14. 02	.....	First ranch in Mason Valley.
	5. 12				
First Crossing W. River		47. 64	8. 90	4, 345	Grazing; no timber.
	6. 00				
Mason		53. 64	2. 90	4, 348	Ranch.
	1. 40				
Geiger		55. 04	1. 50	4, 352	Near second ford (main) Walker River.
	1. 50				
Mason Valley Post-Office		56. 54	.....	.....	Small settlement.

Stockton Well, an old stage-station on the overland route, is near this road, and about nineteen miles from Wadsworth; the station is deserted.

From Wadsworth, Nev., to Dead-Horse Well.—Atlas-sheets Nos. 48 C & 57 A.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Wadsworth.	From Dead-Horse Well.		
Wadsworth		.....	80.68	4,102	Station, C. P. R. R.
	15.70				
Desert Well		.....	64.98	4,031	No wood or grazing.
	6.45				
Ragtown		22.15	58.53	4,002	Carson River; little wood; forage purchased.
	3.87				
Saint Clair Station		26.02	54.66	3,989	Bridge over Carson; little wood; forage purchased.
	6.28				
School-House		32.30	48.38	3,920	
	6.47				
Hill & Grimes		38.77	41.91	3,944	Ranch; no wood; good grazing.
	10.20				
Sulphur Spring		48.97	31.71	3,972	Water; no wood or grass.
	3.45				
Salt Well		52.42	28.26	4,020	Poor water; no wood or grass.
	5.84				
Cox's Station		58.26	22.42	4,379	No wood or water; little grazing.
	5.16				
Summit		63.42	17.26	5,602	No wood or water; little grazing.
	3.30				
Deep Hollow		66.72	13.96	5,244	No wood or water; little grazing.
	13.96				
Dead-Horse Well		80.68	.....	4,117	Water; no wood or grazing.

The above is the road over which freight is now transported from Bellville, Nev., Dead-Horse Wel[1] being about fifty miles from Bellville. Water for the use of the stations is hauled to Salt Well, Cox's Station, and Summit, from near Sulphur Springs, and to Deep Hollow from Dead-Horse Well.

From Wadsworth, Nev., to Lodi, Nev.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Wadsworth.	From Lodi.		
Wadsworth		.....	108.29	4,102	Station on Central Pacific Railroad.
	15.70				
Desert Well		.....	92.59	4,031	Water; no wood or grass.
	6.45				
Ragtown		22.15	86.14	4,002	Carson River; little wood; forage purchased.
	3.87				
Saint Clair Station		26.02	82.27	3,989	Bridge over Carson; forage purchased.
	12.75				
Hill & Grimes		38.77	69.52	3,944	Ranch; forage purchased.
	16.51				
Sand Spring		55.28	53.01	3,926	Forage, wood, and water purchased.
	20.06				
West Gate		75.34	32.95	4,504	Good water; no wood; forage purchased.
	11.96				
Muddy Spring Summit		87.30	20.99	6,219	Winter spring ½ mile south; little wood or grazing.
	7.46				
Chalk Well		94.76	13.53	5,690	Water; no wood or grazing.
	10.25				
Welsh's		105.01	3.28	5,236	Water; no wood; little grazing.
	3.28				
Lodi		108.29	.....	5,356	Mines; no wood; no water; little grazing.

From Wadsworth, Nev., to Ellsworth and Ione, Nev.—Atlas-sheet No. 57 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Wadsworth.	From Ellsworth and Ione.		
Wadsworth		.....	108.76	4,102	Station on C. P. R. R.
	15.70				
Desert Well		.....	98.06	4,031	Water; no wood or grass.
	6.45				
Ragtown		22.15	86.61	4,002	Carson River; little wood; forage purchased.
	3.87				
Saint Clair Station		26.02	82.74	3,989	Bridge over Carson; little wood; forage purchased.
	12.75				
Hill & Grimes		38.77	69.99	3,944	Ranch; little wood; forage purchased.
	16.51				
Sand Spring		55.28	53.48	3,926	Forage, wood, and water purchased.
	20.06				
West Gate		75.34	33.42	4,504	Good water; no wood; forage purchased.
	11.96				
Muddy Spring Summit		87.30	21.46	6,219	Winter spring ½ mile south; little wood or grazing.
	7.46				
Chalk Well		94.76	14.00	5,690	Water; no wood or grazing.
	4.00				
Burnt Cabin Summit		98.76	10.00	6,552	Scant timber; no water.
	0.50				
Forks road to Ellsworth		99.26	9.50	.....	
	9.50				
Ellsworth		108.76	.....	6,871	Mining town; forage, &c., purchased.

From "forks of road" Ione is distant 14.5 miles.

From West Gate a route may be taken to Chalk Well, as follows: To White Rock, 6.500 miles; water; no wood or grazing; East Gate, 2.710 miles; water; little wood, (ranch;) Chalk Well, 14.000 miles; water, no wood or grazing; total, 23.21 miles.

From Austin, Nev., to Ellsworth, Nev.—Atlas-sheets Nos. 48 D and 57 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Austin.	From Ellsworth.		
Austin		.....	55.21	6,594	City of.
	8.69				
Silver Age		.....	46.52	6,014	Well; forage, &c., purchased.
	4.00				
Crowley's		12.69	42.52	.....	Ranch, Reese River.
	11.25				
Summit		23.94	31.37	6,253	Scant timber; no water.
	9.56				
Peterson's		33.50	21.81	6,137	Ranch; forage, &c., purchased.
	10.05				
Cabin		43.55	11.76	6,597	Spring; no wood; little grazing.
	11.76				
Ellsworth		55.31	.....	6,871	Mining town; wood plenty; forage, &c., purchased.

Road but little used. Grade is good.

ROUTE No. 1, VIA IONE, NEV.

From Austin, Nev., to Ellsworth, Nev.—Atlas-sheets Nos. 48 D and 57 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Austin.	From Ellsworth.		
Austin		.....	60.54	6,594	City of.
	8.69				
Silver Age		.....	51.85	6,014	Well; forage, &c., purchased.
	11.77				
Ahle's Ranch		20.46	40.08	5,990	Reese River; forage, &c., purchased.
	5.680				
Elkhorn		26.14	34.40	6,123	Do.
	17.46				
McMahon's		43.60	16.94	6,552	Do.
	4.690				
Summit		48.29	12.25	7,488	Timber; no water.
	3.250				
Ione		51.54	9.00	6,844	Mining town; wood plenty; forage, &c., purchased.
	9.00				
Ellsworth		60.54	.....	6,871	Do.

Good wagon-road.
Buck-board carries the mail and passengers from Ellsworth to Austin.
Austin is distant 88 miles from Battle Mountain; Central Pacific Railroad is connected by stage-line.
Ranches are found at short intervals from Ahles to McMahon's, along Reese River.

From Austin, Nev., to Schmidtlein's Ranch.—Atlas-sheet No. 48 D.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Austin.	From Schmidtlein's Ranch.		
Austin		.....	28.29	6,594	City of.
	8.69				
Silver Age		.....	19.60	6,014	Well; forage, &c., purchased.
	3.80				
Mouth Big Creek Cañon		12.49	15.80	.....	Water; little wood and grass.
	2.00				
Forks of Big Creek		14.49	13.80	6,982	Water; little wood and grass.
	3.20				
Summit, (south fork)		17.69	10.60	8,675	
	9.60				
Sterling Mill		27.29	1.00	6,818	Water; little wood and grass.
	1.00				
Mouth Kingston Cañon, Schmidtlein's Ranch.		28.29	.....	6,220	Water and grass.

Schmidtlein's Ranch is on the west side of Big Smoky Valley.
This is the middle pass through the Toyabe range, from Reese River Valley to Big Smoky Valley. The northern one is at Austin and the southern one by Ophir Cañon.

1877.

PROGRESS MAP OF THE U. S. GEOGRAPHICAL SURVEYS West of the 100th Meridian

To accompany the annual report of
1st LIEUT. GEORGE M. WHEELER.
Corps of Engineers U.S.Army.

Scale 1: 6 000 000.

100 50 0 100 200 Miles

SEASONS of 1869, 1871, 1872, 1873, 1874, 1875 & 1876.

1st. Lieut. Geo. M. Wheeler, Corps of Engineers, U.S. Army, in Charge.

EXPLANATIONS.

Index Areas to Atlas Maps.

Primary Astronomical Stations completed.

Points proposed for primary Astronomical Stations.

Atlas Sheets published

Areas of which maps are in course of preparation.

Areas proposed for occupation. Season, of 1877.

Areas embraced by the Exploration of the 40th Parallel, (Clarence King.)

Lines of Expeditions, prosecuting Explorations and Surveys, conducted by "Officers of the Line," "Corps of Topographical Engineers," and "Corps of Engineers," U.S.Army.

Military Post ☆ *Existing Telegraph Lines* ——— *Proposed Telegraph Lines* ·····

APPROXIMATE AREAS.

	Miles
Area West of 100th Meridian	1 443 360
Areas of 40th Parallel Survey	51 600
Wheeler's Expeditions of 1869, 1871, 1872, 1873, 1874, 1875	317 178
1876	398 773
Balance.	1 044 582

BY ORDER OF THE HONORABLE, THE SECRETARY OF WAR.

UNDER THE DIRECTION OF BRIG. GEN. A.A. HUMPHREYS, CHIEF OF ENGINEERS, U.S. ARMY.

From Dead-Horse Well to Ellsworth, Nev.—Atlas-sheets Nos. 57 A and 57 B.

	Distance in miles.			Altitude in feet above sea-level.	Remarks.
	Between consecutive points.	From Dead-Horse Well.	From Ellsworth.		
Dead-Horse Well			37.77	4,117	Good water; no wood or grazing.
	10.65				
Hot Springs			27.12	4,212	Water; salt grass; no wood.
	15.32				
Old Well		25.97	11.80		Not used; no wood and little grass.
	8.30				
Summit		34.27	3.50	7,602	Timber; little grazing.
	3.50				
Ellsworth		37.77		6,871	Mining town; wood, water, and forage.

Dead-Horse Well was a station on the Wellington stage road from Walker River to Reese River; it is also on the direct road from Wadsworth to Bellville, and from Mason Valley to Bellville, 50 miles from the latter.

PROGRESS MAP.

The changes noted on this sheet are, in addition to the marking of areas occupied and proposed for the season of 1877, and the stage of prosecution of map results, the positions of the present Indian agencies, the naming of railroads, and an addition of practical data showing the changes in lines of communication, military posts, &c., within the year. The short season rendered it impracticable to add so large an area as usual to that already covered in previous years by the several topographical parties, and my own time was spent principally with the party operating in the Lake Tahoe region and in the Washoe mining district, after concluding the organization of the Colorado section.

The immediate vicinity of Lake Tahoe has been so often described, and the later maps will afford so much that is an improvement to the present idea of its mountain picturesqueness, that I need only add my regret that the spoliation of the forests along its shores has become so rapid, in aid of the mines of the Comstock, that shortly the horizon from lake-level will be bare of the covering that has lent so much to the natural beauty of this peculiarly interesting region. Indeed, could the title of the Government be again made perfect to this part of its domain, one might be justified in recommending its segregation from the "public lands," that the natural beauty of the forest might be permanently reserved as a part of a lake region so unique.

PROFILES.

The aneroid profiles joining most of the points of importance within and immediately adjacent to the field of survey have been prepared, and have become a matter of office record.

A special profile-map of the continental divide from Gray's Peak, Colorado, to latitude 35° in New Mexico, has been prepared, showing the elevations of the prominent peaks and passes, and upon it is projected the profile of the ridges facing the plains from the head of the Arkansas southward to the latitude above mentioned.

As the passes leading westward and lying between Gray's Peak and Sherman, the highest point on the Union Pacific Railroad, (8,242 feet,) are known to be each of greater elevation than those necessary to be crossed, as shown by the sketch, in going southward until near latitude 35°, it appears that any through railroad route to the Pacific, south of the Union Pacific Railroad, will necessarily encounter elevations equal to those given.

It does not seem practicable to avail of any new pass for a through western line of railroad between latitude 35° and 40°, except that at the head of Pass Creek, a southern branch of the Huerfano that heads near the source of the Sangre de Cristo Creek, and where, by means of tunneling, a transit of the summit should be made, at an elevation not exceeding an altitude of approximately 9,100 feet above sea-level.

NATURAL RESOURCES.

Upon the sheets in colors, showing the natural distinctions of the surface occupied, the following divisions are made:

1. *Arable.*—This refers to soil susceptible of cultivation by the use of water, when it is apparent that the supply is adequate, assuming that irrigation is necessary.

2. *Grazing.*—Of the various grades, often infringing upon the timbered area.

3. *Timber.*—The gradations in amount, size, and quality cannot be shown.

4. *Arid and barren.*—This embraces that part of the surface absolutely valueless for agricultural purposes, and includes desert wastes and rock exposures.

The positions of mines in place and placer are at present shown only on the regular topographical sheets.

The topographical sheet upon which these divisions are marked is a reproduction from the original sheets regularly issued. A legend is attached to the case of maps, giving the geographical locality of each. A description, supplemented now by the maps themselves, of sheets 61B, 61Cc, 65D, 70A, and 70C, is given in the last annual report.

BAROMETRIC ALTITUDES.

Work in the meteorological branch has been confined principally to the taking of observations with a view to their subsequent computation and determination therefrom of differences of altitude between known points and those at which original observations have been taken. Good progress has been made.

The altitudes are at once used in the construction of the mountain parts of the map, and upon the atlas-sheet the altitudes of the principal settlements and other marked points are noted, while from time to time the altitudes of prominent peaks and other natural objects will be published in list form.

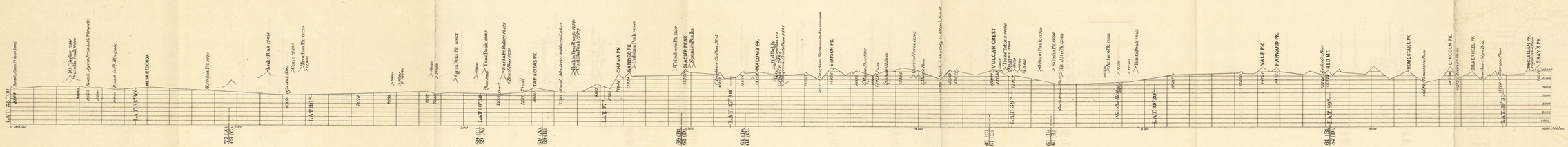
The Signal-Office, through the courtesy of General Albert J. Myer, Chief Signal-Officer, has kindly furnished transcripts of observations taken at a number of stations contiguous to the field of survey.

MINING INFORMATION.

Fifteen districts have been visited and located by the several parties.

The cursory examination that may be carried out hastily, in a district usually not long discovered, has been made, and the facts gathered made the subject of a report.

At the Comstock Lode, made famous from its large production of the precious metals, gold and silver, more extensive examination as to the engineering features of its mining industry has been instituted; added to the overground survey of the contour and superficial improvements, underground examinations along profile lines separated one hundred feet are in progress, and the circumstances of the mining openings upon the various levels will be noted, and the marked features discovered will be illustrated graphically. The conditions of ventilation and drainage will be made a matter of special study, as well as the application of



PROFILE of the ATLANTIC and PACIFIC or CONTINENTAL DIVIDE Between LAT. 35° and LAT. 39°40′N.

Showing also the Relative Position and ALTITUDE of the Principal PEAKS and PASSES of the

SANTA FE, MORA, CIMARRON, TAOS, CULEBRA, and SANGRE de CRISTO RANGES,

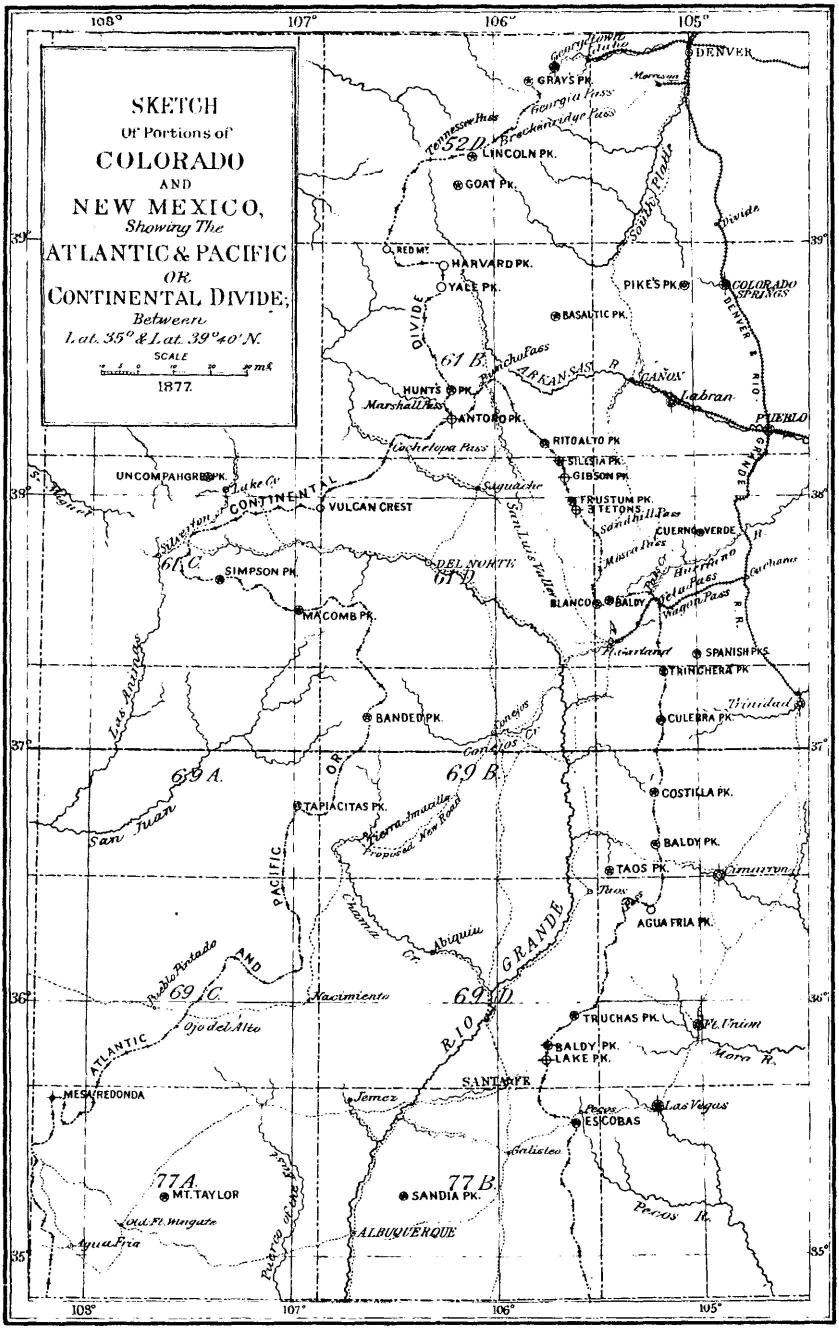
Between Lat. 35° and Lat. 38°30′N.

TO ACCOMPANY ANNUAL REPORT of 1st. LIEUT. GEO. M. WHEELER, Corps of ENGINEERS, U.S. ARMY.

1877.

NOTE: *The Latitudes given refer to both Lines of Elevation. The Atlas Sheet Numbers refer to the main Profile only. The Altitudes along the Profile are shown inside while those for the Supplementary Line are shown outside the Section.*

SCALE: *Division of Horizontal = 10 Miles.*
Do. " Vertical = 1000 feet.
Plane of Reference = Sea Level.


SKETCH
Of Portions of
COLORADO
AND
NEW MEXICO,
Showing The
ATLANTIC & PACIFIC
OR
CONTINENTAL DIVIDE;
Between
Lat. 35° & Lat. 39°40′ N.
SCALE
1877.
108°
107°
106°
105°
39°
38°
37°
36°
35°
DENVER
Georgetown
Idaho
GRAY'S PK.
Morrison
Georgia Pass
Breckenridge Pass
Tennessee Pass
52 D.
LINCOLN PK.
GOAT PK.
South Platte
Divide
RED MT.
HARVARD PK.
YALE PK.
PIKE'S PK.
COLORADO SPRINGS
BASALTIC PK.
DIVIDE
61 B.
Poncho Pass
ARKANSAS R.
CAÑON
Labran
DENVER & RIO GRANDE R.R.
PUEBLO
HUNT'S PK.
Marshall Pass
ANTORO PK.
RITO ALTO PK.
Cochetopa Pass
SILESIA PK.
GIBSON PK.
UNCOMPAHGRE PK.
Lake Cr.
Saguache
S. Miguel
CONTINENTAL
VULCAN CREST
FRUSTUM PK.
3 TETONS
Sandhill Pass
San Luis Valley
CUERNO VERDE
Silverton
61 C.
Mosca Pass
Huerfano
SIMPSON PK.
DEL NORTE
61 D.
Veta Pass
Wagon Pass
Cuchara
BLANCO
BALDY
MACOMB PK.
A
SPANISH PKS.
TRINCHERA PK.
Las Animas
Trinidad
BANDED PK.
Conejos
CULEBRA PK.
Conejos Cr.
69 A.
OR
69 B.
COSTILLA PK.
TAPIACITAS PK.
San Juan
Tierra Amarilla
Proposed New Road
BALDY PK.
PACIFIC
TAOS PK.
Cimarron
Taos
Chama Cr.
AGUA FRIA PK.
Abiquiu
GRANDE
AND
Pueblo Pintado
69 C.
Nacimiento
69 D.
TRUCHAS PK.
Ft. Union
Ojo del Alto
RIO
ATLANTIC
BALDY PK.
LAKE PK.
Mora R.
MESA REDONDA
SANTA FE
Jemez
Pecos
Las Vegas
ESCOBAS
Galisteo
77 A.
MT. TAYLOR
77 B.
SANDIA PK.
Old Ft. Wingate
Puerco of the East
Pecos R.
Agua Fria
ALBUQUERQUE

machinery to the lifting of heavy weights from below the surface and the conditions of practice in the reduction of ores. If time and means permit, nothing will be left undone in the full and fair investigation of the present condition of mining industry in this section, as evidenced by work already prosecuted.

The Sutro Tunnel, well known as the most extended work of its kind in American mining, will be examined in detail, and the rock-specimens gathered during its progress are likely to throw much light on the character of the several volcanic beds or "country rock" that make up the casings of the ore-bearing matter. The next annual report will give the progress made up to that date, while the finished results will endeavor to show in shape for permanent reference the present condition of this industry, now so well recognized in the western interior.

In this duty I have been assisted by Mr. John A. Church, mining engineer, who has taken up the underground work with a commendable energy, and Anton Karl, general service, U. S. Army, who has been engaged in completing plane-table sheets, begun in the year 1876.

THE EAGLE AND WASHOE VALLEY MINING DISTRICT, NEVADA.

[From notes by A. R. Conkling.]

This district was discovered and organized in August, 1875, since which time the North Carson has been worked continuously. Its post-office is Carson, Nev. It is distant from railroad communication three miles. The nearest practicable route is a wagon-road, direct to the Carson Mine, from the Virginia and Truckee Railway. It is bounded on the north by the divide between Washoe Lake and Carson Plain; on the south by Carson River; on the east by the Como Mountains; on the west by the Eastern Summit Range. Area, about 25,000 linear feet, now taken up in North Carson Mine. Long and narrow in shape, the trend is generally northeast and southwest. Other mining-ledges are found in the vicinity, on the southern slope of the foot hills, with a general trend north and south. The general direction of lodes, deposits, and stratifications is northeast and southwest. The ore is richer, and the vein enlarges in descending. The wall-rock is granite. Its slope is nearly vertical. The clayey wall inclines slightly to the east. In age, the country rock is metamorphic, granite, and hornblendic granite. No fossils are found. Ores are worked by the free process.

No water-level has yet been reached. Chloride of silver is the chief ore, with some sulphides. Silver is the principal metal, with a little malachite incrustating the wall-rock. The principal mines now worked are the Montreal, Emerald, Clear Creek, Niagara, (described in Whitehill's report,) and the North Carson. The North Carson is situated 3 miles due north of Carson City. It has one double-compartment shaft, 305 feet deep. The walls of shaft are well timbered. Timber can be hauled to the mine from flume at the rate of $12 per 1,000 feet. At every 100 feet in the shaft there is a station. At the foot of the hill there is a tunnel 610 feet long, not yet (September, 1876) reached by the shaft. Two hundred feet from the mouth of the shaft a little rock has been broken, *i. e.*, sufficient to reach the vein. At 100 feet level there is a drift 320 feet long. The mine has good ventilation.

No ore has been sent away from this mine as yet. Vein of ore varies from 4 to 5 feet. Seventy-five thousand dollars has been expended in the mineral development of the North Carson Mine. The average cost of milling labor per day is $4. Cost per foot for sinking a shaft on a main vein is from $60 to $70. Average cost per foot for running a drift on a main vein, $30. Hay is $30 per ton. Oats, 3 cents per pound; an abundant supply of both. Facilities for raising farm-produce are good.

Timber and wood abundant. Water at North Carson Mine is brought from Virginia water-hoisting works. Main tapped 1¾ miles from Carson. There is one stage and several freight lines. Five churches, 2 school-houses, many stores, and 2 banking-houses. The Indians are those of the Washoe and Shoshone tribes, and are few in number. The principal silver-mining companies are the North Carson, Ayres and Hopkins, Gould and Barnhart, Ida Ayres, All Right, Ayres's Consolidated, Huston, and Montreal and Emerald. These companies are incorporated under the laws of California.

NATURAL HISTORY.

In geology, Mr. A. R. Conkling submits a report of his observations made in the Sierra Nevada, in the vicinity of Lake Tahoe and to the southward, and has collected a number of fossils. His report upon the results of an examination of a number of microscopical section of rocks from various localities is herewith.

Mr. H. W. Henshaw has made an ornithological report as the result of his season's labor, and, as well, has collected specimens in other departments of zoology. The results from further examinations by Dr. J. T. Rothrock and Prof. F. W. Putnam, the one in botany, the other of the archæological collections, with their colaborers, will appear in volumes 6 and 7.

The following gives a list, as prepared by Mr. Henshaw, of the various lots and specimens forwarded by the expedition to the Smithsonian Institution; all of which have been donated to its museum, their practical importance to the survey having ceased with the examination and reports made thereupon. The list is taken from the records of this office and those of the Smithsonian Institution:

List of natural-history collections forwarded to the Smithsonian Institution during the years 1871 to 1876, inclusive.

Subjects.		1871.	1872.	1873.	1874.	1875.	1876.	Total specimens.
Vertebrate fossils	specimen					500		500
	lot					1		
Invertebrate fossils	specimens	126	1,426	1,566	250			3,368
Crustacea	specimens					100	200	300
	lots					1	14	
Mollusca	specimens			600	250	1,000	150	3,000
	lots			66	23	95	15	
Mammals	specimens	9	21	135	52	43	10	270
Birds and mammals, (alcoholic,) specimens.						26	4	30
Mammal crania	specimens			37	3	18	2	60
Birds	specimens	60	522	659	1,055	793	150	3,239
Bird crania, (sterna, &c.)	specimens		4	31	22	9	2	68
Bird-skeletons	specimens			4				4
Bird-embryos	specimens					5		5
Bird-nests	specimens		10	20	6			36
Bird-eggs	specimens	12	20	193	11	14		250
Reptiles, (batrachians)	specimens	135	550	950	750	750	83	3,218
	lots	27	109	192	140	153	8	
Fishes	specimens	15	275	850	650	800	350	2,940
	lots	3	48	109	91	116	49	
Hymenoptera	specimens			450		790	50	500
	lots			43			3	
Lepidoptera	specimens			288		483		771
	lots			144		162		
Diptera	specimens			50				50
	lots			13				
Coleoptera	specimens	1,300	100	4,500	4,200	1,200	2,000	13,300
	lots	135	5	240	211	18	34	
Orthoptera	specimens			500				500
	lots			48				
Arachnida	specimens			250		100		350
	lots			26		16		
Botanical specimens	specimens							*11,000
	lots							

* Approximate.

PUBLICATIONS.

During the year the following maps have been published:

Progress map of 1877.

Profile map (continental divide from Gray's Peak to latitude 35°.)

Topographical atlas-sheets 53 C, 61 D, 65 D, 69 B, 70 A, 70 C, 77 B.

The natural resources of five of these sheets, in colors, will be found accompanying the edition of the annual report, printed and placed at the disposal of this office.

Maps in color showing the natural advantages of the area delineated in sheet 61 C_c, (San Juan,) and 61; (B,) Upper Arkansas Valley, are also added.

The volume numbered four (Paleontology) has passed through the press. Proof of nearly half of volume II has gone to stereotype. The proof of a portion of the "Star Catalogue" mentioned in my last report has been read, and this valuable catalogue will be in the hands of observers during the coming season, should longitude and latitude observations be prosecuted.

Two thousand copies of my annual report (Appendix J J, annual report Chief of Engineers for 1876,) have been published, with a folio of the regular atlas-sheets issued during the year ending June 30th, 1876.

The following atlas-sheets, seventeen in number, are in various stages of completion, viz: 47 B, 47 D, 48 C, 48 D, 52 D, 62 A, 62 C, 69 A, 69 C, 73 A, 73 B, 73 C, 73 D, 77 C, 77 D, 78 A, 84 A.

A number of sheets, enumerated below, have been plotted in various scales, and have either been published or are awaiting publication, as follows: Lake Tahoe region, 1 inch to 1 mile; route of party No. 1, California section, 1875, 1 inch to 4 miles; map of Virginia City, Nev., and vicinity, 1 inch to 500 feet; three plane-table sheets, Virginia, Nev., and vicinity, 1 inch to 1,000 feet; preliminary map of portions of northern Utah and southern Idaho, (for field use;) sketch of cave in Nevada; sketch of personal-equation apparatus; plan of Ogden observatory; three sheets giving positions of astronomical monuments; detailed topographical sheet showing results of Colorado River and Grand Cañon exploring party of 1871.

CONCLUSION.

As regards the progress toward completion of the topographical atlas of the area of territory west of the 100th meridian, the progress-map, herewith, shows the advance made in that direction. The possibility of a more or less minute topographical survey of all of this extended region has not yet been made mandatory by legislative act, but Congress has appropriated money for a number of years. The use of this fund is limited to a fiscal year, and hence, unless an additional appropriation is each year made, which is often unknown until the current year has nearly expired, the project of operations, as a part of which the retention of skilled employés is requisite, cannot be made, until a date often later than the period terminating their office-work which is needed in the reductions of the previous season's field-work; and this is usually so late that full advantage cannot be taken of the entire summer-season. By an increase of assistants enlisted in the general service and the detail of a number of engineer and other officers requisite for the command of the number of field-parties each year engaged, the expenditure for additional service can be limited to the small number of scientists engaged in special

duties, and that of computers and draughtsmen engaged in the technical labors necessary to the rapid production of results. Without adverting to the advantage to the military service growing out of extended topographical surveys, it seems practical to urge the propriety of placing the item for the continuation of this work upon the "Army bill," which usually becomes a law earlier during the session of Congress than the sundry civil bill, (so called,) that frequently is not approved earlier than the middle of June, while parties for the field should be en route during the early part of May.

ESTIMATE.

For continuing the geographical survey of the territory of the United States west of the one hundredth meridian, provided the supply-branches of the War Department shall assist as heretofore; being for field and office work, and for the preparation, engraving, and printing of the maps, charts, plates, cuts, photographic-plate and other illustrations for reports; for temporary office-room at points remote from Washington, D. C., and the purchase at nominal rates of sites for field-observatories authorized by the Department; for the fiscal year ending June 30, 1879	$120,000 00

As follows:

For expenses of parties in the field	$45,000 00
For office-expenses, including salaries	10,500 00
For transportation, including purchase of animals	10,000 00
For material for outfits	6,500 00
For subsistence on expeditions	5,500 00
For forage, winter-herding, fuel, storage, &c	7,500 00
For purchase of instruments	6,000 00
For repair of instruments	1,000 00
For temporary office-room at points remote from Washington	1,000 00
For erection of observatories and monuments at astronomical and geodetic stations	4,500 00
For purchase of sites for observatories	1,000 00
For preparation of maps, charts, &c	6,000 00
For engraving and printing maps, charts, photographic-plate and other illustrations for reports	10,000 00
For contingencies, (field and office)	5,500 00
Total	120,000 00

FINANCIAL STATEMENT.

Amount expended from appropriation for the fiscal year ending June 30, 1877, and from appropriation made available March 3, 1877	$35,329 87
Amount remaining unexpended July 1, 1877, from appropriation for continuing the geographical survey of the territory of the United States west of the one hundredth meridian for fiscal year ending June 30, 1878	43,492 64

All of which is respectfully submitted.

GEO. M. WHEELER,
First Lieut. Corps of Engineers, in Charge.

Brig. Gen. A. A. HUMPHREYS,
Chief of Engineers U. S. A.

APPENDIX A.

EXECUTIVE AND DESCRIPTIVE REPORT OF LIEUTENANT ERIC BERGLAND, CORPS OF ENGINEERS, ON THE OPERATIONS OF PARTY NO. 1, COLORADO SECTION, FIELD SEASON OF 1876.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF 100TH MERIDIAN,
Washington, D. C., April 15, 1877.

SIR: I have the honor to submit the following report of operations of party No. 1, Colorado section, during the last field season:

Owing to the late date at which the appropriation for the survey became available,

the party was not organized until the latter part of August, 1876, at the Rendezvous Camp at Fort Lyon, Colo., and consisted of myself as executive officer and field astronomer; Louis Nell, chief topographer; Francis Klett, assistant topographer; William C. Niblack, meteorologist; A. K. Owen, odometer recorder; two packers, one cook, one teamster, and two enlisted men belonging to Company D, Nineteenth Infantry.

As the field season would be necessarily short, only a limited area could be covered and completed; hence that assigned to me embraced portions of several atlas-sheets, for the completion of which, sufficient topographical data had not been previously obtained. These incomplete sections lie in the southeast corner of atlas-sheet "52 D," southwest corner of "53 C," western portion of "62 A," northeast portion of "61 D," and northwestern portion of "62 C." As it was necessary to go as far north as latitude 39° 20′ and to the south as far as latitude 37° 40′, it seemed advisable to complete the northern section first before the snow would interfere with our movements, and triangulation and topographical work; then to proceed southward and accomplish the work required in the San Luis and Wet Mountain Valleys. Subsequent events proved this surmise to be correct, as we had barely finished our work in the northern portion when we were greeted with a snow-storm on reaching Fairplay, the 13th of October.

After completing the organization, the party proceeded up the Arkansas Valley from Fort Lyon to Pueblo, Col. At this place several triangulation stations were occupied and monuments erected on prominent points in the vicinity. From Pueblo the main party proceeded to Cañon City; thence along the Fairplay road to the 17-mile ranch on Currant Creek, at which point we left this road and proceeded northeastwardly along the road to High Creek and camped on this latter creek, a short distance above the cañon. Before reaching Cañon City, a side party was detached in charge of the chief topographer which proceeded up Beaver Creek to the vicinity of its source, occupying the principal peaks south of Pike's Peak, and establishing the courses and drainage of the streams which flow south from this range and empty into the Arkansas River between Pueblo and Cañon City. The side party having joined the main party at High Creek, we proceeded along the Colorado Springs road to Florissant Post Office. From this point a number of topographical stations were occupied, and the surrounding country thoroughly surveyed.

By your orders Mr. Klett was directed to proceed to Washington on the 1st of October, and he left the party at this place; at the same time I sent one of the enlisted men back to Fort Lyon, since his services in the field were no longer required. From Florissant, after crossing the South Platte River, we proceeded up Tarryall Creek to the junction of Rock Creek, then up this latter creek some 5 miles, where camp was established, and from whence the ascent of the Twin Cones was made.

From Rock Creek the party proceeded westwardly across the upper end of South Park to Fairplay, thence south via the Salt Works and Trout Creek Pass into the Upper Arkansas Valley, down this valley to the junction of the South Arkansas River, thence through Puncho Pass into the San Luis Valley, and down the valley to the Mosca Pass. From camps in the latter valley several prominent peaks of the Sangre de Cristo Range were occupied, a road to Sagauche meandered, and several mines visited and examined.

Passing through the Mosca Pass we entered the Wet Mountain Valley and proceeded to Rosita, where the main camp was established, from which side parties were sent out to occupy the necessary points in the Sangre de Cristo and Wet Mountain Ranges and Cuerno Verde Peak. Here the mines were also examined, and information gained as to their yield and prospects.

From Rosita the party moved to Cañon City by way of the Oak Creek Road, thence by the road which crosses the head of Little Fountain Creek to Colorado Springs. Here a base-line was measured and connected with our system of triangles, as well as with the astronomical monument, and Pike's Peak was ascended and occupied as a triangulation-station. From Colorado Springs the party proceeded to Pueblo and Fort Lyon, which latter place was reached December 10. The property was then disposed of according to your orders, and the party disbanded.

The results obtained during the field season may be briefly enumerated as follows:

Ten triangulation stations were occupied, at which repeated angles were measured by means of an 8-inch transit theodolite by Buff & Berger, reading to 10 seconds of arc. Fifty-one topographical stations were occupied and located by angles to the triangulation stations. The route of the party was meandered and measured with the odometer throughout. At Colorado Springs a base-line over 12,000 feet long was carefully measured. The usual meteorological observations were taken in camp, on the march, on divides, and mountain stations, in accordance with your printed instructions. The mines on the west slope of the Sangre de Cristo Range, and those at Rosita, were visited and examined.

Tarryall Creek was gauged at camp 12, near McLoughlin's Ranch, on October 8,

and its volume found to be 27.5 cubic feet per second, which may be considered as the minimum amount, as rain had not fallen for several weeks previously.

The geology, climate, and agricultural resources of this region have been so ably described in previous annual reports and also by Professor Stevenson in Volume III of your quarto reports, that any detailed description by me would be superfluous, hence I will merely remark that an abundance of water, wood, and grass was found at nearly all of our camps, except in the San Luis Valley. The small valleys along the streams which empty into the South Platte and Arkansas are occupied by settlers whose principal pursuit is stock-raising. Considerable portions of these valleys have been fenced in and are utilized for hay-land and pasturage, as during severe winters, when there is a heavy snow-fall, the cattle must be fed on hay until the snow is reduced in depth. Deer and other game were frequently seen in the mountains after the 1st of November, and herds of antelope in the upper portions of the San Luis Valley, and on the plains east of Pueblo. The streams in this section are generally not well stocked with fish, none being found in some of the larger, as Tarryall Creek. An instance of the devastating effect of violent rain-storms or cloud-bursts was observed at Duck Lake on the Tarryall Creek. In the fall of 1875 a heavy shower of limited area burst over the mountains on the east side of the creek, the water from which brought down so much earth and loose material that the stream was choked up, and the water spread over the valley, converting some hundreds of acres of hay-land into a miry swamp. The temperature during the day in September and October was moderate and pleasant, the nights cool and refreshing. But little rain fell during these months, and the sky was generally free from clouds, which circumstance greatly facilitated our triangulation and topographical work. In November, especially during the latter part of the month, the thermometer ranged during the day from 50° to below the freezing-point, while at night and on some mountain stations the mercury went down to zero and below. Frequent snow-storms also interfered with our work and movements, and made it extremely unpleasant for all members of the party, as well as necessitating the purchase of forage for the animals when the ground was covered with snow.

MINES.

The first mines visited are situated in the new district, in the vicinity of the head-waters of the North Creston Creek. This district was (October 27) about to be organized under the name of Creston district. First discoveries were made in May, 1875, and a number of prospecting shafts had been opened. But little ore had been taken out up to the time of my visit, as there is no mill at the mines and the ore is not rich enough to warrant the cost of shipment to any distance. Some of the quartz which has been milled gave a yield of $12 to $15 per ton. Three to four thousand dollars have been expended in completing lines of communication to the mines. Timber is convenient and abundant on the slopes and in the gulches where the ore is found, and a sufficient supply of water is also available. The distance to the railroad is about 100 miles at La Veta by the way of Sangre de Cristo Pass. Grain and hay are raised in the valley, and can be furnished at the mines at 2½ cents per pound for oats and $15 per ton for hay.

EL DORADO MINING DISTRICT.

This was visited and reported upon by Mr. Niblack. This district lies between South Creston and Deadman's Creek, and is about 7 miles south of Creston district. It was organized in 1874, and a small town has been built which is called Sangre de Cristo Post Office. Two 5-stamp mills have been erected, but were not in operation when visited, October 29. The character of the ores is about the same as those of the first district, but the yield has not been sufficient to induce much expenditure in the development of the several prospecting shafts.

HARDSCRABBLE DISTRICT, ROSITA.

This district has been previously reported upon by Dr. Loew. Since his visit the Pocahontas, Humboldt, and Virginia mines have been worked continuously or nearly so, and the yield has been satisfactory, although it has hitherto been necessary to transport the greater part of the ore to Denver for milling. A new mill, in which the leaching process is used, was finished last December, and a 20-stamp mill was in process of erection. The estimated yield of the three mines mentioned was for 1875 $40,000, and for 1876 $200,000 The average yield of ore reduced was $110 per ton.

In conclusion, I wish to tender my thanks to the topographers, meteorologists, and recorder for their hearty co-operation and general attention to their duties throughout the season, thereby making it possible to complete the work assigned within the allotted time.

Very respectfully, your obedient servant,

ERIC BERGLAND,
First Lieutenant of Engineers.

Lieut. GEO. M. WHEELER,
Corps of Engineers, in charge.

APPENDIX B.

EXECUTIVE AND DESCRIPTIVE REPORT OF LIEUTENANT SAML. E. TILLMAN, CORPS OF ENGINEERS, ON THE OPERATIONS OF PARTY NO. 1, CALIFORNIA SECTION, FIELD SEASON OF 1876.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Washington, D. C., April 15, 1877.

SIR: I have the honor to submit the following report upon the country visited by, and the operations of, Party I, California Division, of the expedition for surveys west of the one hundredth meridian during the field season of 1876. The area for work assigned by yourself to Party I falls in atlas-sheet 47, subdivisions "B" and "D" of the progress map, and is between the meridians distant from Greenwich 119° 48′ and 120° 38′, and the parallels of 39° 18′ and 40° 16′. It is situated immediately north of the portion of the Central Pacific Railroad between the stations of Reno on the east and Cisco on the west. The country to be traversed lay principally in the uplifted region which constitutes the Sierra Nevada Mountains. These mountains are here of considerable breadth, and at first sight give the impression of a confused mass, but a little observation shows that they are composed of nearly parallel ridges, the longer ones having to the northward a direction of about 25° west of north. The summit-line of the range is tortuous, correctly located, however, by the direction of drainage. To the east of this line the waters flow to the lakes and sinks of the Nevada basin. To the west they go to the Sacramento River, thence to the Pacific. The eastern wall of the Sierras crosses the Central Pacific Railroad at about the one hundred and twentieth meridian, which is here the boundary-line between California and Nevada. A single spur of the range projects to the east of this meridian and lies in Nevada. About 25 miles west of the eastern wall arises the second marked ridge of the Sierras, extending nearly parallel to the eastern, and forming here the western limit of our work.

The summit-lines of these ridges have received the local designation of eastern and western summits. The Central Pacific Railroad crosses the true summit-line of the Sierras upon the second of these ridges at about the meridian of 120° 20′. The summit-line, bearing as stated, remains upon this ridge for about 18 miles. It then makes nearly a right angle and crosses to the eastern wall of the Sierras. From this point, latitude 39° 36′, it runs nearly due north to parallel 39° 55′. It then has a direction nearly northwest to parallel 40° 16′, which was the most northern point visited by me. The axis of the second ridge changes direction at the point at which the summit-line leaves it, latitude 39° 29′, bearing nearly due north to parallel 39° 47′. At this parallel is found a second transverse ridge, immediately north of which the longitudinal ridges rise in closer proximity, all having the same trend as the eastern wall. For convenience of description, I have divided the area of my work, situated in the Sierras, into three sections, suggested by the configuration above noted. The southern section is the portion between the Central Pacific Railroad and the transverse divide upon which the summit-line crosses from west to east, and limited on the east and west by the two axial ridges before mentioned. The middle section lies between the same two axial ridges, north of the first and south of the second transverse divides. The northern section is north of the second transverse divide, extending west to meridian 120° 38′ and bounded upon the north and east by the summit-ridge of the Sierras, which here runs nearly northwest. In addition to the mountain area above located, Party I covered a narrow slip along the eastern base of the mountains extending from Reno to the parallel 40° 16′. Of the sections, already indicated, the southern is heavily timbered with pine and broken by long, broad, sloping spurs, usually from the west. The valleys or flats are of small extent and bear the names of the claimants. The waters of this section flow to the Nevada basin, passing the east wall of the mountains by the cañon of the Truckee River. Truckee and Boca are stations of the Central Pacific Railroad, situated in this section. There are several saw-mills from which lumber is carried to the railroad by flumes. These flumes are V-shaped troughs, supported upon trestle-work, extending from a lower to a higher level. At the higher level a stream of water is turned into the trough. This artificial channel then becomes the means for sending down enormous quantities of wood and lumber. Prosser Creek, in this section, has been dammed at the mouth and a pond formed, from which large quantities of ice are procured. Small herds of cattle and sheep are grazed in the flats during summer, but descend to lower altitudes in winter.

