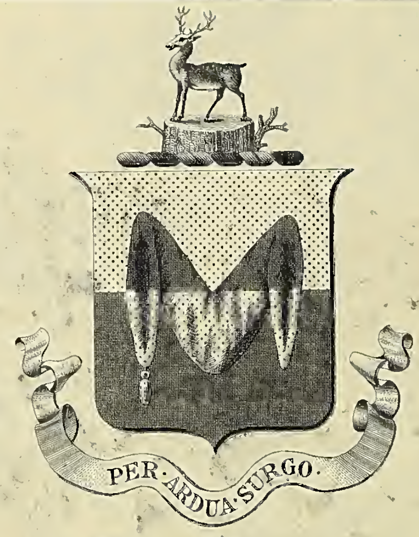
PER·ARDUA·SURGO.

33d Congress, 2d Session. | HOUSE OF REPRESENTATIVES. | Ex. Doc. No. 91.

REPORTS

OF

EXPLORATIONS AND SURVEYS,

TO

ASCERTAIN THE MOST PRACTICABLE AND ECONOMICAL ROUTE FOR A RAILROAD

FROM THE

MISSISSIPPI RIVER TO THE PACIFIC OCEAN.

MADE UNDER THE DIRECTION OF THE SECRETARY OF WAR, IN

1854-5,

ACCORDING TO ACTS OF CONGRESS OF MARCH 3, 1853, MAY 31, 1854, AND AUGUST 5, 1854.

VOLUME VI.

WASHINGTON:
A. O. P. NICHOLSON, PRINTER.
1857.

IN THE HOUSE OF REPRESENTATIVES—FEBRUARY 14, 1855.

Resolved, That there be printed, for the use of the House, ten thousand copies of the reports of surveys for a railroad to the Pacific, made under the direction of the Secretary of War, embracing the report of F. W. Lander, civil engineer, of a survey of a railroad route from Puget's Sound, by Fort Hall and the Great Salt lake, to the Mississippi river; and the report of J. C. Frémont, of a route for a railroad from the headwaters of the Arkansas river into the State of California; together with the maps and plates accompanying each of said reports necessary to illustrate them.

Attest: J. W. FORNEY,

Clerk of the House of Representatives of the United States.

THIRTY-SECOND CONGRESS, SECOND SESSION—CHAPTER 98.

SECT. 10. *And be it further enacted*, That the Secretary of War be, and he is hereby authorized, under the direction of the President of the United States, to employ such portion of the Corps of Topographical Engineers, and such other persons as he may deem necessary, to make such explorations and surveys as he may deem advisable, to ascertain the most practicable and economical route for a railroad from the Mississippi river to the Pacific ocean, and that the sum of one hundred and fifty thousand dollars, or so much thereof as may be necessary, be, and the same is hereby, appropriated out of any money in the treasury not otherwise appropriated, to defray the expense of such explorations and surveys.

Approved March 3, 1853.

THIRTY-THIRD CONGRESS, FIRST SESSION—CHAPTER 60.

Appropriation: For deficiencies for the railroad surveys between the Mississippi river and the Pacific ocean, forty thousand dollars.

Approved May 31, 1854.

THIRTY-THIRD CONGRESS, FIRST SESSION—CHAPTER 267.

Appropriation: For continuing the explorations and surveys to ascertain the best route for a railway to the Pacific, and for completing the reports of surveys already made, the sum of one hundred and fifty thousand dollars.

Approved August 5, 1854.

CONTENTS OF VOLUME VI.

REPORT

OF

LIEUT. HENRY L. ABBOT,

CORPS OF TOPOGRAPHICAL ENGINEERS

UPON

EXPLORATIONS FOR A RAILROAD ROUTE,

FROM

THE SACRAMENTO VALLEY TO THE COLUMBIA RIVER,

MADE BY

LIEUT. R. S. WILLIAMSON,

CORPS OF TOPOGRAPHICAL ENGINEERS,

ASSISTED BY

LIEUT. HENRY L. ABBOT,

CORPS OF TOPOGRAPHICAL ENGINEERS.