There are but few permanent settlers in this section away from the railroad and the mills. At the western side of this section, close on to the base of the second ridge, are nestled three beautiful bodies of water—Donner, Webber, and Independence Lakes. Donner Lake, the lowest of these, is about 5,800 feet above the sea; Independence Lake affords excellent fish. The middle section of my work is bounded by the two axial and two transverse ridges previously mentioned. It comprises an elevated valley of considerable extent, called Sierra Valley. This valley would approach in figure

a rectangular quadrilateral were it not that long-necked spurs project from the south and east, converting it into a right-angle triangle. This valley embraces about 140 square miles. At the southern vertex of the triangle is a little town, Sierraville; at the eastern, is Summit Post office. Between these two is Loyalton. At the northwest corner of the valley is Beckworth's Post office. The western and southern walls are heavily timbered with pine; the northern and eastern are partially bare. The valley is entirely taken up by settlers. At Sierraville, the head of the valley, the altitude is 4,880 feet. Near the head of the valley, vegetables, wheat, and even fruit can be grown with some success. Farther out from the timber and stream free radiation and accumulation of cold air at night prevent this. About three-fifths of the valley supplies good grass, from which large quantities of hay are secured for winter's needs. The meadows are situated along and near to the streams which flow along the north and west sides of the valley. The waters unite near Beckworth's Post office, to form the head of the Middle Fork of Feather River, passing to the west of the cañon of that stream. In the northern section the mountain ridges are nearer together, the valleys long and narrow, with a descending northwest trend. The valleys grow narrower with the descent, soon cañon, and empty their waters into Indian Creek, which here flows nearly west along parallel 40° 5′. Beyond this creek the spurs have a northeast direction to the eastern wall. No attempts are made to grow vegetables, fruits, or cereals in these valleys. A single day's ride, however, down the streams will take one to a region where fruits and vegetables can be grown with partial success. The difference of altitude between the points makes a marked difference, but other causes, easily understood, also facilitate such efforts. The heads of the valleys of this section are above the sea, on an average, about 5,500 feet. The wagon-road leading to Taylorville, which follows along the waters of one of these valleys, (Clover Valley,) descends 1,500 feet in the last three miles before reaching Indian Creek. There are claimants to all the grass-growing lands. Considerable herds of cattle are grazed here during the summer, but, as a rule, removed in winter. Only a few of the ranchmen remain here during the winter. This section, with exception of the small valleys, is well-timbered with pine. Common to the entire mountain area embraced above is the appearance of the surface-rock. It is all of volcanic origin. The entire area has once been flooded with melted rock. The transverse divide between the middle and northern section of my work is a mountain mass of solidified waves of lava, embracing beautiful specimens of the columnar structure. These rocks are generally of trachytic classes. In this region, and all others that I have ever visited where the surface-rock is of like nature, loose fragments are widely spread. Travel is always slow and tedious in such places. In order to account for this universal distribution of fragments, it is only necessary to suppose that surfaces resulting from volcanic action were usually uneven, with sudden ascents and descents from one level to another. The continued action of gravity and the weather would then accomplish what we now see. In places, the surface-rock is cut through by cañons, and the primary formations displayed. I can give no definite information as to the rain-fall in this region. Numerous statements were received upon this point, but the discordancy was correspondingly great. The amount of rain is not, probably, over 12.1 inches. The daily range of temperature was usually very great. On the 19th of September, at a camp on the northern section, at night, the minimum thermometer recorded 19°; the same day the maximum was 77° in the shade, and 112° in the sun; the maximum difference between the wet and dry bulbs for the same day was 20°. During the season, the wet and dry bulbs differed by from 6° to 20°. In the northern section there is usually 6 to 10 feet of snow during the winter, (this not included in the estimated rain-fall.) The inhabitants who attempt to remain at their ranches during winter use snow-shoes from 8 to 12 feet long, and are confined to very limited journeys from December to April. In Sierra Valley and the flats of the southern section the snow-fall is considerably less. The streams of the entire region abound in fish—in the northern sections the brooks are almost alive with mountain-trout. In this section, too, frequent indications of deer were seen, but not so in the middle and southern sections. In addition to the mountain areas described above, party 1 covered a small stretch of country east of the Sierras, extending from Reno along the eastern base of the mountains to the most northern parallel visited. To the east of the Sierras the axes of the ridges lie more nearly north and south. The valleys between them are deserts of sand and sage-brush. A narrow slip of land close in to the eastern wall of the Sierras furnishes good grazing, and is occupied by settlers. The growth of timber ceases entirely at the eastern base of the Sierras.

The routes of communication traversing the region of our work may be briefly stated as follows: From Reno, which is the most eastern point, a road leads nearly directly west across the eastern wall into the southern section. It then divides; one branch continues nearly due west across the second ridge; the other branch turns to the south, and runs near to and parallel with the railroad, crossing the summit-line of the Sierras at the same point. Another road leads from Reno along the eastern base of the mountains to Susanville, beyond the limits of my work. A branch from the road

crosses through Beckworth's Pass to Summit Post Office, at the eastern vertex of Sierra Valley, and continues along the northern side of the valley, passing out along the middle fork of Feather River. From Beckworth's Pass there is a road along the eastern side of the valley, through Loyalton, to Sierraville, which then passes westward across the second ridge. Still another road passes from Reno direct to Loyalton. Three roads lead from the southern into the middle section, and one from the middle to the northern. From the northern section there are three roads crossing east to the Reno and Susanville road. Beckworth's Pass is 5,200 feet above the sea level, about 1,800 feet below the summit-pass of the Central Pacific Railroad. I had intended to include herein a profile of the road to Beckworth's Pass, with grade per mile, but I find the hypsometric observations for that day too unreliable for my purpose.

I shall now proceed to state the movements of the party. The California division of the survey was organized at Carson City, Nev. I was placed in charge of this division of the survey, but your own arrival at an early day at the rendezvous-camp renders reference to any other party than my own unnecessary. I was placed in immediate command of party 1, which consisted of the following members: Myself, as executive officer and field-astronomer; Mr. Gilbert Thompson, triangulator and chief topographer; Mr. F. M. Lee, meteorologist; Mr. William Looram, odometer-recorder; Mr. E. D. Miner, assistant topographer; 2 packers, 1 cook, 1 laborer. A six-mule wagon and driver were placed at my disposal for a few days; 9 riding and 11 pack mules were allowed the party. The instruments supplied were the same as usual during the past two years, except that an attempt had been made to employ a kind of combined transit and theodolite, to be used as an astronomical instrument as well as for triangulation. The rough usage to which such an instrument is subjected in triangulating, and the unfavorable circumstances under which astronomical observations are often unavoidably attempted, combine to condemn the instrument for such double use. Two topographical transits (Young's) were allowed; one, I believe, has before been the allowance.

The party left the rendezvous-camp at Carson City on September 6 for the field of operations, proceeding direct to Reno, meandering and profiling the route. The rations of this party had been accumulated at Reno. Owing to the late beginning of work and the probability of early snow in my area, I decided to work in the northern section first. The party reached Reno on the 7th. I concluded to leave Reno with forty days' rations, and at the end of that time I expected to be able to return without material loss of time. On the 8th I left Reno with the wagon, carrying 32 days' rations and 1,000 pounds of barley. Mr. Thompson was left in charge of the pack-train with 8 days' rations, to follow my trail as rapidly as the regular work would allow. I followed the road along the east base of the mountains, crossing through Beckworth's Pass into Sierra Valley, continued west to Beckworth's Post Office. At this point I passed from the middle to the northern section by the road connecting them. At the head of Clover Valley, one of the small valleys of this section, I was enabled to leave my rations and forage in the custody of a ranchman. I then retraced my course. On the 11th September I met the train, having just entered Sierra Valley. The wagon and driver were then dispatched to Carson City. Mr. Thompson had already occupied one triangulation-station, Peavine Mountain, which is northwest of Reno and east of the Sierras. Two others were made on the main ridge of the Sierras, respectively, on the 12th and 13th. In addition to this, several topographical stations were made before reaching the ration-station in Clover Valley, which was on the 15th September. From this camp we worked to great advantage for 15 days. Parties were sent out in all directions, returning by different routes when practicable. The same animals were not used continuously, which is great economy. On the 1st October the party left the camp. Our packs were now much lighter, rations having been considerably reduced. We proceeded farther north than we had yet been, to the extreme triangulation-point in that direction, which is situated in latitude 40° 16′. At this point the party passed to the east of the Sierras, striking the Susanville road near the northern-shore line of Honey Lake. This lake receives the drainage of the eastern slopes of the Sierras for 50 miles, both north and south. It is about 12 miles wide and 15 long, not over 5 feet deep on an average. Myriads of ducks and geese were seen there. Turning to the south, the party kept the road to the point from which we previously left it, crossed a second time through Beckworth's Pass, followed down the east side of the valley, then up the west to Beckworth's Post Office, then diagonally across the valley to Loyalton, and from there to Reno, reaching the latter October 16. From September 6 to October 16, inclusive, every day had been available for work. Bad weather kept the party in Reno during the 17th. The wagon returned to me at this time, as had been previously arranged. An enlisted man was teamster, and a corporal was in charge of the wagon. One of my packers left me here, but I did not employ another, as the wagon more than replaced him. On October 18 the party left Reno by the only unmeandered road which led to our field of work. It was called the Hennes Pass Road. By it we crossed into the southern section of our work, and continued along the northern side of it. On the 20th another camp was established, with intention of remaining thereat for some time.

From this camp Mr. Thompson was sent to occupy the most western of the triangulation-points. While Mr. Thompson was gone upon this trip I attached an odometer to the wagon, and meandered one of the roads leading into Sierra Valley and returned by a second. Mr. Thompson returned to camp on the 25th. It rained steadily during the 26th and 27th. On the night of the 27th about five inches of snow fell at our camp, and much more in the mountains. The weather permitted no outdoor work on the 28th and 29th. On the 30th of October our camp was moved to within 4 miles of Truckee, as more snow was anticipated. On November 1 the weather promised better, and I started with Mr. Thompson to occupy the last triangulation-station deemed necessary for covering my area. This point was Castle Peak, situated a few miles north of Summit Station of the Central Pacific Railroad. The ascent of this peak was extremely difficult. The snow in the mountains averaged about 18 inches; in many places it was from 2 to 4 feet deep. After the most intense and continued exertion, attended with no little danger, we reached the top late in the afternoon of the 2d November. On the 3d I returned to camp near Truckee. On November 4 and 5 the weather was bad. I learned at this time that Mount Rose, a high point south of the railroad, had not been occupied, the intention of the party operating in that area to do so having been interfered with by bad weather. This point being very essential, I started on November 6 to make the ascent. On account of the snow it was very difficult, but we reached the top on the 7th; returned to camp on the 8th. On the 10th November I dispatched the party to Carson City, going myself, by rail, to Virginia City, to ascertain whether connection with the base, measured near that place, could be made from the work done. Returning to Carson City on the 12th, I found the pack-train arrived. I deemed it advisable to reascend Mount Rose, and accordingly set out for that point on the 13th. The ascent was made on the 14th. The party continued topographical work in the vicinity until the 22d November, when they returned to Carson City and disbanded. During the season the system of work previously adopted in the survey was followed. The system and its advantages have been ably stated by Lieutenant Marshall in his report of 1876. During the season, 13 triangulation-stations were occupied and 46 topographical three-point stations; numerous meander-stations, which can be checked by same method; several points were located by intersections; 1,040 meander-stations were made, each of which was also an aneroid-station; 94 separate cistern-barometer stations were made; 625 miles of travel were meandered; 515 miles traveled without meander. Hypsometric and meteorological observations were made in exact accordance with printed instructions from this office, and my experience enables me to suggest no alterations in said instructions. Of the area visited by this party, approximately $\frac{2}{10}$ is good grazing, $\frac{1}{10}$ barren, and $\frac{7}{10}$ good timber-land. The only mines are located near Peavine Mountain, and were not visited by me. It will be observed that I have given only a general description of the country; but, as the region is of no unusual interest, I deem it sufficient. Any description which would render intelligible the detailed movements of a party in an unknown region would require more time and labor than the information would warrant, since the results will finally appear upon the map. I have therefore only indicated the movements of the main portion of the party.

In conclusion, I cannot recommend too highly the following of my assistants: Mr. G. Thompson, chief topographer; Mr. F. M. Lee, meteorologist, and Mr. William Looram, odometer-recorder. Mr. Thompson has had much experience, and it can be truthfully said that he is untiring in his efforts, and his zeal appears ever to increase. Mr. Lee's familiarity with his duties and interest therein left me little responsibility in that work. Mr. Looram, in addition to the monotonous and wearing duty of odometer-recorder, was ever ready and capable to assist in meteorological observations when necessary. The movements of a party in a field are greatly facilitated by a good packer, and I yield a grateful acknowledgment to my chief packer, Mr. C. H. Howell, as the best I have ever known. His intelligence saved me much anxiety, and his excellent care of the animals was a great practical aid to the expedition.

Very respectfully, your obedient servant,

S. E. TILLMAN,
First Lieut. Corps of Engineers.

Lieut. G. M. WHEELER,
Corps of Engineers, in charge.

APPENDIX C.

EXECUTIVE AND DESCRIPTIVE REPORT OF LIEUTENANT THOMAS W. SYMONS, CORPS OF ENGINEERS, ON THE OPERATIONS OF PARTY NO. 3, CALIFORNIA SECTION, FIELD SEASON OF 1876.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Washington, D. C., April 15, 1877.

SIR: I have the honor to submt herewith the executive report of Party No. 3, California section of the survey, for the field season of 1876, together with a brief report on the mining interests of the Comstock lode.

EXECUTIVE REPORT.

The duties assigned to the party under my charge were to lay out and measure a base-line, and develop it for the use of the outlying parties in the vicinity, and after this was done to commence work on a detailed map of the country embraced by the mining interests of Virginia City, Nev., and the neighboring district.

I arrived in Carson City, Nev., August 23, 1876, and after making the necessary preparations and procuring supplies, laborers, instruments, &c., started by wagon, August 28, for the valley of the Carson River, near Sutro, whither Dr. Kampf and Mr. Karl had preceded me to select a place for the base-line. On arriving in the valley camp was made on the banks of the Carson River, and as it was to be permanent for some time, we made it as comfortable as possible. The base-line was laid out on a very straight portion of the old emigrant road through the valley, and the work of development immediately commenced. On the 4th of September the party was joined by Mr. Louis Seckels, and on the 10th of the same month by James Bullock and an ambulance and team.

The party now consisted of Second Lieut. Thomas W. Symons, Corps of Engineers, executive officer and field astronomer; Dr. F. Kampf, astronomer; Mr. Anton Karl, topographer; Mr. Louis Seckels, meteorological observer; Mr. Simon B. Cameron, aneroid and odometer recorder; James Bullock, teamster, and John Rafferty, cook.

The base development being finished, the party separated, Dr. Kampf remaining at Sutro to measure the base. In this he was assisted by Mr. Seckels and three hired laborers. The apparatus used in the measurement is the invention of Dr. Kampf, and consisted of a wooden rod with finely-graduated scales at both ends, and at the center an apparatus for determining its deviation from the horizontal, and three iron stands with nickel tops, on each of which was engraven a fine line, this line being the initial point of each successive measurement with the rod. Comparisons of the rod were made every morning and evening with the standard rods of the United States Coast Survey, and the reading of the rod corrected for temperature. A full account of the apparatus, the mode of its use, and the results obtained, will be found in the report of Dr. Kampf.

On September 16 I went to Virginia City, with Mr. Karl as topographer and Mr. Cameron as meteorological observer, and the necessary laborers, and commenced work on a detailed contour map of the city and vicinity. This work was done with the plane-table, and the method pursued was the following: A number of points were selected whose projections would occupy different points on the plane-table sheet, and these were occupied with the transit, and their positions carefully computed in reference to the base and the monument points used in its development. These points then being laid down on the plane-table formed the foundation for the detailed work, which was done by Mr. Karl. Other points were occupied with the transit during the time that the sheet was being filled in, and these, together with cross-sight stations, being computed, formed checks which were continually applied to the plane-table work. At each of the points occupied by the plane-table, and at many others, as hills, ravines, cañons, road-crossings, saddles, mesas, &c., barometric observations were taken for altitude, which, being referred to synchronous observations taken in camp under the same natural existing circumstances of atmospheric pressure, temperature, and humidity, gave very accurate relative altitudes, and the altitude of the camp, being determined by a long series of observations, enabled us to determine the elevations of all the points above mentioned above the sea-level very accurately. Besides the barometric readings, elevations to well-determined points were read from the vertical limb of the transit and from the alidade of the plane-table, and level-lines run with the Y-level. From these data the contours are being put in in the office of the survey at Washington.

The constant aim has been to secure the greatest accuracy and to leave no natural feature of the surface or work of any importance unrepresented, and Mr. Karl, for his intelligent devotion to the work and his care and accuracy, deserves the greatest credit.

Three plane-table sheets were filled in, two to a scale of 1,000 feet to an inch, and one to a scale of 500 feet to an inch, the larger scale being used in delineating that portion of the country including Virginia City. The country gone over includes Virginia City and the northern portion of the Comstock lode, the country to the north and west

traversed by the Geiger grade, and that to the east embracing the basin between Mounts Emma and Davidson.

Dr. Kampf, after finishing the base measurement, went to Virginia City and determined the azimuth of the triangulation lines from the astronomical monument, and on October 23 started for Washington. Mr. Seckels joined the party in Virginia City and devoted himself with assiduity and intelligence to the necessary meteorological work. November 20, I received orders to proceed to Carson City to disband for the season, where I arrived November 23. After spending two weeks in Carson, seeing to the storage and shipment of public property, taking inventories, and acting as member of a board of survey, I started for Washington on the 5th of December. In obedience to verbal orders from Lieut. S. E. Tillman, in charge of disbanding the California section of the survey, I stopped at Ogden, Utah, and made an inspection of the Government observatory there, and an inventory of all the public property pertaining to the expedition, the reports of which have been submitted to Lieutenant Wheeler.

On my arrival in Washington I was placed in charge of the meteorological records and computations, and also to supervise the compilation and reduction of the plane-table work. I have carefully recomputed all the positions used in the field and several others, which will give the foundation for the work when it is next taken up in the field.

DESCRIPTIVE REPORT.

The area embraced in the contemplated and partly constructed detailed contour map is 12¼ miles long from north to south and 9½ miles broad from east to west, and contains within its limits the richest mines of silver and gold of which the world of to-day has any knowledge. About 12 miles to the east of the summits of the Sierra Nevada Mountains, a little northeast of Lake Tahoe, in the midst of piled-up masses of volcanic rocks of all kinds, where during the summer rain never falls, and where nothing grows but sage-brush; where the mind of man can imagine nothing to add to the scene to make it one of more cheerless grandeur and desolation, is situated the famed Comstock lode. Above the lode and its branches have been built the towns of Virginia, Gold Hill, Silver City, and American Flat, in which are situated the upper works of the mines and their many adjuncts. Immediately connected with it by virtue of their ore mills are the towns of Dayton and Empire, and from being the outlet of the Sutro Tunnel is the town of Sutro. I shall not attempt to describe these places in detail, but shall simply note some observations of my own and some of the changes which have taken place since other reports have been written, and which are continually taking place.

At the time when Mr. Clarence King wrote his report upon the geology of the Comstock, it was considered that the portion of the lode between the Gould and Curry, and the north line of the Central, corresponding to the south side of the Ophir, was unproductive, and from the apparent closing in of the walls it was supposed that it never would develop into anything of much value. Since then, however, under the names of the Consolidated Virginia and California, this region has developed the Big Bonanza mines, one, the Consolidated Virginia, yielding in the year 1875 alone the enormous amount of $16,731,653.43 from 169,095 tons of ore This is a gigantic illustration of the fact that the vein is very unreliable, and that it is not safe to place very much reliance on analogical reasoning with regard to it.

The old controversy as to there being a single vein of which the outlying ones are branches or spurs is still unsettled, but agencies are at work now which will, in all probability, settle the question at law in a few years at the farthest; these agencies being particularly the Sutro Tunnel, the Mint Mine, and the Great Combination shaft.

In the report of Mr. King the Comstock lode is supposed to extend approximately north and south from the vicinity of the Utah Mine, to the mines in and about American Flat, and no mention is made of a branch lode extending down Gold Cañon. It is generally conceived now that the great lode branches near the head of Gold Cañon, and one branch extends southwestward toward and beyond the Rock Island Mine in American Flat, and the other extends southeastward down the cañon. Some of the most promising and productive mines of all the region are situated in this latter branch, notably the Overman and the Justice, which have both big bonanzas, the latter especially working some very rich ore, of which a specimen now in this office assays approximately $12,000 per ton.

Prospecting and exploitation are still going on in a great many places, both on the lode and off it, and the horizontal limits of pay-ground is not yet reached, or at least is far from being determined. But many things would go to show that the vertical limit of successful working has been reached in some of the mines as long as the present system prevails. In the Savage Mine, nearly or quite a year ago, as a drift was being pushed to the east at a depth of 2,300 feet, a heavy volume of hot water was encountered which drove the workmen back and up the shaft, and, in spite of the pumps, continued to come in until it reached the 1,900-foot level. Since its first influx larger and more powerful pumps have been put in and kept at work continuously except for accidental stoppages, and at last accounts the water was still at about the same level. Although at times the pumps would gain on the water, the water would in a short

time assert its supremacy and come back to its accustomed level. It also flooded a neighboring mine, the Hale and Norcross, which has also been at work pumping ever since, and thus these two mines are unable to proceed with any profitable work or work of exploration, while there is still an enormous drain on the pockets of the stockholders for the expenses of pumping and the other expenses incidental to the flooding of the mine.

Heretofore all the large bodies of water struck in the mines have been at a higher level and have been rapidly pumped out and have not returned in large quantity, and this has strengthened the idea that the water occurs in pockets or reservoirs, and that when these are drained off it will cause no further trouble. This water in the Savage Mine, however, seems to tell a different story. It is very hot, about 154° to 160° F., and in all probability comes from the same heated source as the water which wells up from the Hot Springs in the valley below at Steamboat. As these springs are constant, it is altogether probable that the water which enters the Savage is also constant or nearly so, and that it connects with the heated water which permeates in a more or less connected manner all the fissures and subterranean channels below. In one mine which I visited, the Imperial and Empire, I descended to a depth of 2,135 feet and found the temperature to range from 110° to 115° F. There was at least one stream of hot water coming into the mine, which, on testing, I found to be 154° F. In other parts of the world, where mines have been sunk very deep, it has been found that on an average the temperature increases 1° F. for every 50 to 60 feet of descent from the depth at which the temperature first becomes constant, which is about 100 feet below the surface; this constant temperature being, as near as it can be determined, 47° F. Assuming 55 feet to be the equivalent in descent of 1° F., we have in the Imperial and Empire

$$\frac{2135^{ft.} - 100^{ft.}}{55^{ft.}} + 47^{\circ}\text{ F.} = 84^{\circ}\text{ F.}$$

or, according to this rule, the temperature at the depth of 2,135 feet should be 84°. Instead of this, and in spite of the fact that great quantities of cold air are pumped in, it reaches in places as high as 110° and 115° F. Undoubtedly the cause of this great heat is the inpouring and circulating hot water, which comes in quite large quantities, the amount pumped from the mine being about 6 miner's inches. There are two hypotheses to account for this heated water: one being that it is heated by the chemical action going on in some mineral or other vein through which it passes. It is asserted and believed by many that as the hot Savage water came in from the east, when the exploration shall be pushed on eastward a vein of the same general character as the Comstock will be struck, the chemical action in which is the cause of the heating of the water. The supposition that such a vein exists is no doubt very materially strengthened by the existence of this hot-water stream, but it can scarcely be considered as proof. The other hypothesis, and to my mind the more plausible one, is that the water comes up from the heated interior of the earth. The water which falls to the earth in the form of rain and snow, and which penetrates below the surface, exists in many conditions throughout the crust of the earth, sometimes occurring in pockets, which are filled slowly by infiltration or narrow inlets, but which on being struck empty themselves quickly and are no further cause of trouble; sometimes in large fissures through which the water is continually circulating, and which, on being struck, give an almost unintermitted stream for months and years. Such a fissure exists in the Sutro Tunnel, and it is observed that when such a fissure-vein of water is encountered, it diminishes its yield for some time until it reaches a point when it becomes constant. This may be accounted for on the supposition of connecting pockets, which are gradually drained off. This water finally finds its way down to the heated interior of the earth and is there converted into steam, which in its efforts to rise forces back the water, and thus an equilibrium is attained, the water and fire making the steam and the steam holding the water in suspension. The steam in its efforts to escape percolates up through the water and heats it, and this in turn heats the surrounding rocks, and possibly is the cause, not the effect, of the chemical action which is continually going on in the mineral veins. When this hot water and steam can find a direct outlet to the surface, they appear in the form of hot springs and geysers; when they cannot, they give up their heat to the rocks and the down-pouring cold surface-water. There is no doubt that the mine in which this water occurs is debarred from further downward progress if the water remains constant, unless some new method of drainage is found and adopted; for if it were possible to keep it down by a great addition to the pumping force, it would cost so much that the mine would be totally unprofitable. What this new method of drainage will be remains to be seen. Possibly it may be the Sutro Tunnel.

The tunnel has now reached a length of between 15,000 and 16,000 feet, and is being pushed forward with marvelous celerity, making on an average 300 feet per month in length. It will, when it reaches its entire length, (which it will probably do in the spring of 1879,) strike the Comstock, near the Savage, at a depth below the surface of about 1,900 feet, and then the water which may impede the working of the mine will have to be pumped a vertical distance of 1,900 feet less than now. It is altogether

possible that, with the present engine-force, which now makes no permanent headway against the water, the water may be raised to the tunnel-level and run off through it to the Carson River. At any rate, it will very much facilitate the keeping down of the water and will afford a new foundation 1,900 feet below the surface from which to work As with the Savage, so with the other mines which are much troubled with water; when the tunnel or one of its branches reaches them, it will take off the water which comes in above the tunnel-level, and will lessen very much the work of pumping out that which comes in below. It will also greatly assist in ventilation; but in regard to its merits in this respect I am unable to speak.

As regards the feasibility of using the tunnel for the extraction of ore, it admits of discussion, and can only be decided when the time comes. The ore now, after being hoisted, is taken from the shaft, and in some instances, as the Bonanza Mines, is milled very near the mine; in others, it is hauled in wagons to various distances from one to three or four miles, and in others still it is taken by the railroad to the mills along the Carson a distance of from 12 to 15 miles. If the ore when taken from the tunnel-mouth should be conveyed to the present existing mills and reduced, it would unquestionably be more expensive than now; but if new mills should be built near the tunnel-mouth and run by the tunnel-water, or built on the banks of the Carson River, just below, in my opinion the ore could be reduced at a much lower cost than at present, and the ore which now is too poor to work or which barely pays for milling might be made to pay a good profit. The capacity of the tunnel of course would be limited; but with a double track, and care and economy in its service, it would probably meet all the demands upon it.

Situated, as the Comstock is, in the midst of a dry, totally-unproductive desert, over 6,000 feet above sea-level, on the side of a mountain, needing and using vast quantities of supplies of various kinds, it may not be wholly uninteresting or uninstructive to inquire as to the nature and source of these supplies, and the methods of getting them to their destination.

One of the first wants felt by the pioneers of the Comstock was water, and it was procured in very limited quantities from a few springs in the vicinity. As the lode became more and more developed, the mines and mills and the gathering people demanded more and more water, and the want of it was severely felt. The mills sunk shafts and drifted for water, and a good deal was obtained from the tunnels driven into the mountains in search of the precious metals. A company was finally formed for the purpose of gathering and furnishing water, and their supply was chiefly obtained from the prospecting tunnels and conducted in pipes about Virginia City and Gold Hill. But the supply was still far from sufficient and the quality very bad, and the company finally achieved a great triumph in hydraulic engineering by bringing to the cities of the Comstock an abundant supply of fresh and clear mountain water from the summit streams and lakes of the Sierras. The water is now taken from Dall's Creek, in the Sierras, but the company are extending their flume to tap Marlette's Lake, from whence nearly all the water will be taken. This lake is 1,600 feet above Virginia City and within a mile of Lake Tahoe. The water will be conducted in a wooden flume in a northerly direction for about 5 miles, then, passing under the mountains through a tunnel nearly a mile long, it pursues its winding way in a flume for 6 miles, when it reaches the point where it becomes necessary to make the descent into the Washoe Valley below. There it is received into a double line of iron pipes, which conduct it down to and across the valley and up the opposite mountain. The pipes are, one, 12 inches in diameter and riveted with $\frac{3}{4}$-inch bolts. It is $\frac{5}{16}$-inch thick at the lowest point, where the pressure is greatest, and tapers from this point to the entrance and exit, where it is only $\frac{1}{16}$-inch thick. The other is a 10-inch pipe, lap-welded, and of uniform thickness. From the point of entering the pipe the water makes a descent of 1,963 feet in a horizontal distance of $1\frac{1}{4}$ miles into Washoe Valley. There it commences to ascend until it reaches a point 1,498 feet above the lowest point, at a distance of 6 miles from it. Here it is again received into a flume, and is conducted circling about the mountain-slopes a distance of about 8 miles, until it reaches its destination. The flume has a fall of 1 foot to each 44 feet horizontal distance. The amount supplied now is about 3,000,000 gallons daily, but its capacity, when fully completed, will be more than 10,000,000 gallons daily.

The mines and mills devour a vast amount of fuel and lumber. In that volcano-formed land there is no coal, and the fires must be fed with wood. All the wood which grew about the Comstock was used up long ago, and now, as before in the case of water, it is the Sierras which furnish the supply. This is taken from the great basin about Lake Tahoe, and from the eastern summits above Huffaker's, and is brought down the mountains in flumes, which are gradually extended backward as the supply is exhausted. There are saw-mills on the mountains at which is cut the square timber and the lumber used in the mines and in the cities. The flumes are so constructed that timber 40 feet long can be sent down. The wood and lumber when it reaches the valley is mostly taken by the Virginia and Truckee Railroad, and conveyed to the places where it is to be used. Immense quantities of wood are also floated down the Carson River to Empire, Dayton, and Sutro, and it is estimated that at least 250,000 cords of wood

are annually used by the Comstock and its co-operating industries. This immense amount of wood may be better conceived of when we remember that if it should be piled up 8 feet high it would cover an area of 100 acres. The square timber is used in great quantities in the mines, in the construction of galleries, shafts, inclines, &c., and in stoping.

The fertile plains and hill-sides of California furnish the subsistence for the men and women of the Comstock, and for their horses, mules, and cattle; and the manufactories of the Pacific coast provide most of the machinery for the mines and mills, although some com- s from the far-off Eastern States.

As everywhere on the Pacific side of the Rocky Mountains, there are great numbers of Chinamen about the Comstock. They are not allowed to be employed in the mines or mills, or in any of the work connected therewith, being prevented by the miners' union. They find employment as laundry-men, as household servants, as peddlers of vegetables, and as gatherers of garbage and wood. The wood business is a fine illustration of how a thrifty race can make money out of the most unpromising materials. A Chinaman gets a donkey and a pack-saddle, and spends all his time during the summer going out on the hills and grubbing up the stumps and roots of the fir and pine trees which were long ago cut down. When he gets as much as his donkey can carry, he loads him up and drives him back to the place where he has his wood-pile. It is a picturesque, but not a pleasant, sight to see a dirty Chinaman driving an overloaded donkey, possibly lame and trembling with pain and exhaustion, along some lonely road. In the winter, when the snow is on the ground and the roads are impassable in the country, John loads up his donkey with the smallest amount of wood which will make a respectable showing, and travels about the streets in search of some one who wants his load of wood more than they want a dollar. The Chinamen have never succeeded in making friends of the white men, and I cannot but think that the cause lies in their utter inoffensiveness. They will submit tamely to all kinds of neglect, contempt, and abuse, and this only begets the feeling in the mind of the strong, hearty, world-buffeting American or European that they are unworthy of any consideration. In the land of fighting-men, they are the non-fighters, the cringing class; and as long as they are so, they will be treated in the same manner as at present.

All the supplies, machinery, wood, lumber, &c., are brought to the market by the Virginia and Truckee Railroad, which is itself a wonder in that land of wonders. It was first completed from Virginia to Carson in the winter of 1869 and 1870, and has since been extended to connect with the Central Pacific at Reno. It is an immense auxiliary to the mining interests of Nevada, as we see when we consider the vast amount of freight of all kinds carried and the great use it is in transporting ore to the mills.

There are at the present time about fifty mines being worked or prospected on the Comstock and its branches, but of this number there are only five or six which pay expenses; all the rest are working on assessments. There are about 400 incorporations on the Comstock, employing a nominal capital of $3,000,000,000. This would be the actual value of the mines incorporated with the stock at par. Their values, at the ruling prices of June 1, 1876, according to the San Francisco Stock and Exchange Board, was $163,580,000.

The following table, taken from the report of the State assessor for the quarter ending September 30, 1876, will give an idea of the condition of the principal mines:

Abstract statement from the quarterly assessment-roll of the proceeds of the mines of Storey County, Nevada, for the quarter ending September 30, 1876.

Name.	Tons of ore extracted.	Value per ton.	Gross yield or value.	Actual cost of extraction.	Actual cost of reduction or sale.	Total cost.	Net yield or value on which taxes are levied.	Total amount of tax.
Belcher*	30,936	$18	$566,976.10	$216,552.00	$351,866.00	$568,418.00	$113,395.23	$2,778.18
California	53,061	97	5,156,026.84	354,881.48	742,643.70	1,445,468.43	3,710,558.41	72,355.89
Consolidated Virginia.†	15,660	97	1,533,308.64	315,850.05	191,660.30	1,145,036.64	613,323.45	11,959.81
Chollar-Potosi*	6,720	19	129,998.47	142,167.83	74,860.00	217,027.83	25,999.69	506.99
Crown Point*	4,783	13	65,676.35	.....	.....	170,000.53	13,135.27	321.81
Imperial	1,515	62	94,857.00	15,153.50	18,180.00	33,333.50	61,523.50	1,507.33
Justice†	6,911	31	214,971.30	62,203.50	76,025.50	141,684.50	85,988.54	2,106.62
Ophir†	27,358	25	969,096.72	273,585.00	328,302.00	601,887.00	387,638.69	7,558.95
Overman*	439	25	11,393.46	17,560.00	5,278.44	22,838.44	2,278.69	55.83
Total	.....	.....	7,742,305.00	.....	.....	4,345,794.87	5,013,841.52	99,335.10

*80 per cent. deducted by law and exempt from taxation.
†60 per cent. deducted by law and exempt from taxation.

It will be seen from an examination of the table that the only mines which have a paying record are the California, Consolidated Virginia, Imperial, Justice, and Ophir

The climate about Virginia City is wonderfully fine for the health and spirits of human beings. All through the summer it very seldom rains, and the meteorological records show an almost unbroken succession of cloudless, warm days and cool, delightful nights. The dryness of the atmosphere makes the heat very easy to bear, as long as the system has enough liquid to evaporate freely. The thermometer had a range very often of from 35° to 50° in the shade in a single day. One day I tested the sand on the plain below Sutro, and found it to be heated by the sun's rays to 135° F. That same night the thermometer went down to 44° F.

I wish to express my thanks to every member of my party for their unceasing and cheerful co-operation, and to the citizens of Virginia and the neighboring towns for their uniform courtesy and kindness, and their readiness to aid us by every means in their power.

Very respectfully,

THOMAS W. SYMONS,
Second Lieutenant of Engineers.

Lieut. GEO. M. WHEELER,
Corps of Engineers, in charge.

APPENDIX D.

EXECUTIVE AND DESCRIPTIVE REPORT OF LIEUTENANT R. BIRNIE, JR., THIRTEENTH INFANTRY, ON THE OPERATIONS OF PARTY NO. 4, CALIFORNIA SECTION, FIELD SEASON OF 1876.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Washington, D. C., April 15, 1877.

SIR: I have the honor to submit the following report of the operations of Party No. 4, California Section, of the survey for the field season of 1876.

The party was organized at Carson on the 1st of September; Lieut. R. Birnie, executive officer; J. C. Spiller, topographer; W. A. Cowles, meteorological recorder; S. F. Wood, odometer recorder; Benjamin P. French, packer; Joseph Easten, assistant packer; George Willig, cook; Private Peter D. Niver, Company D, Twelfth Infantry.

We were provided with one 10-inch and one 20-inch triangulation instrument, (Würdemann's,) two small theodolites, (Young & Sons,) pocket-compasses, two cistern and three aneroid barometers, (Green,) and wet and dry bulb and maximum and minimum thermometers; the meterological instruments having all been compared with standards, and a final comparison of the barometers made just before leaving Carson. Rations for twenty-five days were taken here, which, with instruments, bedding, &c., made a little more than 220 pounds per mule for the ten pack-mules. The number of riding-mules was eight; we had also one extra mule and one bell-mare.

I was instructed to complete with the party the surveys of Atlas-sheets 48 C and D, a previous expedition under this survey having passed through the eastern portion of 48 D, and Clarence King's survey of the fortieth parallel having embraced about two-fifths of the area of the sheets, along the north line, thus leaving us a belt of country running east and west about 116 miles, and north and south 36 miles, Austin, Nev., being in the northeast corner of the area. It was found necessary, however, to extend our routes considerably beyond these limits, for the purpose of carrying on the triangulation, and in these cases topographical notes were taken as well. Fremont in 1844 and 1845, and more particularly Simpson in 1859, had partially explored this country.

DESCRIPTION OF THE ROUTE.

We left Carson City September 5, and, passing through Empire and Dayton, made our first camp, with the party of Lieutenant Symons, on the north bank of the Carson, a few miles below Dayton. The following day Mr. Spiller and myself climbed a peak about 8 miles to the north of this camp, to determine, if possible, something of the mountainous character of the country we were about to enter; but the point proved too low, and a topographical station was made. It was deemed necessary to occupy Mount Lyon, the highest peak in the vicinity, in order to connect our triangulation with the base being measured and developed by Lieutenant Symons's party.

At Camp No. 1 the party was divided. Mr. Cowles, with the pack-train, proceeded down the Carson to Buckland's ranch, one day's march, meandering the route close along the north bank of the river, passing ranches at intervals along the river, and the

site of Old Fort Churchill. This was abandoned several years since; the adobe buildings are still standing in part, but the wood-work has been all removed.

The remainder of our party forded the Carson at the camp, and, passing by the west of Mount Raw, a few miles from the river came upon and followed the still excellent road that leads from Dayton to the old mining town of Como. This place, now entirely deserted, is situated at the summit and in the first saddle of the Como range, south of Mount Raw. In 1863 it was a flourishing town, and we were told two daily lines of stages were running between the town and Dayton. The mines proved unremunerative, and it was soon abandoned, the remains of two or three houses now alone remaining. Wood in small quantities is hauled from the vicinity to Virginia City. There are two springs, one on each side of the divide, and about a mile from the summit. Several more springs were found along the eastern slope of Mount Lyon, being about the head of Churchill Cañon, that runs to east from the range, and then turns north into the Carson; water flows only in the upper part of the cañon.

Mount Lyon was occupied September 8, and proved a most valuable station. This is the highest peak in the Como range, and is distinctly visible from Carson City, from which it is about 16 miles distant, and bears nearly due east. Mount Raw is in the same range, 5 miles to the north. Every prominent point afterward occupied was visible from Lyon. The Toyabe range to the east, 125 miles distant, the limit of our area in that direction, formed the horizon. Irregular low broken, and barren hills and desert flats seemed to extend to the great flat of the Humboldt, and Carson sink and lake; the Carson River, winding eastwardly through these, was marked by a line of cottonwood trees; and to the southeast, some 20 miles distant, appeared the north bend of the Walker River, where, according to report, (except in Reese River Valley, away to the eastward,) we would find the only agricultural settlements, or country worth the farmer's toil. The rest was pictured as very barren indeed.

Just beyond the great flat appeared the Sand Spring range, running north and south. The range is much depressed about the Sand Spring Pass, and this depression continues to the next range, (although the two are separated by the Fairview Valley;) there it is the wash flowing westwardly, through Middle and West Gate, into Fairview Valley that cuts the range through and leaves no summit to surmount. The Fairview Peaks rise abruptly on the south side of the wash; while on the north several parallel ridges of low hills rise steadily higher, and converge to Grant's Peak and the well-marked range to its north. The Desatoya range, still farther east, rises abruptly across this low vista, and gives the source of the drain through West Gate. Beyond the Desatoya could be seen the tops of the peaks in the Shoshone range, and beyond these the Toyabe, the highest of all, and running north and south with the others. The mountains looked, in the distance, barren enough, the valleys misty, and the whole doubly interesting to us entering it as almost entirely strange; for it was remarkable how little information could be obtained of it in Carson City.

It was seen that our primary triangulation must depend almost wholly upon points, without our area, and a scheme was projected by Mr. Spiller which was afterward successfully carried out.

From Mount Lyon to Buckland's, to join the party by a direct route, we passed over a plateau of igneous rock to the east of the divide. This is a good range for cattle, and a number were seen about. In the abrupt descent from this plateau to the Carson we found ourselves in a cañon where the intricate mass of bowlders and the steep sides made the passage almost impracticable; finally, coming upon Churchill Cañon, which, toward its mouth, is a broad open drain, we followed to its junction with the Carson, just opposite old Fort Churchill, and thence about two miles along the south bank of the river, and crossed the bridge at Buckland's. Mr. Cowles came in late the same evening, having encountered a rough ascent over lava rock in occupying a station upon the ridge between the Carson and Walker Rivers.

A low peak just north of old Fort Churchill was occupied by Mr. Spiller, and called Churchill Butte. September 11 we left this camp in two parties; the one to proceed by the wagon-road to Wadsworth, to occupy Tu-til Peak, near that place, and to proceed thence to a rendezvous on the Carson at Ragtown; the other followed the road along the north bank of the river and camped at Gates's ranch. Here Mr. Cowles and myself forded the river and occupied a station in the low range south of it. This is a range of barren hills in a desert; they have caused the river to turn away sharply to the north to find a passage for itself. Late at night we recrossed the river to camp, with the pack-train at the Log Cabin. The river was too deep for the packs to cross; they consequently moved along the north bank of the river, and had traveled about ten miles. The next day we followed the river-bank and arrived at Ragtown. This is a rather dreary-looking place, containing only a couple of houses; there is no cultivated ground. It is the first station and the first good water out from Wadsworth, on the freight-road south from that place to Belleville, Ellsworth, and Ione. Ragtown was a station on the overland stage-road, which was running until the Pacific Railroad was finished. It is also the southern terminus of the 40-mile desert of the emigrant-route via the Humboldt River. The desert road extended from Humboldt Lake to

Ragtown. To be compelled to abandon there the exhausted cattle, with their wagons, was no uncommon occurrence with the emigrants. The road is not traveled now.

The water of the Carson is made very muddy by the working of the mills upon its banks in the vicinity of Empire and elsewhere; while the soil of its banks is also exceedingly clayey and alkaline. Below old Fort Churchill fording the river is by no means safe. As far as Gates's (Camp No. 3) much of the land in the immediate vicinity of the river is taken up and fenced in; a little is cultivated, but it is better adapted for hay-ranches. Hay and butter, for sale about the mines, are principally produced.

The river is about 150 feet wide, the bottom generally soft and miry, the banks steep. The water is from 3 to 4 feet deep. There is a good bridge at Buckland's, (the first one below Dayton,) a passable ford at low water at Gates's, and another said to be at Davis's ranch, between Buckland's and Gates's. Except these ranches in the river-bottom, the Carson here flows through a very desert. A little above Ragtown we passed several deserted houses, in ruins, deserted since the overland stage-route was abandoned. At Ragtown the river is quite as muddy as above, and looks very treacherous, with the shifting sandy bottom. Captain Simpson says of the water of Carson Lake, in June, 1859, "The water is of a rather whitish, milky cast."

Soda in quantity is obtained from a couple of small lakes 3 to 4 miles east of Ragtown. The water is simply run into earth vats, allowed to evaporate, and sink into the soil, when the soda remains sufficiently refined for transportation. Mr. Cowles visited these lakes September 15. I returned the same day from Wadsworth, bringing with the pack-train a lot of barley for our future use.

On the 16th we left this place. Mr. Cowles having directions to proceed with the pack-train by way of the Ellsworth freight-road, and await my arrival at West Gate, Mr. Spiller and myself took the old overland road, along which follows the Western Union Telegraph line. We camped at Stillwater, on the slough that connects Carson Lake with the Humboldt and Carson Sink.

Stillwater has a telegraph office and about half a dozen houses. It is the county-seat of Churchill County, Nevada, but at present being remote from travel, is very isolated and dull. There is good land in the vicinity, and artesian wells could undoubtedly be used to advantage. The distribution and flow of the water of Carson River are very remarkable. Three and a half miles below Ragtown the river separates into two nearly equal streams; the left branch, about 2 miles further on, again divides, this making three streams. The central one is called New River. The country here is a great flat about 4,000 feet above sea-level; on the south side is the Carson Lake, shallow, but with generally well-defined shores. It is about 9 miles in length by 6½ in width. On the north side where the river enters there is swampy ground. This lake is connected with the Carson and Humboldt Sink by the slough before mentioned, which runs nearly north and south, and is about 22 miles in length.

The first branch of the Carson flows into Carson Lake, New River enters the slough, and the third branch turns to the north into the sink. The sink is of much greater extent than the lake. The alternate tongues of water and land, the little islands and pools which form its southern shore, show from a distance the marshy character of the land, and indicate a shallow body of water, and a surface that would be sensibly affected by changes in the water-level. The Humboldt River enters this sink from the north. I was told by persons living along the slough that at times the flow of water in it would be toward Carson Lake and the reverse, depending upon the relative height of the water in the two lakes. At the time of our visit there seemed to be a scarcely perceptible set toward the sink. Captain Simpson, when camped upon this slough, in June, 1859, says: "Carson Lake voids itself rapidly through it to its sink to the north."

The freight-road followed by Mr. Cowles crosses the Humboldt branch of the Carson at Saint Clair's Bridge, and follows on the east of and near the Carson branch.

The slough is also crossed by a bridge at Hill and Grimes, 2½ miles from Carson Lake.

The travel along this road to Belleville, &c., has made a market for farm-products. There is a number of ranches and one school-house. We also find ranches on the Humboldt branch. The Stillwater road crosses this by a bridge about three miles from Saint Clair's.

The land in this flat, away from the water, is very sandy and almost desert.

Both our parties left this valley on the east, and crossed the Sand Spring Range into Fairview Valley, near the east side of which our routes came together at West Gate. Mr. Cowles crossed the range at the Sand Spring Pass, halting there one day to occupy a mountain station. At Sand Spring water costs 25 cents per head for the animals per night, and wood could scarcely be purchased.

From Stillwater, by the old road, I entered the foot-hills about 18 miles to the north of Sand Spring. We left the road at the summit, and spent several days in the mountains about La Plata and Tarogqua Peak to the north. The range here is called the Silver Hill Range.

Tarogqua Peak rises very abruptly from the plain just east of the southern end of

the sink. The summit is 4,800 feet above the lake, and from it a fine view was obtained. About this peak there are numerous springs, and there is some woodland along the eastern slope of the range, but toward Sand Spring the range is capped with volcanic rock, and entirely destitute of wood and water, (Sand Spring being at the edge of a low flat.)

By the road the summit is about 18 miles from Stillwater, and Mountain Well, within a half mile of the summit, is the only water between Stillwater and West Gate; the water is now scarcely fit for use, the well having been standing open for several years. An old wagon-road leads from the summit to La Plata, about 3 miles to the north. Not many years ago this place, like Como, gave promise of being a flourishing mining-town. There still remain a fine stone and brick foundation and chimney of a large mill which was stopped in the building. A second mill was erected in Black Rock Cañon, near by, about the same time. Now the place has reverted to a pasture-ground for sheep and cattle. There are two small springs of water, one in an old tunnel near the mill, and another half a mile to the north.

Crossing Fairview Valley we found quantities of bunch-grass. The altitude of the valley is but 4,000 feet, and it is a good winter range for cattle; in summer there is no water. The drainage is toward the Humboldt salt-deposit, which is in the northern part of this valley. To the south and in the upper portion of the valley there is a large barren flat. At West Gate there is a single house where travelers can be accommodated. Good water is obtained from a well. The telegraph office, until recently established here, has been discontinued.

We remained at this camp about a week, during which time, trips were made into the adjacent country. One was by the Ellsworth freight-road as far as Tyler's Station, or Chalk Well, so called from the chalky appearance of the water, which does not rise more than a few feet in the well. To return to West Gate we followed a road which connects these places, but makes a detour through East and Middle Gates.

A station was occupied near Chalk Well, on the west side of which is a small spring. At East Gate there is running water and a small vegetable-farm, the nearest market to which is Ellsworth, 28 miles distant. An old road crosses the Desatoya Range here from Putnam Creek. It was made by Captain Simpson, in 1859, in his outward route. (East Gate was called by him the Gate of Gibraltar, and the Desatoya Range the Sedaye or Lookout Mountains.) Following the water-course toward West Gate, water rises to the surface at White Rock. Here, at the junction of Captain Simpson's two roads, a station was built. The fork to the north, which he followed on his return route, crosses the Desatoya Range by Edwards Creek Pass, and this one was afterwards used for travel. From White Rock our route was through Middle Gate, where water again was found at the surface, and thence to West Gate.

Very little wood is to be found in the vicinity, the nearest to the station being about 11 miles distant on the east slope of the Fairview Range. This range is remarkable for the scarcity of water about it; although the peaks rise in even slopes more than 4,000 feet above the Fairview Valley, and some wood and grass abound, yet no running water was found. A dry camp had to be made for the ascent of the highest peak. The formation at its summit is a flaky shale. One large spring is reported on the east slope of the range and to the south of this peak.

A number of cattle range the country and seem to subsist well, though the pasture is undoubtedly scant. It is believed the animals accustom themselves to remain a long time without water. In known cases they come to water at intervals of from thirty-six to forty-eight hours, and as soon as their thirst is satisfied start off to the hills again.

From West Gate the road by Cold Springs, &c., was followed to Patterson Ranch, on Edwards Creek, while a small party made a detour to the north, towards Grant Peak. We ascended along Bench Creek, a small but constant stream running to the foot-hills. Wood was plenty along it. Good pasture-land was found about the summit, there being a plateau of grass-land to the south of the peak. We camped one night near the summit to take observations for azimuth from the peak. Thence we followed a trail that descends very abruptly to Cherry Valley, in the range, 3 miles to the north of the peak. In this valley and its surroundings several hundred head of horses range, in a half-wild state. At Clan Alpine, which is near the mouth of the cañon drain from Cherry Valley into Edwards Creek Valley, there is a small agricultural settlement. A mill erected by a mining company which commenced operations here some years since is now used as a barn. We crossed the valley to Patterson's, directly opposite. A second observation for azimuth in connection with Grant's Peak was made at Patterson's, the tent in camp having been previously sighted from the peak. From Patterson two roads lead to Austin; the one to the north, with the telegraph line, goes by New Pass, Mount Airy, and Jacobsville, and was the road last used by the stage company; the other is by way of Edwards Creek, Smith Creek, and Emigrant Pass, and thence several roads cross Reese River Valley to Austin.

The Desatoya Range being next in order, we proceeded to work up its topography from New Pass south to the drainage of Putnam Creek. In the mountains there is

plenty of water. It is found in nearly all the cañons on the west side, between Gibraltar Creek at East Gate and Edwards Creek. Cedar Creek, next south of Edward's Creek, was meandered in ascending the highest peak from Patterson's. Edward's Creek, and the road along it, and through the pass to Smith's Creek, were meandered by Mr. Cowles. On the east side of the range the two important drains are Smith's Creek and Putnam Creek flowing into Smith's Creek Valley, but both sink soon after leaving the foot-hills. On Smith's Creek a quantity of land is under cultivation. We were encamped upon it for several days, at A. Maestretti's Ranch, who has title to the water-right of the stream. The land has not yet been sectionized by the land-survey. Settlers already located have, however, the first right to purchase when the land is opened for sale. The country drained by these two streams affords a range for cattle that in the summer season, I think, can scarcely be surpassed in the State, and generally the winters are not too severe to pass in Smith's Creek Valley. This valley is at an elevation of 6,000 feet above the sea-level. Two years since there was so much snow that it was necessary to feed hay to the cattle. This with a very large herd is impracticable, and in that winter a number of valuable cattle perished. Fairview Valley, to the west, is 2,000 feet lower, and there cattle can range throughout the winter. Putnam Creek was meandered, and the return trip made by the flat in Smith's Creek Valley. On the western side of this flat is a number of hot springs. There are about twelve of these. The openings are circular, and descend in a conical shape—some of them apparently 6 feet deep. I had not with me a thermometer reading more than 124°, and could not tell the temperature, which was far above the indication of my thermometer. The water was quite clear; the flow very small. Bubbles rose at intervals to the surface. A piece of buckskin held in the water was almost at once acted upon, and when taken out was twisted and stiff and appeared like raw-hide. The circumferences varied from a few inches—mere openings—to one 3 feet across, which was the largest. There is little or no deposit, but some green and black to red fungus. The springs were in one line, extending north and south about 100 yards, on a slight ridge, and on the slopes of which a little grass was growing. There were a number of cold springs, too, intermingled with the hot, but none of them had any flow, the water remaining at one level, and the springs trampled by cattle, so that there appeared no opening in the bottom of them, as in the case of the hot springs.

Two springs, the water of which is quite warm, are found about 6 miles to the north of them in this valley; the cattle drink freely of their water. The barren flat in this valley covers nearly 20,000 acres of land. White sage grows on the slopes to the hills; of this the cattle are very fond. At this season of the year (October) there is no water in the valley. Simpson, in the spring of 1859, speaks of a lake being there, and also of a considerable stream (Engleman Creek) flowing between Smith's and Putnam Crecks. This creek was not to be seen.

From Smith's Creek Mr. Spiller proceeded along the foot-hills to the north, to make a station in the range south of New Pass; afterward to join the northern road and follow it to Mount Airy, and thence to an appointed rendezvous at Birchim's ranch, on Reese River. The rest of the party followed the southern road, which led to the same point.

This camp was 10.7 miles southwest of Austin. We remained there several days duplicating and arranging the notes of the party. Austin was visited, and Mount Prometheus, near there, occupied. We are indebted to Mr. Melville Curtis, engineer of the Manhattan Mining Company, for the bearings and distance to connect this point with an astronomical monument previously established at Austin by this survey. The Reese River Valley presented a good base of operations for completing the survey of the eastern portion of our area, the same purpose that the Carson River and old overland road with its water-stations had served in our route eastward.

The valley of the river here lies between the Toyabe Range on the east and the Shoshone on the west. The Toyabes rise above 11,700 feet and the Shoshone about 10,000 feet. The two ranges converge at the head of the valley and range south into the desert, while the Toyabes to the north of latitude 39° 30′, and the Shoshone north of 39° 15′ decrease in altitude and have little water. The river rises in the Toyabes, about latitude 38° 45′, and flows to the north. A second source is from copious springs, in the valley a few miles south of Birchim's, forming a branch that soon unites with the other. The river-bed crosses the Central Pacific Railroad at Battle Mountain Station, near which place it joins the Humboldt River; water nearly flows to its mouth. The ranges are well wooded, and some of the trees are fit for timber, but the growth is generally stunted. None of the cañon-streams of the Shoshone reach the river. The soil of the valley is much impregnated with alkali; toward the upper part of the valley is a number of grain-ranches; barley is principally raised, the past season being an exceptionally prosperous one. The lower ranches on the river are adapted to making hay.

Mr. Spiller was assigned to work up the topography of the Toyabe Range. He entered the range by way of Big Creek, occupied Geneva Peak, and then worked southward to latitude 39°. Once crossing into Big Smoky Valley by Kingston Cañon, and then recrossing the range to Washington, he finally rejoined the party at McMahon's

Ranch. From this place he made a trip to Poston Peak, at the headwaters of Reese River. In this range, from Prometheus to Poston, a distance of 48 miles, six prominent peaks were occupied. Severe weather was encountered by that party, with snow-storms and cold. Especially on Poston Peak the party suffered severely; there Mr. Spiller had both ears badly frozen. This work occupied twenty days.

In the mean time the party moved up Reese River Valley. The road from Austin to Ione was meandered throughout. From Elkhorn the pack-train went to Washington, in the Toyabe foot-hills, to resupply Mr. Spiller's party. With Mr. Cowles, I made a trip of six days into the Shoshone Mountains. We recrossed the valley to Washington, and then proceeded to McMahon's, to rendezvous with the other party. In the Shoshone Range, from Mount Airy south to Ione Pass, a distance of 40 miles, seven prominent points on the main divide were occupied.

The party was now ready to move westward, through the southern portion of our area, with the object in view to complete the survey of the area in a north and south direction as we moved. At our camp at McMahon's we separated as usual, the next rendezvous being appointed at Ellsworth. Mr. Spiller, Private Niver, and myself formed one party. Our route led us a second time to Ione. This is a mining-town on the western slope of the Shoshone Mountains, a little south of latitude 39° 30′.

The mines have been opened for some years, and promised well when first opened. For several years back little work has been done in them. New capital at this time was awakening the place to a good deal of activity. The same may be said of the town of Ellsworth, across the valley to the west; here, however, new discoveries were also being made. From Ione we crossed the Ione Valley in a southwesterly direction, to Antelope Springs, in the Mammoth Mountains. This valley is but an extension south of the Smith's Creek Valley, the divide between them being very low. The Mammoth Range, here so called, is but an extension of the Desatoya Range. Paradise and Park Peaks, south of Ellsworth, were occupied. The range is not high, but there is an abundance of wood and a number of springs. Ione Valley, east of it, is without water; but it drains well to the south, and gives some pasturage instead of barren flats. To the west the range falls abruptly to barren foot-hills and the Hot Springs Valley with its alkaline flat. The difference of level between Ione Valley and Hot Springs Valley is about 2,000 feet, the same as observed to the north between Smith's Creek Valley and Fairview Valley. The same range forms the dividing line, but on the west the two valleys do not run into each other, as do Smith's Creek and Ione, but a considerable range of hills running east and west separate Hot Springs and Fairview Valleys.

This Mammoth Range is a very distinct line of demarkation between the country to its west and that to the east between latitude 38° 40′ and 39° 30′. The type of country westward extends as far as Mason Valley, and to the Como Range. The Carson River, in its lower part, struggles through it. Apparently finding itself baffled in its westerly course, the desert turns off to the north, to absorb the waters of the Humboldt and Truckee Rivers. The type is a country whose valleys are alkaline flats, and whose mountains are low, igneous hills, without wood and with very little water.

From McMahon's the remainder of the party had returned along the Reese River Valley and crossed the Shoshone Range to Petersen's Ranch, in Smith's Creek Valley, and thence proceeded south through Ione Valley to Ellsworth. Ellsworth is several miles from the summit of the range, and on the eastern slope. The first mines were worked about the site of the town. The impetus now at work is derived from mines on the western or exposed slope of the range. A new town, called Summit City, is being built at the summit, and near these mines. At present water must be hauled there, but it can be brought in pipes from a spring at no great distance.

From Ellsworth, Chalk Well was revisited, to complete the survey of the freight-road from West Gate. Our next camp after Ellsworth was at Welsh's Spring, near the mouth of Marble Falls Cañon, and at the base of the bluffs on the west side of the range. It is but 5½ miles from Ellsworth. About 3½ miles across the small valley, west of this spring, is the Illinois mine, the principal one of the new mining district of Lodi.

At Ellsworth, I engaged an Indian guide to take a small party through the very dry country lying between West Gate and Hot Springs Valley. Mr. Spiller, the guide, one packer, and myself composed the party. The rest of the party moved southwesterly to Hot Springs Valley, and camped there at some cold-water springs, where they also found some grass for the animals, but were badly off for wood. Our small party was out four days.

The first day, after having occupied the highest point in the hills just west of the Illinois mine, we marched northwest about 9 miles, and camped high up on the rocky slopes of a low peak that was occupied as a station the following day. At this camp the water was in a hole, under and inclosed in the solid rock, and besides being scarce was very difficult to obtain. The guide gave us to understand, however, that in the spring we would find there plenty of water. The wood there was very scant sage-brush. Our second camp was at a spring 7 miles west of this; this spring is hidden in a flat

body of rock; the water was plenty for us, though not abundant. It did not flow, but stood in the sand of one of the rocky ravines. Here we were a few miles east of the Fairview Mountains. Our next camp was at an old arrastra on the west slope of a peak we called Slate Peak. This peak is in the southern extension of the Fairview Range, and there was noticeable another drain cutting through this range to the north of Slate Peak, with sides much more precipitous, however, than those of the West Gate wash that cuts it to the north. Noticing also that Fairview Range is a different formation from those in its vicinity, we can readily conclude that it is much older. At the arrastra referred to was worked the first ore from a mine supposed to be rich in gold; the location is at the head of Fairview Valley. A small mill (5-stamp) was afterward erected in Hot Springs Valley, where water was obtained by sinking a well. Want of capital is assigned as the cause for quitting the work.

The mill is still standing and nearly complete. At the arrastra we managed to obtain a little muddy water by cleaning out the bottom of an excavation previously made for that purpose; there were indications of a spring during part of the year. From this place we crossed the divide at the head of Fairview Valley to Hot Springs Valley, following a road but seldom used since the mine ceased to be worked. The road led to the mill. The whole party then crossed the valley to Dead Horse Well, on the west side of the valley.

There is a copious flow of water from the Hot Springs, in the eastern part of the valley; the water is too hot to bear the hand in it. The deposit is like that of the springs in Smith's Creek Valley.

The alkali flat in this valley contains about 14,000 acres. It is rich in borax, and has been worked to some extent. At Dead Horse Well observations for azimuth were taken, in connection with Basalt Peak near by, which was occupied as a primary triangulation-station. Belleville is south of Dead Horse Well, about 50 miles distant. There are several wells at this place and an abundant supply of tolerably good water. Our route thence was north, along the Belleville and Wadsworth freight-road, to Sulphur Spring, in the Sand Spring flat, 31.7 miles. The road is along the west slope of the Sand Spring Range, and there is no water. At one of the stations (Deep Hollow) water is sold for $1.50 per barrel; it is hauled a distance of 14 miles, from Dead Horse Well. Salt Well is a station three miles short of Sulphur Spring, but the water of the well is not fit for drinking purposes.

The Sand Spring flat covers an area of 20,000 acres; it opens on the northwest to the Carson Slough; the divide is scarcely perceptible. The soil is wet, and water stands in the lowest part.

The water at Sulphur Spring is not very good. Drinking-water is brought from the slough, 10 miles distant. There is a station at the spring. The wood used is brought about 50 miles, by the return freight-teams from Belleville.

In the Sand Spring Range, nine points were occupied, from Tarogqua south to Basalt, 44 miles. We next moved by the southeast of Carson Lake to Allen's Springs. These are the calcareous springs spoken of by Simpson in 1859. At the southwest of Carson Lake there is a large area of porous alkaline ground, that is but little raised above the surface of the lake, and comparatively recent beach-marks indicate the more modern overflows of the water.

Our next rendezvous was appointed in Mason Valley. Mr. Spiller, with the train, proceeded south to Walker River, crossed it at the old Indian agency, and thence moved along the road to Lee's Mill. With Mr. Cowles and one packer I returned to Carson Lake and camped on its southwest shore, near the ruins of an old station. The tules said to be here formerly are entirely gone. We had to carry an old telegraph-pole about half a mile to camp to make our fire; there was no drift-wood. The telegraph line formerly here now passes through Ragtown, &c. The mules would not drink the water of the lake, even after they had been without water for more than 24 hours. The lake was swarming with water-fowl. From here we followed the old road west, past Houton Well, (now deserted,) to Buckland's, where had been our second camp out from Carson; thence we proceeded, by the good wagon-road, to Mason Valley. The Hot Springs in the northern part of this valley have been long known. I here observe that there is an east and west water-shed extending across our whole area from the Toyabe Range, and extending to the Sierras. Starting around the head of Reese River, it joins the Shoshone, then divides Smith Creek and Ione Valleys, and so continues to the west, about the latitude 39° 15′. It finally forms the divide between the Carson and Walker Rivers. It is most marked south of the West Gate Wash, the Farview Valley, and Carson Lake to Buckland's.

To follow from the mouth of Churchill Cañon the broad open drain, one will be surprised to find that it separates from the cañon about 4½ miles from the Carson, and continues with a very slight rise to the divide between the Carson and Walker Rivers, and from this divide to the valley of Walker River. The drain continues the same; indeed the summit cannot be perceived in traveling. Our barometric observations show a constant rise from the mouth of Churchill Cañon south through this drain to Walker River. It would seem to indicate that there had been a connection at one

time between the waters of the two rivers. It certainly presents a very easy pass from one river to the other.

From Lee's Mill we marched in two days to Carson City, following a new road recently established between Dayton and Mason Valley. We arrived at Carson on the evening of the 26th November, when I reported to Lieutenant Tillman. Mr. Spiller made a trip from Carson to Mount Rosa and return before going East.

MINING DISTRICTS.

Four mining districts in operation were visited. Austin, next to Virginia City, is the center of the most prosperous mining district in Nevada. The Manhattan Silver Mining Company, owning several fine mines and a good mill, is now doing the principal work, and is in active operation. A full report of this district has been made by Clarence King.

UNION MINING DISTRICT.

This district has been established about thirteen years. The first discoveries were made by A. J. McGee. It was at first worked actively about eighteen months, and in May, 1876, active operations again commenced. The present recorder is James F. Duckett. The post office is Ione City, Nye County, Nevada; George W. Veatch, postmaster. A buckboard runs weekly from Austin, Nev.; the distance is 51½ miles. The nearest railroad communication is Wadsworth, on the Central Pacific Railroad, 120 miles distant. The district extends 12 miles north and south, and 6 miles east and west, with the foot-hills of the range. The north line is about three-fourths of a mile north of Ione. The mineral belt is from one-half to three-fourths of a mile wide, and, running with the longer line of the district, crops out at intervals through the 12 miles. Croppings show both in cañons and upon spurs on the west slope of the range, and about one-third of the distance from the summit to the foot-hills. The range trends north and south; the lodes have the same direction, and dip to the northeast, uniformly with the country-rock. The walls are covered in places with a thin seam of white clay, and these give the richest deposits. Vegetable impressions have been found, but no fossils. Chloride is the principal ore found; it has been worked by crushing dry and roasting. The water-level has not been reached in the mine. The ore contains a good deal of iron, and some lead and antimony. Gold is found in all the ore, generally in paying quantities. The principal mines now worked are the Storm King and the Clipper. The first is being worked by the Ural Silver Mining Company; an incline has been run 350 feet, with two levels several hundred feet in length; the amount of good ore in sight is not great. In connection with this mine a shaft is being sunk, several hundred yards from the ledge, to strike the incline at a depth of about 800 feet, if the incline continues with its present pitch. This company is also putting up, a few miles south of Ione, a fine mill with capacity for 20 stamps. A revolving furnace (White) will be used, and improved machinery throughout. At the present writing, it should be completed. In the Clipper mine several inclines have been run, a small force was at work, and gold has been taken from it; the work was not on the vein at the time. Some fifteen other mines are considered in favorable condition for working; on all of them a considerable amount of labor has been expended.

The Pioneer Mill, owned by James M. Cammack, is in the town of Ione; it has been idle for some time. It has a fine engine, and the reverberatory furnaces used for roasting the crushed ore are in good condition. The stamps are out of order. When first opened the mines were found to contain pockets of rich chloride, and paid well.

Two veins run with the mineral belt, and the excavations made show them to be extended. The value of the ore extracted is claimed to have far exceeded the amount expended on the mines. The ore will generally be easily extracted by inclines and levels run on the veins. Wood is abundant, and there is a running stream at Ione. The cost of freight from the railroad is 2½ cents per pound.

MAMMOTH MINING DISTRICT.

The first discoverers were R. B. Craig and James Donelly. It was organized December 23, 1863, and has been worked with more or less vigor since that time. Patrick Downey is recorder. The post office is Ellsworth, Nye County, Nevada.; P. O. Tyler, postmaster. The route of the buckboard from Austin, through Ione, terminates here. The freight-route is from Wadsworth, on the Central Pacific Railroad, about 110 miles distant; freight from Wadsworth is 2½ cents per pound; returning, the price is 1½ cents per pound.

Willow Spring, a short half mile west of the town, is the center of the district; from this point to the center of the bounding lines north, south, east, and west, is 5 miles. The area of the mineral croppings is about one-half mile wide by 3¾ long, the longer line crossing the Mammoth Range east and west, and the mines are located on both side

of it. The range trends north and south; the lodes on the east trend north and south, and those on the west, northeast and southwest. The eastern slopes are gentle, and there the discoveries are in the foot-slopes, and adjacent to the town. The country-rock is granite. None of the mines there are being worked. The Mount Vernon mine was most extensively developed, and is considered valuable. It is now flooded with water, which, in the granite, is reached at 100 feet.

On the western slope the strata are much exposed, the descent being very abrupt. The discoveries range through about 1,000 feet in altitude, commencing near the summit, and extending a little more than half way down the slope. The deposits are richest in the slate and limestone. A metamorphic rock also abounds. The Last Chance, Grant and Colfax, and Canada mines, on all of which work was being done, are in the same belt of rock. It is about 600 feet wide, and cuts across the country-rock. The Lisbon mine, also on this slope, has been worked to a considerable extent. The Last Chance may be taken as a sample of the first three; it has three shafts or inclines, respectively 100 feet, 133 feet, and 40 feet, with about 70 feet of levels, run on the vein. The hanging wall is a seam of indurated clay, about 4 feet thick, the foot-wall slaty limestone; barren horses of slaty limestone occur at intervals, but the continuity of the vein seems well established. The ore is principally chloride, with a little iron, and traces of copper. Assays show its value to range from $68 to $236 per ton, with an established average of over $80 to the ton. The dip is southwest; the inclination to 60 feet is 75°; below that, as far as developed, it is 85°. The Grant and Colfax has a shaft of 60 feet, with a level of 40 feet on the ledge, and a tunnel has been run 100 feet, that will reach the ledge 110 feet farther on. The Canada has a tunnel run 35 feet on the ledge. These three mines have been actively worked since their discovery, which is recent. The ore will be easily extracted; its transportation to the mill, which must be on the eastern slope, to be convenient to water, will be a matter of some difficulty. It is contemplated to build a wagon-road; it can be graded to the summit in about 1 mile. This would give a grade of about 450 feet from the summit to Ellsworth; where the mill is to be situated, the distance would be about 4 miles, with an easy grade. Mr. W. H. Raymond, of Oakland, Cal., is negotiating for the Last Chance mine, and it is expected to shortly erect a new mill at Ellsworth. The one already there is a 10-stamp mill, with Stedefelt furnace, 750-pound stamps, an engine of 40-horse power, and with 2 settlers and 5 pans. Wood is abundant and convenient, and there are unfailing springs just above the town. Gold is found in the ore, and said to average from $10 to $15 to the ton. The indications of increased prosperity for this district are good.

LODI MINING DISTRICT

Was discovered by F. M. Pearson, A. Welsh, and J. H. Williams, and was organized in September, 1875. It has been actively worked since that time. The recorder is Joel Holden. Ellsworth is the post office. From Wadsworth the distance is about 100 miles; the road to within 10 miles of Lodi being identical with that to Ellsworth and Ione. The district is bounded on the east by Mammoth district, south by the old Wellington road, west by the Hot Spring Range, and north by the Wadsworth road. The principal ledge is situated on the east slope, and at the eastern extremity of a somewhat detached group of hills, but which have here a ridge extending several miles east and west. Lodi Peak, the highest point, is 6,486 feet above sea-level, and 1½ miles west of the ledge. This ledge trends a little west of north, and the mineral croppings show an area about 1 mile long by 300 feet broad. The walls are nearly perpendicular, being an exceedingly hard black rock, apparently a fissure, retaining well its width. The richest deposit is found where the ore vein contracts to a couple of feet, the remainder of the fissure being here filled with a loose, friable, yellow-colored rock. The ore is carbonate. It contains about 7 per cent. of antimony, a good deal of iron, and about 25 per cent. of lead-carbonate. The assays give about $15 to the ton in gold. The Illinois mine on this ledge has one shaft 60 feet, and another 90 feet, deep, on the vein. In the latter shaft is a drift 20 feet north, at a depth of 60 feet. Several locations have been made on the extension of this mine. The Lodi mine, northwest of this ledge, has a shaft 115 feet deep, with a cut across the ledge at 60 feet; its walls are perpendicular, and trend east and west. From the Illinois mine about $20,000 worth of ore has been shipped to San Francisco; a quantity of this assaying $500 to the ton. The average of the assorted ore is $300 to the ton. This mine has also been purchased by Mr. Raymond. No mill has been erected as yet. The shafts and drifts will be run in the vein matter. There is no water near the mines. Two springs, Welsh and Wilkinson, are on the opposite side of the valley which separates the Lodi hills from the Mammoth Range; they are, respectively, about 3 and 3½ miles from the Illinois mine, in a direct line. The highest one is 90 feet above the level of the mine. The lowest (Welsh) is about the level of the mine. Timber could be obtained from the Mammoth Range. On this, the west side, however, the timber only grows near the summit. Freight from Wadsworth costs 2¼ cents, and returning 1¼ cents.

There is a large number of cattle in the vicinity of these three mining districts. For Ione and Ellsworth, the source of grain and hay supply is Reese River Valley, and this is also the nearest point to Ellsworth. Reese River Valley is distant about 8 miles from Ione, 17 from Ellsworth, and 34 from Lodi; the distance to Lodi is largely increased by a necessary detour through Burnt Cabin Summit to cross the Mammoth Range. From this valley, the cost of forage at Lodi, at present prices, would not exceed 3½ cents per pound for barley and 2 cents for hay; at Ellsworth, 3¾ cents for barley and 1½ cents for hay; at Ione, 3 cents for barley and 1¼ cents for hay.

It is contemplated to build a narrow-gauge railroad from Battle Mountain, on the Central Pacific Railroad, to Austin, Nev. This would make the distance from railroad communication for Ione 51½ miles, and for Ellsworth, via Petersen's Ranch and the Lower Reese River Valley, 55 miles. From Lodi to Austin, by the route through the valley, would be about 62 miles, as against 100 miles to Wadsworth. The advantage in supplies of water, forage, and the character of the road-bed would also be in favor of the Austin route.

Lander City was built on Big Creek, about the mouth of its cañon from the Toyabe Range; a great deal of prospecting was done, but to little purpose, and the place was deserted for Austin when that camp became prosperous. A few ranches are now found along the creek.

Following up Big Creek, and crossing the range into Kingston Cañon, we find another old mining camp, on which a great deal of money has been expended. The Sterling Mill, at the mouth of this cañon, is held in good order; it is a 20-stamp mill, the motive being furnished by a turbine water-wheel. The remains of two other mills, from which the machinery has been removed, are found not far from it.

At Washington also a camp was started, and there is quite a little village of houses, all but two of which are now deserted.

There is no doubt that much labor, toil, and money have been expended in this country on worthless mines. The failures, however, are often due to other causes; prominent among which are undue expectations, lack of facilities for transportation; and again in one case a thriftless expenditure of a company's money, and in another a lack of means. These camps were started at a time when mining was a rage in Nevada; now it has sobered down very much. The success of Austin, and the undoubted fact that a large quantity of mineral does exist in these mountains, must lead us to hope that, with proper care and management, a future day will see this a prosperous mining region.

WORK DONE BY THE PARTY.

The party was in the field 83 days, and including Mr. Spiller's trip to Mount Rosa, after our return to Carson, the following will indicate the work done, viz:

Number of main camps	29
Number of side camps	47
Number of miles meandered	1,073.89
Number of miles traveled and not meandered	633.42
Number of mountain stations occupied with a 10-inch or 20-inch instrument	22
Number of topographical stations occupied, being either included in the triangulation or three point stations, with 30-inch instrument	70
Number of additional three-point stations	244
Number of aneroid-barometer stations	501
Number of cistern-barometer stations	104
Number of variations determined by observations on Polaris	27
Number of azimuths determined	3
Number of latitudes determined by sextant	30

A great number of points were fixed by cross-bearings, care being taken in this respect with regard to every topographical feature of importance distinguishable from two or more stations. For this purpose two methods were introduced by Mr. Spiller and used. In the first, all the sights to points, taken at an occupied station, were numbered consecutively around the horizon from one upward; then, on sighting any one of these points from a second station, a convenient note was made, citing the number or designation of the previous station and the number of the sight from it to the point to be fixed by the cross-sight. In the second, on a sketch made from a previous station, was recorded in brackets, at the sketch of the point cross-sighted, the sight taken from a second station. Both these methods obviate the necessity of making more than one complete sketch of a view having nearly the same aspect from two different stations. They tend to cause stations to be occupied in pairs with reference to a number of prominent topographical features, and this I believe to be an excellent practice.

The altitude of points fixed by cross-sights was determined by angles of elevation or depression from barometric stations.

TRIANGULATION.

The main points on which our triangulation depends are: Mount Rose, 10,820 feet; Mount Lyon, 8,815 feet; Tutib Peak, 7,062 feet; Basalt Peak, 6,599 feet; Fairview Peak, 8,412 feet; Tarogqua Peak, 8,771 feet; Grant Peak, 9,965 feet; Desatoya Peak, 9,921 feet; Paradise Peak, 8,662 feet; and Bunker Hill, 11,405 feet, and Poston or Davies Peak, 11,756 feet, in the Toyabe Range. From each of these stations repeated angles were taken to Cory's Peak, the highest point in the Wassuck Range, and situated just west of Walker Lake; and from Mount Rose, Basalt, Paradise, and Davies Peaks angles were taken to White Mountain Peak, which is to the east of Benton, Cal. The triangle—Davies, Mount Rose, and White Mountain Peaks—which will be completed when the angle at White Mountain Peak is measured, is a very large one. The lengths of its sides are—

	Miles.
From Davies to Rose	142.45
From Rose to White Mountain	134.25
From White Mountain to Davies	88.00

The instruments were returned in good condition, except that the wet bulb of psychrometer No. 8 was broken, being blown from the top of a peak by the wind.

Mr. Spiller was untiring in his efforts to do the work thoroughly and well.

Mr. Cowles, in addition to his designated duties as meteorological observer, constantly performed those of a topographer as well, and in both instances with credit to himself.

RATIONS.

The twenty-five days' rations taken at Carson lasted the party as far as West Gate The day after we reached that place, the team in charge of Corporal O'Neil arrived from Carson, with provisions for the party for the remainder of the season. Taking out sufficient to last us as far as Dead Horse Well, I instructed the corporal to return to Ragtown for grain left there by me, and, returning through West Gate, to proceed to Ellsworth, leaving there some grain; thence to proceed by the old Wellington road to Dead Horse Well, and leave there a supply of rations for fifteen days and the remainder of the grain. These orders he faithfully carried out, and proceeded to Reno, where he reported to Lieutenant Tillman. On our arrival at Dead Horse Well, the rations there were taken up, and lasted through the field-season.

FORAGE.

Although much of this country is well adapted to grazing loose animals, there is little luxuriant growth of grass. At the time of the year in which we traveled through it the pasturage was very dry and short, where there was any at all. In every instance we were compelled to pitch our camp either on ground already taken up by ranchmen, or, more often, in places where the pasturage was much too scanty to subsist the animals by feeding loose overnight. We were thus compelled to carry or purchase grain at all times, and hay was fed whenever it could be obtained. The animals came in in excellent condition, having been fed during the season a daily average of 6½ pounds of barley and 6.3 pounds of hay. The price of barley varied from 4½ cents per pound at West Gate to 3 cents in Reese River Valley and 2½ cents in Mason Valley. Hay was 2½ cents per pound at West Gate and 1 cent in the valleys.

A list of road-distances, with remarks as to wood, water, &c., is transmitted herewith.

After the disbandment of the parties at Carson, and in accordance with instructions, I proceeded to Camp Independence, California, with the animals, &c., used by the parties in the field. I left Carson December 4; two non-commissioned officers and three privates of Company D, Twelfth Infantry, and four civilian employés, being of the party. We had in charge two six-mule teams and one light wagon, with eighty-five animals in all. We arrived at Camp Independence, without accident, December 13. I at once turned over the property to Lieutenant Wotherspoon, Twelfth Infantry. This completed my duties in the field.

Respectfully submitted,

R. BIRNIE, JR.,
First Lieutenant Thirteenth Infantry.

Lieut. GEORGE M. WHEELER,
Corps of Engineers, in charge.

APPENDIX E.

EXECUTIVE AND DESCRIPTIVE REPORT OF LIEUTENANT CHARLES C. MORRISON, SIXTH CAVALRY, ON THE OPERATIONS OF PARTY NO. 2, COLORADO SECTION, FIELD-SEASON OF 1876.

OFFICE OF UNITED STATES GEOGRAPHICAL SURVEYS,
WEST OF THE 100TH MERIDIAN,
Washington, D. C., April 1, 1877.

SIR: I have the honor to render the following executive report of operations of party No. 2, Colorado Division of the survey, during the field-season of 1876, together with a brief description of the country traversed and its resources:

EXECUTIVE REPORT.

The Colorado Section, consisting of Party No. 1, which was taken charge of by Lieutenant Bergland, Corps of Engineers, shortly after its leaving the rendezvous-camp, and my own party, No. 2, was organized at Fort Lyon, Colorado, late in August.

The parties took the field on the 29th and 30th of August, respectively. The personnel of the one under my charge was Lieut. C. C. Morrison, Sixth Cavalry, executive officer and field astronomer; Mr. Frank O. Maxson, topographical assistant; Mr. George M. Dunn, meteorological observer; Mr. Lanier Dunn, aneroid and odometer recorder; A. R. Mitchell and Martin Sanchez, packers; Edmund Rocroft, laborer; Thomas Kennedy, packer and cook.

From Fort Lyon the party proceeded to Trinidad, following generally the drainage of the Purgatoire, following on the west side, thus cutting all drains coming in on that bank. About eight miles above Trinidad we left Purgatoire, following up Long's Cañon, crossing the divide at its head, and coming down upon the upper waters of the Canadian. Here a belt of country was closely surveyed, locating the heads of that river. Thence we proceeded across the heads of the Vermejo and Point, via Elizabethtown and Taos Pass, into the valley of the Rio Grande. Entering the Taos Valley, some two miles southeast of Fernandez de Taos, we passed through the lower edge of the valley, striking the Rio Grande at Cieneguilla; thence following the main stream, through the cañon of the Rio Grande known as the Caja del Rio, the party proceeded to Santa Fé, at which point rations were obtained and comparisons were made of meteorological instruments with those of the Signal Department, as the survey of the belt of country to the south was to be referred for its vertical element to this point. Three days' observations were taken here for horary curve, and the triangulation-station on the hill just north of this city was re-occupied for development of the base and system of triangles to the south. The party left Santa Fé September 21, and on the 23d Old Placer Peak was occupied by Mr. Maxson, as triangulation-station, while the mining district of New Placers was examined by myself. Stations were then made on the Sandia and Manzano Mountains for triangulation and topography.

At Mosca Peak the party was detained four or five days by cold heavy rains—the equinoctial storm. From the Manzano Range we worked eastward over the plateau extending from the base of these mountains and re-occupied Pedernal Peak; thence, proceeding southwest, through the plains of the many alkaline lakes, we passed the Salt Lake proper, from which salt chemically very nearly pure is obtained in coarse crystals. We recrossed the Manzano Range by Comanche Pass, having first occupied Osha Peak for triangulation and topography, and worked up the eastern slope of the range. Descending Comanche Cañon, we crossed the plateau extending to the Rio Grande, striking the river opposite Los Lunas. From Los Lunas a meander line was run to Socorro, on each bank of the river; the one by Mr. Maxson, the other by myself. At this place rations were obtained, and the party proceeded to the Socorro Mountains, camping at Culebra Springs. Socorro Peak, Culebra, and Polvadera Peaks were all occupied for triangulation and topography. Thence we proceeded to the Magdalena Mountains, leaving the main camp in cañon Del Agua. Mr. Maxson and myself, with one packer, ascended the peak, expecting it would be necessary to stay away one night and a day for triangulation, topography, and azimuth observations. Before reaching the top we were caught in a blinding snow-storm. We made camp at the edge of timber-line, and then had to wait four days, without tents and with insufficient blankets, with no water except that obtained by melting snow, and but scant supplies. Our animals suffered much from want of water and grass, as we had nothing we could melt snow enough in for them, nor would they eat, as they suffered from thirst. The point was very important in the system of triangles. Over three hundred angular readings were made on this one point by Mr. Maxson, and an astronomical azimuth was determined by myself. He afterward occupied Garcia Peak, in the same range, while I examined the mineral deposits in these mountains.

From the Magdalena Mountains we proceeded via the Quinza drain to the Ladrones

Mountains, then, after occupying these for triangulation and topography, to Sabinal; here the party was divided, Mr. Maxson, Mr. George Dunn, and one packer proceeding up the Puerco Creek, while the main party proceeded to Los Lunas, where the side party was to rejoin them. Again we were reminded of the approaching winter season. The mountains inclosing the valley were covered with snow. From Los Lunas we moved to Ojo de la Casa, on the western slope of the Manzanos, thence southward to Abo Pass, running along the base with traverse-lines up the drains and occupying South Manzanos Peak, working up thus the western draining and topographical forms of these mountains. In the low range to the south several subordinate points were occupied for topography as three-point stations, from which accurate sketches, instrumentally checked, were made. The belt extending to the river was thus traversed. From Socorro we proceeded to Fort Craig, at which point we were to obtain rations. Arriving there November 10, we were detained by a snow-storm for three days. From Fort Craig we worked up the belt east of the river between the Chupadero plateau and the Rio Grande up to Abo; thence we proceeded to Mesteñito Spring; here we were overtaken by another snow-storm, covering the grass entirely. To save our animals we proceeded to a ranch, at Antelope Spring, where forage could be obtained, marching all day in a blinding snow-storm, unable to see a hundred yards ahead of us. The trail had to be followed by occasionally noticing little depressions in the snow. We arrived late in the afternoon. That night the thermometer fell to 16½° below zero. Fortunately none of the animals were frozen, although at other ranches we afterward heard of fourteen being frozen to death in one herd and twenty-nine in another, and doubtless if we had not been able to obtain the shelter of a stockade ours also would have been lost. This extreme cold determined us to start on the return trip. Moving to Los Posos del Puis, we there reached the point farthest southeast covered by our work during the season. Moving northward over the main route from Fort Stanton to Anton Chico, we passed through there November 30. The weather having moderated somewhat, we occupied Mesa Chupaines for triangulations; thence, crossing the Gallinas Creek at the La Liendre, we went up Cañon del Agua, and from there to Fort Union by way of Las Vegas. At this point we received the most cordial treatment at the hands of the officers. From Union our route led to the Vado de la Piedra, or Rock Ranch ford of the Canadian; thence, by the Dry Cimarron route to the Chaquaqua Cañon. Leaving the old Dodge cut-off a short distance beyond this, we went by the new route, which crosses the Purgatoire at Nine-Mile Bottom and makes junction with the Trinidad road a short distance south of Aqualine Station. This route we followed to Fort Lyon, at which post the party arrived December 14. The topographical instruments used during the season were first Buff and Berger 8-inch transit, graduated to 10 seconds horizontal limb, capable of being read by a practiced eye to 5 seconds. This instrument was very good, and worked to entire satisfaction during the season; it was used on all mean-triangulation stations. One of Stackpole's 7-inch transits, one Young, and one Cassella meandering transit were also used. Horizontal distances were measured by odometer, checked by numerous three-point stations, the whole depending upon the primary and secondary triangulation-points of the system developed from the base near Santa Fé, the co-ordinates of the extremities of which were astronomically determined in 1873.

The meteorological instruments used were two cistern barometers, three aneroids with the complement of hygrometers, maximum and minimum, and pocket thermometers. One of the cistern barometers used had Lieutenant Marshall's improvement, consisting of a closely-fitting inner tube filled with plaster of Paris, completely enveloping the barometer tube, excepting opposite the scale, where a slit was made to permit reading. This barometer was used for mountain work, and was very much stronger, supported as it was, than the ordinary tube. It was dropped from the shoulder of the meteorologist once, falling on end; it then fell over to its side on a board floor and did not break. Later in the season it was broken by a kick from a mule; even then it was not shattered, but cracked throughout the length of the tube opposite the scale where unsupported. Although a little heavier, it is certainly much better able to stand a season's work than the present form, which does well enough for the standard for camp. The field astronomical instruments used were one sextant and artificial horizon.

The season's work was very satisfactory; each of the assistants, Mr. Maxson, George M. Dunn, and Lanier Dunn, bending every effort to secure such results as deserved the highest commendation. Working in the most untiring manner, Mr. Maxson's labors were rewarded by his triangles closing very finely. The meteorological work also attested the care of Mr. Dunn. Each member of the party endeavored to contribute to a harmonious whole, and succeeded. Between seven and eight thousand square miles of country were completed, in accomplishing which the party traveled between eighteen and nineteen hundred miles, occupied fifteen triangulation stations, one hundred and ninety-one three-point stations, and about fifteen hundred minor stations, the altitudes of all which were determined and entered into the vertical representation of the country. The transportation returned in fair condition, considering that nearly all the time they had no corn and much of the time but scanty grass, and at many camps were without water.

GENERAL DESCRIPTION OF THE COUNTRY.

The country traveled by the party was entirely south of the Arkansas, and may be divided into three belts: First, that extending from that stream to the south to the Raton spur of the Rocky range; second, the heads of the Canadian and its branches in the main range; third, the valley of the Rio Grande and the plateau between it and the Pecos. This first belt constitutes a vast rolling plateau of uninteresting aspect, treeless, save along the b ooks which seek outlet in the Arkansas. Little agricultural land is found; that little is confined to the immediate vicinity of the streams. Valuable this land certainly is as grazing land, but it has little to attract the stranger. In the belt, nearly a hundred miles across, but few ranches are found. Along the immediate valley of the Purgatoire, evidence of the farmer is seen, and it is claimed, doubtless justly, that the finest of fruits thrive in this valley. The grain there produced is very promising. Once out of the immediate valley a wide expanse of gently rolling monotonous country pains the eye in the hot, dry air of an August noonday. Here and there it is broken by an arroyo, in which an uncertain supply of alkaline water may be found. These arroyos deepen as they approach the Purgatoire, and may well near their mouths be termed cañons, boxed up as they are by their sandstone walls, rendering the country almost impassable, which, farther out on the plains, can be traversed in almost any direction by wagons.

Here little is seen of more interest than the large herds of antelopes, which, with gentle swinging gait, keep just out of rifle range.

On the main freight wagon route from West Las Animas, but a year ago the terminus of the Atchison, Topeka and Santa Fé Railroad, we find a few ranches. After leaving Sizer's ranch on the Purgatoire, at which point the road diverges therefrom, we first come to the old stage-station known as Alkali Station. Here is a little hut, with stables and corral, used as a shelter to the stock-tender and his animals. It is now deserted, or was at the time we passed. The water is slightly impregnated with alkaline salts. Farther on are Vogel's ranch, Bent's Cañon, Lockwood's ranch, and Hogback; of these, that at Bent's Cañon is much the most promising ranch. Near Hogback is a sharp, bare hill of plutonic rock, from which this station gets its name. About 8 miles from Trinidad the road again approaches the Purgatoire at a point where the valley widens out, rendering available considerable arable land, depending simply upon proper irrigation and cultivation to provide ample supplies for the town springing up at El Moro, the present terminus of the Denver and Rio Grande narrow-gauge road, which, with enterprise, is feeling its way to the south, gathering the freight of New Mexico. This latter town has all the bustle of the last railroad town, and may eventually be extended to unite with Trinidad, the older and larger place, some 5 miles beyond, the growth of which seems to have increased with the proximity of El Moro, rather than to have been sapped by it, as is so frequently the case. Situated as these are at the entrance to Raton and Long's Cañon Passes, they are less likely to die out as the road passes on beyond. The coal-field in the vicinity of Trinidad will contribute to its support. Beyond the cul-de-sac in which Trinidad is situated, the character of the country changes entirely. The rise from West Las Animas to Trinidad, of 2,158 feet, is very gradual. Here the foot-hills of the main Rocky range and the Raton spur close in. Leaving the main stage-road at Trinidad, our course lay up the Purgatoire for about 8 miles. Ranches, with their cultivated fields, claimed each inch of ground capable of tillage, till leaving the stream we follow a less frequented road, ascending the cañon with even grade. Gently rising, we pass beyond the piñon growth marking the lower hills and reach the pine-covered country extending to the heavily broken plateau of the Raton Pass, hardly to be styled as a mountain range in comparison with the bare, bold crests of the serrated range from which it springs. Although not reaching the elevation, it offers in its broken surfaces, its many cañons, its sharp rises and sudden cuts, almost as great difficulties to engineering skill in locating a road across it as the more prominent ranges. From the Purgatoire to Elizabethtown is a fan-like succession of secondary ridges, broken by the cañons of the Vermejo, the two branches of the Poñil and the Van Brimmer Park. This whole section is well grassed, timbered, and watered, and for a mountain range could not be excelled for cattle. For a railroad pass to Cimarron and country east of the mountains it is, while higher, of so much better grade than the Raton Pass, that Long's Cañon would probably be adopted in preference to the latter, having for its southern outlet the course of the Canadian to Red River Station. For a direct pass to Elizabethtown it could be only made available by the most careful study of the minor topography, deviating in many places from the present located wagon routes Elizabethtown is situated at the head of a fine park at the base of the Bald, between this peak and the main range; with perhaps less bustle than in former days, it is still a mining town of some little prosperity. From Elizabethtown to the entrance of Taos Pass extends a beautiful park, presenting no difficulty to a railroad route; the pass is a good one, and will doubtless be eventually utilized; the wagon road is fair, but in need of work.

Taos Valley is one of the finest grain-growing districts in New Mexico, extending from

the base of the mountain nearly to the Cañon of the Rio Grande, from the mouth of the United States Mountain Cañon to the Cañon of Pueblo Creek. On it are Fernandez de Taos, the old Mexican town, near which is the Pueblo de Taos, the old Indian town, former capital of the Pueblo Nation, Rancho de Taos, formerly subordinate to the Fernandez Plaza, but now nearly equal in population, and Los Cordovas, at the junction of the streams watering the other towns. The Rio Grande opposite this valley is boxed in a great cañon about 800 feet deep, extending 60 miles to the north, on both sides capped with basalt. The Arroyo de Cieneguilla runs just east and south of the basalt, and from the little town on the other river-bank of the same name the stream divides the two formations; on the west is the purplish black of the basalt, on the east the variegated, tinted, illy formed granite from the nearly fused quartz and feldspar, with its white, pink, and red shades, to the dark gray of the more micaceous, friable rock. On the west the direct result of the internal heat is vomited forth upon the earth. On the east is found the metamorphosed sandstone, burnt crisp by the more indirect action. Farther down, the river again cuts asunder the basalt plateau, but to open out at La Joya into a wide valley, needing but American enterprise to reclaim it from a sandy plain and render it rich in crops of cereals. Even the simple efforts of the Mexican have been rewarded with rich vineyards and fair orchards. The native fruit, excepting the grape, is not of fine flavor, but where the trees brought from the East have been cultivated the result has been very encouraging indeed. La Joya, Los Luceros, Plaza del Alcalde, San Juan, and San Ildefonso are found on the river, and Santa Cruz, Pojoague, Cuyamungue, and Tezuque on the tributary streams, where crossed by the main road leading to Santa Fé. Between Santa Fé and the Rio Grande is a low range of hills. South of Santa Fé the main range dies out. The mountains beyond these, east of the Rio Grande, in prolongation of the main axial line, are more broken up; they lose their continuous ridge-like form. North of the Galisteo are the Cerillos, which are but low hills, azoic in formation, broken by many basaltic dikes. They would be of little importance but for the mines of argentiferous galena and copper. Several thin mines of turquoise have been rudely worked by Indians, Spaniards, and Mexicans. There are throughout the whole region evidences of old mines, worked probably by the Spaniards with Indian labor, before the latter drove their former conquerors from the country. South of the Galisteo are the old Placers, the Puerto or New Placer Mountains, the Sandia, San Pedro, and San Isidro Mountains, in all of which are mineral deposits. The formation in these ranges is mainly azoic; toward the west there are carboniferous croppings. The Sandias are capped with fossiliferous limestone. The Placers have auriferous copper-ores, also iron and coal. The Puerto or New Placers are full of metalliferous ores and deposits, copper, lead, iron, gold, and silver ores. The Sandias have many traces of copper and lead. The ores of the whole region require careful handling, with more skill than has yet been given them. There is no doubt as to their existence in paying forms if properly treated. About both the new and old Placers gold-diggings that would give very large returns with hydraulic washing extend nearly around the entire bases. The water-supply is very limited, but with the advent of capital means will be found to bring water there, to reclaim its cost twenty-fold. Real de Dolores, Real de San Francisco, Alamocito, San Antonito, San Antonio, and Tijeras all are found in the basins between these mountains. West of the Sandias is the Rio Grande Valley. South of the Sandias are the Manzanos, the northern portion of which range consists of a low plateau broken up by numerous cañons, the branches of the Tijeras Cañon, Coyote Cañon, Cañon del Norte, Cañon Infierno, Cañon de los Ejes and Moyas. The western slope is abrupt, indeed cliff-like; the dip of the rock to the east renders it gently rolling country in that direction. Just south of Cañon Moyas the range shoots up into the Mosca Peaks, which run above timber-line. The limestone is again here found. From Mosca southward to Manzano Peak the elevation of the higher points is about 10,000 feet. The formation is similar to that of the Sandias. The cañons on the west are short and bounded by high, cliff-like walls; those on the east and southeast are longer and more tortuous. The range can be crossed by Hell Cañon, also just north of Mosca, following up Tejique Creek, or by Comanche Cañon, south of Mosca. That by Hell Cañon is a rough wagon-road, the others but horseback-trails. The main drainage is to the east; Chilili Tejique; Torreon Manzano, Osha, and Abo Creeks being the principal waters. On the west there are no running streams, but along the base are found Ojo de la Casa, Ojo del Trigo, El Hediondillo, Cañon de Salas, Ojo del Cañon de Monte Largo, Cristoo, and Justamente Springs. Farther out on the plains are Ojo de la Cabra, the Ojuelos, and Ojo de los Casos. At the Ojuelos is a fine sheep-ranch. From the base of the mountain the country slopes gently to the river in nearly uniform grade. The river valley proper, or that which can be placed under irrigation with but little trouble, is in places from 3 to 5 miles wide. The soil, while sandy, is rich in salts nourishing to plants, and, with water, produces the most inviting fields. Hardly a tenth of the present arable land is now utilized. Many little towns extend along the river from Albuquerque to Fort Craig; on the west bank are Atrisco, Padillas, Pajarito, Isleta, Los Lunas, Los Charez, Ranchitos de Belen, Belen, Pueblitos de Belen, Los Jarales, Punto del Bosque, Bosque, Ranchitos de Sabinal, Sabinal, Pueblito de Sabinal, Picacho de Sabinal, San

Carlos, San Geronimo, Alamillo, Polvadera, Limitar, Escondido, Socorro, San José, San Antonio, San Antonito, and San Marcial. On the east bank are Ranchitos e Isleta, Los Pinos, Perolta, Valencia, Tome, Ranchitos de Tome, Constancia, Casa Colorada, Valleta, Chihuahua, Las Nutrias, Ranchas, San Francisco La Joya, La Joyita, Sabina, Pueblito de la Parida, La Parida, Bosquecito, Valverde, La Mesa, and Contradera. These towns vary in population from a few families to perhaps 1,500. The principal towns are Isleta, Los Lunas, Belen, and Socorro on the west bank, Valencia, Constancia, and La Joya on the east bank. Socorro is marked by much more American enterprise than the majority of New Mexican towns, arising largely from the mines in the Magdalena Mountains bringing money into the section. The approach of a railroad will brighten up the prospects of the country, which needs but enterprise supported by capital to make it rich in its own resources. The grapes will be probably the main source of income of those living in the valley proper. West from Socorro are the Socorro Mountains, a short ridge of azoic rock. Copper is found here. West of this range are the Magdalena Range, running north and south, which have throughout their whole extent mineral ledges and deposits. A few fissure-veins with quartzite wall-rocks are found, but generally the one is in indefinite deposits. The northern end of the range has, for surface rock, carboniferous limestone resting on azoic quartzite. It is here that argentiferous galena, carbonate, and yellow oxide of lead are found. At present the mines are not extensively worked. The ores exist in sufficient abundance to well pay for working with experienced management, but with haphazard work, of men ignorant of proper treatment of the ores, they are apt to obtain a reputation which will keep capital away. Just west of these mountains is a low range of hills, near the Corona del Pueblo Spring, in which are found argentiferous copper-ores. Sinking prospect shafts and mining with little or no system has been done here with the poor results almost sure to follow such treatment of the deposits. North of these are the Ladrones, a sharp uplift broken into a serrated edge difficult of approach, and so nearly destitute of water as to discourage the prospector; traces of copper are found throughout the range. The southwest spurs are capped with limestone. The eastern rocky slope is quartzite. Mule Spring, in a drain of this southern spur, is one of the few water-croppings in the range proper. The northern slope is very precipitous. The range has little to support life; grazing is not as good as usually found in mountains; hence less game and very few cattle are seen. The point as a triangulation-station is very important, connecting the surveys from the north and west with the system south and east. The peculiarity of this range, as of nearly all mountains in Southern New Mexico, is the suddenness of their uplift. With but few foot-hills of much importance, they rise directly from the plains extending about their bases; hence, the water-sheds being small, few streams are found. The plains, with their porous soil and nearly level surface, quickly drink up the rains and give them out only by the rock-croppings at the springs which run but a short distance. From Abo Pass, extending to the south, is a much broken plateau of sandstone country, west from which is a narrow plateau of drift; very little water is found in this belt. The few springs are the Ojo Sepulto, Ojo Parida, Ojo del Cibolo, and Ojo de las Cañas; and the tanks are Aguejes de los Torres, de los Tomasceños, and del Cañoncito on the west, and the Llano and Coyote Springs on the east. The water supply at the Parida is very good; that at Llano Spring has been developed by digging; that at the other points is very limited. On the eastern portion of this belt is a sharp basaltic butte, standing in the center of a limited volcanic overflow of the sandstones.

Abo Pass, which separates this belt from the main range, is a low divide, well calculated for a railroad-pass; indeed, the best in connection with the cañon Piedra Pintada to be found any place along the range this far north. At Abo and Quara are old ruins, presumably Spanish, built at the first occupation of the country, before Europeans were expelled by the Pueblo Indians. The two main buildings, in each case from their form Catholic churches, are about 100 feet long, built of stone—a laminated sandstone. The walls vary from 3 to 7 feet thick, the former being the usual thickness; the latter that of the abutments. Their European architecture is probable from being built in that form of a cross usually adopted by the descendants of the Spaniards in their churches. Arches are also found, in which respect they differ entirely from the ruins found in the San Juan country, which are ascribed to the Aztecs. In both ruins the altars were at the north end of the building.

East from the mountains extends the immense plain, broken by the mesa-edge on the south known as the Jumanes. Farther east are three hills known as Las Animas, one of which we called Rattlesnake Hill, from the number of those snakes we saw there, probably from three to five hundred. In sixty-five minutes three of us killed seventy-nine snakes, varying in size, all of the same species. The largest had thirteen rattles. They had been out to the south of the hill, and toward sunset came in for their night-shelter in the rocks. Southeast of these hills about 18 miles are more alkaline lakes. Wells have been dug near them, giving fair water. The station is known as Posos del Pino. From here northward to Pedernal the country is greatly rolling, with fair grazing. Beyond Pedernal it is more or less broken by drains leading into Cañon Piedra

Pintada and Cañon Blanco. From Cañon Blanco the route was through the plateau country, extending north to the Dry Cimarron, all of which, to Fort Lyon, was described in your annual report of 1876.

I desire to take this opportunity to tender my thanks to the members of the party for their cordial co-operation in the work, as also to the officers of the military posts visited for their uniform courtesy.

I am, sir, very respectfully,

CHAS. C. MORRISON,
First Lieutenant Sixth Cavalry.

Lieut. GEO. M. WHEELER,
Corps of Engineers, in charge.

APPENDIX F.

EXECUTIVE AND DESCRIPTIVE REPORT OF LIEUTENANT M. M. MACOMB, FOURTH ARTILLERY, ON THE OPERATIONS OF PARTY NO. 2, CALIFORNIA SECTION, FIELD SEASON OF 1876.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Washington, D. C., April 30, 1877.

SIR: I have the honor to submit the following executive report of the operations of party No. 2, California division, of the survey under your charge during the field season of 1876.

The party rendezvoused at Carson City, Nev., during the latter part of August and the first part of September, being one of the parties organized there under your supervision. It was composed as follows: Lieut. M. M. Macomb, Fourth Artillery, executive officer and field astronomer; Frank Carpenter, topographer; Alfred Dubois and Sergeant G. W. Ford, Twelfth Infantry, recorders; H. W. Henshaw, naturalist; A. R. Conkling, geologist; W. H. Rideing, general assistant; two packers, one teamster, and two cooks.

During the first few days of September, Mr. Carpenter was employed in working up the topography of Eagle Valley, in which Carson City is situated. On the 7th, he was sent out with a small party for the purpose of making, if found advantageous, a primary triangulation-station on Spanish Peak, north of the Central Pacific Railroad, at the same time surveying a line through country that would not be traversed by the other parties, the trip to occupy seven or eight days. Meantime arrangements were made for the storage of all surplus property, the purchase of forage for use during the season, and the supplying of parties in the field. For this latter purpose it was found necessary to increase the means of transportation, and, accordingly, on the 13th, six team-mules were purchased by telegraphic authority from the Quartermaster-General.

While at the rendezvous, Messrs. Henshaw and Conkling found ample employment for their time in their respective branches, the former in making collections in zoology, the latter in visiting the various mines and mineral and thermal springs in the vicinity. Besides these duties, both rendered assistance to the other members of the party in keeping up the hourly series of meteorological observations commenced August 26, a detail being constantly employed day and night.

The work especially assigned to my party was the survey of Lake Tahoe and the neighboring country, the line of the Central Pacific Railroad being the northern limit. Part of this area lies in Nevada, part in California, and when mapped will appear upon Atlas-sheets 47 D and 56 B. A short description of its general topographical features will be given here.

Beginning with the peaks just north of the well-known Carson Pass in the Sierra Nevada, there is a well-marked bifurcation, the main ridge here sending out a bold and lofty spur to the northward, itself continuing on, but with diminished height, to the northwest. This spur is loftier than the main ridge, having an average altitude of 9,800 feet. It culminates to the south in Freel's Peak, and to the north in Mount Rose, in whose vast mass it terminates. Both of these points are over 10,800 feet above sea-level. It is called the Eastern Summit, in contradistinction to the main ridge, which is known as the Western. Southwestwardly from Mount Rose runs a long spur, reaching almost to the western summit, between which and itself it leaves a narrow valley. There is thus formed in the bosom of the Sierras a triangular basin with a length of about 37 miles and a base of perhaps half that dimension. At the southern apex of this triangle the Upper Truckee takes rise, and meanders its way for about 15 miles through the beautiful and fertile Lake Valley, finally expanding into Lake Tahoe, which occupies the northern part of the basin. Vastly increased in volume, it issues from the lake, through the narrow valley above referred to, a heavy and rapid stream. Flowing west a short distance, it changes its course to the north, and then making a grand

sweep to the east, flows onward, finally emptying into Pyramid Lake, which has no visible outlet. Thus the waters of the Lake Tahoe Valley are tributary to that great interior basin, that peculiar system of so-called "sinks," in which all the waters of Nevada, with a few trifling exceptions, are swallowed up. The eastern summit breaks down quite precipitously to the east into the valley of the Carson, some of the branches of which river rise in the little valleys of Hope, Faith, and Charity just east of Carson Pass. The western summit slopes gradually to the west, all its waters from Carson Pass to Summit Station on the Central Pacific Railroad (some 43 miles) being collected into the American River by its south, middle, and north forks and their various branches, by which, as might be expected, numerous valleys and deep cañons are formed.

It was not until the 14th of September that the party moved into the area assigned to it, when camp was made at Glenbrook, on the east shore of Lake Tahoe. The route followed from Carson was over the King's Cañon road, which, winding up the slope of the eastern summit until it attains an altitude of some 2,500 feet above our camp in Eagle Valley, descends to the lake, giving grades practicable for heavy teams. Another route between Carson and Glenbrook, known as the Clear Creek route, and used by the Lake Tahoe stage-line, joins the first mentioned at the summit. A steep grade on this road not far from the summit causes the King's Cañon route to be preferred for heavy teaming. The stage-route is about a mile and three-quarters shorter than the other, by which the distance is about fifteen and a quarter miles. Travelers by either route pay toll at the summit.

Glenbrook is very prettily situated on a small bay about the middle of the east shore of the lake. A brook flowing through a deep and shady glen empties into this bay and gives the place its name. Settled in 1860, it was the first place of any permanence on the lake, and is now the principal village, claiming some four hundred inhabitants. It is the center of the Lake Tahoe lumber-trade and possesses four saw-mills and a planing-mill. The saw-logs are floated here from lumber-camps on the north, west, and south shores of the lake, and I was informed that about 25,000,000 feet of sawed lumber are annually turned out. The principal markets are Virginia and Gold Hill, the great mining center of Nevada. The lumber is now carried to the top of the eastern summit by means of a narrow-gauge railroad built in 1875. As the grade of the wagon-road from Glenbrook to the summit is about 290 feet to the mile, the railroad avoids this by running some three miles north of Glenbrook, then ascends the slope by a zigzag, the general plan of which would be a flattened and distorted Z. The angles of the Z are arranged as the ordinary railroad Y, and thus a considerable difference of level is overcome by moderate grades. From the summit a flume between 9 and 10 miles in length runs down the Clear Creek Cañon, and by this fire-wood or lumber can be delivered within a mile of Carson. Received here by the cars of the Virginia and Truckee Railroad, it can be carried to the points where it is wanted.

One of the first objects to strike the eye after reaching Glenbrook is a prominent mass of basalt just to the south, which bears the interesting name of Shakespeare's Cliff. A moment's careful inspection will show on an almost vertical escarpment not far from the summit a mass of greenish-gray lichens standing out plainly against the dark surface of the rock. A glance at this will without any stretch of the imagination transform it into a truly striking resemblance to the head and bust of the great poet as seen in profile; the high forehead, massive brows, and pointed beard being wonderfully reproduced. This was plainly visible from our camp in the neighborhood of a mile to the north. Situated about the middle of the eastern shore, and not half a mile from it, with an altitude of some 800 feet above the lake, the cliff affords a fine panorama of the entire western and the greater part of the northern and southern shores. Of the lake itself I attempt no description, as that will be found in full in the report of the geologist, but the following facts in connection with it may be of interest:

The geographical position of the lake is well fixed by the one hundred and twentieth meridian of west longitude transversing its length, and the thirty-ninth parallel of north latitude crossing its southern end. Its developed shore-line may be set down in round numbers at 70 miles, and its superficial area at about 188 square miles, of which two-thirds lies in California, the remainder in Nevada. Five counties border upon it: Washoe, Ormsby, and Douglas in Nevada; Eldorado and Placer in California. The principal settlements are Glenbrook, on the east shore, Rowland's, on the south, and Tahoe City on the west. The others are McKinney's, on the west, near Sugar-pine Point, Yank's on the south, and Hot Springs on the north shore, and State-line Point. At all these points accommodations may be found for tourists. During the summer and fall Tahoe City is connected with Truckee on the Central Pacific Railroad by a daily line of stages carrying passengers and mails, while Glenbrook is similarly connected with Carson. A small steamer makes a daily tour of the lake, touching at all the places mentioned. A stage is also sometimes run between Hot Springs and Truckee. A good road connects Glenbrook and Rowland's, whence a moderately good one runs to Yank's. Thence to McKinney's there is a trail, very bad, near Emerald Bay, and from McKinney's to Tahoe City there is a road. A rough trail, passable for riding or pack

animals, connects Tahoe City, Hot Springs, and Glenbrook. Finding at Glenbrook an excellent camping-ground and good feed for the animals, it was decided to make a main camp here and study the features of the eastern summit by detours to the south and north. Accordingly, on the arrival of the topographer at this camp, a trip was made to the south, and a main station established on a well-defined point, showing well from the stations in the neighborhood of the base, near Virgin a City. About this time, also, a second small party, in charge of the geologist, was ordered to make a trip around the lake, putting up signals on points along its borders, which might be of assistance in establishing the shore-line, and at the same time obtaining reliable information concerning the trails and roads about the lake.

The work along the range to the south having been completed as far as thought necessary from this camp, a detour was made to the north. During this trip the narrow-gauge railroad already referred to was surveyed and the lake shore meandered far enough to the north to be connected with without difficulty on the home trip.

A main triangulation station was also made and the topography of the range finished as far as possible to the northward. Marlette Lake was likewise visited and surveyed. This little lake is beautifully situated in a basin just west of the main ridge, and considerable interest attaches to it from the fact that it is the source from which the Virginia Water Company intend drawing their supply. It is easily reached by a very fair wagon-road which leaves the stage-road at Spooner's Station, about five-eighths of a mile from the summit. It drains into Lake Tahoe, but by damming its outlet it has been increased to many times its original size. It now measures about 1½ miles in length by half a mile in breadth, with a superficial area approximating to 300 acres. Our barometric observations make its altitude 7,750 feet or 1,548 feet above Lake Tahoe, and high enough above Virginia City and Gold Hill (some 16 miles distant in a straight line) to give a good head there. In order to get the water across the ridge a tunnel is being pierced through the granite rock composing it about 3 miles north of the lake where the ridge is narrowest. This tunnel is in a fair way toward completion, and will have a length of nearly 4,500 feet, with a cross-section of about 6 by 8 feet. The water will be led to its west end by a ditch or flume. On the eastern slope the flume has been built and is in operation, being at present fed by some of the mountain streams of that slope. Pursuing a tortuous course down the mountain-side until a steep slope is reached, the flume discharges its contents into a pipe which descends rapidly until it reaches its lowest point at Lake View, on the low ridge separating Eagle and Washoe Valleys. Following up this ridge for some 5 miles the pipe delivers its waters to a flume which conveys them to their destination, Gold Hill and Virginia.

Returning from this trip to the Glenbrook camp, September 24, we were delayed a day on account of its being necessary to discharge the two packers and a cook, whose places I was fortunately able to fill without much difficulty. Meantime the party sent around the lake having reported, camp was moved on the 26th to a point near Rowland's, on the south shore of the lake.

About 3.3 miles south of Glenbrook the road passes Cave Rock, which is the most prominent object on the eastern shore, being easily discernible from our stations on the western ridge. It is a mass of porphyritic trachyte rising some 150 feet above the lake, the road being carried round its base on trestle-work. The rock derives it name from a cave extending some 30 feet into its side. The top and sides of this cavern are darkened by a peculiar pitchy deposit similar to that described in full in vol. v, (Zoology, p. 559,) of the published reports of this survey.* Between 2 and 3 miles farther Zephyr Cove is reached, once a popular stage-station, but now deserted.

In the palmy days of staging, before the completion of the overland railroad, the road was kept in beautiful condition, and sprinkled twice a day. Although not traveled nearly so much as formerly, it is still an excellent road, and a great deal of farm and dairy produce passes over it to the Virginia markets. In about 4 miles from Zephyr Cove Small's Station is passed, at which point the Kingsbury Grade road crosses the eastern summit, coming out in the Carson Valley about 3 miles south of Genoa. A little less than a mile farther on Kearney's Station is reached. When the the State-line was run it was found to pass directly through the inn, and it is said that guests may dine either in Nevada or California by simply changing sides at the table. The boundary monument on the lake shore near by was visited and brought into the scheme of triangulation. Here we left the main road, which continues up the east side of the valley, and took the road along the south shore of the lake to Rowland's, and camped in a meadow near by. Leaving the main party here, the topographer and myself, with a small party, started for Freel's Peak. Bad weather and a broken barometer obliged us to devote two days to our observations here. A small monument and a bottle containing records found on the summit showed that the peak had been visited Sep-

* It is worthy of remark that careful observations by the naturalist of the party do not confirm the theory there advanced ascribing the deposit to lizards, but point rather to the opinion expressed by Prof. Cope, that it is produced by some small mammal, probably the *Neotoma cinerea*.

tember 15, 1874, by a reconnoitering triangulation party of the United States Coast-Survey. On the completion of our work here the topographer made a detour into Hope Valley, working down the valley of the Carson almost to Genoa, and returning by the Kingsbury Grade, thus finishing the topography of the eastern summit included between that road and Hope Valley. Meanwhile, finding it impossible to use the Army wagon on the west side of the lake, I sent it back to Carson, with all surplus impediments for storage, and had sufficient stores to last the remainder of the season deposited at Glenbrook, where was left also the wagon and such team-mules not used as riding or pack animals. The means of transportation was thus reduced to ten pack and twelve riding mules and one extra animal.

Breaking camp at Rowland's we proceeded south through Lake Valley, striking the main road in about 4½ miles. Following this some 3½ miles, Osgood's toll-house is reached. Here the road leaves the Truckee River and winds up the slopes of the western summit, which it crosses, descending the western slope through the cañon of the South Fork of the American, which is here a rapid mountain stream. The road crosses it by a bridge at Slippery Ford, and soon after passes a lofty and almost perpendicular cliff bearing the hackneyed name of "Lover's Leap." At Strawberry Station, a mile farther on, there is another toll-house. Following the main road some 4 miles farther, we left it at the Georgetown junction and passed up into the mountains, camping at Sawyer's Ranche, within easy striking distance of our objective point—Pyramid Peak, in the western summit. Clouds and mists hanging about the peak interrupted our work greatly, and kept us two days at this point. There is a fine stock range here, affording pasturage for several hundred head of cattle. I was informed by the proprietor that in the season he produced as much as 125 pounds of butter a day, though at present he was not making more than 60. The stock is generally driven out about October 15 to winter in the Sacramento Valley. The distance from Sawyer's by road to Strawberry is 12 miles; by trail only about 3½. The trail is passable for riding animals, but dense groves of small trees make it impracticable for heavily-laden pack-mules. Locating the next main camp at Yank's, on the southern shore of Lake Tahoe, and on the west side of Lake Valley, surveys were made of Fallen Leaf and Cascade Lakes, and Tallac Peak occupied for topographical and triangulation purposes. This peak is a most interesting one, not only on account of its own beauty as seen from the lake, but because of the beautiful view from its summit. Situated only about 3 miles from the lake in a straight line, and fully 3,500 feet above it, the bird's-eye view obtained is simply perfect. The Hot Springs Hotel, at the northern end of the lake, was clearly visible, as well as the houses of the settlements on the south shore. The little steamer, a white speck upon the blue expanse, was seen making its daily rounds.

Fallen Leaf and Cascade Lakes, and many others of less size embowered in trees, lay beneath our feet. To the southwest Pyramid Peak rears its rugged crest, embracing between itself and Tallac a deep rocky depression, dotted with numerous pools, and known as the "Devil's Basin."

Fallen Leaf Lake (118 feet above Tahoe) is easily accessible from Yank's by a wagon-road which leaves the head of the lake at Gillmore's Ranch, and passes on several miles farther to a fine soda spring; from there on a trail leads nearly to the summit of Tallac. A herd of several hundred Angora goats find subsistence on the slopes of the mountains south of Gillmore's Ranch.

Cascade Lake (330 feet above Tahoe) is oval in shape, and about a mile long, deriving its name from a fine water-fall some 250 feet high at its head. For interesting facts relating to the glacial origin of these lakes I refer to the report of Mr. Conkling.

On the 17th of October we left Lake Valley and proceeded on our way around the lake. In the neighborhood of Emerald Bay the trail is exceedingly steep and difficult, and some trouble was experienced from several of the pack-animals rolling down the steep slopes. After leaving here, however, no difficulty was met with. The bay is about two miles long by three-fourths of a mile broad, narrowing down at the entrance to a quarter of a mile. At its extremity is the summer residence of Mr. Ben. Holladay, jr., which is entirely concealed in a grove of aspen and willow. A more charming retirement it would be hard to find.

From the north point of the bay to Rubicon Point the shore is steep and rocky, but the trail from there to McKinney's is excellent. Before reaching McKinney's the trail crosses a bold projection known as Sugar Pine Point, from the fine trees of that name growing there. A large lumber-camp located here afforded a good opportunity of witnessing the mode of lumbering generally in vogue on the lake. The trees are sawed instead of cut down and converted into saw-logs as they lie. These logs vary from 20 to 60 inches in diameter, the length varying to suit purchasers, generally between 20 and 30 feet. Perhaps the most interesting feature is the great wagons on which the logs are hauled to the lake. These are made immensely strong, the wheels being constructed of a section cut from a saw-log, and are from 3 to 3½ feet in diameter, being about 6 inches broad at the tire, and bulging out at the center. The heavy cross-beams on the wagon-body are furnished with iron stirrups of peculiar construction, in which rest

the ends of heavy planks used in loading. The wagons are drawn by six or eight yoke of oxen. To give an idea of what can be done by these wagons it is a matter of record that 14,900 odd feet of lumber in the shape of saw-logs has been placed upon one of them. This was popularly known as the "boss load," and photographs of it can be obtained at Truckee.

We took advantage of the lumber-camp smithy to have our mules shod, many of them being badly in need of it, and while waiting occupied several topographical stations in the western summit.

A good trail, opened some years ago by Mr. McKinney, runs from here to Georgetown, crossing a branch of the Middle Fork of the American some eight miles from McKinney's, and called by him the Rubicon. From here we moved up the valley of Blackwood Creek, containing abundance of fine feed, and camped near Twin Peaks. The weather being excellent, a day sufficed for our work here. To the north we saw several fine points, (among them the Needle and Granite Chief,) which we intended to occupy, though our hopes of this were somewhat dashed by Mr. McKinney's statement that he looked for snow every day, and that the probabilities were that in a short time the higher peaks would be impassable.

Meandering the lake-shore as far as Tahoe City, we moved thence down the Truckee and encamped October 26 at the head of Squaw Valley, which drains into that stream. This valley is well watered, and produces abundance of fine hay. A cattle-ranch is located here, and we found the ranchmen busily engaged in collecting their stock previous to driving them out for the winter. They informed us that a trail led out of the valley to the west, passing near the peaks we wished to occupy, while a second trail constructed by them during the summer permitted egress to the north. Wishing to ascertain the proximity of the peaks, I ascended a higher point at the summit of the pass, called Fort Sumter from its peculiar outline, but a heavy mist completely shut out the view.

The 27th was stormy and rainy, and during the night about 4 inches of snow fell, which continued all the next day. The stock was driven out just in the nick of time, as the meadows were now covered with about 8 inches of snow. Several bales of hay left by the ranchmen afforded feed for the mules, so that I was not obliged to move out at once, which I was unwilling to do, as this would be our last chance to work up the topography of this portion of the range.

The 30th, breaking bright and clear, afforded an opportunity of making a final attempt at the "Needle," or, should this prove impracticable, at least of making a topographical station on the high point near the summit of the pass. We found the snow deeper than we expected, but finally made the point only to find, however, that the mists, which had been gathering during the ascent, completely enveloped the higher peaks, and in a few moments our own, giving us just time to catch a fleeting glimpse of the Needle, about a mile and a half to the northwest, "pointing its lean finger to the sky" as if in mockery at our efforts.

On this trip I obtained for the first time occular evidence that there are deer in these mountains by a well-marked trail in the snow. From this it was evident that the animal, driven from the mountains by the snow, had taken a hasty survey of the valley, then turned in its tracks and made a rapid exit. I decided to follow its example, and on November 1, after having meandered Bear Creek, which we had passed a few days before, left the valley in a snow-storm. Soon after reaching the Truckee and Tahoe turnpike the snow ceased, allowing the road and river to be meandered as far as Truckee on the Central Pacific Railroad. Learning that Lieutenant Tillman was encamped only about 4 miles from here, on Prosser Creek, I moved on there to consult him concerning the connection of our triangulation. Finding that he and his topographer were absent on a trip to Castle Peak, we proceeded to work up the topography north of Lake Tahoe, camping in Martis Valley. From here we attempted the ascent of Mount Rose, but found it impracticable from the west. Camp was then moved to Hot Springs, near the extremity of the promontory known as State Line Point. This is one of the most interesting places on the lake, and the view is exceedingly beautiful, especially at this season, when the mountain peaks, capped with snow, contrast strongly with the dark pine forests clothing their rugged sides. For the accommodation of tourists, a hotel and a number of small cottages have been erected, the water of the springs being utilized for bathing purposes. The proprietor received us with true Californian hospitality, tendering us free use of the cottages and baths, which kindness we were glad to take advantage of. While here the survey of the lake was completed, and connection made with the monuments of the California and Nevada State line. Lieutenant Tillman visited us at this camp, and obtained information with reference to points occupied by us to the southward. Learning of our failure to reach Mount Rose from the west, he determined to attempt the ascent from the north. Of the success of this attempt we had the unexpected pleasure of being eye-witnesses. While occupying a high point north of the lake and some 7 or 8 miles southwest of Rose we were delighted to observe, through the telescope of our instrument, Lieutenant Tillman at work. The next day we passed over the eastern summit, connecting with the work previously

done, and camped at Franktown, in Washoe Valley. November 9, we reached the rendezvous-camp at Carson, where Messrs. Henshaw and Conkling were detached from the party under orders received from you early in the season. We then passed up the Carson Valley as far as Genoa Hot Springs, connecting with work previously done. Upon the completion of this we proceeded to occupy a peak in the range of mountains east of Carson Valley, and known to us as Mount Como. This is a high point almost due south of the peak, in the same range occupied by Lieutenant Birnie's party early in the season under the name of Mount Lyons.

On the way to our peak a meander was obtained of Eldorado Cañon, the general course of which is nearly north and south, its mouth being near Dayton on the Carson River. Soft gray limestone occurs near the entrance quite plentifully, and is burned in a lime-kiln at this point. A good toll-road runs up this cañon, and a small stream meanders its way through it, crossing the road at frequent intervals. The slopes on either side are bare of vegetation, except now and then a little sage or a scrubby pine. The lack of vegetation allows one to see easily the fantastic shapes into which the elements have carved the rocky sides, but the heat in summer must be very great. Near the head of this cañon is situated the Virginia City Company's coal-mine, the product being a lignite of fair quality. Proceeding onward some 3 miles from the mine we camped near the base of what is locally named Mineral Hill, where lie the springs in which Eldorado Creek rises. This hill stands up well when viewed from the neighborhood of Virginia City, and was observed, I believe, by the party there under the name of Como. The point known to us under this name, however, lies some four miles to the southeast, and is considerably higher, being in the main range, which runs nearly north and south, and is called in the neighborhood the "Como Range," after an abandoned mining-town of that name near Mount Lyons. It has also been frequently called the Pine Nut Range, after the timber of that name, which was once quite plentiful, but which has now been almost entirely cut off for fuel.

About 28 miles in length, it breaks down on the north into the valley of the Carson River, which sweeps round that end, and on the south into that of the West Walker. About 4 miles north of us the ridge sends out a spur to the eastward, which drains to the north into the Carson, and on the south into the West Walker. Just to the east lies a barren, sandy valley containing a small alkaline flat. To the east of this is a range of low, sandy hills, beyond which lies Mason's Valley, through which flows the main stream of the Walker River. The eastern slope is quite steep, while the western falls gradually off to the Carson Valley, being broken up into valleys and cañons by minor ranges and foot-hills. Mineral Hill is high enough to hide the Carson Valley to the northeast, but it is visible for nearly its whole length south of Genoa.

Finishing our work here we returned to Carson by way of the Brunswick Cañon, through which runs a fair wagon-road, which crosses the cañon by a bridge at the Brunswick Mill, where there is a toll-house.

Leaving Carson again, the quartz-mills along the river between Empire and Dayton were located; then passing through Virginia City the survey of the Geiger Grade, leading thence into Steamboat Valley, was taken up where the work of Lieutenant Symons's party ceased, and camp was made at Steamboat Springs, on the Virginia and Truckee Railroad. These springs are among the most interesting in the State, and have been known for many years. Clouds of vapor continually rising make them conspicuous for several miles. From the name one might be led to expect that the emission of this vapor would be accompanied by a sound like that made by the exhaust-steam of a western river steamer, but I noticed nothing of the sort. The rocky mound in which the springs lie is situated at the base of a spur of Mount Rose. Numerous small pools are found on the summit of this mound, the temperature of the water varying from blood-heat to almost boiling. Besides the pools, long irregular fissures occur from a few inches to a foot in width, and extending to a considerable depth. In these the water can be seen boiling and bubbling violently, sometimes disappearing entirely, then rising to view again. In some of the pools I noticed a white deposit like that frequently seen in sulphur springs. The water when cool is perfectly drinkable, and is not so impregnated with minerals as to prevent the use of soap in washing. A hotel has been erected here and has connected with it a commodious bath-house, which is built directly over some of the fissures above referred to. The springs are easy of access, being by rail only 11 miles from Reno on the Central Pacific Railroad, and about 20 from Carson. They are considerably resorted to during the summer on account of the medicinal properties of their waters. Steamboat Creek flows a few hundred feet east of the springs and empties into the Truckee. Steamboat Valley contains a considerable amount of arable and grazing land, and widens out on the north into the Truckee meadows.

Our next camp was at Glendale, a small hamlet on the Truckee, and formerly a station on the old transcontinental emigrant-road. Passing from here up the east side of Steamboat Valley along the base of the range running north from Mount Davidson several topographical stations were made on the ridge, and a small portion of the shore

of Washoe Lake meandered. The rendezvous-camp was reached November 25th, and the party disbanded.

We were in the field eighty days, during which time we traveled in all 1,024 miles, of which 654 were meandered. Seven main triangulation stations were occupied, and fourteen secondary. Eight hundred and thirty-four station were made on meander line, and one hundred and two three-point stations as checks or for the location of important points. One hundred and three cistern-barometer altitudes were observed besides the aneroid determination at each meander station. The highest point reached was Freel's Peak, in the eastern summit of the Sierras, 10,862 feet above sea-level, the lowest 4,222 feet, on the Central Pacific Railroad.

But few sextant latitude observations were needed as checks, since every important point could be located by triangulation. The instrumental outfit of the party was the same as that generally allowed and needs no special mention. For interesting points concerning the natural history and geology of the area visited, I beg to refer to the special reports of Messrs. Henshaw and Conkling.

Very respectfully, your obedient servant,

M. M. MACOMB,
Second Lieutenant Fourth Artillery, U. S. Army.

Lieut. GEO. M. WHEELER,
Corps of Engineers, in charge.

APPENDIX G.

PRELIMINARY REPORT ON EXAMINATION AT THE COMSTOCK LODE, BY JOHN A. CHURCH.

VIRGINIA CITY, NEV., *June* 30, 1877.

SIR: I have the honor to submit a short report of the work in the Washoe mining district during the month of June, 1877, in accordance with your instructions. Arriving on the ground on the 11th day of that month, it was obviously impossible to do more in the short remainder of the fiscal year than to place and enter upon the prosecution of the work.

I find that the period of seven or eight years which have passed since the last extended study of this region has been the period of greatest activity and greatest change the Comstock lode has ever witnessed. The mines have been opened a thousand feet deeper than in 1869, and have changed from a vertical to an inclined system of working, in correspondence with the change in the dip of the vein. To meet this altered condition of things the mines have all established a separate system of hoisting for the incline; these are being raised to the head of the incline by a "giraffe" and then dumped to a car which is run upon the cage and hoisted as formerly through the vertical shaft. None of them attempt to raise the ore by one continuous hoist through both the inclined and vertical shafts. Preparations are now completed in one shaft and going on in two others for resuming the extraction through vertical shafts by sinking in the east country-rock of distances in two cases of more than half a mile from the outcrop of the vein.

Changes quite as important have been effected in machinery. The geared pumping-engines, which were formerly used by all the mines, have been replaced in most of them by very elaborate and expensive direct-acting compound engines, controlled by the Davey valve gear, which has been somewhat modified in this region. The pumps are all of the Cornish pattern and are now raising water from depths of 2,000 and 2,300 feet. Direct-acting hoisting-engines have also been introduced at one shaft, and the speed of hoisting increased in those mines which are extracting great quantities of ore. Self-dumping skeets have taken or will take the place of the ordinary cage and car in two of the deep shafts. These alterations in the method of working are all important in view of the great depths to which these mines will probably be carried. The machinery now on the ground is sufficient for depths of 3,000 feet, and the method of working the incline and vertical shafts separately adapts it to much deeper sinking.

Underground engines are used in considerable numbers for pumping, hoisting, and ventilation, and as these are all worked by compressed air, the mines along this lode offer probably the most extensive series of air-compressing engines to be found in any district. They are mainly of two types, the Burleigh and a modified Waring.

All these changes have produced great effects upon the mining of the district and the financial fortunes of the owners. As now instituted, the mining industry of Washoe presents important opportunities for studying the effect and economy of modern mining-machinery.

Ventilation and pumping have become questions of especial importance. The heat

of the vein, and also of the country-rock, has on the whole increased, or, at all events, high temperatures have become more common as the workings gained in depth. Observations on this point have been collected, and a system will soon be instituted which, it is hoped, will afford valuable information upon the best means of overcoming the heat of the mines.

The deep adit called the Sutro Tunnel has penetrated about 17,500 feet, and is now about 2,750 feet from the lode. It is advancing at a rate of speed which should take it to the vein about March, 1878. It will, however, reach the line of the deep shafts sunk in the east country rock some time next month. Its completion cannot fail to have important results upon the drainage of a vein that is liable to sudden outbursts of water in great quantities, as the Comstock is.

The milling of the ores has undergone some alterations, but nothing so extensive as those above indicated in the mining. The latest-built mills are models of convenient arrangement and economy. On the whole, the ore which is now extracted is richer than any which has been obtained since the earliest period of mining on the Comstock vein, and the problem of milling these ores with as high, or a higher, return as was formerly obtained from less-rich ores has been successfully grappled with.

I have thus sketched, in a very general way, the condition of the field to which I am assigned. My work so far has consisted in preparing for the observations necessary to a study of the ventilation and drainage of the vein and the position of the ore-bodies found below the 1,000-foot levels.

I have great pleasure in acknowledging the courtesy and frankness with which every one connected with the mines has received me. No restraint has been placed upon investigation, but, on the contrary, the survey can count upon the active co-operation of the mining companies, even at some trouble and cost to themselves.

I am, very respectfully, yours,

JOHN A. CHURCH,
Mining Engineer.

LIEUT. GEO. M. WHEELER,
Corps of Engineers, in charge.

APPENDIX H.

GEOLOGICAL REPORT ON THE PORTIONS OF WESTERN NEVADA AND EASTERN CALIFORNIA BETWEEN THE PARALLELS OF 39° 30′ AND 38° 30′, EXPLORED IN THE FIELD-SEASON OF 1876, BY MR. A. R. CONKLING.

NEW YORK CITY, *April* 16, 1877.

SIR: The area examined is bounded on the north by a line drawn through Truckee, Cal., and Washoe City, Nev.; on the east by the Mount Davidson Range and the Como Mountains; on the south by Job's Peak and Pyramid Peak; and on the west by the Western Summit and the Truckee River.

Nearly all of this region is covered by granite, with occasional outbursts of basaltic rocks. No fossils are found except at the State prison quarries, one mile east of Carson City. There is abundant evidence of the former existence of glaciers in the mountains bordering Lake Tahoe. Thermal and mineral springs occur in several localities. A few ore-deposits are found within the area explored in 1876, but only one of them possesses sufficient importance to deserve more than a passing notice.

Two ridges, running north and south, traverse this section of country. They are termed the eastern and western summits. Lake Tahoe separates the one from the other. The latter range is more broken up by precipitous cañons and minor ridges than the former. Both the summits are sparingly wooded, from the base to the crest-line, and may be regarded as parallel lines of elevation.

Having given an account of the general features of the area explored in 1876, I now propose to take up the geology in the following order:

1. Description of the Carson Valley and vicinity.
2. Sketch of Lake Tahoe.
3. The eastern summit.
4. The western summit.

THE CARSON VALLEY.

There are several thermal springs in the Carson Valley within a radius of about fifteen miles of the capital of Nevada. The most important spring rises in yellowish sandstone about a mile east of Carson. The temperature of the water is 111 degrees F. A bath-house has been erected at the springs adjoining the State prison. Another hot spring occurs in mica slate 2½ miles northeast of Carson. The water is clear and has a temperature of 120 degrees F. There are several wells about 10 inches deep in

the ground filled with this thermal water. Both these springs contain sulphereted hydrogen, a gas generally evolved in the fissures of rock in a volcanic region. At Genoa, 14 miles south of Carson, and near Franktown, 10 miles north of the same place, warm springs occur. Both houses and hotels have been built at both these localities. I was unable to learn the temperature of either of these thermal waters. I collected quart bottles full of water from the above springs for analysis, but upon reaching Washington it was found that either the cold weather or careless treatment in transportation had resulted in the breakage of the bottles and consequent loss of contents.

The greater part of the Carson Valley belongs to the Quaternary, and there is very little rock *in situ*, excepting on the eastern side of the valley, where a few minor ridges and buttes of basalt occur. The line of upheaval in these ridges is north and south. Beginning on the north, we have a low range of gray granite, which contains numerous crystals of black hornblende, and separates Washoe Valley from the Carson Valley. Rocky tors of granite outcrop in various places on this divide. The North Carson Mine occurs in this ridge, but for a description of it see chapter on mines. At Swift's Spring, 2¼ miles northeast of Carson, a ledge of gray mica slate outcrops. This is the only locality in the valley where a metamorphic rock is found. I did not find the continuation of the mica-slate beds. Olivine incrusts a low ridge of diorite about 50 feet high and a quarter of a mile long in the eastern part of the Carson Valley. A mass of granular yellow sandstone about 30 feet thick outcrops at a point a mile east of Carson. This sandstone is underlaid by clay, and apparently does not cover more than an acre. Invertebrate fossils are common in the rock, particularly the genus *Unio*, which is oftentimes stained by the oxide of iron. Vertebrate remains have also been found, but I was unable to obtain any. Black mica is sparingly disseminated through the sandstone. The rock is extensively quarried by the inmates of the State prison, and is much used for building purposes. The State-house and railway shops of the Virginia and Truckee Railroad are constructed of this sandstone. Buttes of gray basalt, with a porphyritic texture, are found a short distance east and southeast of the State prison. The Como Mountains form the eastern boundary of the Carson Valley. They are composed of trachyte-porphyry. The height of this range is about 8,500 feet.

A bed of soft gray limestone, having a compact texture, occurs near Dayton, and a bed of blue limestone is found near the stage-road about half-way between Carson City and Clear Creek. This rock is burned in kilns at both localities, but I was unable to examine either of the deposits of limestone, and hence cannot state the thickness or dip of the strata.

A bed of lignite occurs about 8 miles due east of the Carson Valley. It lies in the El Dorado Cañon, on the line of Ormsby and Lyon Counties. The locality is known as the Virginia City Company's Coal-mine. A good wagon-road from Dayton renders the mine easy of access.

This lignite was discovered by English miners soon after the finding of the Comstock Lode. Prior to 1865, 9,800 tons of brown coal were exported from the mine, and under the incorporation of 1872, 21,600 tons were taken out, making a total of 31,400 tons since the formal opening of the mine. After 1863 the Virginia City Company suspended work for about eight years. Out of the 31,400 tons which the mine has yielded, 13,800 tons have been burned in Storey County, and the balance at the company's hoisting-works. The amount of money expended since the re-incorporation of 1872 is $110,000, and previous to that time about the same sum, making in round numbers the total cost of working the mine $220,000. I visited this deposit of lignite in the El Dorado Cañon on November 20, 1876, in company with Prof. W. F. Stewart and Mr. R. M. Daggett, the superintendent of the company. The object of our visit was to select a spot for the sinking of a new shaft. After some consultation a locality was decided upon about 1,200 feet southwest of the present hoisting-works. Professor Stewart has described the lignite beds in detail, and I condense from his report the following: "The coal indications in Western Nevada generally appear in the Tertiary. There is reason to believe that the El Dorado lignite belongs to this age. The mine lies near the head of the cañon. There are two shafts, called respectively the Virginia and Newcastle. The former shaft is 420 feet deep, and is the one most used, as the hoisting-works are at the mouth of it, while the latter one is but 85 feet deep and is now full of water. For about 300 feet from the surface the formation consists of alternating layers of marl, soft gray sandstones, shales, fire-clay, carbonized vegetable matter, and beds of weathered lignite. Below this is pudding-stone or bowlder clay. There are three veins of lignite, which are, counting from the surface, respectively 16 feet, 15 feet, and 6 to 8 feet in thickness. Bowlders and volcanic ashes occur between the veins. Pyrite is found with the lignite in the form of cubes. In making a section across the lignite beds from southeast to northwest we have first granite, then the miscellaneous formation containing the veins of lignite, then a dike of basalt, next sedimentary strata referred to the Tertiary, and finally an extensive mass of trachyte, which covers the country for several miles."

SKETCH OF LAKE TAHOE.

Lake Tahoe lies in the heart of the Sierra Nevada, at an elevation of 6,202 feet above the sea-level. It is one of the largest fresh-water lakes in the West, and, unlike many other sheets of water, contains no islands. Lake Tahoe is inclosed by two parallel ranges of grayish granite, called respectively the Eastern and Western Summits.

Lake Tahoe is 21 miles long and 12 miles in the widest part. The breadth, however, varies greatly, the southern portion being much narrower than the northern. The shore-line is very diversified. The numerous bays, rocky promontories, bold headlands, estuaries, and beaches, oftentimes covered with pebbles, remind one of a miniature ocean. Hot springs are found on the north side of Lake Tahoe, near Campbell's hotel. They rise in granite. Standing on the dock in front of the hotel, the observer may see bubbles of gas in several places rising in the clear water of the lake. One spring is inclosed by a brick wall about 3 by 4 feet. The temperature of the water in this spring is 132° F. A bath-house has been built near the hotel directly over another spring, having a temperature of 128° F. The spring-water contains sulphydric acid.

Lake Tahoe is remarkable for its great depth. It is probably the deepest lake in the United States. There are only two lakes in Europe that are deeper than Tahoe, viz: Lago Maggiore and Lago di Como, in Italy. The shallow water has an emerald-green color, which is more frequently observed on the southern and southeastern portions of the lake than elsewhere. The width of the emerald-green zone varies greatly. In some places this zone is nearly half a mile broad, especially in the shallow water of the southern part of the lake. Where the bottom slopes rapidly the emerald-green water extends only 100 to 150 feet from the shore-line. The deep water is of elegant ultramarine-blue color. The transparency of the water is wonderful. According to experiments made by Prof. John Le Conte, a white object can be seen at a depth of 115 feet. The depth of the water at the line of junction of the ultramarine-blue and emerald-green colors is at least 100 feet. The temperature of Lake Tahoe, taken on the north shore in November, is 50° F. This lake does not freeze in winter, and I am inclined to believe that there is but little variation of temperature, if any, throughout the year. The temperature of the deep Alpine lakes is 39°.2 F. at all seasons of the year. People living on the borders of the lake rarely bathe in it, even in midsummer.

Soundings were made in Lake Tahoe in November, 1875, by Messrs. John McKinney and Thomas Jackson, two of the oldest settlers in this section of California. The apparatus used belonged to the Coast Survey, and was forwarded from Oakland, by Prof. Joseph Le Conte. It consists of a hexagonally-shaped plumb attached to a rope about one-quarter inch in diameter. Rhombic pieces of brass are fastened to the rope at intervals of 100 feet. There is a bit of leather half-way between the pieces of brass, and the space between each bit of leather and brass is divided equally by a scrap of red cloth. By means of this apparatus many soundings were taken along the State line, which runs through the middle of the lake, and in the western part of this body of water from Emerald Bay to Observatory Point. The sounding-line was not used at any place east of the State line. Supposing the reader to be familiar with the outline of Lake Tahoe, and beginning at the southern end, the first sounding is 900 feet near the point where the State line trends to the southeast. Going northwards the depth increases steadily. Soundings taken at five localities indicate a depth respectively of 1,385 feet, 1,495 feet, 1,524 feet, 1,600 feet, and 1,645 feet. The average depth of the lake measured along the State line, for 10 miles due north and south, is from 1,200 to 1,410 feet. Commencing on the western shore of the lake, near Emerald Bay, the first sounding is 750 feet. At Rubicon Point, 4 miles further north, the depth is 850 feet near the shore. This is owing to the fact that the face of this rocky headland slants quite abruptly. At Meigs's Bay the depth is 750 feet, at McConnell's it is 700 feet, and Barton's Mills it is 330 feet. A short distance eastward of the two latter places the lake deepens rapidly. Midway between the State line and the shore at McConnell's, the sounding taken was 1,506 feet, and at a point a few miles north, opposite Barton's Mills, the sounding-line marked 1,540 feet. Keeping tolerably near the shore we have 772 feet as the next sounding north of Barton's Mill. The last observations to be mentioned were taken in the northwestern portion of the lake. In front of Tahoe City, the depth was found to be 312 feet; a little further east the sounding-line indicated 1,350 feet, and still further near the State line it is marked 1,501 feet. In general it may be said that while the depth increases in the middle of the lake in going from south to north, it decreases in the same direction in the western portion. In some places the sediment at the bottom adhered to the plumb, and the specimens thus brought up enable us to form some idea of the lake-bed. Near Emerald Bay mica was found in the soundings in considerable quantities, evidently derived from the disintegration of the granitic rocks bordering the lake. But the most interesting sediment was obtained at a point near the deepest part of the lake, 3½ miles southeast of the Warm Springs, and about 3½ miles northeast of Observatory Point. I have examined this sediment with the microscope and find that it contains many species of Diatoms. Not being very familiar with the protophytes, I sent some of the sediment to Prof. H. L. Smith, of

Geneva, N. Y., for investigation. A few days afterwards Professor Smith informed me that he had identified the following species: *Cyclotella operculata, C. rotula, Pinnularia viridis, Navicula varians, Epithemia turgida, E. sorex, E. argus, E. gibba, E. Westermanii, Gomphonema, dichotomum, G. tenellum, G. herculaneum, Himantidium undulatum, Fragilaria capucina, Cocconeis placentula, Navicula elliptica, Cocconema lanceolatum* and varieties, *Mastogloia* ——, *Cymbella* ——, *Celosira undulatum. Melosira italica* is the commonest species. The sediment consists chiefly of it.

Prof. Joseph Le Conte has examined sediment from the bottom of Lake Tahoe. He informs me that a few Diatoms are found at a small depth, while the sediment at great depths consists entirely of Diatoms and certain organic particles, which puzzled him for a long time, as they were much disintegrated. Finally Professor Le Conte recognized this organic matter to be the pollen grains of conifers. They are blown over the lake, sink, and do not decompose on account of the coldness of the water. In closing the chapter on Lake Tahoe I cannot do better than make a brief reference to the appearance of the lake in windy weather. During storms it is not uncommon to see waves 2, 3, and sometimes 4 feet in height. In ordinary weather sufficient motion is imparted to a row-boat to cause sea-sickness. Even on a calm day there is a gentle undulating movement of the water along the lake-coast. During a fresh gale, the waves beat against the shore with almost as much noise and force as on the Atlantic coast. The shore-line is continually shifting, especially on the southern side of the lake, where a sand-beach occurs. Scattered along the coast of Lake Tahoe are numerous pebbles, which are wafted by the waves from place to place as on a sea-beach.

THE EASTERN SUMMIT.

This name has been given to the mountain-range forming the eastern boundary of Lake Tahoe, and extending north and south for about 34 miles. My observations were confined to the portion of the eastern summit lying between Mount Rose and Job's Peaks. The ridge-line of this range is gently undulating, and has a nearly uniform height, there being no lofty pinnacles rising above it. There are but few precipitous gorges in the eastern summit, and the cañons are regular in form, with the exception of Clear Creek Cañon, which is not only very broad and winding, but nearly traverses the entire range. The main stage-road to Glenbrook runs through the bottom of Clear Creek Cañon, and the western part of the road from Carson City through King's Cañon extends along the northern side of this cañon. These roads unite at the summit of the pass, 7,186 feet high, near the toll-gate. From this point a broad wagon-road is continued down the western slope of the range to Glenbrook, a distance of 2¼ miles. There is but one other pass that is traversed by a wagon-road, viz, the pass between Genoa and Kearney's Station. There are several other defiles in the Eastern Summit that can be made practicable for wagons. A wagon-road crosses the range and descends on the western slope to the Virginia tunnel. There is a road running to the head of the cañon due south of Mount Rose. The topographical features of the country would not prevent the prolongation of these two roads across the range to the foot of the western side.

The western slope of the Eastern Summit, like other ranges in the far West, is much steeper than the eastern slope. The entire range is densely wooded, although the timber has been removed on the eastern side. As the method of lumbering practiced here is somewhat peculiar, a description of it may be of interest. On account of the large size of the trees, saws are used instead of axes in felling them. After a tree is cut down, it is sawed into sections about 5 feet long. Deep holes are bored into these sections with a long-shanked auger, into which powder is stored, and the wood is blasted in the same manner as rock. There is no arable land on the eastern slope of the Eastern Summit, except in Clear Creek Cañon, where a few vegetables are raised. There are a few small Alpine lakes on the summit of the range. The Twin Lakes are scarcely worthy of the name, being only 400 by 200 feet in area. Marlette or Silver Lake is about half a square mile in area. This lake is partly artificial, its size having been increased by damming. A tunnel about 8 by 6 feet in cross-section runs out of Marlette Lake. It will be 4,500 feet long when finished and has a southeasterly direction. The waters will be conducted from the east end of the tunnel to the Carson Valley by a flume. The water in the streams of the Eastern Summit is cold and clear. The creeks running down the eastern slope flow through the Carson Plain and empty into the Carson River, while those on the western side of the summit empty into Lake Tahoe. There are no irrigating-ditches in the Eastern Summit, but the waters of several streams are diverted from their natural course and conducted through flumes for the transportation of lumber. The principal flumes in this range are the Clear Creek Cañon, the Franktown, and the Washoe City.

The streams in the Eastern Summit are rapid, narrow, and easily fordable. The soil of the range is largely composed of disintegrated granite. Numerous spurs diverge from the eastern slope of this range, and extend in some cases far out into the plain, appearing like buttresses. There are no spurs on the western slope, unless the head-

lands and points projecting into Lake Tahoe are considered as such. A general account of the topographical features along the eastern border of Lake Tahoe may be appropriately given in connection with the Eastern Summit. Beginning at the northeast corner of the lake we have the semicircular Todman's Bay, which has for the most part a sandy beach. In the northeast corner, black magnetic sand occurs on the shore. For the next 6 miles the banks of the lake are steep, and several low promontories extend from the shore. Just north of Glenbrook a bold rocky headland projects far out from the general shore-line, and forms a very conspicuous point in the northern half of the lake. Glenbrook, the most important settlement on Lake Tahoe, and the headquarters of the lumber trade, lies in a small bay. There is considerable arable-land in this vicinity. A strip of productive land extends back from the lake for a distance of 2 miles, where it is called Spooner's Meadow. Proceeding south the coast-line is quite uniform until Cave Rock is reached. This is a very conspicuous point. The name is derived from the fact that a cave about 20 feet long and 10 feet high occurs on the south side of this projecting rock, which consists of porphyritic trachyte. There are three low, densely wooded tongues of land on the eastern side of Lake Tahoe south of Cave Rock. The shore-line is regular, and sandy for the remaining portion of this coast of the lake. A good wagon-road follows the eastern border of this sheet of water from Glenbrook to Lake Valley. There are no outlying ridges belonging to the Eastern Summit that run parallel to it. The Eastern Summit is bounded on the east by the alluvial valleys of Carson and Washoe. The low ridge of granite that separates these valleys may be regarded as a spur of this main range. There is no other place between Washoe City and Carson City where rock occurs *in situ*.

The Eastern Summit consists chiefly of granite and syenitic granite. A few eruptions of igneous rock have taken place throughout the range. Beginning at the northernmost part of the range explored by me, the first upheaval is Mount Rose, where a conical mass of basalt has broken through the granite. Many bowlders of this rock are scattered over the country for several miles to the east and south. The color of the rock is blue, and on the summit of Mount Rose the basalt is laminated and ferruginous. There are no trees within 300 feet of the top of the peak, the only vegetation being moss and occasional tufts of grass. There are many anticlinal ridges running in every direction on the west of Mount Rose. The rock forming the summit is much disintegrated, and the south side, which is quite steep, is covered with *débris*. This peak is 10,820 feet high. A spur of the Eastern Summit, near Carson, consists of trachyte. On the western side of the range, just south of Glenbrook, a mass of feldspathic diorite, about 700 feet high, occurs. It has been called Shakspeare's Cliff, on account of a peculiar grouping of the lichens on the face of the cliff bearing a strong resemblance to the profile of the poet. The north side of this butte is perpendicular half-way down, with soil and *débris* sloping to the valley. The south side contains many pillars of the diorite, showing the prismatic structure finely. Some of these columns are curved, and of considerable length. Shakspeare's Cliff is 773 feet above Lake Tahoe. The butte known as Cave Rock has already been mentioned. It is about 150 feet high. No igneous rock is found south of this point in the portions of the Eastern Summit explored by me.

The conical mountains known as Job's Peaks and Freel's Peak form the southernmost limit of this range. These peaks, together with their outliers on the north and west, consist of grayish granite. Some of the ridges diverging from Job's Peaks have a serrated outline, and are densely wooded with pine and spruce. The summits of these peaks are covered with loose fragments of granite, while the slopes are dotted with rocky tors and projecting crags, which present a very picturesque appearance. The altitude of these mountains is as follows: Freel's Peak, 10,862 feet; Job's Peak, 10,650 feet; Job's Sister, 10,760 feet. In general, it may be said that the ridge-line of the plateau-like range called the Eastern Summit consists entirely of granite, which is flanked in several places by igneous rocks, which are usually spurs of the range. The average height of the Eastern Summit is about 9,800 feet. Ore-deposits occur in the Eastern Summit, the principal of which are the following:

1. The Montreal mine. This mine is situated about 2½ miles northwest of Carson City. It was first opened in 1870, and has been worked at intervals ever since. A tunnel, several hundred feet long, has been driven in the side of the mountain, above which is still another tunnel 150 feet in length. The ore occurs in gray granite and quartz rock. The granite is frequently poor in mica. Dark-blue sandstone-veins traverse the country-rock. There is but little water in the mines. The ore is argentiferous; some of it is said to assay as much as $1,700 per ton. The main rock forming the slope of the mountain in which the Montreal mine lies is syenitic granite. A small stamping-mill was in course of erection in September, 1876, and eighteen men were working at that time.

2. The Emerald mine adjoins the preceding. This mine was discovered in 1874, and has been worked at intervals since then. A tunnel 400 feet long has been driven in the granite. The rock is darker within the tunnel than at the surface, where it is soft and crumbling. The ore assays $90 to the ton.

3. The Clear Creek Cañon mine known as the William's Lode. This mine was opened in the autumn of 1875, and has been worked at intervals from that time. The wall-rock is granite, overlaid by grayish clay. The vein runs north 71° east, and is about 3 feet wide. The dip is 37°. There is a tunnel 300 feet long, and a shaft 75 feet deep has been sunk. The minerals found are malachite, azurite, pyrite, and crystalline-quartz. About $60,000 has been expended on this mine, and but two men were working in September, 1876. Half a mile northward is the Woodstock Lode. The vein-matter runs northeast and southwest, and is exposed in a small prospect-hole. Both the Williams and Woodstock Lodes are argentiferous. There are several other prospect-holes on the ridge between Clear Creek and Carson City, but no developments of any account have been made thus far.

4. The Niagara mine. I did not visit this mine, but the following description is condensed from the report of Mr. H. R. Whitehill for 1873–'74: "The Niagara mine is situated north of King's Cañon, and west of Carson. The vein is incased in slate and gneiss, and is 30 feet wide on the 100-foot level. Besides two cross-cuts on the surface, there is a shaft 5 by 6 feet sunk to the depth of 100 feet. A drift about 70 feet, running in a westerly direction, (the dip of the vein being almost 45° to the west, pitching into the hill,) cuts the vein at about 40 feet, and thence runs 35 feet through the lode toward the west wall. The rock contains from 5 to 30 per cent. of copper, which gives it a green color. The copper schist lies east of the gneiss, in which free gold is found. This mine has good clay walls, and is, doubtless, a true fissure-vein. Assays of ore from this mine have reached into the hundreds. It is incorporated, and is divided into 30,000 shares. The extent of this claim is 1,500 feet along the lode."

THE WESTERN SUMMIT.

This term has been given to the range bordering Lake Tahoe on the west. The portions of it explored in 1876 lie between Pyramid Peak and the town of Truckee, a distance of about 35 miles. The range rises abruptly from the level of the lake to a comparatively narrow serrated ridge-line, and passes gradually into a series of broad plateau-like foot-hills, which extend westward to the Sacramento Valley.

The Western Summit is composed of several ridges running parallel or nearly parallel to each other. Beginning at the southern end, there is the Pyramid Peak Range on the extreme west; then come two minor irregular ridges between it and the Tallac Range. The latter is of a very picturesque outline. The cañons of the Western Summit are winding and greatly diversified. This range is not densely wooded, except along the foot of the slopes, and the peaks are rocky and barren. Quaking-aspens grow on the eastern slope and in Blackwood and Truckee Cañons. There is scarcely any vegetation in the upper parts of the range. Some of the peaks are remarkable for the great variety of lichens growing on their rocky summits. Black, yellow, gray, brown, and red lichens are found on Twin Peaks. White thorn and manzanita bush abound on the easterly side of the Western Summit, and a few ferns are scattered hither and thither. The principal trees are pine, spruce, and fir. In the southern part pines attain the height of 150 feet. The trunks of these trees are oftentimes covered with bright-green moss for a distance of 30 feet from the ground. There is but little arable land in this range; Squaw Valley, Blackwood Cañon, and Tahoe City being the only places where it may be found to any extent. There are numerous lakes on the Western Summit; the most important of which are Fallen Leaf, Cascade, and Echo Lakes. The one first named is situated in the western side of Lake Valley, about 1⅛ miles from Lake Tahoe, which is 118 feet lower. Fallen Leaf Lake is about 1 mile wide and 3½ miles long. The temperature of the water was 54° F. in October. On the northeast shore of this lake are found pebbles of a great variety of rock, such as slate, basalt, granite, diorite, &c., all of which have been brought from the lofty Western Summit. Cascade Lake is about 1½ miles from Lake Tahoe, and lies directly in front of Tallac Peak; but, unlike Fallen Leaf Lake, its discharge-creek has considerable fall, and the surface of Cascade Lake is 350 feet above Tahoe. A lumber-road leads from the former to the latter.

Echo Lake lies between two rocky ridges on top of the Western Summit, about 1 mile from the Placerville road. It is about 1½ miles long and one-fourth mile broad. The southern bank of the lake is lined with conifers and a few alder bushes. Elsewhere the shores are very barren and rocky. Beside these just-described lakes there are at least twenty others of minor importance throughout the Western Summit. These mountain lakelets usually lie in cup-shaped depressions in the granite.

The principal streams in the Western Summit are the south fork of the American River and the Truckee River. The former rises near the "Devil's Basin," flows south, then southwest, and empties into the Sacramento River. The latter rises at the head of Lake Valley, flows northward through Lake Tahoe, just as the Rhone flows through the Lake of Geneva, then turns westward, and finally, after running northerly for several miles, takes a northeastern direction and empties into Pyramid Lake.

Most of the brooks in this range rise on the ridge-line, flow eastward, and empty into

Lake Tahoe, the more prominent of which are Blackwood and McKinney's Creeks. The water of all these streams is cold and clear.

There are two passes in the Western Summit that are traversable with vehicles: The Placerville stage-road, called the "grade," on the eastern slope, several miles south of Mount Tallac, which was constructed in 1860, soon after the discovery of the Comstock Lode; the other pass that is traversed by a wagon-road is the cañon of the Truckee River, from the town of the same name to Tahoe City. The road runs along the south side of the river for 7 miles from Truckee, when it crosses the stream and continues on the northern shore to the lake. A wagon-road traverses a spur of the Western Summit on the north side of Lake Tahoe, from Warm Springs to Truckee. A road runs up to the head of Blackwood Cañon, which might be continued across the range. A wagon route follows the lake shore from Warm Springs to Tahoe City, and thence to McKinney's. There are no irrigating ditches in this range. The topography of the western shore of Lake Tahoe may be aptly described in the following manner: The southwestern shore of the lake presents bold and rocky headlands. Emerald Bay is an indentation of the coast, extending 2¼ miles inward. The opening of the bay is about half a mile broad. Going northward, the shore is tolerably regular, but rises abruptly from the level of the lake. At Rubicon Point a steep rocky promontory juts into the lake. From this place to Tahoe City there is very little rock *in situ*, the shore being a comparatively level strip of alluvium, with a sandy beach, and bordered with a very thick growth of manzanita as far as Sugar Pine Point. The coast-line runs north, without any marked features until Meigs's Bay is reached. This is a picturesque bight, about half a mile in breadth, which is bounded on the north by Sugar Pine Point. This tongue of land is the longest in Lake Tahoe, and covers at least 3 miles in width, including its sinuosities. On the northern side of this point the shore-line trends nearly due west for a mile, and then northward again, without appreciable curves, to Tahoe City, forming the broad Upson's Bay. At this locality the land bears northeast to Observatory Point, a V-shaped cape jutting far out into the lake. The coast-line then runs northerly and curves gradually until it has an eastward bearing, forming the semi-circular Cornelian Bay. The northern shore of the lake tends gently to the southeast until the western boundary of Todman's Bay is reached, thus forming the rocky promontory known as State-line Point, which divides California from Nevada. This point stretches far out into Lake Tahoe, and diminishes gradually in width till the apex consists simply of a row of detached masses of rock, decreasing in size until the water-level is reached.

There has been much more erosion and denudation in the Western than in the Eastern Summit. In the former range the gorges have precipitous walls. The slopes of many ridges are covered with *débris*.

The scenery throughout the Western Summit is exceedingly picturesque. The variety in the landscape seen from any of the high peaks is unique. The rugged mountains azure lakes, and winding cañons present a scene of surpassing grandeur. There is a striking contrast between the eastern and western slopes of this range in reference to the timber; the former being for the most part bare and rocky, while the latter is densely wooded.

There is abundant evidence of the former existence of glaciers in the Western Summit. I have condensed the following extract from Prof. Joseph Le Conte's paper on "Ancient Glaciers of the Sierra,*" as he has studied the glacial phenomena thoroughly:

"Between the Eastern and Western Summits lies a trough fifty miles long, twenty miles wide, and 3,000 to 3,500 feet deep. This trough is Lake Valley. It was formerly occupied by a great glacier rising near Pyramid Peak, filling Lake Tahoe, and escaping northeast toward the plains. Some of the ice escaped by Truckee Cañon, for I have found glacial markings on the rocks in this cañon. During glacial times the trough of Lake Valley, the lower half of which is now filled with the waters of Lake Tahoe, was a great *mer de glace*, receiving tributaries from all directions except the north. The tracks of the smaller glaciers are more easily traced than those of the principal one. Of the two summits, the western is the higher. It bears the most snow now, and in former times gave origin to the grandest glaciers. Again, the peaks on both these summits rise higher and higher as we go toward the upper or southern end of the lake. Hence, the largest glaciers ran into the lake at its southwestern side. Between this point and Sugar Pine Point, a distance of about nine miles, I saw the pathways of five or six glaciers. North of Sugar Pine Point there are also several. They are all marked by moraine ridges running down from the summits and projecting as points into the lake. Inasmuch as the highest mountains are on the southwesterly end of the lake, the greatest glaciers have been there as well as the profoundest glacial sculpturings. I need only name Mount Tallac, Fallen Leaf Lake, Cascade Lake and Emerald Bay. These three fine little lakes, (for Emerald Bay is also almost a lake,) nestled closely against the loftiest peaks on the western summit, are all per-

* Am. Journal, Ser. III, vol. v, p. 125; Proc. Cal. Acad. Sciences, vol. iv, part 5, p. 259.

fect examples of glacial lakes. South of Lake Tahoe extends Lake Valley for fifteen miles as a plain gently rising southward. Its lower end is but a few feet above the lake-surface, and covered with glacial drift modified by water and diversified, particularly on the western side, by *débris* ridges, the moraines of glaciers which continue to flow into the valley or into the lake long after the main glacier had dried up.

"*Fallen Leaf Lake glacier.*—This lake is bordered on either side by an admirably-marked *débris* ridge (moraines) 300 feet high, 4 miles long, and 1½ to 2 miles apart. These moraines may be traced back to the termination of the rocky ridges that bound the cañon. On the one side the moraine lies wholly on the plain, on the other side its upper part lies against the slope of Mount Tallac. Near the lower end of the lake a somewhat obscure branch ridge comes off from each main ridge, and, curving round, they form an imperfect terminal moraine, through which the outlet of the lake breaks its way. On ascending the cañon, the glaciation is very conspicuous, and becomes more and more beautiful at every step. From Soda Springs upward it is the most splendid I have ever seen. In some places the whole rocky bottom of the cañon is smooth, polished, and gently undulating, like the surface of a glassy but billowy sea. The glaciation is distinct also up the sides of the cañon 1,000 feet above its floor. There can be no doubt, therefore, that a glacier once came down this cañon, filling it 1,000 feet, scooped out Fallen Leaf Lake just where it struck the plain, and changed its angle of slope, and pushed its snout 4 miles out on the level plain nearly to the present shores of Lake Tahoe, dropping its *débris* on either side, and thus forming a bed for itself. In its subsequent retreat it seems to have rested its snout some time at the lower end of Fallen Leaf Lake, and accumulated there an imperfect terminal moraine.

"*Cascade Lake glacier.*—On either side of the creek, running out of this lake from the very border of Lake Tahoe, runs a moraine ridge up to the lake, and thence along each side of it up to the rocky points, which terminate the true mountain cañon above the head of Cascade Lake. I have never anywhere seen more perfectly-defined moraines. I climbed over the larger western moraine and found that it is partly merged into the eastern moraine of Emerald Bay, to form a medial at least 300 feet high and of great breadth. From the surface of the little lake, the curving branches of the main moraine, meeting below the lake to form a terminal moraine, are very distinct. At the head of the lake there is a perpendicular cliff, over which the head of the river precipitates itself, forming a very pretty cascade of 100 feet or more. On ascending the cañon above the head of the lake for several miles I found everywhere above the lip of the precipice, over the whole floor of the cañon, and up the sides 1,000 feet or more, the most perfect glaciation. There cannot be, therefore, the slightest doubt that this is also the pathway of a glacier which once ran into Lake Tahoe. After coming down its steep, rocky bed it precipitated itself over the cliff, scooped out the lake at its foot, and ran on till it bathed its snout in the waters of Lake Tahoe, and probably formed icebergs there. In its subsequent retreat it seems to have dropped more *débris* in its path, and formed a more perfect terminal moraine than did Fallen Leaf Lake glacier.

"*Emerald Bay glacier.*—All that I have said of Fallen Leaf Lake and Cascade Lake applies almost word for word to Emerald Bay. This beautiful bay, almost a lake, has been formed by a glacier. It is also bounded on either side by moraines, which run down to and even project into Lake Tahoe, and may be traced up to the rocky points that form the mouth of the cañon at the head of the bay. Its eastern moraine, as already stated, is partly merged into the western moraine of Cascade Lake to form a huge medial moraine. Its western moraine lies partly against a rocky ridge running down to Lake Tahoe to form Rubicon Point. At the head of the bay, as at the head of Cascade Lake, there is a cliff about 100 feet high, over which the river precipitates itself and forms a fine cascade. Over the lip of this cliff and in the bed of the cañon above, and up the sides of the cliff-like walls, 1,000 feet or more, the most perfect glaciation is found. The only difference between this glacier and the two preceding is that it ran more deeply into the main lake, and the deposits dropped in its retreat did not rise high enough to cut off its little rock basin from that lake, but exists now only as a shallow bar at the mouth of the bay. This bar consists of true moraine matter, *i. e.*, intermingled bowlders and sand, which may be examined through the exquisitely transparent water almost as perfectly as if no water were present. Some of the bowlders are of large size. One sees from the top of Tallac Peak the whole course of these three glaciers, their fountain amphitheaters, their cañon beds, and their lakes inclosed between their moraine arms."

Professor Le Conte has found abundant evidence of the former existence of a great glacier in Lake Valley. Bowlders and pebbles of slate on the north shore of Fallen Leaf Lake can easily be traced to their parent rock in the cañon above the lake. These pebbles have also been traced along the western shores of the great lake beyond Sugar Pine Point to the extreme northwestern shore, nearly thirty miles from their source. The Fallen Leaf Lake glacier was once a tributary to a much greater glacier that filled Lake Tahoe. Again, Le Conte finds additional evidence of a Lake Tahoe *mer de glace* in the contrasted character of the northern and southern shores of the lake. The same

observer states that all the other sierra lakes he has seen certainly owe their origin to glacial agency. Lake Tahoe has been partly shaped by the same operation, and traces of glacial deltas are found along the western shore.

Le Conte thinks careful examination would discover the pathways of glaciers running into the lake from the eastern summit, but he failed to detect any evidences of them. In my own examination of this range I found no traces of glaciers, particularly no glacial scratches. There are some bowlders scattered over the eastern side of the range that may have been transported by glaciers.

The predominating rock in the western summit is granite. But igneous rocks such as basalt, diorite, and phonolite have broken through the granite in several places. This range may be fitly divided into the Pyramid Peak ridge, the Tallac Peak ridge, the Twin Peak ridge, and the ridge north of Truckee Cañon.

Beginning on the south, the Pyramid Peak ridge consists chiefly of granite. This is the westernmost ridge of the western summit, and its southern boundary is the American Fork Cañon, a narrow, windy valley with precipitous sides composed of gray granite. The peak itself is a mass of coarse-grained, yellowish granite in the form of a pyramid, rising about 300 feet above the ridge-line. The altitude of Pyramid Peak is 10 003 feet. The north side of this peak is much steeper than the other sides. Angular fragments of granite cover the slopes of Pyramid Peak for a distance of a quarter to a half mile from the top. There is a small grass patch on the northeast side of the mountain. The eastern declivity of Pyramid Peak passes gradually into the "Devil's Basin," a vast amphitheater of granite, probably formed by glacial agency, and containing a series of lakelets. A serrated ridge forms the eastern boundary of this basin. The rock is grayish granite, with large, dark specks of the same rock disseminated through it at the point where the Placerville road crosses the western summit. At first sight these spots presented the appearance of hornblende, but on close examination it was found that they were only a darker variety of the granite, although the forms were six-sided. This peculiarity of structure was observed frequently in the southern portion of the western summit. About a mile north of the Placerville road is Echo Lake, (7,478 feet high,) which forms the outlet of a lake-basin extending several miles to the westward. Numerous islands occur in the lakes of this basin, and some of them have a little soil and a few trees. The rock bordering Echo Lake is gray syenitic granite, which is much traversed by joints. On the northeast side of this lake a wall of granite rises abruptly to a height of several hundred feet, and forms the southern end of a mass of the same rock extending north to Gilmore's Cañon.

Although not strictly belonging to the western summit, a brief description of Lake Valley may be given here. The greater part of this valley is Quaternary. There is no rock *in situ* for 4 or 5 miles from Lake Tahoe. A morass covered with coniferous trees extends back from the lake about half a mile, and east and west for a mile and a half. Lake-weed and eel grass abound in this marsh, where the water varies from 6 inches to 3 feet in depth. Mallard ducks and grebes are common. The sandy beach on the northern side of Lake Valley is lined with alder bushes. About five miles from Rowland's, near Barton's ranch, two buttes of gray granite occur. Black mica, limpid quartz, and grayish-white feldspar are the constituents of the rock. The buttes are several hundred feet in height, and may be considered as outliers of either the western or eastern summits. The country between these buttes is strewed with large granitic bowlders. At the head of Lake Valley, near Hawley's ranch, dark grayish graphite occurs with quartz. A wagon-road runs from Rowland's along the eastern side of Fallen Leaf Lake to Soda Springs, two miles from Gilmore's ranch, on the lake. According to the aneroid, the springs are 325 feet above it. The temperature of the water is 46½° F. The spring-water contains carbonic acid, sesquioxide of iron, and sulphureted hydrogen. It is bottled and sold at Rowland's and other hotels on Lake Tahoe.

The Tallac Peak ridge runs from Gilmore's Cañon to Blackwood Cañon. Between this ridge and that of Pyramid Peak are two minor ridges without any name, composed of many dome-shaped peaks and rocky tors alternating with V-shaped ravines. A vast amphitheater bounds Tallac Peak on the south. The rock is gray granite as far as the springs, where it passes into basalt, having a slaty structure. The creek which flows into Fallen Leaf Lake has cut a small channel in the bottom of this basin, in which are a few cascades. There are several lateral cañons on the south side of Gilmore's Cañon, which rise in rocky terraces one behind another. The western and southern portions of Gilmore's Cañon afford fine examples of *Roches Moutonnées*. The rock is granite on these sides of the cañon and basalt on the northern. A small number of conifers are scattered over the cañon. Mount Tallac is a mass of bluish basalt upheaved through granite. The rock shows nearly every variety of structure known to the members of the basaltic groups. There are both granular and compact species. Some specimens are porphyritic with compact matrix. Incrustations of olivine occur in places. Nearly all the northeast side of Tallac Peak is composed of compact basalt. The wall of rock forming this side rises perpendicularly 700 feet or more from the plateau to the east of it. Three detached masses of rock that have undergone much disintegration project from the face of the main peak. The jointed structure of the basalt has been favorable to

denudation on account of the many fissures in which the water and melted snow freeze, thus expanding the cracks till the rock splits and falls. The difference of hardness in the basalt is well shown in the northeastern side of Mount Tallac. Isolated crags and pinnacles stand out boldly from the mountain, while the rock that formerly connected them with it has been worn away by the influence of the elements. A vast amount of talus lies at the foot of the eastern slope of Tallac. Seeds of the white-thorn and manzanita bush have been scattered over this *débris* and taken root in the rocky soil, thus forming a dense thicket impassable for pack-animals. The southwestern declivity of Tallac Peak slants gradually to Lake Gilmore, and is covered with nutritious grass, together with occasional clusters of trees except for a distance of about 300 feet from the summit. Ledges of blue basalt outcrop in many localities on the southern and western slopes. The height of Tallac Peak is 9,732 feet. Lake Gilmore occupies the bottom of a basin with lofty walls, and is 1,333 feet below the summit of Tallac according to the mercurial barometer. The temperature of the water in this lake is 50° F. The eastern slope of Mount Tallac has been grooved and polished by glaciers. I found fine examples of glacial scratches about half a mile from the summit. In some places the face of the cliff is as smooth as if cut by a chisel. The southern side of this mountain is exceedingly steep, and nearly all of it is covered with rocky *débris*, while a solitary coniferous tree here and there breaks the monotony of the scene. Granite surrounds Tallac Peak on all sides except on the northeast, where Lake Tahoe forms the boundary-line. A description of this mountain would be incomplete without a brief reference to the magnificent view seen from the top. The view is as varied as it is interesting. On the one side the entire range of the western summit is visible, while on the other there is the broad expanse of Tahoe with the eastern summit beyond. Twenty mountain-lakes are in sight. Their mirror-like surfaces, reflecting the blue sky form a pleasant contrast with the somber hues of the densely timbered ridges. The prominent features of the country lying in front of Tallac Peak, as far as Emerald Bay, have already been mentioned. Near the head of this bay is a knob of granite called the Emerald Isle, which is 150 feet high and 300 feet long, and has the shape of a pear. There is a waterfall about 50 feet in height, a quarter of a mile from Mr. Holladay's house. The cañon in which the inlet of Emerald Bay runs is very picturesque. It is narrow, windy, and the walls are very steep. Climbing up the cañon for half a mile from the bay I could catch a glimpse through the clusters of trees of several small cascades. At Emerald Bay and from this point northward the rock is gray granite to Sugar Pine Point. Near Rubicon Point the rock contains red feldspar. There are four more peaks belonging to the Tallac Peak Ridge, the northermost of which is capped by a sharp granite turret. This feature of peaks culminating in rocky tors occurs elsewhere in the western summit. The ridge becomes very narrow at the head of the creek emptying into Meigs's Bay. From this point to Blackwood Cañon there is no rock *in situ* within from a half to one mile of the lake-shore. The mountain behind McKinney's Station is basalt, and the slopes are covered with a dense growth of white thorn and manzanita. Some mineral indications have been found in the ridge about 1½ miles from McKinney's and 1,000 feet above Lake Tahoe according to the aneroid. The ledge was discovered in July, 1876, and work was begun in September. It is claimed by Messrs. Niles, Bellinger, Sims, and Casey. The vein runs northwest and southeast. In September, 1876, two men were working at an opening in the ledge 7 feet long and 4 feet wide. No analysis has yet been made of the ore, but it is said to contain nickel. On the northeast side of this mountain is Quail Lake, a body of water having an area of about an acre, and 400 feet above Lake Tahoe. Going northward, the rock is chiefly basalt as far as Blackwood Cañon. Blue basalt occurs at the head of this cañon.

The Twin Peak ridge runs from this point north to Truckee Cañon. Twin Peaks are just north of Blackwood Cañon, and consist of basalt and diorite. From the summit of these peaks the observer beholds many V-shaped cañons and serrated ridges. Some of the mountains have the dome structure, some are sharp like a knife-edge, others are conical, or pyramid-shaped or have the forms of a *mesa*. Scattered among these picturesque ridges of granitic and basaltic rocks are a few lonely Alpine lakes in cup-like basins. Twin Peaks are 2,604 feet above Lake Tahoe. West Twin Peak is formed of grayish basalt. The greater part of it is composed of myriads of horizontal prisms averaging about 9 inches in diameter, which decrease in size as the base is approached. At the junction of the East and West Twin Peaks the rock is dark-blue porphyritic basalt with white crystals of feldspar. East Twin Peak consists of gray porous diorite. The whole ridge from Blackwood Cañon to Tahoe City is basalt, of gray and blue colors. Very little granite is found north of this cañon, but south of it as far as Lake Valley, and from 200 to 500 feet from the lake-shore, many bowlders of this rock having a rounded form occur. The cañon of the Truckee River is formed of basalt. At the beginning of the cañon, in leaving Lake Tahoe, the basalt is porous and slightly porphyritic. There is *débris* on the north wall of the cañon, where several crags of basalt outcrop. About a mile from Tahoe City the Truckee River breaks through a mass of pudding-stone basalt, that is slightly ferruginous. Many conifers and some quaking-aspens grow

in the Truckee Cañon, as well as white thorn and manzanita. Six miles from the entrance of the cañon, Squaw Valley is reached. Squaw Creek flows through this valley, which has a broad fertile flood-plain. At the head of the valley there is a steep precipice with rounded bases. The rock is porphyritic diorite. The southern side of Squaw Valley is steeper than the northern. A little farther down the Truckee Cañon is Claraville, the site of an abandoned mining town. Several prospect-holes are seen in the north wall of the cañon. In 1863 a population of 500 people gathered at this point amid great excitement. Soon afterward the mines gave out, and it is difficult now to find the slightest vestiges of a former settlement. The gold occurred in placer-diggings. Beyond Claraville the river takes a northerly course, and the east side of the cañon is blue basalt as far as Truckee. Tors of trachyte 30 feet high outcrop along the western side. Near the fish ranch there is a very irregularly formed butte of gray basalt having a laminated structure. The laminæ are about half an inch thick. The rock on both sides of the cañon has undergone much disintegration. At the town of Truckee coarse-grained gray granite outcrops. It is similar to the rock forming the greater part of the western summit.

The ridge north of Truckee Cañon is the northernmost on the western side of Lake Tahoe. The ridge extends as far as a line drawn through the town of Truckee and Washoe Peak. It consists principally of basalt and phonolite. At Tahoe City a kind of globuliferous basalt occurs on the cliff just north of the post-office. The lower part of it has been eroded by the waves of the lake like a headland on a sea-coast The rock is somewhat ferruginous and much decomposed. It crumbles in the fingers. Near Tahoe City porphyritic granite, containing numerous crystals of white feldspar, is found. Compact bluish granite occurs at Observatory Point, which is a spur of the ridge projecting far into the lake. Beyond this point gray phonolite extends along the lake-shore for 2 miles or more. The remainder of the ridge consists of bluish basalt as far north as Boca, and stretching back from the lake for several miles. Various spurs diverge from this ridge. The crest lines are often dotted with turrets of basalt, and a vast amount of *débris* is strewed over their slopes. Near Wallace's ranch, 5 miles southeast of Truckee, I observed basalt similar to that on Lake Tahoe. A feature worth mentioning in connection with the geology of the Western summit is the absence of sedimentary rocks. No fossils are found by which one can determine the position of these archæan and igneous rocks in the geological series.

In closing a report on the geology of Lake Tahoe and vicinity, a brief reference may be made to the lake as a resort for tourists and pleasure-seekers. Since the completion of the Central Pacific and Virginia and Truckee Railroads, Lake Tahoe has become very accessible. A small steamer, carrying the mail, makes a daily tour of the lake. There is sufficient hotel accommodation for a large number of travelers. Hotels have been erected at the following points on the lake: Hot Springs, Glenbrook, Kearney's, Rowland's, Yanks, McKinney's, and Tahoe City. The finest scenery is found in the southwestern corner of Lake Tahoe, near Tallac Peak. There is no part of the United States that surpasses this region in scenery. In my extensive travels on the continent of Europe I have seen but one lake more picturesque than Tahoe, viz, the lake of Luzerne, in Switzerland. Grace Greenwood, writing from California, says: "Tahoe is the most beautiful lake I have ever beheld. * * * I think Lake Tahoe must yet become a great pleasure resort. I have seen no more charming spot in all my tours for a summer's rest and rambling."

Respectfully submitted.

ALFRED R. CONKLING.

Lieut. G. M. WHEELER,
Corps of Engineers, in charge.

APPENDIX H 1.

REPORT ON THE LITHOLOGY OF PORTIONS OF SOUTHERN COLORADO, AND NORTHERN NEW MEXICO, BY A. R. CONKLING.

NEW YORK CITY, *May* 10, 1877.

SIR: I have the honor to submit herewith a report on the lithology of the portions of Southern Colorado, and Northern New Mexico, explored by me in the field-season of 1875:

The majority of the rocks occurring in this region are of igneous origin. They cover large areas on both sides of the Spanish Range. The most common rocks are dolerite, basalt, granite, trachyte, diorite, granulite, sandstone and limestone. Dolerite occurs more frequently than any other species; vesicular dolerite covers large tracts of country, as in the plateau bounding the San Luis Valley on the west. Compact bluish dolerite is found in the buttes near Costilla post office, New Mexico, and in the mesa northeast of Fort Garland. Olivine is found in the dolerite at several localities. The basalt is usually of a blue color, and varies in texture from compact to scoriaceous.

In some places this rock is incrusted with calcite; and in the amygdaloidal varieties the cavities are occasionally filled with zeolites. Near the head of Uraca Creek, New Mexico, a dark-brown species of scoriaceous basalt occurs having the cavities elongated and very narrow. A gray variety of this rock is found abundantly near Fort Union, New Mexico. The diorite has in general a compact texture, but considerable variety of color. The granite presents great variety in both color and texture. The various colors of this rock observed are gray, red, pink, light and dark shades of blue, and white; reddish granite is the most common, on account of the feldspar of the same color being the predominating constituent. The varieties in texture observed are compact, granular, and porphyritic, and the latter being the most frequent. The granite is generally poor in mica, although a micaceous variety of this rock occurs just west of the Moreno Valley, New Mexico. The feldspar porphyry usually presents great irregularity in the size of the crystals imbedded in the compact matrix. The color of this rock is commonly gray, occasionally inclining to white. The granulite is in general of a reddish color, and granular in texture. Granulite and granite constitute the predominating rocks, in the several mountain ranges from La Veta Pass to Santa Fé. The trachyte presents a compact texture as a rule, and a color varying from light gray to pink. The sandstone is generally of a yellowish color, and has a fine-grained structure. In several localities the rock is ferruginous when the color becomes bright red. Near Costilla peak the sandstone passes into a conglomerate. The fossiliferous sandstones have been described in the geological report. The limestone is usually light blue in color, and of a compact texture. This rock covers a large tract of country in the eastern portion of the area explored in 1875. Besides these rocks may be mentioned clay-slate, and hornblende porphyry, both of which occur in several localities.

The paucity of crystalline schists is remarkable, the only localities being near Uraca Mountain, on Elizabeth Baldy, and on the eastern side of Antelope Creek, in the Wet Mountain Valley. A hard siliceous variety of conglomerate occurs near the top of the sandstone mesa bounding the Vermejo Valley on the west. The matrix of this rock is dark brown, and contains black and white fragments of quartz.

In order to determine with accuracy those rocks having a texture so compact that the constituent minerals could not be recognized with the naked eye, I have made sections of such rocks that were deemed desirable to prepare for microscopic examination. On account of the heterogeneous texture and opacity of some of the specimens of rock, much time and labor have been expended in preparing them. In some cases the brittleness of the rock rendered it impossible to make a section sufficiently thin for microscopic analysis. Such was the case with some specimens of trachyte that were interrupted by fissures. The rock could be ground on the wheel to a certain degree of thinness, after which it invariably crumbled, thus destroying the section. Fifty sections of rock have been prepared by me, and mounted on glass with Canada balsam. The results of my microscopical investigations may be condensed in the following description:

No. 139. Diorite, from Rio Hondo, N. Mex., consisting of white plagioclase, and a few crystals of hornblende. Much olivine, and specks of magnetite occur as accessories.

No. 144. Basalt, from Rio Colorado, N. Mex., containing much disseminated greenish nepheline, pyroxene, and specks of magnetite. The rock is slightly amygdaloidal.

No. 171. Dolerite from Huertano Butte, Colo., consisting of plagioclase, augite, and much olivine.

No. 173. Nepheline-dolerite from west side of Huerfano Butte, Colo., containing augite, nepheline, and particles of magnetite. The texture of the rock is very compact.

No. 174. Diorite from Cucharas River, Colorado, composed of hornblende and plagioclase. Olivine and magnetite occur as accessories.

No. 190. Syenitic granite from Ute Creek, New Mexico, containing quartz, triclinic feldspar, and a few crystals of mica; black hornblende is abundantly disseminated.

No. 205. Basalt, from near Laughlin's Peak, N. Mex., consisting of nepheline, augite, and some olivine.

No. 206. Dolerite from East Spanish Peak, Colo., made up of plagioclase and pyroxene.

No. 207. Granite from head of Cimarron Creek, New Mexico, composed of reddish orthoclase, grains of quartz, muscovite, and specks of magnetite. A few crystals of a black mineral occur which may be melanite.

No. 208. Syenite, from Cieneguilla Valley, N. Mex., containing plagioclase, hornblende and many grains of quartz.

No. 210. Dolerite, from Rider's Cañon, Colo., composed of plagioclase, many crystals of augite, and specks of magnetite.

No. 211. Diorite, from near Taos Peak, N. Mex., consisting of hornblende, plagioclase, and a few grains of quartz.

No. 216. Dolerite, from San Luis Valley, Cal., containing plagioclase, brownish pyroxene, and a few particles of mica.

No. 217. Dolerite, from Colorado Cañon, N. Mex., consisting of crystals of augite, plagioclase, and specks of magnetite. The rock has a porphyritic structure.

No. 225. Trachyte, from Rosita, Colo., composed chiefly of plagioclase and a little sanidine. A few grains of augite and magnetite also occur.

No. 227. Trachyte, from Taos Range, N. Mex., consisting of sanidine and plagioclase, with streaks of augite and a few specks of magnetite.

No. 229. Trachydolerite, from head of Moreno Valley, N. Mex., including crystals of augite, plagioclase, and irregularly-defined crystals of mica, as well as black specks of magnetite.

No. 233. Dolerite, from San Luis Valley, Colo., containing augite and many crystals of plagioclase.

No. 237. Dolerite, from near Gardner, Colo., consisting of large crystals of augite, plagioclase, and specks of magnetite.

No. 239. Dolerite, from Cerro Blanco, Colo., containing plagioclase and augite.

No. 242. Domite, from Laughlin's Peak, N. Mex., consisting chiefly of plagioclase and a few crystals of augite.

No. 251. Andesite, from East Spanish Peak, Colo., containing plagioclase, a few crystals of pyroxene, specks of magnetite, and dark colored mica.

No. 255. Dolerite, from Comanche Creek, New Mexico, composed of plagioclase, augite, and a few particles of olivine.

No. 258. Dolerite, from Costilla Peak, N. Mex., containing crystals of augite, plagioclase, and specks of magnetite.

No. 259. Dolerite, from East Spanish Peak, N. Mex., consisting of augite and plagioclase.

No. 260. Dolerite, from head of Indian Creek, Colorado, composed of grains and crystals of plagioclase and augite.

No. 261. Dolerite, from South Fork of Cucharas River, Colorado, containing augite, plagioclase, and a green mineral, which is probably olivine.

No. 264. Syenite, from Taos Range, N. Mex., consisting of quartz, crystals of hornblende, plagioclase, and opaque particles that are probably magnetite.

No. 267. Dolerite, from Moreno Valley, N. Mex., containing augite, plagioclase, and specks of magnetite. Pyrite occurs abundantly as an accessory.

No. 268. Quartz, porphyry from ridge of Golconda mine, N. Mex., consisting of plagioclase and quartz.

No. 269. Dolerite, from San Antonio Cañon, N. Mex., containing many microliths of plagioclase, grains of augite, and specks of magnetite.

No. 271. Granite from head of Purgatoire River, Colorado, composed of quartz, oligoclase, and a few crystals of mica, and small particles of an opaque mineral that is probably magnetite.

No. 275. Granite, from Taos Range, N. Mex., containing quartz, orthoclase, mica, and a few grains of hornblende.

No. 288. Rhyolite, from ridge east of Costilla Peak, N. Mex., consisting of plagioclase, some quartz, and crystals of magnetite.

No. 291. Andesite, from Cerro Blanco, Colo., composed chiefly of plagioclase, a few crystals of augite, and many particles of magnetite.

No. 292. Andesite, from Taos Range, N. Mex., containing a few crystals of augite, plagioclase, specks of magnetite, and a little mica.

No. 293. Dolerite, from Colorado Cañon, N. Mex., consisting of plagioclase, many crystals of augite, and some olivine.

No. 294. Dolerite, from Elizabeth Baldy, N. Mex., containing grains of augite, plagioclase, and magnetite.

No. 295. Dolerite, from top of Costilla Peak, N. Mex., composed of plagioclase, augite, olivine, and crystals of magnetite.

No. 298. Diorite, from Costilla Peak, N. Mex., consisting of crystals of hornblende plagioclase, much olivine, and specks of magnetite.

No. 299. Diorite, from Walsenburg, Colo., containing plagioclase, hornblende, and some disseminated mica.

No. 301. Andesite, from Uraca Creek, New Mexico, composed of plagioclase, crystals of augite, and specks of magnetite.

No. 302. Basalt, from tower near head of Cucharas River, Colorado, consisting of nepheline, crystals of augite, and particles of magnetite.

No. 345. Diorite, from a point just west of Laughlin's Peak, N. Mex., containing plagioclase, hornblende, some olivine, and magnetite.

No. 384. Dolerite, from Uraca Creek, New Mexico, comprising augite, plagioclase, and many specks of magnetite.

No. 385. Dolerite, from Rio Grande, New Mexico, containing augite and crystals of plagioclase.

No. 386. Dolerite, from head of Cucharas River, Colorado, made up of crystals of plagioclase, augite, and specks of magnetite.

No. 388. Dolerite, from mesa northeast of Fort Garland, Colo., composed of many fine crystals of plagioclase, and well-defined crystals of augite. This rock resembles closely No. 233. They are not more than 10 miles apart.

No. 394. Dolerite, from Costilla Cañon, N. Mex., consisting of pyroxene and plagioclase.

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

ALFRED R. CONKLING.

Lieut. GEORGE M. WHEELER,
Corps of Engineers, in charge.

WASHINGTON, D. C., *June* 30, 1877.

The following manuscript, prepared by Mr. A. R. Conkling, and received too late to be forwarded with the annual report of 1876, is herewith submitted.

GEO. M. WHEELER,
Lieutenant of Engineers.

APPENDIX H 2.

REPORT ON THE FOOT-HILLS FACING THE PLAINS FROM LATITUDE 35° 30′ TO 38° APPROXIMATELY, BY MR. A. R. CONKLING.

Beginning at Las Vegas, New Mexico, which is just east of the foot hills, we have the rolling prairie extending as far as Fort Union, 28 miles northeast, without any marked elevation. The foot-hills on the eastern side of the Las Vegas range consist of grayish sandstone, horizontally stratified. Upon approaching Fort Union broad mesas of moderate elevation lie in front of the foot-hills. These mesas are also composed of sandstone. At the head of the Rio Mora, a grayish mass of eruptive granite has broken through the sandstone. In the vicinity of Fort Union extensive dikes of basalt occur. The western limit of the basalt is, according to my observations, at Torquillo, which lies about 17 miles west of Fort Union. Basalt occurs on the plain lying north of the fort. It covers the surface as far as Ocate Crater, which is just 13 miles north. With the exception of the basaltic lava of Ocate Crater, the basalt is invariably of a dark blue color and scoriaceous texture. Ocate Crater or Mountain is 8,902 feet above the sea-level. It is longer from north to south than from east to west. The summit is bowl-shaped, with the opening on the west side. The slopes, and even the interior of the crater, are covered with grass, while on the northwestern side there is soil enough to support a small growth of piñons and cedars. The northern slopes of the mountain are impassable for animals, but a mule can be ridden to the summit by way of the south side. The land slopes very gradually south of the crater. There is a low butte of basalt on the southwest. The major part of the basaltic lava on the plain of Fort Union has probably come from the Ocate Mountain. There is much variety in the lava of Ocate. The color of the lava varies from bright red to brownish black, and the texture is generally vesicular, though also compact and scoriaceous in some cases. The reddish lava has so many crystals and grains of white leucite disseminated through it as to present a porphyritic structure. Between Ocate Mountain and Fort Union there is a broad and low mesa of basalt, which is bordered on the west by a mesa of gray sandstone. On the southern part of the Fort Union reservation blue limestone outcrops, dipping very slightly to the southwest. Fossil shells, of the genus *Inoceramus*, are found in the limestone, which, according to Professor White, are of cretaceous age. On the ordnance reservation, one mile west of the post, a well has been sunk to the depth of 78 feet. The following section will illustrate the geological structure at this place:

	feet.
Clay	17
Soft yellow sandstone	6
Decomposed lava	6
Basalt	37
Red volcanic scoria	4
Sandstone and gravel	8

The well adjoins Captain Shumaker's quarters.

ORE DEPOSITS NEAR FORT UNION.

There are a few deposits of ore near Fort Union, but none of them are workable. In the Turkey Mountains, about 9 miles from the fort, ground has been broken, where some malachite, or rather rock stained by green carbonate of copper, has been found. There is a single shaft at present, about 30 feet deep, which is partially filled with water. The cupriferous rock occurs in a vein 2½ feet wide at the surface and 6 feet wide at the bottom of the shaft. The lode runs north and south, and occurs in red sandstone. At several other localities ground has been broken in the hope of finding valuable min-

erals, but all without avail. At one time placer-mining was carried on for a few days in one of the gulches of the Turkey Mountains. Gold was found in small quantities amid intense excitement. By the time a large crowd of miners had been collected about the spot the placers gave out. It is my opinion that the gulch was simply "salted." At Coyote, about 14 miles from Fort Union, traces of copper have been found half a mile north of the town. Ore was first discovered here in the summer of 1866. In the same year a mining company was organized with Kit Carson as president and J. B. Collier as vice-president. There was no definite capital, but small personal assessments were made to begin work. There is a vein about 4 feet wide occurring in gray micaceous sandstone, having general direction from northeast to southwest. This vein contains a little malachite and azurite, and is traceable at intervals for the distance of a quarter of a mile. At one point a shaft 22 feet deep has been sunk. At another point, on the ridge near the summit, a slope has been driven about 40 feet in the sandstone rock. Both these places had been abandoned at the time of my visit.

Just east of the plain of Fort Union are the Turkey Mountains. The height of the ridge above the plain is about 700 feet, and the length is perhaps 15 miles. The mountains are composed of grayish sandstone, horizontally stratified, with numerous vertical joints. The ridge runs northwest and southwest, and is much broken up by cañons.

The formation between Fort Union and the Canadian River is both igneous and sedimentary. Directly northeast of the Turkey Mountains a large number of buttes and mesas of basalt occur. Most of the buttes are conical in shape and rounded on top, but a few have the turreted form. Many of the mesas have a perpendicular border of basalt about 10 feet thick, and slopes slanting very gradually on some sides and quite abruptly on the others.

About 15 miles east of the Turkey Mountains limestone outcrops, containing a species of ammonites, which Professor White informs me belongs to the cretaceous. A zone of cretaceous limestone appears to lie between the basalt on the west, and horizontally stratified sandstone on the east. But my observations in this section of country were too limited, by the rapid daily marches, to enable me to define the limits of this zone either on the north or south. Nearing the Canadian River, sandstone again outcrops, containing fossil angiospermous leaves, identical with those occurring in the sandstone near Trinidad, about 65 miles farther north. The Canadian River has cut a channel in the sandstone about 300 feet deep. There is a little soil alongside the river in the bottom of the cañon. The country lying east of the Canadian is a rolling prairie as far as the eye can reach. On the west side of the Canadian the country is much broken up by cañons and ravines, rendering it well-nigh impassable. From the Canadian, our route lay northeast over a rolling prairie, with an occasional low mesa to break the monotony of the plains, until the basaltic country in the vicinity of Laughlin's Peak was reached. Amygdaloidal basalt, with particles of white calcite in the cavities, covers the country on both sides of the Santa Fé road, from a few miles east of the Canadian River to beyond Laughlin's Peak. The geological formation of Laughlin's Peak is peculiar. It is a mass of pinkish trachyte breaking through a plain of basalt. The mountain is 8,949 feet above the sea. The slopes are covered with grass, and the summit has a depression like a crater. Some of the basaltic buttes east of Laughlin's Peak are very perfect in outline. All of them have a moderate height. Sometimes the buttes are altered to ridgy, saddle-shaped hills, a form which volcanic cones have frequently been observed to assume by degradation. There are no lava bombs, lapilli, volcanic sand, or ashes, as in the extinct volcanoes of Central France. The basalt is usually *in situ*. Very little water occurs in this basaltic country. One can travel miles without finding running water, and the only animals seen are occasional herds of antelope that roam over the plain.

On the north side of Laughlin's Peak a mesa-like ridge, with precipitous sides, runs north as far as Trinidad, about 28 miles distant. This is the Raton mesa. On the west side of Laughlin's Peak a hard, grayish slate outcrops, which is overlaid by a bed of loose black shale. The dip of both these rocks is slightly to the southwest. The shale outcrops again at a point about 5 miles west, but I was unable to trace the beds any farther. A narrow dike of basalt has broken through the shale about half a mile from Hole-in-the-Rock. At Hole-in-the-Rock, which by the bye is merely a break in the strata that has been denuded so as to leave a gap, the sandstone with horizontal stratification outcrops again, presenting the same lithological character as the sandstone in the foot-hills a few miles farther west. No fossils were found. The thickness of the exposed strata was not more than 30 feet. On account of the rapid progress through this section of country it was impossible for me to define the limits of the sandstone. Dikes of basalt have in many places broken through and sometimes overlaid this sandstone. Mesas of vesicular basalt cover the country for 15 miles west of Laughlin's Peak. Tenaja Creek has cut a cañon in the mesa, which is known as Bragg's Cañon. On the lower part of Teneja Creek a bed of gray laminated slate outcrops, dipping very gently to the west. Between this creek and the foot-hills of the Cimarron Range the country is rolling prairie without any rock *in situ*. The Canadian River forms the dividing-line between the igneous rock on the east and the sedimentary rock on the west. This refers only to the upper part of the river. The foot-hills from Fort Union

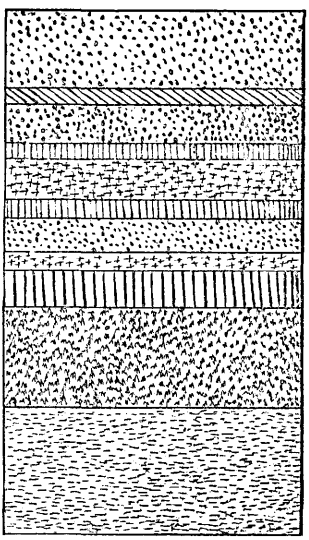
to Cimarron consist of sandstone, except in the vicinity of Uraca Peak, where basalt occurs.

According to De Groat, at the entrance of the Rayado Valley a marly-limestone formation occurs near the basalt. The limestone is suitable for making lime, and it is burned in limekilns built of blocks of basalt. The limestone has also been used for building. In the eastern part of the Maxwell grant the same limestone formation which outcrops at the entrance of the Rayado Valley extends from a point just north of Arnis Ranch to Rock Ranch. The breadth of the limestone is about 8 miles, along the easterly boundary of the grant.

From Cimarron to Trinidad the geology is quite simple. Sandstone, of a color varying from white to gray or yellow, with horizontal stratification, covers this section of country. These foot-hills are densely wooded with conifers and much broken up by cañons. Various creeks, rising in the Cimarron Range, flow through the foot-hills, having cut broad cañons with steep sides. These main cañons have in turn many lateral cañons. At Crow Creek, 12 miles from Red River, some invertebrate fossils were found. A species of *Inoceramus* and a fragment of a shell belonging to the genus *Rudistes* were collected. According to Professor White these fossils are cretaceous. This fact, together with the occurrence of cretaceous fossils at other localities in the foot-hills, indicates that they were formed during the Cretaceous age. Seams of lignite occur in the sandstone at various points. Remains of plants, particularly the leaves of angiospermous trees, are common in the rock where lignite is found. But it is impossible to determine with certainty the age of the lignite-beds without some other guide than these fossil leaves. Prof. J. J. Stevenson, formerly connected with the Geographical and Geological Surveys west of the Hundredth Meridian, has shown that fossil leaves are utterly unreliable in stratigraphical geology. I therefore, in view of the occurrence of invertebrate fossils, feel justified in expressing the opinion that the foot-hills from Fort Union to Trinidad belong to the Cretaceous age. In the vicinity of Trinidad these fossil leaves are very common. A number of specimens were collected, but they have not as yet been determined. It may be stated that among the leaves collected are those of the oak, maple, and poplar.

As regards the beds of lignite mentioned above, no attempt has been made to work any of them, as far as I could ascertain. If limestone occurred in the immediate vicinity of the lignite, the latter could be worked for the purpose of making lime; but as there is no lignite nearer than 50 miles to the limestone, it is evident that it would not be expedient to transport the brown coal such a distance. The lignite is very brittle. In most places it crumbles so easily that it is difficult to collect a specimen that was not in the form of powder.

Several seams of lignite occur on the western side of the Vermejo Cañon. The following section will illustrate their mode of occurrence:



60 feet of sandstone.
3 feet of siliceous conglomerate.
25 feet of yellow sandstone.
1 foot of lignite.
30 feet of limonite or hydrous oxide of iron.
10 feet of lignite.
20 feet of sandstone.
10 feet of limonite.
15 feet of lignite.
75 feet of yellow sandstone.
100 feet of sandstone covered by a sandy soil.

It will be observed that veins of limonite occur in connection with the lignite or brown coal.

A stratum of hard siliceous conglomerate, about 4 feet thick, runs through the sandstone near the top of the mesa, about 6 miles north of Vermejo Post-Office. The rock is fine-grained, and has a brownish color.

Bituminous coal occurs at Trinidad. The outcrops of the coal are either in the Raton plateau, just south of the town, or on the west, 4 miles from the town, on the south bank of the Purgatoire River. The principal deposit of coal occurs at a point 3 miles south of Trinidad, near the Santa Fé road. The vein runs north and south, and has a width varying from 9 to 12 feet, with an average thickness of 5 feet according to the statement of Mr. James, the superintendent of the mine. This vein is traced for a length of 2 miles on the north, and outcrops on the north side of the Raton Mountain. The coal is underlaid by a bed of yellow sandstone. A layer of limonite about 2 feet thick overlies the coal at the place where it is mined. The coal is said to be free from pyrites.

According to Mr. James, there are nine good workable veins of coal in the vicinity of Trinidad, all of which have the same general direction. The coal is mined with the ordinary pick, and carried out in a hand-car running on a tramway. A tunnel about 5 feet wide, and not high enough to allow a man to walk uprightly, has been driven in the mountain to work the coal. This tunnel is about 150 feet long. The coal is sold for $1.50 per ton at the mine. Coke is made and sold for $6 per ton at the mine. The coke is transported in ox-teams to Denver, where it is sold for $19 per ton. At the time of my visit (June, 1875) but three miners were working at the mine. This mineral property is said to be owned by the Denver and Rio Grande Railroad Company. The vein of coal outcropping on the Purgatoire River, 4 miles west of Trinidad, is about 4 feet thick, and underlaid by shaly sandstone destitute of fossils. The coal is some 25 feet above the level of the river. The strata dip gently to the west at this point. But little work has been done at this locality. There are a few abandoned openings of coal. Limonite outcrops on the Santa Fé road within 3 miles of Trinidad, but none of the iron-ores in this vicinity have been worked yet. Labor is cheap and abundant. A writer in the New York Sun states that there are 1,000 square miles of coal in the neighborhood of Trinidad, and now, (1876,) since the Denver and Rio Grande Railroad is completed as far as this town, there appears to be no reason why Eastern and Central Colorado cannot be supplied with coal from Trinidad. As regards the age of this coal I am in doubt. It is either Tertiary or Cretaceous, but which of these I am unable to say.

Fossil leaves are abundant in the sandstone a few miles from Trinidad, but I have already stated that these leaves are not reliable. No invertebrate fossils were found within less than 30 miles from Trinidad. But as the foot-hills on the eastern side of the Spanish Range belong to the Cretaceous age, according to my observations, it is possible that the foot-hills containing the Trinidad coal belong to the same period. However, I am not justified in expressing an opinion on this question.

THE COAL OF THE MAXWELL LAND-GRANT.

What I have written in the succeeding pages about the coal of the Maxwell grant has been translated from the pamphlet of Messrs. De Groot and Leembruggen, published in the Dutch language, at the Hague, in 1874. My imperfect knowledge of this foreign tongue has been a constant drawback to me. Still it is believed that some interesting facts will be found in the translation. It is my opinion that this coal belongs to the Cretaceous age, reasoning from the fact that I have referred the foot-hills in which this coal formation occurs to the same age. I have been unable to find any expression of opinion on the geological age of the coal in the above-mentioned work. I will now quote the principal part of the description of the coal formation given by Messrs. De Groot and Leembruggen:

"The coal formation extends from the Cimarron River northward to the northern boundaries of the grant in the Territory of Colorado. On the west the boundaries of this formation run half a mile east of Ute Creek, along the Poñil Park, Van Bremmer Park, Francisco Pass, and Francisco Park, to the northern limits of the grant. On the east the coal formation is bounded by mesas and by the 'plains,' which are covered with Quaternary deposits as far as the Cimarron River. On this eastern part of the grant the strata of the coal-formation, and the coal-beds occurring therein, lie horizontally, while those beds in the western part which rest on metamorphic rock have a moderate dip of at most 10° to 15° with the horizon. This coal-field appears to have undergone a gentle and slow upheaval.

* * * * * * *

"In the western part of the grant the ridges of hills have a moderate height, the range of mountains is circular, and the valleys, which are likewise circular, pass on both sides gradually into the hills. Faults of minor importance have occurred here. When one enters the valleys from the eastward a large quarry is presented to the eye, wherein the component beds of the coal-formation are exposed in nearly vertical walls. In this locality the valleys are wider, and the dislocations in the strata have been the greatest. Undoubtedly the coal-formation extends under the plains on the east, but within the grant it does not come to the surface, it being covered with alluvium.

"In the southeastern part of the grant, granite and gneiss rocks have been upheaved, which have partly overlaid the westerly edge of the coal-formation, and exerted a favorable influence on the coal occurring therein, but the rocks have also broken through a part of this coal-formation, and overlaid a region 4 or 5 miles broad. In this area the rocks have undergone considerable change, which has resulted in the formation of quartzites, hard shales, clay schist, and sandstone. These metamorphic rocks occur along the western end of the coal-formation, while more westerly the granite and gneiss rocks are found, which were the cause of the metamorphism. We can never say with certainty how far the coal-formation extends outside the limit of the grant, but it is certain that it extends east from the Spanish Peaks, and that coal has been worked within from 2 to 4 miles of Trinidad, in the vicinity of boundaries of the

Maxwell grant. The mesas which occur in the northern and eastern boundaries of the coal-formation consist of basalt, and belong to the Fisher's Peak, a basaltic mountain that has the genuine 'trap' form, and, together with the mesas in the northeastern part of the Maxwell grant, belongs to the Raton Mountains, which, on the northern part of the grant, extend east and west, and continue on the eastward for 26 miles beyond the grant.

"The basaltic mass of the mesas in the northeast part of the grant also outcrops in various little mesas, but it has filled besides many fissures in the coal-formation, and accordingly comes to the surface in dikes. Wherever this has taken place in the coal-formation the basalt has metamorphosed the rock and the coal in the immediate neighborhood. In one place in Red River, 7 miles in the valley above the Red River Station, the basalt has broken through a coal-bed 2 feet thick horizontally, overlying merely a small part of the metamorphosed coal, and where the basalt has destroyed the coal the space is filled with a basaltic mass. This metamorphosed coal is graphite, in some places very pure graphite, that can be developed in order to be used for crucibles, for greasing tools, or for diminishing friction. The basalt has done but little damage in the coal-formation, and it is certain that the rock has been penetrated by the heat developed thereby; it has also co-operated to enhance the good properties of the coal as fuel. The coal-beds outcrop, especially on the western edge of the coal-formation, and likewise in all the valleys of the creeks which run through this formation. There are three localities where the coal-beds have been developed and investigated. A description of them will now be given.

"SECTION IN THE POÑIL VALLEY.

"Three miles from the plains in the Poñil Valley, and 5 miles from Cimarron, about 6,900 feet above sea-level, a section of the coal is exposed on both sides of the Poñil Creek. The coal-bed is 4 feet thick, and consists of pure coal without bands of clay. It is inclosed by 1 foot top-clay and by 2 feet under-clay. The clay and sandstone beds that lie above the coal have sufficient firmness to rest on large openings without caving in, while the quartzose clay sandstone that lies under the coal is a very hard rock that makes an admirable foundation, which never will be exhausted during the working of the coal.

"As regards the properties of the coal of New Mexico, it may be stated that it is particularly fitted for the preparation of coke, for use in generating steam, and for making iron. This coal is also useful for smiths' work. It is less fitted for making gas. In the valley of the Poñil clayey spherosiderite is found, apparently derived from the claystone beds which accompany the coal, whence these lenticular balls of clayey carbonate of iron have occurred in the valley by means of weathering.

"SECTION IN THE VERMEJO VALLEY.

"In a cañon of the Vermejo Valley an important outcrop of the coal-formation is found, wherein occur never less than seven large and small coal-beds, and clayey spherosiderite, in lens-formed balls, as well as clay ironstone, in thin beds. Entering this cañon 3¾ miles in the Vermejo Valley, on the south side, and three-quarters of a mile in the cañon, on the nothwest side, the outcrop is seen. The coal-formation has here a thickness of 200 feet. The coal is always at least 21.5 feet thick. The four lowest beds have sufficient dimensions as to be capable of being developed. The lowest of these beds contains a mass of coal 7 feet thick. In the second bed, counting from below upward, occur two beds of iron-ore, the one being carboniferous and the other argillaceous. Each of these deposits of ore varies from 2.5 to 3 inches thick, and corresponds to the black-band ore of Scotland and South Wales.

"The third and fourth coal-beds have about the same thickness, viz, 3 feet of pure coal, but clayey concretions occur also. A deposit of claystone, 2 feet thick, lies above the fourth coal-bed, in which lens-formed masses of spherosiderite are imbedded. The size of the 'pennystoms' of argillaceous iron-ore, which occur in the previously-described beds, varies from very small to 2 feet in diameter and 9½ inches thick. These coal-beds lie horizontally, and are similar in quality to those in the Poñil Valley.

"SECTION IN THE COTTONWOOD CAÑON, RED RIVER.

"In entering the valley of the Red River one sees the coal-formation exposed at a point 4 miles from Red-River Station, (Stockton ranch,) on the south side of the cañon. There is a workable coal-bed 5¼ feet thick. This bed is free from claystone concretions, and lies horizontally. The coal has the same good properties as that of the Vermejo and Poñil Valleys. In case railway communication between Cimarron au Fort Lyon and Granada is brought about, the coal at the above-mentioned localities

can be worked advantageously on account of the favorable position it occupies. No shaft needs to be made for the development of the coal. In each of the three localities the coal can be worked by galleries driven into the sides of cañons. As regards the evolution of gas, it may be said that, according to present developments, there is no reason to dread this source of danger. The value of these workable coals is highly important in this region, which is situated so far from the great North American coal-field, and when deep borings shall have been made here the richness of the coals will appear to be much greater than we can safely estimate this wealth at the present time.'

Proceeding north from Trinidad, the country is underlaid by sandstone until the Spanish Peaks are reached. Here dikes of basalt and trachyte-porphyry occur. In Rydar's Cañon a bed of coarse-grained limonite occurs near the wagon-road.

Near the placita of La Molina, a few miles from East Spanish Peak, a dike of basalt occurs, having a height of 25 feet and a width of 5 feet. It runs northeast and southwest, and has broken through the yellow sandstone. As far as my observations go, this is the only basalt near the Spanish Peaks. At Walsenburg and at Fisher's Peak this rock of course is found, but between these places and East Spanish Peak I observed no basalt, except at the locality mentioned above.

In the plain lying northeast of Trinidad a few buttes of basaltic rocks are found. Near the Santa Clara Creek I noticed two buttes of hornblende-porphyry, having a granular texture.

At Walsenburg, on the Cucharas River, a bed of coal occurs. The locality is on the west side of the river. As my visit at Walsenburg was so short, I was unable to examine this deposit of coal, and therefore merely mention the occurrence of the mineral. No attempt had been made to work the coal at that time, (June, 1875.) It is possible that this coal may belong to the same age as the coal of Trinidad. There are several low ridges of basalt running north and south near Walsenburg.

Twelve miles east of the town an isolated butte of basaltic rocks occurs in the midst of the plain. It is called the Orphan Peak, or Cerrito del Huerfano. The main part of the butte consists of granular diorite, while on the west side a mass of compact basalt outcrops. This butte is about 200 feet high and 200 yards long. It is longer from north to south than from east to west. These detached masses of igneous rock, lying east of the Spanish Peaks at distances varying from 20 to 25 miles, were evidently upheaved toward the close of the elevation and formation of the main range. Lateral vents existed in the earth's crust through which the basalt was erupted. The numerous dikes of trachyte and hornblende-porphyry on the eastern and northern sides of the Spanish Peaks, and on the eastern side of Sheep Mountain, bear evidence of the vast amount of igneous action that has played a very important part in shaping the physical features of the country. These dikes of rock are in general not more than 100 feet high. They run in all directions, especially in the vicinity of the Spanish Peaks, whence the dikes radiate like the spokes of a wheel. Near the head of Bear Creek two of these walls run at right angles to each other. The country lying east of the Huerfano and north of Badito, which borders on the region traversed by dikes, has been described in the annual report for 1875.

APPENDIX I.

REPORT ON THE ORNITHOLOGY OF PORTIONS OF NEVADA AND CALIFORNIA, BY MR. H. W. HENSHAW.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN,
Washington, D. C., April 15, 1877.

SIR: I have the honor to transmit the following report upon the ornithology of the region visited by me during the field-season of 1876.

Very respectfully, your obedient servant,

H. W. HENSHAW.

Lieut. GEO. M. WHEELER,
Corps of Engineers, in charge.

My opportunities for investigating the bird fauna of this region began in the vicinity of Carson City, Nev., during the last week of August. The rendezvous-camp established here continued till September 15. Up to this date most of my time was occupied in making collections in natural history, such points being visited in the neighborhood of Carson as were accessible by daily trips. The party, in immediate charge of Lieu-

tenant M. M. Macomb, to which I was attached for the season, left Carson on the 15th of September, and from that date till the termination of my field-work, except a period of ten days from November 10 to the 20th, which I spent at Carson, I was occupied in the immediate vicinity of Lake Tahoe, or in the mountains lying contiguous to it. It will thus be seen that the season's results fall under two distinct heads, according as they were obtained in the valleys to the east of and adjoining the main chain, or were derived from observations in the mountains. In presenting lists of the birds observed, with such notes as I was able to gather, I have thus divided them. In connection with my work it is pleasant to be able to speak of the assistance and co-operation so cordially extended to me by the officer in charge, as well as by the remaining members of the party. Furthermore, I have to gratefully acknowledge the substantial assistance received from Mr. H. G. Parker, of Carson City, Nev., not only in the shape of rare birds, the results of his enthusiastic labors, but also for much information concerning the haunts of birds, which his thorough acquaintance with the country enabled him to supply.

By the last week in August such of the birds as still remained in the neighborhood, and which do not winter here, had either congregated in flocks or were in the act of assembling, preparatory for their departure in search of a more congenial winter climate; while not a few of the less hardy species, as the tanagers, orioles, grosbeaks, &c., had already taken their leave; hence a very considerable number of species that are common to the region as summer visitants were not seen at all by us; from which fact it results that our list of the birds noticed during the season is very far from being a complete enumeration of the actual number of species belonging to this region.

The valley, on the west side of which Carson City is situated, does not possess, owing to the almost complete absence of timber, the natural characteristics which serve to attract a great number of species of birds.

Along the banks of the Carson River, and fringing the borders of the other small streams, especially where they debouch from the mountains, is found a limited amount of shrubbery, which serves to invite and give shelter to the species that usually frequent similar localities. The remainder of the valley, not lying close enough to the streams to admit of irrigation and cultivation, is clothed only and everywhere with sage-brush and grease-wood, and is inhabited by but a limited number of the feathered tribe. The foot-hills and eastern faces of the mountains immediately overlooking the Washoe and Carson Valleys were formerly covered with a dense pine forest, which closely hemmed in the valleys. Within a few years this has been entirely swept away, leaving the hills comparatively, and in some places absolutely, denuded of vegetation. As a consequence, most of the wood-loving species that formerly extended down to, or even into, the valleys, have retreated upward, and now only appear below as occasional stragglers, or in winter.

The avifauna of the region about Carson, the mountains being excluded, offers to our notice little or nothing that is peculiar, or that will serve to distinguish it from that much farther to the eastward. In fact, a large proportion of the forms are those common to the interior province generally, of which the entire eastern portion of Nevada may be regarded as an integral part.

It is only when we leave the plains and low open valleys, and ascend into the foot-hills, that we begin to meet with any well-marked change in the aspect of the bird-life. This change is a somewhat abrupt one, and is quite strictly coincident with the line of demarkation between the valleys and the elevated foot-hills, being hence chiefly indicated by the presence of such species as are pre-eminently mountain forms. Thus in the shrubbery skirting the foot-hills, and in the ravines, we find the California jay (*Cyanocitta* var. *californica.*) Reaching the foot-hills the mountain-quail begins to be numerous.* Still higher up the shrubbery of the mountains was found to be the home of the curious Thick-billed sparrow (*Passerella* var. *megarynchа.*) It is, however, in the pine region proper that the change becomes most marked.

Here are found *Turdus ustulatus; Cyanura* var. *frontalis; Selasporus rufus; Sphyrapicus ruber* and *Picus albolarvatus.*

All of the above species are found as regular summer inhabitants of this region, while the woodpeckers and jays are constant residents.

From the occurrence of these species, which may be regarded as belonging essentially to the Pacific province, along this, the eastern slope of the Sierra Range, we may safely draw the line which shall divide the middle from the Pacific province at the foot of the eastern slope of the mountains, and consider this slope of the main chain as belonging, so far as its avian fauna is concerned, to the Pacific province.†

*As ascertained by Mr. Ridgway, this species is found somewhat farther to the eastward, reaching the mountains by means of the connecting foot-hills. The flocks appear, however, to be little else than stragglers, and with the eastern slope of the main chain this bird ceases to be common, and the species is soon lost altogether.

†Two of the mammals found by us along this slope also point to the same conclusion. The large Spermopilus instead of being the interior form *grammurus* is the *var. beechyie* of the Pacific province. Similarly the small Sciurus is *douglasii* instead of *richardsoni.*

Below is appended a full list of the Pacific province forms that find their eastern limit along the eastern slope of the main chain.*

I. Species limited by eastern slope:

1. *Zonotrichia coronata.* Fall migrant.
2. *Passerella* var. *megarynchа.* Summer resident.
3. *Pipilo* var. *oregonus.* Resident.
4. *Cyanura* var. *frontalis.* Resident
5. *Cyanocitta* var. *californica.* Resident.
6. *Picus albolarvatus.* Resident.
7. *Sphyrapicus ruber.* Resident in small numbers; fall migrant.
8. *Oreortyx picta.* Resident.

II. The following Pacific province species find their limit as above in the breeding season, but during the migrations, especially in the fall, they occur more or less frequently at points at variable distances to the eastward:

1. *Turdus pallasii* var. *nanus.* Migrant.
2. *Turdus swainsoni* var. *ustulatus.* Summer resident.
3. *? Thryothorus bewickii* var. *spilurus.* Resident.
4. *Troglodytes hyemalis* var. *pacificus.* Winter resident.
5. *Helminthophaga celata* var. *lutescens.* Summer resident.
6. *Myiodioctes pusillus* var. *pileolatus.* Summer resident.
7. *Melospiza melodia* var. *heermanni.* Resident.
8. *Melospiza melodia* var. *guttata.* Perhaps accidental. One specimen in West Humboldt Mountains in fall. (Ridgway.)
9. *Junco oregonus.* Resident.
10. *Zonotrichia leucophrys* var. *intermedia.* Summer.
11. † *Agælaius phœniceus* var. *gubernator.* Summer.
12. † *Nepocætes niger.* Summer.
13. † *Chætura Vauxii.* Summer.
14. *Selasphorus rufa.* Summer.

As noticed above, the fauna of the plains and valleys to the east of the main chain is, in respect to its summer residents, indistinguishable from that of the middle province.

As showing the sharpness with which the line of demarkation is drawn by the Sierra Range we are able to note but two species, which may be considered as characteristically belonging to the middle province, which, in their range westward, intrude beyond the limit assigned and reach into the mountains. These are *Carpodacus frontalis* and *Pica melanoleuca* var. *hudsonica.* The first is numerous about Lake Tahoe, but does not, so far as I could ascertain, reach to the west of the divide. *Pica hudsonica* scarcely finds its way into the range, but is mostly limited by the foot-hills. A few individuals, however, were noticed by us on the borders of Tahoe.

Of the specimens procured along the eastern slope during the season a number have proved of especial interest, as illustrating the differentiation which takes place in a species or variety when found at a point remote from the locality or region where its peculiarities attain their maximum development, and which consequently may be considered its true home.

The eastern slope of the Sierras, though belonging, as has been shown, to the Pacific province, occupies a somewhat intermediate position between the Pacific and Middle provinces, and, as it differs climatically more or less from either region, its birds might be supposed to indicate to some extent, in plumage or otherwise, the changes undergone in the conditions of environment. Such has been found to be true. This is best illustrated in the cases of several birds that are represented by different varieties in the two provinces. In all such instances, while they are seen to partake more largely of the characteristics pertaining to the Pacific forms, they are yet, to a very appreciable extent, intermediate, and, when compared with their respective types from the west coast, will be seen to divaricate directly toward the conditions distinguishing the middle province forms. Thus the Californian jays (*Cyanocitta floridana* var. *californica*) of the eastern slope not only have smaller bills and feet than coast examples, but their colors throughout are decidedly lighter, thus approaching in characteristics the var. *woodhousei* of the interior, which in its typical form begins to occur only in the eastern part of Nevada. Similar differences, though not carried to the same extent, are found in the Steller's jay, in the variety known as var. *frontalis*, which, though confined to the Sierras, becomes somewhat lighter colored, with smaller bill, at its eastern limit than in the Californian coast range on the west.

* For a number of these, as well as for indications of the character of their occurrence, I am indebted to the admirable list of Mr. Ridgway; vide Bull. Essex Institute, vol. 6, No. 10; vol. VII, Nos. 1 and 2; and also in several instances to verbal notes furnished by him.

† These three birds breed in the valleys adjoining the mountains.

The Western Orange-crowned Warbler, (*Helminthophaga celata* var. *lutescens*,) which is distinguished varietally, as it occurs on the west coast, mainly by its brighter coloration, is here decidedly paler, though still approximating more closely to this than to the interior and eastern form, *H. celata*. The same is true of *Myiodioctes pusillus* var. *pileolatus* as compared with *M. pusillus*. The Song Sparrow of this region, though referable to the Pacific type, (*Melospiza melodia* var. *heermanni*,) yet very distinctly approaches the *M.* var. *fallax* of the middle province, and only a short distance to the east of the main chain will be found to merge into the latter. Perhaps, however, in no bird is this tendency toward variation better shown than in the remarkable thick-billed sparrow, (*Passerella iliaca* var. *megarynchа*.) In its typical region, the southern coast range of California, the bill of this bird is enormously developed, till it becomes almost misshapen through its extreme depth. Coincident with this is a change of color, it being several shades darker than its representative from the interior, *P.* var. *schistacea*. Examples from the eastern slope, though unmistakably of this variety, show in the modification of these peculiarities that many steps have been taken toward the *schistacea* form. The colors are lighter; the bill, though still much larger than is ever found in the latter bird, is perhaps scarcely half the size found in extreme examples of *P.* var. *megarynchа*. Other species showing a similar tendency might also be cited, all having the same significance, viz, a differentiation from the typical condition of their respective forms toward the interior type, coincident with their intermediate habitat.

The small number of species of the Warbler family (*Sylvicolidæ*) represented in the Sierra Range, as remarked by us during the season of 1875 in California, and again the past season on the eastern slope, as compared with the number found in the Rocky Mountains, is a matter of much interest. When the comparison is extended to the middle and Pacific provinces proper, nearly the same numerical ratio is found to exist. Noticeable as this is in the cases of these two provinces, when a like comparison is made with the eastern province, a much greater discrepancy in the number of this group is seen. To so great an extent is this true that in a division of the continent into two longitudinal sections this family would enter as a very important factor of the problem, the number of Warblers found in the eastern province, (its divisional line being drawn at about the one-hundredth meridian,) as compared with the western half, being nearly as two to one. No fewer than forty-two species of Warblers inhabit the eastern region. The greater proportion of these occur in the extreme eastern part, being there distributed to the several avian faunas that have been marked out from along its southern border to its northernmost limits. The greatest number of species occur towards its northern portions, especially in the Alleghanian and Canadian faunas as restricted; those whose habitat is northern, visit, of course, the lower faunas in their migrations.

As localities to the westward are noted it will be found that the number of species diminishes, and several birds are lost sight of ere reaching the Mississippi River. On its western edge the eastern province loses quite a large proportion of its characteristic species, no fewer than fourteen which occur along its eastern half, being absent in Kansas. A small percentage of eastern species still persist when the middle province is entered, some of them being found clear across the continent, forming, indeed, the larger percentage of the sylvicoline avi-fauna.

The following is a list of the eastern species that remain when the middle province is reached:

1. *Helminthophaga celata.*
2. *Dendroica æstiva.*
3. *Geothlypis trichas.*
4. *Icteria virens.*
5. *Myiodioctes pusillus.*
6. *Setophaga ruticilla.*

Helminthophaga ruficapilla, Dendroica coronata, D. striata, D. maculosa, and Seiurus noveboracensis have all been found more or less numerously in Colorado and elsewhere within the limits of the middle region. They do not, however, breed there, but occur only as migrants in spring or fall as they pass to or from their northern summer haunts within the eastern province; hence they are not included in the above list.

To those enumerated are to be added several species which are characteristic of the middle province, in so far at least as they are not found at all within the limits of the eastern; one or two of these occur, so far as known, only as migrants, their proper habitat being the Pacific province; several are confined to the extreme southern portion of the Rocky Mountains; three only are confined to this province.

The additional species are:

7. *Helminthophaga luciæ.*
8. *Helminthophaga virginiæ.*
9. *Dendroica occidentalis.*
10. *Dendroica townsendi.*
11. *Dendroica nigrescens.*

12. *Dendroica audubonii.*
13. *Dendroica olivacea.*
14. *Dendroica graciæ.*
15. *Geothlypis macgillivrayi.*
16. *Setophaga picta.*
17. *Cardellina rubrifrons.*

Helminthophaga luciæ, virginiæ, and *Dendroica graciæ,* are the only ones belonging exclusively to this region.

Of *Dendroica occidentalis, townsendii,* and *nigrescens,* the two first come more properly within the Pacific province, as they breed about the Columbia River and Northern Sierras, and only find their way to the Rocky Mountains during the fall migrations, and then to the southern portions of the chain. *Dendroica nigrescens* is equally an inhabitant of both regions. *Dendroica olivacea, Setophaga picta,* and *Cardellina rubrifrons* only occur in our territory in Southern Arizona. This portion of that Territory, as well as the corresponding part of New Mexico, faunally considered, belongs with and is indivisible from Northern Mexico.

Leaving the middle region and approaching the Pacific coast, we find that the number of warblers still diminishes, whether we consider the mountains proper, or the low coast regions. In this province we find no species which we have not recognized in one or the other of the two provinces mentioned, though *D. occidentalis* and *D. townsendii* are characteristic of this province as summer residents.

The following is the list:

1. *Helminthophaga ruficapilla.*
2. *Helminthophaga celata* var. *lutescens.*
3. *Dendroica æstiva.*
4. *Dendroica occidentalis.*
5. *Dendroica townsendii.*
6. *Dendroica nigrescens.*
7. *Dendroica coronata?*
8. *Dendroica audubonii.*
9. *Geothlypis trichas.*
10. *Geothlypis macgillivrayi.*
11. *Icteria virens.*
12. *Myiodioctes pusillus* var. *pileolatus.*

Two instances are to be noted here where birds continuing unchanged as they pass from the eastern into the middle province, are in the Pacific region differentiated into varieties, namely, *Helminthophaga* var. *lutescens* and *Myiodioctes* var. *pileolata.*

The evident preponderance of the number of species of this group in the Eastern United States, taken in connection with the fact that so large a proportion of the forms that occur in the western half of the country are eastern species, but little changed, or, as in most instances, actually the same, and that so few are peculiar to that region, seems strongly to favor the assumption that it was in the East that the family had its origin, and that few, perhaps none, of the group were indigenous to the West.

A further consideration of the number of warblers inhabiting the more northern and eastern parts of North America, in comparison with those of the southern parts of Mexico and South America, seems to point to the conclusion that the original center of the family was actually in this (the former) region, and that it radiated out from a comparatively circumscribed area, to become firmly established in and indigenous to the sections where it now flourishes. The Canadian and Hudsonian faunas, as restricted by Allen, receive a larger proportion of warblers in the breeding season than are to be found in any other region of North America of similar extent.

In his geographical distribution of mammals, Wallace arrives at a similar conclusion respecting the *Motacillidæ,* (warblers,) giving their probable origin as North-Temperate America.

LIST OF BIRDS OBSERVED NEAR CARSON CITY, NEV., FROM AUGUST 25 TO SEPTEMBER 16, AND FROM NOVEMBER 10 TO NOVEMRER 20, 1876, WITH NOTES.

TURDIDÆ.

1. *Turdus migratorius,* L., var. *propinquus,* R.—Nevada Robin.

Under the above name Mr. Ridgway has recently described a western variety of the robin, and has indicated certain differences that obtain in the species as it occurs from the eastern base of the Rocky Mountains westward, as compared with examples of the bird from the region east of the Missouri Plains.

The specimens we have seen from Nevada correspond well with his diagnosis of the above bird, and, while we cannot consider the forms in question as illustrating "two

very strongly marked geographical races," they yet appear to be admissible as slight varietal forms.

Apparently not a common species in the valleys during the summer and fall; said to be abundant in the early spring months along the water-courses.

2. *Oreoscoptes montanus* (Towns.).—Sage Thrush.

Fairly numerous amongst the sage-brush. The Sierras appear to limit absolutely the westward range of this species, and it seems to be entirely wanting in California, except in the extreme southern portion, where it reaches across the southern line quite to the coast; so to the northward, where it finds no lofty mountain barriers, it extends to the Columbia River.

SAXICOLIDÆ.

3. *Sialia mexicana*, Sw.—Western Bluebird.

Common.

4. *Sialia arctica*, Sw.—Arctic Bluebird.

Noted about Carson in November, when it frequented the cedar and piñon hills, descending at this season from the mountains, where found earlier.

SYLVIIDÆ.

5. *Regulus calendula*, (L.).—Ruby-crowned Wren.

Quite numerous in the cottonwoods and in the shrubbery of the streams.

PARIDÆ.

6. *Parus montanus*, Gamb.—Mountain Chickadee.

Though, as its name implies, a lover of the mountains, where an inhabitant of the conifers, it yet in fall descends lower, and in the depth of winter is found quite commonly among the deciduous vegetation of the valleys.

TROGLODYTIDÆ.

7. *Troglodytes aëdon*, V., var. *parkmanni* (Aud.).—Parkman's Wren.

Not common; not seen about houses, but frequenting the shrubbery.

8. *Cistothorus palustris*, Wils., var. *paludicola*, Bd.—Long-billed Marsh Wren.

The sedgy margins of Washoe Lake contain thousands of these noisy little wrens, which winter here.

MOTACILLIDÆ.

9. *Anthus ludovicianus* (Gm.).—Titlark.

Not seen about Carson in September, but found on my return in November in small numbers. Found along water-courses, but chiefly in wet, meadowy ground or among stubble.

SYLVICOLIDÆ.

10. *Helminthophaga celata* (Say), var. *lutescens*, Ridgw.—Western Orange-crowned Warbler.

Occurs in small numbers in fall in the shrubbery that skirts the foot-hills.

11. *Dendroica audubonii* (Towns.).—Audubon's Warbler.

Appearing in the valleys only during the migrations.

12. *Geothlypis trichas* (L.).—Maryland Yellowthroat.

A few of this species were seen till into September. They are quite numerous earlier, breeding in the low portions of the valleys.

13. *Myiodioctes pusillus* (Wils.), var. *pileolata*, Ridgw.—Western Black Cap.

One or two seen along the borders of Washoe Lake.

LANIIDÆ.

14. *Collurio borealis* (V.).—Great Northern Shrike.

Makes its appearance about Carson from the north in October. Saw several.

15. *Collurio ludovicianus* (L.), var. *excubitoroides* (Sw.).—Western Loggerhead Shrike.

Appears to be resident in considerable numbers. Quite common in November.

FRINGILLIDÆ.

16. *Carpodacus frontalis* (Say).—House Finch.

Abundant; frequenting especially, and in large flocks, the shrubbery along the Carson River.

17. *Passerculus savanna* (Wils.), var. *alaudinus*, Bon.—Western Savanna Sparrow.

Numerous in wet ground.

18. *Pooecetes gramineus* (Gm.), var. *confinis*, Bd.—Western Grass Finch.

Common among the sage-brush.

19. *Melospiza melodia* (Wils.), var. *heermanni*, Bd.—Heerman's Song Sparrow.

I saw but few of this sparrow in the valleys. It however occurs about Carson, according to Mr. Ridgway, as a common summer resident, and a greater or less number winter.

20. *Poospiza belli* (Cass.), var. *nevadensis*, Ridgw.—Artemisia Sparrow.

The artemisia wastes are peculiarly suited to the habits of this species, and all the year round it may be found in the same localities. It builds its nest in the sage-bush in summer, and as fall approaches the flocks congregate together, not to leave their desolate surroundings, but to wander hither and thither in more extended circles over the same hunting-grounds.

21. *Junco oregonus* (Towns.).—Oregon Snowbird.

In fall and winter numerous in the valleys.

22. *Spizella socialis* (Wils.), var. *arizonæ* (Coues).—Arizona Chipping Sparrow.

Common in summer.

23. *Spizella breweri*, Cass.—Brewer's Sparrow.

Very numerous, inhabiting the sage-brush.

24. *Zonotrichia leucophrys* (Forst.), var. *intermedia*, Ridgw.

This species remains in the mountains till late in the fall, but, gradually descending, becomes by November quite common in the low valleys, where among the brush-wood it remains during the winter.

25. *Chondestes grammaca* (Say).—Lark Finch.

Tolerably numerous. I saw more individuals in November than in August. Frequents at this season for the most part open ground.

26. *Cyanospiza amœna* (Say).—Lazuli Finch.

By the latter part of August nearly all this species had migrated to the south, and only an occasional individual was seen. Numerous in summer.

ICTERIDÆ.

27. *Agelæus phœniceus* (L.).—Red-winged Blackbird.

This is the common species of the marshes about Carson, and of the region generally. This appears to be its western limit. The *A.* var. *gubernator*, according to Mr. Ridgway also occurs in the marshes.

28. *Xanthocephalus icterocephalus* (Bp.).—Yellow-headed Blackbird.

This bird does not appear to be found in any considerable numbers in this locality. They were more or less common in November about the tulle sloughs, and remain during the winter.

29. *Sturnella magna* (L.), var. *neglecta*.—Western Meadow Lark.

Very numerous both in summer and winter, being chiefly found in the pastures, but frequenting to some extent the sage-brush.

30. *Scolecophagus cyanocephalus* (Gm.).—Brewer's Blackbird.

More numerous even than the red-wings, as, too, more generally distributed. In winter they may be seen in almost any situation.

CORVIDÆ.

31. *Corvus corax* L., var. *carnivorus* Bartr.—American Raven.

A common resident.

32. *Gymnokitta cyanocephyala Maxim.*—Blue Crow.

Not an inhabitant of the valleys proper at any season, but often seen in large flocks flying from one range of piñon hills to another. They are resident, and breed among the piñons.

33. *Pica melanoleuca* (L.), var. *hudsonica*, Sab.—Magpie.

The magpie is a very common inhabitant of the valleys, being naturally fond of the densest thickets that fringe the various streams, where they build their nests. The bird plays an important role as a scavenger, and the slaughter-houses form the centers around which all the individuals of a locality congregate.

34. *Cyanocitta floridana* (Bartr.), var. *californica*, Vigors.—Californian Ground Jay.

This species crosses the Sierra range, and is found along the eastern slope of the mountains. It reaches, however, no farther than the foot-hills, but is soon replaced to the east by the closely allied form, the Woodhouse's Jay, (*Cyanocitta* var. *woodhousei*.) I found it numerous in the brush of the foot-hills; not present in the pine woods of the mountains. By November all had passed farther south.

TYRANNIDÆ.

35. *Tyrannus verticalis*, Say.—Arkansas Flycatcher.

A very abundant species about Carson, where they nest in the shade-trees along the streets. They leave for the south in August, and by the last of the month all had departed.

36. *Sayornis sayus* (Bon.).—Say's Flycatcher.

A single specimen was taken September 8. The species is doubtless a common one during the summer.

ALCEDINIDÆ.

37. *Ceryle alcyon* (L.).—Kingfisher.

Common on all the streams.

CAPRIMULGIDÆ.

38. *Antrostomus nuttalli* (Aud.).—Nuttall's Poorwill.

Present in considerable numbers during summer. The species migrates during the month of September, and is then very frequently started up from among the scrub and brush of the hillsides.

39. *Chordeiles popetue* (Vieill.), var. *henryi*, Cass.—Western Night-Hawk.

Numerous in the valleys. All had disappeared by the last of August.

TROCHILIDÆ.

40. *Selasphorus rufus* (Gmel.).—Rufous-backed Humming Bird.

An occasional individual seen, which had strayed down from the neighboring mountains. Probably not found in the valleys at all in summer.

PICIDÆ.

41. *Picus villosus* (L.), var. *harrisii*, Aud.—Harris's Woodpecker.

Not common in the valleys, but occasionally seen in the trees about Carson in the fall.

42. *Colaptes mexicanus* (Swains.).—Red-shafted Flicker.

Quite common in the valleys in summer; more numerous in fall.

STRIGIDÆ.

43. *Otus vulgaris* (L). var. *wilsonianus* (Less.)—Long-eared Owl.

The only arboreal species that is at all common in the valleys. This bird is very numerous and lives the year round in the little copses of willows and the denser thickets bordering the swampy lands. Their food consists almost exclusively of field-mice, of which they kill vast numbers, a fact which should earn them the protection of the farmers.

44. *Speotyto cunicularia* (Mol.), var. *hypugæa* (Bon.).—Burrowing Owl.

An abundant resident in some of the high pasture lands about Carson, their location being only determined by the presence of suitable burrows made by the several species of ground-squirrels (*Spermophilus.*)

FALCONIDÆ.

45. *Falco communis* Gmel., var. *anatum*, Bon.—Duck Hawk.

In fall making its appearance in considerable numbers along the sloughs and on the borders of the lakes, where it is always ready to capture the water-fowl disabled by the gunners. Its powers of wing are ample to enable it to overtake, in fair pursuit, any of the ducks, and many fall its victims.

46. *Falco sparverius* L.—Sparrow Hawk.

Numerous.

47. *Pandion haliætus* (L.).—var. *carolinensis*, Gmel.—Fish Hawk.

Common on the lakes and streams.

48. *Circus cyaneus* (L.). var. *hudsonius*, L.—Marsh Hawk.

The most abundant of all the predatory birds. Exceeding numerous in the marshes. Never, I think, interfering with the water-fowl, except when wounded, and deriving its subsistence chiefly from the smaller species of rodents.

49. *Buteo borealis* (Gmel.)., var. *calurus*, Cass.—Western Red-tailed Hawk.

Not very common, and seen in the low valleys only in fall and winter.

50. *Archibuteo lagopus* (Brunn.)., var. *sancti-johannis*.—Rough-legged Hawk.

Coming down from the mountains in considerable numbers as fall approaches, and' like the Duck Hawk, making its headquarters about the sloughs and open sheets of water. Its chief dependence are mice, but it also seizes many wounded ducks.

51. *Aquila chrysætus* (L.).—Golden Eagle.

Mr. Parker presented me with a specimen of this eagle, which he had killed in the fall near Carson. Its occurrence so low down is not common.

52. *Rhinogryphus aura* (L.).—Red-headed Vulture.

Numerous about Carson, where very useful as a scavenger.

COLUMBIDÆ.

53. *Zenaidura carolinensis* (L.).—Carolina Dove.

Abounds in the low valleys everywhere.

PERDICIDÆ.

54. *Oreortyx picta* (Dougl.).—Mountain Quail.

Scarcely found in the valleys, yet ranging from the high mountains over the foothills, and so occasionally met with in the valleys, or at the head of ravines, whither they resort after water.

55. *Lophortyx californicus* (Shaw.).—California Valley Quail.

A few have been introduced about Carson, as I was informed by Mr. Parker. They do not appear to increase at a very rapid rate.

CHARADRIIDÆ.

56. *Aegialitis vocifera* (L.).—Killdeer.

Numerous in summer and fall, becoming rarer as the season advances, and probably but few actually winter in this vicinity.

RECURVIROSTRIDÆ.

57. *Recurvirostra americana*, Gmel.—American Avocet.

Rather abundant during the migrations; many breed about Washoe Lake.

SCOLOPACIDÆ.

58. *Gallinago wilsonii* (Temm.).—Wilson's Snipe.

Not abundant, but still found in considerable numbers, especially during the fall migration. A few doubtless winter.

59. *Ereunetes pusillus* (L.).—Semi palmated Sandpiper.

60. *Totanus melanolencus* (Gmel.).—Greater Yellowlegs.

Of frequent occurrence in spring and fall, during the migrations.

ARDEIDÆ.

61. *Ardea herodias* L.—Great Blue Heron.

Common.

62. *Herodias egretta* (Gmel.).—Great White Egret.

An occasional individual seen.

63. *Botaurus minor* Gmel.—Bittern.

Very common in the marshes.

RALLIDÆ.

64. *Rallus virginianus* L.—Virginia Rail.

Rather numerous.

The *Porzana carolina* was not seen by us, but was found by Mr. Ridgway breeding in the Truckee Valley, and doubtless it is found in all the marshes of this vicinity.

65. *Fulica americana* Gm.—Coot.

Breeds in great numbers in the tules of Washoe and other lakes of this region. In fall appears in immense numbers.

ANATIDÆ.

66. *Cygnus buccinator* Richardson.—Trumpeter Swan.

Mr. Parker informed me that occasionally a swan strayed on to Washoe Lake. At the sink of the Carson River this swan is found in fall in very great numbers.

67. *Anser hyperboreus* Pall.—Snow Goose.

Coming from the north in large flocks in October and November.

68. *Branta canadensis* (L.).—Canada Goose.

Migrants from the north appear in the fall in large flocks; some merely make a temporary sojourn, and continue their course southward. Many of those arriving late remain about the lakes all winter.

69. *Branta canadensis* (L.), var. *leucopareia* (Brandt).—White-collared Goose.

A single individual of the above variety, one of a small flock, was shot in November by my friend Mr. Parker. The three forms of the Canada goose (*canadensis*, *hutchinsii*, and *leucopareia*) appear to come from the north in associate bands, the flocks being often composed in this locality of varying numbers of either bird.

70. *Dendrocygna fulva* (Gm.) Burm.—Fulvous Tree Duck.

With a habitat extending far down into Central and South America, this duck yet occurs along our southern borders, and it is probable with greater regularity and in more considerable numbers than the isolated records of its capture would seem to imply. A specimen is in the Smithsonian from New Orleans, and the species was found at the mouth of the Colorado River by Dr. Palmer. It was detected at Fort Tejon, Southern California, by Xantus, while as high up as San Francisco it seems to be of not very unusual occurrence.

To the notices above is to be added the fact of its occurrence at Washoe Lake, Nevada, where the species was found by my friend Mr. Parker in the early part of this year (1877). He succeeded in shooting three out of several large flocks, one of which specimens is now before me. As this neighborhood is almost destitute of trees, it is certain they do not spend the summer here, but probably pass on to some of the heavily-timbered valleys, as the Lower Truckee, which would appear well adapted to their peculiar arboreal habits. Their occurrence here may, however, be somewhat of an accidental nature, as Mr. Parker writes that they were seemingly driven in with myriads of other fowl by a severe snow-storm, and that neither himself nor any of the gunners of that vicinity had ever seen them about the lake before. Notwithstanding which fact, it is by no means unlikely that future investigations will show the bird to be a regular summer resident of such portions of this region as are suited to its needs.

71. *Anas boschas* L.—Mallard.

A common summer resident; very abundant in fall and winter.

72. *Dafila acuta* L.—Pintail.

Most abundant in the late fall, when, with other species, it appears from farther north.

73. *Chaulelasmus streperus* (L.).—Gadwall.

Breeds commonly, and in fall is numerically one of the best represented of the family.

74. *Mareca americana* (Gm.).—Baldpate.

Very numerous, especially late in fall.

75. *Querquedula carolinensis* (Gm.).—Green-winged Teal.

Very numerous. Is in August and early September perhaps the most numerously represented of any of the family.

76. *Querquedula discors* (L.).—Blue-winged Teal.

Not nearly so common as either of the other two species.

77. *Querquedula cyanoptera* (V.).—Red-breasted Teal.

It breeds in great numbers in the region generally. I believe it migrates south earlier than any other species. I failed to detect its presence in November, and think none remain to winter.

78. *Spatula clypeata* (L.).—Shoveller.

Very abundant, both as a summer resident and a fall migrant.

79. *Aix sponsa* (L.).—Summer Duck.

Rather uncommon.

80. *Fuligula marila* (L.).—Greater Blackhead.

One of the later arrivals in fall from the north. Abundant.

81. *Fuligula marila* (L.), var. *affinis*, Eyton.—Lesser Blackhead.

Like the preceding.

82. *Fuligula collaris* (Donovan).—Ring-necked Duck.

Breeds abundantly in the various lakes. I found the young as late as September 3 still unable to fly.

83. *Fuligula ferina* (L.), var. *americana* (Eyton).—Redhead.

Present in the fall, but never, I think, in great numbers.

84. *Fuligula vallisneria* (Wils.).—Canvas-back.

Was told by Mr. Parker that he had shot quite a number of this species about Washoe Lake.

85. *Bucephala albeola* (L.).—Buffle-headed Duck.

In considerable numbers in fall.

86. *Mergus serrator* (L.).—Red-breasted Merganser.

Numerous.

87. *Mergus cucullatus* (L.).—Hooded Merganser.

Quite abundant, but occurring late in fall.

88. *Erismatura rubida* (Wils.).—Ruddy Duck.

Apparently not very common.

PELECANIDÆ.

89. *Pelecanus trachyrynchus* Lath.—White Pelican.

Only appearing on Washoe Lake in fall, and in small numbers. Said to breed in great numbers on Pyramid Lake, to the north.

GRACULIDÆ.

90. *Graculus dilophus* (Sw.).—Double-crested Cormorant.

This cormorant is found on the various lakes in summer.

LARIDÆ.

91. *Larus delawarensis* Ord.—Ring-billed Gull.

This gull was found in great numbers on Washoe Lake in September and October. During the fall its distribution throughout this region is very general, and wherever found it is abundant.

92. *Larus californicus* Lawr.—Californian Gull.

Mingled with the preceding were a few of this species or variety.

The relationship of these two birds appears not to be thoroughly established yet, and in a series of eight specimens from Washoe and Tahoe Lakes, I find several in the immature plumage which I assign with difficulty. In adult plumage the present bird is said to have a larger bill than the preceding species, and to present some distinctive points of coloration, especially in its darker mantle. The only adult bird I have agrees well with the diagnosis, but in the case of the immature plumage there appear to be no thoroughly reliable distinctive characteristics which will serve to distinguish the two species.

93. *Sterna regia* Gambel.—Royal Tern.

Found on Washoe Lake in small numbers late in the fall.

94. *Hydrochelidon fissipes* (L.).—Black Tern.

Seen in small numbers on Washoe Lake in August. None were present in November.

COLYMBIDÆ.

95. *Colymbus torquatus* Brunn.—Great Northern Diver.

Present on Washoe Lake in November, where I saw two individuals. Was informed, however, that its occurrence here was unusual. Its dispersion over all portions of the west in fall and winter appears to be general.

PODICIPIDÆ.

96. *Podiceps* (*Æmophorus*) *occidentalis* Lawr.—Western Grebe.

Breeds abundantly in Washoe Lake. The young still in the down were taken August 31. One of the main subgeneric characters of this bird is the absence of colored ruffs or other nuptial ornaments about the head during the breeding season, it thus forming a striking exception to the general rule obtaining in the family. The young, the first I believe ever taken, are now before me, from the above locality. They scarcely need description, more than that conveyed in the general statement that in the distribution of colors they almost exactly resemble the old birds. In this respect they seem to carry out the peculiarities of their parents, inasmuch as the young of the other grebes are all, so far as I am aware, curiously streaked or mottled in their first or downy plumage.

LIST OF BIRDS OBSERVED ON THE EASTERN SLOPE OF THE SIERRAS, NEAR CARSON CITY, NEVADA, FROM SEPT. 16 TO NOV. 7; WITH NOTES.

TURDIDÆ.

1. *Turdus migratorius* L., var. *propinquus* Ridgw.—Nevada Robin.

During the month of September the Robins began to be rather numerous along the mountain sides, the number of those resident here during the summer having doubtless been increased by the arrival of birds reared farther to the north, while they were rendered more conspicuous from the fact of their having flocked. In early November they were seen in great flocks at different localities, where were found various kinds of wild berries. The majority of these birds, if not all, pass farther south to winter.

2. *Turdus nævius* Gm.—Varied Thrush.

A male of this species which I saw confined in a cage in a store in Carson City was said by the owner to have been captured during the previous spring in the adjoining mountains. For this statement I cannot vouch, but give it for what it is worth. This thrush has never been recorded from any locality east of the Sierras; yet there seems to be no reason why during the migrations, as in the case of other birds possessing a similar summer habitat, the species may not occur along the eastern slope. That it actually does so, however, remains to be proven.

SAXICOLIDÆ.

3. *Sialia mexicana* Sw.—Mexican Bluebird.

During the month of September and early October this species was rather numerous among the pines at an elevation of about 7,000 feet. After this fewer were seen, a partial emigration having perhaps taken place, or, as is more likely, the species having retired from the high altitudes to the valleys, where they winter in considerable numbers.

4. *Sialia arctica* Sw.—Arctic Bluebird.

At the time the preceding species began to diminish in numbers the present bird attracted attention by a corresponding increase, and it soon almost wholly represented the other in the mountain region. They winter among the pines and in the brushy ravines, forming a close association with the Titmice, Nuthatches, etc.

SYLVIIDÆ.

5. *Regulus calendula* (L.).—Ruby-crowned Kinglet.

Abundant during the fall months among the pines, sometimes in small companies of their own species, but more often distributing themselves by twos and threes among the flocks of winter birds.

PARIDÆ.

6. *Lophophanes inornatus* (Gamb.).—Plain Titmouse.

A resident, but not very numerous. Inclined to favor with its presence the cedar and piñon hills rather than the pine region proper, from which, however, it is not entirely absent.

7. *Parus montanus* (Gamb.).—Mountain Chickadee.

Appears to be the only other representative of the family in this region. A constant resident of the pineries.

SITTIDÆ.

8. *Sitta carolinensis* Gm.; var. *aculeata*, Cass.—Slender-billed Nuthatch.

An abundant resident of the pine timber.

9. *Sitta pygmœa* Vig.—Pygmy Nuthatch.

The most abundant of the tribe, keeping exclusively in the pines, among which they wander in large flocks.

CERTHIIDÆ.

10. *Certhia familiaris* L., var. *americana*, Bon.—American Creeper.

Only a few seen, and these among the pines.

SYLVICOLIDÆ.

11. *Helminthophaga celata* Say, var. *lutescens* Ridgw.—Western Orange-crowned Warbler.

This variety was found rather common during September about Lake Tahoe, frequenting chiefly the brushy thickets on the mountain sides. It probably breeds all along the eastern slope.

12. *Dendroica audubonii* (Towns.).—Audubon's Warbler.

The only numerously represented species of the family. Not, I think, nearly as abundant as in the Rocky Mountains at the corresponding season. Keeping generally in the pines, but also seizing much of its food from the ground.

TANAGRIDÆ.

13. *Pyranga ludoviciana* (Wils.).—Louisiana Tanager.

A very much belated individual of this species was seen September 18. The species had passed south long before.

AMPELIDÆ.

14. *Myiadestes townsendii* (And.).—Townsend's Solitaire.

None seen till the first days of October; after this, small companies were occasionally noted in various localities through the mountains. Probably more or less pass the summer on the higher summits.

FRINGILLIDÆ.

15. *Carpodacus cassini* Bd.—Cassin's Purple Finch.

In September this Finch was not uncommon about Lake Tahoe. After which none were seen, the species having migrated. It is a summer resident in this region.

16. *Melospiza melodia* var. *heermannii* (Bd.).—Heermann's Song Sparrow.

Quite rare among the mountains. Occasionally one seen in October in the thickets along the streams.

All examples of the Song Sparrow I have seen from this region, while referable to the above variety, yet mark quite a decided step in the advance towards the central region form, the *M.* var. *fallax*. They are not so dark colored as specimens from the California coast, and the bills appear to be somewhat slenderer, approximating in these particulars to *fallax*.

17. *Junco oregonus* (Towns.).—Oregon Snowbird.

Very abundant everywhere. I presume this hardy species winters in the mountains; at least many remain till the snow falls to a considerable depth.

18. *Zonotrichia leucoprys* (Forst.), var. *intermedia* Ridgw.—Western White-crowned Sparrow.

This bird was found by Mr. Ridgway breeding abundantly on the eastern slope. It

is found all over the mountains, and in fall crosses the range, and is found but little less abundantly in Southern California.

NOTE.—The *Zonotrichia leucophrys*, though not noted by us, doubtless occurs mingled with flocks of the above bird, especially as it was found by us in Southern California.

19. *Zonotrichia coronata* (Pall.).—Golden-crowned Sparrow.

The great mass of these sparrows, in their journey southward, keeps on the western slope of the Sierras. It occurs, too, along the eastern spurs in fall, but, comparatively speaking, in very small numbers.

20. *Passerella iliaca* (Merr), var. *megarynchа* Bd.—Thick-billed Sparrow.

This appears to be the only Passerella occurring along the eastern slope, where it is numerous in summer and fall, and where I believe it is resident.

In a recent report (1876) I was led to combine the present bird with *P. schistacea*, separating them from the *P. townsendi* and *iliaca* mainly on the strength of the different proportions. Subsequent examination, however, has convinced me that the genus is represented by but one species, and that the three western forms, *townsendi*, *schistacea*, and *megarynchа* are but varieties of one and the same species. These under different conditions of climate have become more or less differentiated from the original type till they represent well-marked geographical races, the intergradation of which with each other and with *iliaca* it is perfectly possible to show. As noticed in an earlier part of this report, all specimens of the variety *megarynchа* from the eastern slope of the Sierras show very decided intermediate characters between the extreme condition this form assumes in the Coast Range and the *P. schistacea* from the interior, a fact to be expected from the half-way position of the region. A series connecting the two may very readily be formed. An examination of the material in the Smithsonian, much of which was collected by the expedition, enables us to speak with equal confidence of the close relationship existing between *schistacea* and *townsendi*. Specimens connecting the two in a very complete chain may easily be selected. Hitherto no specimens intermediate between *iliaca* and *townsendi* have been met with, and though the differences separating them have been chiefly modifications of color only, differences of degree of intensity and not of pattern, this has been deemed sufficient to keep them apart.

It will be remembered that the habitats of the two are, in the northwest, in close juxtaposition to each other, *iliaca* being one of quite a number of eastern birds that in the north find their way across the continent and reach Alaska. *Townsendi*, with its summer home in the northern portion of the Pacific province, also reaches Alaska, and it is probable that here the two forms come together. At all events, a series of sixteen specimens collected by the expedition in California, in 1875, presents unquestionable evidence of the intergradation of the two. Of these I do not find one which compares exactly with the usual style of *townsendi*, as it appears in specimens from Kodiak, Sitka, etc. The one extreme of this series exhibits quite a close approach to the dark olive-brown of *townsendi*, with its unstreaked dorsum; the other in its light condition quite suggests the ferruginous style of coloration of *iliaca*: such specimens have the back obsoletely streaked. One other specimen from California in the Institution so closely approaches *iliaca* that it was so labeled, and supposed in the absence of others showing its true relation to be a straggler of this species. In connection with the above suite its position as one of the series showing the intergradation of the two forms is readily seen.

The following measurements illustrate the relations, in size, the four forms bear to each other:

P. iliaca: Wing, 3.40; tail, 3.07; bill, .32; tarsus, .93; (average of ten specimens.)

P. townsendi: Wing, 3.20; tail, 3.15; bill, .49; tarsus, .94; (average of twenty-three specimens.)

P. schistacea: Wing, 3.13; tail, 3.37; bill, .44; tarsus, .91; (average of nine specimens.)

P. megarynchа: Wing, 3.21; tail, 3.58; bill, .51; tarsus, .93; (average of eight specimens.)

As will be seen from the above measurements, *schistacea* and *megarynchа* agree in having the tail considerably in excess of the wing; while in *iliaca* and *townsendi* the wing exceeds the tail. In *townsendi*, however, this discrepancy in favor of the wing is very slight, and, indeed, in some few specimens the two are equal, or the tail may even be slightly in excess of the wing. It would appear, therefore, that in respect to the relative size of these parts, *townsendi* indicates the first step in the variation, which is seen to be more marked in *schistacea*, and to find the limit in *megarynchа*.

One unexpected fact shown by these measurements is, that not only does an increase in length of tail take place in the three western varieties, a variation shown in other species, whose habitat extends from the eastern into the western province, but a decrease in size of wing. The different proportions which ensue come, then, from two

causes: first, actual increase in the length of the tail; second, actual decrease in the length of the wing.

By the above arrangement the four forms will stand as follows:

Passerella iliaca (Merr.).—Habitat: Eastern province of North America; breeds from British America northward, across to mouth of Youkon. In migrations to eastern edge of great plains; occasional in spring in Colorado (Maxwell) fide Ridgway.

Passerella iliaca, var. *schistacea* Bd.—Habitat: Middle province; restricted by western edge of plains and eastern slope of Sierras; an occasional straggler in Kansas and California in fall.

Passerella iliaca, var. *townsendi* (Aud.).—Habitat: Pacific province; breeds in northern Sierras; Southern California in winter; confined to western slope of Sierras.

Passerella iliaca, var. *megarynchа* Bd.—Habitat: Southern Sierras, eastern as well as western slope; probably a resident species.

21. *Pipilo maculatus* (Sw.), var. *megalonyx* Bell.—Long-spurred Towhee.

I saw but few Pipilos, and these on the brushy foot-hills, or in the chaparral of the mountain sides. They were extremely shy, so much so that I failed to secure specimens. They were doubtless of the above variety, as the variety *oregonus* is a more northern form.

22. *Pipilo chlorurus* (Towns.).—Green-tailed Finch.

Not uncommon in October; probably rather numerous in summer.

ICTERIDÆ.

23. *Scolecophagus cyanocephalus* (Wagl.).—Brewer's Blackbird.

Rather numerous during the fall months on the borders of Lake Tahoe.

CORVIDÆ.

24. *Corvus corax* L.—Raven.

Not nearly so common in the mountains as in the valleys below.

25. *Picicorvus columbianus* (Wils.).—Clarke's Crow.

A very abundant resident throughout the pine-region, appearing to live exclusively upon the pine-seeds.

26. *Pica melanoleuca* L., var. *hudsonica* (Sab.).—American Magpie.

As noticed in the previous list, scarcely reaching into the mountains, and but few were seen on the immediate borders of Lake Tahoe.

27. *Cyanura stelleri* Gm., var. *frontalis* Ridg.—Blue-fronted Jay.

Very abundant on the eastern slope, here replacing the var. *macrolopha* of the Rocky Mountains. A permanent resident.

TYRANNIDÆ.

28. *Empidonax hammondi* (Xantus).—Hammond's Fly-catcher.

This was the sole representative of the family noted by us in the mountains. It probably is not uncommon as a summer resident.

CAPRIMULGIDÆ.

29. *Antrostomus nuttalli* (Aud.).—Nuttall's Poorwill.

Not uncommon in fall in the shrubbery of the open mountain sides, but avoids the pine-woods.

TROCHILIDÆ.

30. *Selasphorus rufus* (Gm.).—Rufous-backed Humming-bird.

The only humming-bird seen by us in the mountains. Very numerous in September and the first of October.

An unaccountable fact to us in connection with the present bird is the apparent absence of all adult males in the fall from localities and regions where the young and fe-

males abound. In the fall of 1875, while in Southern California, we failed to find a single adult male in the valleys, although the species was very numerously represented by adults of the other sex and by the young. The absence of the males was attributed to the fact of their having found their way into the mountains, though this seemed a hardly adequate explanation. The experience of the past season was but a repetition of that of the previous year, except that our ground of observation was exchanged for the mountains. Where females and young were to be seen by scores, a most careful search failed to discover a single adult male.

Mr. Ridgway, we learn, had a similar experience in fall along the eastern slope, and was equally at a loss to understand whither the males had betaken themselves.

ALCEDINIDÆ.

31. *Ceryle alcyon* (L.).—Belted Kingfisher.

Present on the shores of Lake Tahoe in small numbers, as on the small streams.

PICIDÆ.

32. *Picus albolarvatus* (Cass).—White-headed Woodpecker.

Numerous in the pine-woods, to which it strictly confines itself, and where it is resident.

33. *Picus villosus* (L.), var. *harrisii* Aud.—Harris's Woodpecker.

Perhaps the most numerously represented in the mountains of any of the family where resident, but not confining itself so closely to the pineries as the preceding bird.

34. *Picoides arcticus* (Sw.).—Arctic Woodpecker.

This species appears to be of rather common occurrence about Lake Tahoe, where I saw it occasionally in September, October, and November. It, without doubt, breeds here.

35. *Sphyrapicus ruber* (Gm.).—Red-breasted Woodpecker.

Apparently not very common. Probably a few breed along the eastern slope.

36. *Sphyrapicus thyroideus* (Cass).—Brown-headed Woodpecker.

Not at all uncommon in the pine-woods about Lake Tahoe, where it breeds and is a constant resident.

37. *Asyndesmus torquatus* (Wils.).—Lewis's Woodpecker.

I saw but few of this species. It is probably a summer resident, and does not winter in the region.

38. *Colaptes mexicanus* (L.).

Numerous; less so, however, in the mountains than in the valleys below.

STRIGIDÆ.

39. *Bubo virginianus* (Gm.), var. *arcticus* (Sw.).—Western Horned Owl.

Abundant; its hooting heard at every camp.

40. *Otus vulgaris* (L.), var. *wilsonianus* (Less.).—Long-eared Owl.

Common in the thickets of the meadowy lands bordering upon Lake Tahoe.

FALCONIDÆ.

41. *Falco communis* Gmel., var. *anatum* Bon.—Duck Hawk.

Met with frequently in early fall. Probably this species leaves the mountains when severe weather comes on and winters in the valleys. At all events it becomes quite common in the lower regions in November.

42. *Pandion haliætus* L., var. *carolinensis* Gmel.—Fish Hawk.

Rather rare; one or two seen about Lake Tahoe.

43. *Circus cyaneus* L., var. *hudsonius* L.—Marsh Hawk.

Present in the meadows through the mountains, and though not nearly so numerous as below, it is still common.

44. *Buteo borealis* (Gmel.), var. *calurus* Cass.—Western Red-tailed Hawk.

Abundant. With this hawk, as is the case with most of the species, a change of habitat is made necessary in the late fall, when snow and severe weather cause the disappearance of the small mammals, reptiles, and other game upon which it preys. They then move down into the valleys and remain about the lakes, where not only are found an abundance of water fowl, but where the marshes afford them an unfailing supply of certain small rodents through the season.

45. *Archibuteo lagopus* (Brunn.), var. *sancti-johannis*.—Rough-legged Buzzard.

Very numerous. In early November, in a meadow of considerable size not far from Lake Tahoe, I found that scores of this hawk had congregated. From one to half a dozen were visible at any hour of the day, sweeping with heavy wing over the surface of the turfy ground, and now and then dropping with almost certain aim upon one of the small Meadow Rats (*Arvicola riparius*) whose excavations honeycombed the ground in all directions, and whose immense numbers accounted for the unusual abundance of the hawks at this one locality.

46. *Aquila chrysaëtus* (L.)—Golden Eagle.

Apparently rather more numerous in this region than the succeeding bird.

47. *Haliætus leucocephalus* (L.)—Bald Eagle.

Rather rare. In fact eagles are rarely abundant in any portion of the west which I have visited, and the sight of one is an event of sufficiently unusual occurrence to attract the attention and elicit comment from the most unobservant of a party. The white-headed is much more numerous as an inhabitant of either coast than as a bird of the interior.

TETRAONIDÆ.

48. *Canace obscurus* (Say.)—Dusky Grouse.

The whole pine-timbered region lying along the eastern slope of the Sierras west of the Carson Valley, was formerly the home of very great numbers of this fine bird. Some of the stories told by the early settlers of its abundance are almost incredible.

The sound of the woodman's axe is followed by the almost complete abandonment of a locality, and chiefly from this cause and from the persecution they have been subjected to at the hands of the settlers and the Indians, the localities are very few where the grouse still exist in abundance. The steep sides of many of the deep cañons have proved inaccessible to the lumberman, and still retain the primeval growth of forest. Here the grouse still maintain their foot-hold, and will continue to do so long after the surrounding country has been swept bare of woods.

PERDICIDÆ.

49. *Oreortyx pictus* (Dougl.)—Plumed Partridge; Mountain Quail.

This beautiful bird ranges from the coast across the mountains, and is found along the eastern slope, where, at an elevation of about 6,000 feet, it is quite abundant. As noticed before, it reaches the lower foot-hills, but in very much diminished numbers. Usually a resident bird wherever found; the only effect winter has upon their range is to cause them to abandon the higher elevations occupied in summer, and to appear farther down upon the mountain-sides.

The mountains of this whole region lying about Lake Tahoe seem to be entirely abandoned by the species in winter, and a very complete migration takes place during the late fall. The flocks then pass not to the South, but westward, and winter upon the western slopes of the mountains, descending to a greater or less distance toward the foot-hills, according to the depth of snow, the severity of the weather, &c. Such at least is the explanation offered by the hunters and residents for their disappearance about November from this section, where earlier they are very abundant, and which I have every reason to believe is the true one. Those living in summer on the low foot-hills about Carson remain to winter. But those whose summer habitat is higher up in the mountains proper thus make a short migration to a region better adapted to their wants.

The snow upon the eastern slope falls to a great depth, and the winter is very severe, much more so than on the western side—facts which appear to have been thoroughly acquired by experience by these birds, till the habit of migration in anticipation of winter has become a fixed and constant one.

SCOLOPACIDÆ.

50. *Gallinago wilsonii* (Temm.)—Wilson's Snipe.

But a single one of this species was seen; this in a meadowy spot on the border of Tahoe in October.

ARDEIDÆ.

51. *Ardea herodias* L.—Great Blue Heron.

Common about Lake Tahoe.

52. *Botaurus minor* Gm.—Bittern.

Numerous on Lake Tahoe.

RALLIDÆ.

53. *Rallus virginianus* L.—Virginia Rail.

Saw but one, in a marsh near Lake Tahoe.

54. *Fulica americana* Gm.—Coot.

Extremely abundant in October and November about and on the lake.

ANATIDÆ.

55. *Anser hyperboreus* Pall.—Snow Goose.

Appears from the north in flocks in October, and sometimes make use of the lake as a temporary stopping-place.

56. *Branta canadensis* (L.)—Canada Goose.

Passes over the lake in great flocks, but less often rests here.

57. *Anas boschas* L.—Mallard.

Numerous in fall. This species appears to breed regularly in the little ponds and lakelets that abound in the mountains, and two or three flocks, each a little family group, will often be encountered in such places in fall ere they have started out in search of winter quarters.

58. *Mareca americana* Gm.—Baldpate.

Also occurring in fall.

59. *Querquedula carolinensis* (Gm.)—Green-winged Seal.

The only teal I saw about the lake. This species is rather numerous.

60. *Spatula clypeata* (L.)—Shoveller.

Probably breeds about the lake, but only in small numbers.

61. *Fuligula collaris* (Donovan.)—Ring-necked Duck.

In small numbers in fall; probably summers in the marshes of the lake.

62. *Oedemia* ——?

One of the large Sea Ducks occurs here in fall, and I saw several off the shores of the lake; the species I was unable to determine satisfactorily.

63. *Mergus serrator*, L.—Red-breasted Merganser.

A few seen on the lake in October.

PELECANIDÆ.

64. *Pelecanus trachyrynchus* Lath.—White Pelican.

Occasionally a flock strays on to the waters of the lake in fall.

GRACULIDÆ.

65. *Graculus dilophus* (Sw.)—Double-crested Cormorant.

A few of this species are said to pass the summer on the lake, where, however, they do not breed. They appear to leave the lake early in October, and I saw none at the time of my visit. Mr. Ridgway has identified the form from this region as the above

LARIDÆ.

66. *Larus delawarensis* Ord.—Ring-billed Gull.

I shot a single immature gull on Lake Tahoe, November 1, which I refer with but little doubt to this species. I am unable to state the numerical proportion which this bird bears to the next in this region during the late fall. According to Mr. Ridgway it should replace entirely in winter the next species.

67. *Larus californicus* Lawr.—Californian Gull.

Of five gulls shot on Tahoe, about November 1, four appear to belong to this species. They unquestionably winter here.

COLYMBIDÆ.

68. *Colymbus torquatus* Brunn.—Great Northern Diver.

I saw a number of specimens in possession of Mr. McKinney, which he had shot on the lake in fall. They do not appear to be very numerous.

69. *Podiceps auritus* (L.), var. *californicus* (Heerm.)—American Eared Grebe.

Very numerous all along the borders of Tahoe in fall. So utterly fearless and unsophisticated are they that they swim about the wharves, utterly regardless of the presence of humans but a dozen or twenty feet away.

APPENDIX J.

REPORT UPON THE HEMIPTERA COLLECTED DURING THE YEARS 1874 AND 1875, BY MR. P. R. UHLER.

PEABODY INSTITUTE, BALTIMORE, MD.,
March 24, 1877.

SIR: I have the honor to transmit the following report upon the Hemiptera collected by the expedition during the years 1874 and 1875.

Very respectfully, your obedient servant,

P. R. UHLER.

Lieut. GEO. M. WHEELER,
Corps of Engineers, in charge.

HETEROPTERA.

SUBFAMILY EURYGASTRINÆ.

Eurygaster, Lap.

E. alternatus.

Tetyra alternata, Say; Amer. Ent. iii, tab. 43, fig. 3.
Eurygaster alternatus, Dallas; Brit. Mus. List. Hemipt. i, p. 47, No. 1.

San Ildefonso, N. Mex., September, 1874, collected by Dr. H. C. Yarrow; also, near Colorado River, California, July 20, by William Somers.

SUBFAMILY ASOPINÆ.

Perillus, Stål.

1. *P. claudus.*

Pentatoma clauda, Say; Journ. Acad. Philad. iv, p. 312, No. 2.

San Ildefonso, N. Mex., in August, Dr. Yarrow and Mr. Shedd; also, Abiquiu, N. Mex., in September, and on the foot-hills and plains of that Territory in October, by Dr. O. Loew. Also, near the Mojave River, California, in July, Dr. O. Loew.

2. *P. splendidus.*

Zicrona splendida, Uhler; Proc. Ent. Soc. Philad. 1863, p. 22.

Found at Santa Barbara, Cal., in July, by Mr. Shoemaker, and in Southern California, by Mr. Henshaw.

ZICRONA, Am. et Serv.

Z. cuprea.

Zicrona cuprea, Dallas; Brit. Mus. List I, p. 108, No. 2.

Southern Colorado, in June, Lieut. W. L. Carpenter.

SUBFAMILY HALYDINA.

BROCHYMENA, Am. et. Serv.

B. obscura.

Halys obscura, H. Schf.; Wanz. Ins. v, p. 68, fig. 513.

From Pueblo, Colo., in July, Mr. Wilkins; also San Ildefonso, N. Mex., August 17, Dr. O. Loew.

PRIONOSOMA, Uhler.

P. podopioides.

Prionosoma podopioides, Uhler; Proc. Ent. Soc. Philad. 1863, vol. ii, p. 364.

From Santa Barbara, Cal. Collected by Dr. Loew.

SUBFAMILY PENTATOMINA.

EUSCHISTUS, Dallas.

1. *E. crenator.*

Cimex crenator, Fab; Ent. Syst. iv, p. 101, No. 87.
Pentatoma obscura, Palisot-Beauv; Ins. Afr. et Amer., p. 149, pl. 10, fig. 7.

Collected at Santa Barbara, Cal., in July, by H. W. Henshaw.

2. *E. impictiventris.*

Euschistus impictiventris, Stål; Enum. Hemipt. ii, p. 26, No. 21.

From San Ildefonso, N. Mex., in August, Mr. Shedd.

3. *E. fissilis.*

Euschistus fissilis, Uhler; In U. S. Geol. Surv. of Montana 1871, p. 396, No. 1.

Collected in Southern Colorado, June-July, by Lieut. W. L. Carpenter.

4. *E. serous.*

Pentatoma serva, Say; Heteropt. New Harmony, p. 4, No. 5.
Euschistus serous, Stål; Enum. Hemipt. ii, p. 26, No. 19.

From San Ildefonso. Collected by Dr. H. C. Yarrow.

Chlorochroa, Stål.

1. *C. ligata.*

Pentatoma ligata, Say; Heteropt. New Harmony, p. 5, No. 6.

From Camp Lowell, Ariz., September 9, by Mr. Johnson.

2. *C. Sayi.*

Chlorochroa Sayi, Stål; Enum. Hemipt. ii, p. 33, No. 6.
Pentatoma granulosa, Uhler; U. S. Geolog. Survey of Montana 1871, p. 398.

Collected at San Ildefonso, N. Mex., in July and August, by Dr. H. C. Yarrow; also in August, by Mr. Shedd; in Southern Arizona, by H. W. Henshaw; at Tierra Amarilla, N. Mex., September 15; at the San Juan River in New Mexico, by Mr. Browne, and on the plains and foot-hills of Northern New Mexico, in October.

THYANTA, Stål.

1. *T. rugulosa.*

Pentatoma rugulosa, Say; Heteropt. New Harmony, p. 7, No. 16.

From Southern Colorado, in October.

2. *T. perditor.*

Cimex perditor, Fab.; Ent. Syst., vol. iv, p. 102, No. 90.
Thyanta perditor, Stål; Hemipt. Fabr., vol. i, p. 29.

Obtained at Camp Bowie, Ariz., August 1, by Mr. Rutter; at Santa Fé, N. Mex., in June, by H. W. Henshaw; above timber-line in New Mexico, by Lieut. W. L. Carpenter; and in the Mojave desert, July, by G. Thompson.

Murgantia, Stål.

M. histrionica.

Strachia histrionica, Hahn; Wanz. Ins., vol. ii, p. 116, fig. 196.
Murgantia histrionica, Stål; Enum. Hemipt. ii, p. 37, No. 4.

Inhabits Plaza del Alcade, Arizona, in August, collected by Dr. H. C. Yarrow; Cave Spring, Arizona, July, H. W. Henshaw; Pueblo and San Ildefonso, N. Mex., Dr. H. C. Yarrow; New Mexico, in September, by S. Bedell, and Northern New Mexico, on the plains and foot-hills.

BANASA, Stål.

B. sordida.

Atomosira sordida, Uhler; Proc. Boston Soc. Nat. Hist. 1871, p. 6.

Originally obtained in Cambridge, Mass. The present specimen is from Tierra Amarilla, N. Mex., collected in July by Mr. Shedd. This is the first record of the occurrence of this insect in the region west of the Mississippi Valley.

ACANTHOSOMA, Curtis.

A. cruciata.

Edessa cruciata, Say; Heteropt. New Harmony, p. 8, No. 1.

Belongs to the regions north of the United States, but the specimens here reported were obtained at Abiquiu, N. Mex., by Dr. O. Loew.

FAMILY COREIDÆ.

SUBFAMILY COREINA.

MARGUS, Dallas.

M. inconspicuus.

Syromastes inconspicuus, H. Schf.; Wanz. Ins., vol. vi, p. 14, fig. 570.

Obtained at San Ildefonso, August 17, by Mr. Shedd, and by Dr. H. C. Yarrow; also in Southern Colorado, June 5, by Lieut. W. L. Carpenter.

CHELINIDEA, Uhler.

C. vittigera.

Chelinidea vittiger, Uhler; Proc. Ent. Soc. Phila., vol. ii, p. 366.

Collected in Northern New Mexico, June–July, by Lieut. W. L. Carpenter.

CATORHINTHA, Stål.

C. mendica.

Catorhintha mendica, Stål; Enum Hemipt., vol. 1, p. 187, No. 2.

Collected by Lieut. W. L. Carpenter, in Southern Colorado, June 5 to July 5.

ANASA, Amyot et Serv.

A. tristis.

Cimex tristis, De Geer; Mém. iii, p. 340, pl. 34, fig. 20.
Anasa tristis, Stål; Hemipt. Fabr. i, p. 56, No. 3.

Collected at Colorado Springs, Colo., in July, and at San Ildefonso, N. Mex , in August, by Dr. H. C. Yarrow; Southern Colorado, June, Lieut. W. L. Carpenter.

SUBFAMILY ALYDINA.

STACHYOCNEMUS, Stål.

S. apicalis.

Alydus apicalis, Dallas; Brit. Mus. List II, p. 479.
Stachyocnemus apicalis, Stål; Enum. Hemipt. i, p. 215.

From the foot-hills and plains of New Mexico, in October, by Lieut. W. L. Carpenter.

SUBFAMILY MICTINA.

PACHYLIS, St. Farg.

P. gigas.

Pachylis gigas, Burm.; Handb. der Ent. ii, p. 338, No. 3.

Collected at the Bowie Agency, Ariz., August 15, by Mr. Johnson.

SUBFAMILY ANISOSCELIDINA.

LEPTOGLOSSUS, Guer.

1. *L. corculus.*

Anisoscelis corculus, Say; Heteropt. New Harmony, p. 12, No. 1.

From Tierra Amarilla, N. Mex., July, collected by Mr. Shedd; and from Arizona, by Mr. Rutter.

NARNIA, Stål.

N. femorata.

Narnia femorata, Stål; Stettin. Ent. Zeit. xxiii, p. 296, No. 154. Stål. Enum. Hemipt., vol i, p. 166, No. 1.

Collected at Camp Lowell, Ariz., August 23, by Mr. Henshaw.

SUBFAMILY BERYTINA.

NEIDES, Latr.

N. spinosus.

Berytus spinosus, Say; Amer. Ent., vol. i, pl. 14.

From Pueblo, Colo., collected by Dr. H. C. Yarrow.

SUBFAMILY PSEUDOPHLŒINA.

DASYCORIS.

D. humilis.

Dasycoris humilis, Uhler; U. S. Geological Survey of Montana, 1871, p. 403.

Obtained at Colorado Springs, Colo., in July, by Dr. Yarrow.

SUBFAMILY RHOPALINA.

CORIZUS, Fallen.

1. *C. Sidæ.*

Lygæus sidæ, Fab; Ent. Syst. iv, p. 169, No. 116.
Corizus sidæ, Signoret; Ann. Soc. Ent. France, ser. 3, vii, p. 95, No. 32.

Collected near the Mojave River, California, in July, Dr. O. Loew; also in the vicinity of the Colorado River, California, July 20, by W. Somers.

2. *C. hyalinus.*

Lygæus hyalinus, Fab; Ent. Syst. iv, p. 168, No. 115.
Corizus hyalinus, Stål; Hem. Fabr. i, p. 68, No. 2.

From Taos, N. Mex., in August, by Mr. Shedd; from Pueblo, Colo., in July, by Dr. Yarrow; and from Santa Fé, N. Mex., June, Mr. Henshaw.

LEPTOCORIS, Kahn.

L. trivittatus.

Lygæus trivittatus, Say; Journ. Acad. Philad. iv, p. 322, No. 2.
Leptocoris trivittatus, Stål; Enum. Hemipt. i, p. 226.

From Southern Colorado, July, Lieut. W. L. Carpenter.

FAMILY LYGAEIDÆ.

LYGAEUS, Fab.

1. *L. reclivatus.*

Lygæus reclivatus, Say; Journ. Acad. Philad. iv, p. 321, No. 1.

From Southern Arizona, Mr. Henshaw; San Ildefonso, N. Mex., Dr. Yarrow and Mr Shedd; Cave Spring, Ariz., July, Mr. Henshaw; Pueblo, Colo., July, Dr. Yarrow and Mr. Wilkin; Abiquiu, N. Mex., Dr. O. Loew; Mojave Desert, Cal., July, and near Mojave River, July, Dr. O. Loew.

2. *L. costalis.*

Lygæus costalis, H. Schf.; Wanz. Ins. vii, p. 22, fig. 706.

Obtained in California.

3. *L. fasciatus.*

Lygæus fasciatus, Dallas; Brit. Mus., Hemipt. ii, p. 538, No. 17.
Lygæus aulicus, H. Schf; Wanz. Ins. vi, p. 76, fig. 646.

Common in the Atlantic region south of Massachusetts; also in Texas, Mexico, and the West Indies. The only specimen in this lot was collected in Southern California, by J. A. Hasson.

MELANOCORYPHUS, Stål.

M. facetus.

Lygæus facetus, Say; Heteropt. New Harmony, p. 13, No. 2.

From the plains and foot-hills of New Mexico; June to October; collected by Lieut W. L. Carpenter.

MELANOPLEURUS, Stål.

M. bistriangularis.

Lygæus bistriangularis, Say; Heteropt. New Harmony, p. 14, No. 3.
Melanopleurus bistriangularis, Stål; Enum. Hemipt. iv, p. 169.

Collected at Camp Bowie, Arizona, August 8, by Mr. Albruiz.

NYSIUS, Dallas.

1. *N. angustatus.*

Nysius angustatus, Uhler; United States Geological Survey of Montana, 1871, p. 406, No. 2.

Obtained at Pueblo, Colo., in July, by Dr. Yarrow and Mr. Wilkin; at Fort Garland, in July, Mr. Hunt.

2. *N. californicus.*

Nysius californicus, Stål; Eugenies Resa, Hemipt., p. 242, No. 56.

Collected in New Mexico, in September, by S. Bedell; at Fort Garland, in August, by Mr. Shedd; July, by Dr. Yarrow, and in Southern California, June–July, by H. W Henshaw.

ISCHNORHYNCHUS, Fieb.

I. didymus.

Lygæus didymus, Zett; Vet. Akad. Handl. 1819, p. 71, No. 20.
Cymus Franciscanus, Stål; Eugenies Resa, p. 252, No. 84.
Ischnorhynchus didymus, Fieber; Europ. Hemipt., p. 199.

Southern Colorado, Dr. H. C. Yarrow.

GEOCORIS, Fallen.

1. *G. pallens.*

Geocoris pallens, Stål; Eugenies Resa, p. 250.

From the Mojave region, California, in July, Dr. Loew.

2. *G. bullatus.*

Salda bullata, Say; Heteropt. New Harmony, p. 18, No. 2.
Ophthalmicus borealis, Dallas; Brit. Mus. List, ii, p. 585, No. 8.

A specimen from Pueblo, Colo., collected by Dr. Yarrow; and a pale variety was obtained above timber-line in New Mexico, by Lieutenant Carpenter.

LIGYROCORIS, Stål.

L. constrictus.

Pamera constricta, Say; Heteropt. New Harmony, p. 15, No. 1.
Beosus abdominalis, Guer; La Sagra Hist. de Cuba, Ins., p. 397.

Southern Colorado, June and July, Lieut. W. L. Carpenter.

MYODOCHA, Latr.

M. serripes.

Myodochus serripes, Oliv; Encyc. Method., viii, p. 106.
Myodocha petiolata, Say; Heteropt. New Harmony, p. 19.

From New Mexico, August 23, by Dr. H. C. Yarrow.

TRAPEZONOTUS, Fieb.

T. nebulosus.

Lygæus nebulosus, Fallen; Mon. Cim., p. 65, No. 7.
Pamera fallax, Say; Heteropt. New Harmony, p. 17, No. 6.
Trapezonotus nebulosus, Fieber; Eur. Hemipt., p. 190.

From Southern Colorado, June-July, Lieut. W. L. Carpenter; also found above timber-line in New Mexico by the same gentleman.

PERITRECHUS, Fieb.

P. Fraternus.

Peritrechus fraternus, Uhler; Boston Soc. Nat. Hist. Proc., 1871, p. 11.

From Tierra Amarilla, N. Mex., in July, collected by Mr. Shedd.

SUBFAMILY LARGINA.

LARGUS, Hahn.

L. cinctus.

Largus cinctus, H. Schf.; Wanz. Ins., vol. vii, p. 6, fig. 683.

From Sienaga, Ariz., August 23, by Mr. Rutter; from Southern California, by Mr. J. A. Hasson; Santa Barbara, Dr. O. Loew; Southern Arizona, August, Mr. Henshaw; and from Camp Lowell, October 17, by Mr. Rutter.

FAMILY PHYTOCORIDÆ.

MIRIS, Auctor.

M. instabilis.

Miris instabilis, Uhler; Bulletin U. S. Geolog. Surv. of the Territories, vol. ii, No. 5, p. 50.

A very common insect in the Atlantic region and in Texas. The present specimen was collected above timber-line, in New Mexico, by Lieut. W. L. Carpenter, and also in Southern Colorado, in July.

PHYTOCORIS, Fallen.

P. nubilus.

Capsus nubilus, Say; Heteropt. New Harmony, p. 22, No. 10.

From near Colorado Creek, New Mexico, July 18, by Lieut. W. L. Carpenter.

LOPIDEA, Uhler.

L. media.

Capsus medius, Say; Heteropt. New Harmony, p. 22, No. 11.

Collected at San Ildefonso, N. Mex., in August, by Mr. W. C. Shedd; at Tierra Amarilla, N. Mex., in September, by Dr. H. C. Yarrow; in New Mexico, September, by S. Bedell.

LYGUS, Kahn.

1. *L. annexus.*

Lygus annexus, Uhler; U. S. Geological Survey of Montana, 1871, p. 413.

From Pueblo, in July, by Mr. Wilkin; Tierra Amarilla, N. Mex., September, Dr. H. C. Yarrow; Abiquiu, N. Mex., Dr. O. Loew; Northern New Mexico, Lieut. W. L. Carpenter

2. *L. lineatus.*

Lygæus lineatus Fab; Ent. Syst. Suppl., p. 541, No. 124-5. Syst. Rhyng., p. 234, No. 152, *Capsus 4-vittatus*, Say, Heteropt.; New Harmony, p. 20, No. 5.

An inhabitant of many parts of the United States from Northern New York to Texas. The present specimens were collected in Northern New Mexico, in June-July, by Lieut. W. L. Carpenter.

3. *L. lineolaris.*

Capsus lineolaris, Palisot-Beauv; Ins. Afr. et Amer., p. 187, pl. xi, fig. 7.

Common in most parts of temperate North America. From Northern New Mexico, June-July, Lieut. W. L. Carpenter.

4. *L. invitus.*

Capsus invitus, Say; Heteropt. New Harmony, p. 24, No. 21.

Sometimes common on the blossoms of *Vitis labrusca* in June, in Maryland. A variety of this species was captured in Northern New Mexico, in June, by Lieut. W. L. Carpenter.

CALOCORIS, Fieb.

1. *C. rapidus.*

Capsus rapidus, Say; Heteropt. New Harmony, p. 20, No. 4.
Capsus multicolor, H. Schf; Wanz. Ins. viii, p. 19, fig. 795.

Common in Eastern United States and in Texas. From Pueblo, Colorado, in June, by Dr. H. C. Yarrow; and from Tierra Amarilla, N. Mex., by S. Bedell.

2. *C. superbus.*

Calocoris superbus, Uhler; U. S. Geog. Surva. W. of 100th M., vol. v, 1875, p. 838, No. 2.

From San Ildefonso, N. Mex., August 17, by Mr. Shedd.

RESTHENIA, Amyot & Serv.

R. insignis.

Capsus insignis, Say; Heteropt. New Harmony, p. 22, No. 12.

Collected in Northern New Mexico, by Dr. H. C. Yarrow and Lieut. W. L. Carpenter.

CAMPTOBROCHIS, Fieb.

C. nebulosus.

Camptobrochis nebulosus, Uhler; U. S. Geolog. Survey of Montana, 1871, p. 417.

From Tierra Amarilla, N. Mex., by Dr. H. C. Yarrow.

STIPHROSOMA, Fieb.

S. stygica.

Capsus stygicus, Say; Heteropt. New Harmony, p. 24, No. 18.

From Northern New Mexico, July 18, by Lieut. W. L. Carpenter.

AGALLIASTES, Fieber.

A. associatus.

Agalliastes associatus, Uhler; U. S. Geolog. Survey of Montana, 1871, p. 419.

Collected at Pueblo, Colo., by Dr. H. C. Yarrow.

ORECTODERUS, Uhler.

1. *O. obliquus.*

Orectoderus obliquus, Uhler; Bulletin U. S. Geogr. Surv. of the Territories, vol. ii, No. 5, p. 54.

From Northern New Mexico, Dr. H. C. Yarrow.

2. *O. amœnus*, new sp.

Smaller and more slender than *O. obliquus*. Orange-fulvous, polished, not obviously punctured, the hemelytra dull, excepting the long cuneiform silvery white streak

opening from the base of the corium. Head much longer than wide, polished, narrowed behind the eyes, the width between the eyes scarcely narrower than the collum; face moderately decurving; eyes blackish, reniform, very prominent; antennæ moderately stout, rod-like, the basal joint constricted at its origin, the second joint very long, infuscated, of even thickness throughout; rostrum slender, infuscated, reaching upon the venter. Pronotum nearly bell-shaped, longer than wide, very narrow in front, finely polished, the posterior margin concave. Marginal lines of the corium all around, and of the clavus, brownish; cuneus infuscated at tip, and with a large white spot at base; membrane fuliginous, but paler at the basal angle. Legs long and slender, the tibiæ and tarsi tinged with piceous. Venter highly polished, orange, a little infuscated, moderately clavate posteriorly. Length to tip of venter 4½ millims. To tip of wing-covers 6 millims. Width of pronotum 1⅛ millims.

A single wing cover is in the lot from New Mexico. Other specimens have been taken in Texas and Illinois.

FAMILY ACANTHIADÆ.

ACANTHIA, Fabr.

A. lectularia.

Cimex lectularius, Linn; Syst. Nat. ed. 12. vol. ii, p. 715, No. 1.
Acanthia lectularia, Fab; Ent. Syst. iv, p. 67, No. 1.
Acanthia lectularia, Amyot & Serv; Hemipt., p. 313, No. 1.
Acanthia lectularia, Fieber; Eur. Hemipt., p. 134, No. 1.

From Nothern New Mexico, October, Lieut. W. L. Carpenter.

FAMILY ARADIDÆ.

ARADUS, Fab.

A. rectus.

Aradus rectus, Say; Heteropt. New Harmony, p. 29, No. 4.

From the foot-hills of New Mexico, October, Lieut. W. L. Carpenter.

FAMILY PHYMATIDÆ.

PHYMATA, Lat.

P. erosa.

Cimex erosus, Linn; Syst. Nat. ed. 12, vol. ii, p. 718, No. 19.
Cimex scorpio, DeGeer; Mém. iii, p. 350. pl. 35, fig. 13.
Phymata erosa, Amyot & Serv; Hemipt., p. 290, No. 2.

From San Ildefonso, N. Mex., August 17, Mr. Shedd.

FAMILY NABIDÆ.

CORISCUS, Schrank.

C. ferus.

Cimex ferus, Linn; Fauna Suec., p. 256, No. 962.
Nabis ferus, Fiber; Eur. Hemipt., p. 161, No. 9.
Coriscus ferus, Stål; Enum Hemipt. iii, p. 113, No. 13.

Collected in New Mexico, and at Colorado Springs, Colo., June, by Dr. H. C. Yarrow; also Southern Colorado, June-July, Lieut. W. L. Carpenter, and above timber-line in New Mexico.

SUBFAMILY REDUVIINA.

PRIONOTUS, Lap.

P. cristatus.

Cimex cristatus, Linn; Cent. Ins. Rar., p. 16, No. 42. Amœn. Acad., vol. vi, p. 399, No. 42.
Reduvius novenarius, Say; Amer. Ent., vol. i, pl. 31, No. 2.
Arilus denticulatus, Westwood; Drury Illust., vol. ii, p. 73.
Prionotus cristatus, Uhler; Bulletin U. S. Geo. Surv. Territ., vol. ii, No. 5, p. 61.

A single specimen from Northern New Mexico, collected by Lieut. W. L. Carpenter.

PINDUS, Stål.

P. socius.

Pindus socius, Uhler; U. S. Geolog. Survey of Montana, 1871, p. 420.

From the plains and foot-hills of Northern New Mexico, in October, by Lieut. W. L. Carpenter.

SUBFAMILY APIOMERINA.

APIOMERINA, Hahn.

A. flaviventris.

Apiomerus flaviventris, H. Schf; Wanz. Ins., vol. VIII, p. 77, fig. 847.

A variety of this species was collected near Santa Fé, N. Mex., in June, by Mr. Henshaw; Northern New Mexico, June 5 to July 5, Lieut. W. L. Carpenter; also at Bowie, Ariz., August 8, by Mr. Albruiz.

SUBFAMILY PIRATINA.

RASAHUS, Stål. (Nec Amyot.)

R. liguttatus.

Petalochirus liguttatus, Say; Heteropt, New Harmony, p. 33, No. 2.
Pirates mutillarius, Guer; La Sayra, Ile de Cuba, p. 410. (Exclus. syn.)

From the Mojave Desert, California, by Dr. O. Loew, and from Los Angelos, in June by J. Brown.

MELANOLESTES, Stål.

1. *M. abdominalis.*

Pirates abdominalis, H. Schf., Wanz. Ins., vol. viii, p. 63, fig. 832.

Collected in Northern New Mexico, June–July, by Lieut. W. L. Carpenter.

2. *M. picipes.*

Pirates picipes, H. Schf; Wanz. Ins., vol. viii, p. 62, fig. 831.
Reduvius pungens, Lee; Proc. Philad. Acad. Nat. Sci. 1855, p. 404.
Melanolestes picipes, Stål; Enum. Hemipt., ii, p. 107, No. 3.

From Abiquiu, N. Mex., September, Dr. H. C. Yarrow.

SUBFAMILY ACANTHASPIDINA.

CONORHINUS, Lap.

C. rubrofasciatus.

Cimex rubrofasciatus, DeGeer; Mém. iii, p. 349, pl. 35, fig. 12.
Conorhinus rubrofasciatus, Amyot & Serv., Hemipt., p. 384, No. 1, pl. 8, fig. 2.

From Camp Lowell, Ariz., Mr. Rutter, August 23; and from near the Colorado River, California, July 20, by Mr. Somers; also from the Mojave Desert, by G. Thompson.

FAMILY STENOPODIDÆ.

STENOPODA, Lap.

S. culiciformis.

Cimex culiciformis, Fab; Ent. Syst., p. 728, No. 162.
Stenopoda cinerea, Lap, Essai, p. 26, pl. 52, fig. 2.
Stenopada culiciformis, Stål; Hemipt. Fabr., i, p. 129, No. 1.

A nympha of this species was collected at Abiquiu, N. Mex., by Dr. H. C. Yarrow.

FAMILY SALDIDÆ.

SALDA, Fab.

S. interstitialis.

Acanthia interstitialis, Say; Journ. Acad. Philada., vol. iv, p. 321, No. 1.

From Northern New Mexico, July, Lieut. W. L. Carpenter.

FAMILY HEBRIDÆ.

HEBRUS, Curtis.

H. sobrinus, new sp.

Robust, brunneo-fuscous, beneath chiefly black-piceous, with the sternum, coxæ, and legs testaceous. Head stout, not so long nor so tapering anteriorly as in *H. pusillus* Fallen, the vertex and face very convex, the tip thickly hairy; antennæ dull testaceous.

pubescent, the basal joint thickest, narrowed at base, longer than the second, the third longest, slender like the succeeding ones; under side of head and the bucculæ dull testaceous; the rostrum slender, reaching upon the venter, dull testaceous; eyes, dark brown, with coarse and few facets. Pronotum broader than long, flattened, the humeri well defined by a brown sulcus; impressed line between the lobes distinct, as also the three fovear on the centre, those of each side less distinct; the surface very minutely punctured; pleural pieces darker, with a few very remote, large punctures. Venter smooth, blackish-piceous, densely sericeous pubescent, margined with dull fulvous. Hemelytra pale brownish, minutely pubescent, the nervures darker, the membrane scarcely reaching to the tip of the abdomen.

Length scarcely 2 millimeters. Width of pronotum ¾ millimeter.

Habitat.—New Mexico, Lieut. W. L. Carpenter. San Ildefonso, N. Mex., in July, Dr. H. C. Yarrow.

FAMILY HYGROTRECHIDÆ.

HYGROTRECHUS, Stål.

H. remigis.

Gerris remigis, Say; Heteropt. New Harmony, p. 35, No. 1.

From water on the plains of Southern Colorado and Northern New Mexico, June, July, and October, by Lieut. W. L. Carpenter.

FAMILY GALGULIDÆ.

GALGULUS, Latr.

1. *G. oculatus.*

Naucoris oculata, Fab; Syst. Rhyng., p. 111, No. 5.
Galgulus oculatus, Latr; Hist. Nat. Ins., xii, p. 286, pl. 95, fig. 9.
Galgulus bufo, H. Schf; Wanz. Ins., v, p. 88, fig. 536.

Collected at San Ildefonso, N. Mex., August 17, by W. G. Shedd; Cave Spring, Ariz., Mr. Henshaw.

2. *G. variegatus.*

Galgulus variegatus, Guerin; Icon. Regne Animal, p. 352.
Galgulus pulcher, Stål; Öfv. Vetensk. Akad. Förhandl. 1854, p. 239, No. 1.

Santa Barbara, Cal., Mr. Henshaw and Dr. O. Loew; also at Abiquiu, N. Mex., Dr. H. C. Yarrow, in September.

FAMILY NAUCORIDÆ.

AMBRYSUS.

A. Signoreti.

Ambrysus Signoreti, Stål; Hemipt. Mex. Stettin. Ent. Zeit., xxiii, p. 460, No. 336.
Naucoris Pocyi, Amyot & Serv; Hemipt., p. 434, pl. 8, fig. 5.

Taken at San Ildefonso, N. Mex., July, by Dr. H. C. Yarrow; in New Mexico, July, by Lieut. W. L. Carpenter; and in the Mojave River, Cal., in July, by Dr. O. Loew.

FAMILY BELOSTOMIDÆ.

BELOSTOMA, Auctor.

B. annulipes.

Belostoma annulipes, H. Schf; Wanz. Ins., viii, p. 28, figs. 803, 804.

A nympha was taken near San Ildefonso, in July, and an imago at Pagosa, Colo., September 5, by Dr. H. C. Yarrow.

PEDINOCORIS, Mayr.

1. *P. macronyx.*

Pedinocoris macronyx, Mayr; Verhandl. Wien. Zool.-Botan. Gesell, 1863, p. 350, tab. 11, figs. 1-4

Obtained in the Gila River, Arizona, by Dr. C. G. Newberry.

2. *P. indentata.*

Zaitha indentata, Hald., Proc. Acad. Philada., vi, p. 364.
Pedinocoris brachonyx, Mayr; Verhandl. Wien. Zool.-Botan. Gesell, 1863, p. 351, tab. 11, fig. 5.

From the Mojave River, California, July, Dr. O. Loew, and from Kernville, Cal., by Mr. Henshaw, September 2.

ABEDUS, Stål.

A. breviceps.

Abedus breviceps, Stål; Stettiner Ent. Zeit., xxiii, p. 462.

Collected at San Ildefonso, N. Mex., August 17, by Mr. Shedd; Camp Lowell, Arizona, August, Mr. Henshaw, and in Arizona, July, by Mr. Rutter.

FAMILY NOTONECTIDÆ.

NOTONECTA, Linn.

1. *N. undulata.*

Notonecta undulata, Say; Heteropt. New Harmony, p. 39, No. 1.

From Abiquiu, N. Mex., September, by Dr. Yarrow, and San Ildefonso, N. Mex., August 17, Mr. Shedd.

2. *N. insulata.*

Notonecta insulata, Kirby; Fauna Bor. Amer., iv, p. 285, No. 399.
Notonecta rugosa, Fieber; Rhynchotographien, p. 52, No. 7.

Collected at Camp Lowell, Ariz., in August, by Mr. Henshaw, and elsewhere in Arizona, in July, by Mr. Rutter.

FAMILY CORISIDAE.

CORISA, Geoff.

1. *C. interrupta.*

Corixa interrupta, Say; Journ. Acad. Philada., iv, p. 328, No. 1.

From New Mexico, in October, by Lieut. W. L. Carpenter, and from San Ildefonso, N. Mex., by Dr. H. C. Yarrow.

2. *C. alternata.*

Corixa alternata, Say; Journ. Acad. Philada., iv, p. 329, No. 2.

From San Juan River in New Mexico, by Mr. Browne.

3. *C. sutilis.*

Corixa sutilis, Uhler; Bulletin U. S. Geogr. Surv. of the Territ., vol. ii, No. 5, p. 73.

From the plains of Northern New Mexico, in October, by Lieut. W. L. Carpenter.

HOMOPTERA.

FAMILY STRIDULANTIA.

CICADA, Fab.

1. *C. synodica.*

Cicada synodica, Say; Journ. Acad. Philada., vol. iv, p. 334, No. 6.

From Southern Colorado, June-July, by Lieut. W. L. Carpenter.

2. *C. rimosa.*

Cicada rimosa, Say; Journ. Acad. Philada., vol. vi, p. 235, No. 2.

Collected in Southern Colorado, June-July, by Lieut. W. L. Carpenter.

FAMILY MEMBRACIDÆ.

CERESA, Fairm.

C. bubalus.

Membracis bubalus, Fab., Ent. Syst., vol. iv, p. 14, No. 23.
Ceresa bubalus, Fitch; Catalogue of Ins. N. Y. State Cabinet, p. 50, No. 682.

From San Ildefonso, N. Mex., and near Pueblo, Colo., by Dr. H. C. Yarrow; also from San Ildefonso, by Mr. Shedd.

SMILIA, Germar.

S. vau.

Membracis vau, Say; Journ. Acad. Philada., vol. vi, p. 299, No. —.
Smilia vau, Fitch; Cat. of Ins. of N. Y. State Cabinet, p. 48, No. 658.

Collected in Northern New Mexico, June-July, and also in October, by Lieut. W. L. Carpenter.

CAMPYLENCHIA, Stål.

C. curvata.

Membracis curvata, Fab., Syst. Rhyng., p. 13, No. 34.
Membracis latipes. Say; Long's Exped., ii, p. 302, No. 5.
Enchenopa Antonina, Walk; Brit. Mus. List. Homopt. ii, pp. 488-491, Nos. 32, 33, 35, 36, 37.
E venosa, Walk; Brit. Mus. List. Homopt. ii, pp. 488-491, Nos. 32, 33, 35, 36, 37.
E. densa, Walk; Brit. Mus List. Homopt. ii, pp. 488-491, Nos. 32, 33, 35, 36, 37.
E frigida, Walk; Brit. Mus. List. Homopt. ii, pp, 488-491, Nos. 32, 33, 35, 36, 37.
E. bimaculata, Walk; Brit. Mus. List. Homopt. ii, pp. 488-491, Nos. 32, 33, 35, 36, 37.

Collected in New Mexico, by Mr. Rutter.

PUBLILIA, Stål.

P. modesta.

Publilia modesta, Uhler; Bulletin U. S. Geolog. Survey of the Territ., vol. ii, No. 5, p. 78, No. 2.

Collected at San Ildefonso, N. Mex., by Dr. H. C. Yarrow, and at Cave Spring, Ariz., by Mr. Henshaw.

DARIUS, Fab.

An immature specimen of species allied to *D. lateralis*, Fab., was in the collection of Dr. O. Loew, from the Mojave Desert, California.

TELAMONA, Fitch.

T. pyramidata, new sp.

Similar in form to *T. querci*, Fh., but not quite so broad, the base of the dorsal prominence more compressed. Color (of the alcoholic specimen) yellowish, clouded with brown, particularly on the sides and tip of the prominence; also at the end of the scutellum, and on the base and more largely on the tip of the hemelytra. Head uneven, yellowish, remotely, finely and irregularly punctured with brown; cheeks and rostrum hairy. Pronotum with brown, coarse, sunken punctures, the punctures finer anteriorly and placed less closely, and so, also, a little way from the apex; central carinate line interruptedly brown, smooth; humeri prominent, laminar, almost rectangular. Dorsal prominence subpyramidal, compressed above, the tip rounded, edged with piceous, with a few coarse, deep, dragged punctures, which are bounded by tumid, almost linear, oblique interstices; the carinate line continued to the tip of pronotum, and paler both below and behind the summit; the apex, with four irregular, longitudinal rows of punctures, with raised linear interstices; lateral edge smooth pale, somewhat interrupted with brown. Hemelytra obscured hyaline, with a large oval spot at tip; their extreme base, the two upper nervures on the middle, and the punctures bounding the nervures each side throughout their length brown. Legs yellowish, tinged with piceous, the tibiæ spotted with brown on their outer sides; bristles pale yellowish, the base and extreme tip of tarsi, and the nails piceous. Venter blackish, with the incisures yellowish.

The hemelytra extend considerably beyond the pronotum and are obliquely narrowed at tip.

Length to tip of pronotum, 8 millimeters; to tip of hemelytra, 9 millimeters. Width between the humeral angles, 4 millimeters. Altitude to summit of dorsal prominence, scant 4 millimeters.

Collected in Southern Colorado, in July, by Lieut. W. L. Carpenter.

FAMILY FULGORIDÆ.

SCOLOPS, Germar.

S. sulcipes.

Fulgora sulcipes, Say; Journ. Philada. Acad., vol. iv., p. 335.

Obtained in Southern Colorado, June-July, by Lieut. W. L. Carpenter.

FAMILY TETTIGONIDÆ.

PROCONIA, Amyot & Serv.

P. costalis.

Tettigonia costalis, Fab., Ent. Syst., Suppl., p. 516, Nos. 22, 23. Signoret, Ann. Soc. Ent. France, 3d ser., ii, p. 359, pl. 12, fig. 8.
Cercopis marginella, Fab., Syst. Rhyng., p. 96, No. 44.
Cercopis lateralis, Fab., Ent. Syst., Suppl., p. 524, No. 24. Coquebert, Illustr., vol. i, p. 35, tab. 9, fig. 3.
Tettigonia lugens, Walker; Brit. Mus. List, Homopt., iii, p. 775, No. 108.
Tettigonia pyrrhotelus, Walk., l. c. iii, p. 775, No. 109.

Widely distributed in North America, occuring on both sides of the continent, and as frequent in the cold north of British America as in the warm regions of the subtropics.

Captured near Abiquiu, N. Mex., by Dr. O. Loew.

TETTIGONIA, Sign. (Geoff.)

T. hieroglyphica.

Tettigonia hieroglyphica, Say; Jour. Acad. Philada., vol. vi., p. 313, No. 6.

Taken in Northern New Mexico, by Lieut. W. L. Carpenter, and in the Mojave Desert, in July, by Dr. O. Loew.

HELOCHARA, Fitch.

H. communis.

Helochara communis, Fitch; Heteropt., New York State Cabinet, p. 56., Nos. 753, 754.

Taken in Northern New Mexico, in July, by Lieut. W. L. Carpenter.

BYTHOSCOPUS.

B. siccifolius.

Bythoscopus siccifolius, Uhler; Bulletin U. S. Geolog. Survey of the Territories, vol. ii, p. 93, No. 2.

Taken in New Mexico, September, by Lieut. W. L. Carpenter.

Many specimens of APHIDÆ, obtained from various kinds of plants, are included in several of the bottles, but they are changed too much by their alcoholic bath to admit of correct determination.

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