1855.

LETTER TO THE SECRETARY OF WAR.

WASHINGTON, D. C., *May* 6, 1857.

SIR: In obedience to instructions from the War Department, I have the honor to submit the accompanying report of the exploration and survey in California and Oregon, conducted by Lieutenant R. S. Williamson, United States Topographical Engineers, in 1855. The preparation of the report has devolved upon me, in consequence of the severe and protracted illness of Lieutenant Williamson; and it is due to myself to state that I have performed the duty with extreme reluctance, partly because it was not originally designed for me by the Department, and partly because it properly belongs to the officer by whose forethought and professional ability the expedition has been brought to a successful termination.

Wishing to convey Lieutenant Williamson's ideas, as far as they are known to me, I have been guided by his recorded field notes, and by his opinions expressed to me in conversation, in preparing the portion of the report which relates to regions traversed by him. During a part of the field work I was entrusted with a separate party, with instructions to prepare a written report of the results of my examinations. For any opinion given in this portion of the report he, of course, is not responsible.

At the completion of the survey for a railroad route from the Sacramento valley to the Columbia river, the season was so far advanced and the animals were in so jaded condition, that Lieutenant Williamson considered it impracticable to make any examination of the Sierra Nevada until the ensuing spring. Before that time, orders were received from the War Department, directing him to return at once to Washington to prepare the maps, profiles, and reports of the exploration already made. The second survey contemplated in his original instructions was consequently omitted.

At Lieutenant Williamson's request, I have prepared a full statement of the method used in deducing altitudes from the barometric observations. For unpublished and very valuable information on this subject, I am indebted to Captain A. W. Whipple, United States Topographical Engineers.

I should do injustice to Lieutenant Williamson, if I did not express his high appreciation of the energy and ability with which the officers of the escort, and the civilian assistants, labored to advance the objects of the exploration.

Of those who accompanied me when detached from the main command, I feel at liberty to speak in less general terms. Lieutenant Crook, who was the only officer with me, officially and personally contributed, in a high degree, to the success and to the harmony of the expedition. Mr. Fillebrown and Mr. Young, although suffering from severe attacks of intermittent fever, and deprived of the services of a physician, willingly continued with the party, and discharged their accustomed duties with energy and accuracy. The masterly sketches of views upon the route, and the characteristic style of the topography upon the accompanying maps, testify to the professional skill of Mr. Young. Mr. Anderson, who was my only scientific assistant in some of the most difficult and perplexing portions of the survey, aided me in every way in his power. To him, and to Mr. Fillebrown, the government is chiefly indebted for the numerous barometric observations taken upon the routes explored. Dr. Newberry was only attached to my command for a few days, as he proceeded by water from Fort Dalles to San Francisco, where he remained until the completion of the field work. While waiting in that city he zealously occupied himself in making a large and valuable zoological collection. His reports speak for themselves. The great energy which Mr. Coleman displayed in discharging the laborious duties of chief of train, is worthy of the highest praise. Had it not been for his continued and untiring exertions, many of our animals must have been lost in crossing the Cascade mountains. To the men of the topographical party generally, much commendation is due. Although deprived of the protection of an escort, and of the services of a physician, to both of which they were entitled by the terms of their agreement, they, with hardly an exception, faithfully performed their duties until the end of the survey.

I am, sir, very respectfully, your obedient servant,

HENRY L. ABBOT,
2d Lieut. U. S. Topographical Engineers.

Hon. John B. Floyd,
Secretary of War.

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INTRODUCTION.

INSTRUCTIONS FROM THE WAR DEPARTMENT.

War Department, *Washington, May* 1, 1855.

Sir: The following duties are assigned to you, under the appropriations for continuing explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi river to the Pacific ocean, and for military and geographical surveys west of the Mississippi.

1. To make such explorations and surveys as will determine the practicability, or otherwise, of connecting the Sacramento valley, in California, with the Columbia river, Oregon Territory, by a railroad, either by the Willamette valley, or (if this route should prove to be impracticable) by the valley of Des Chutes river, near the foot slopes of the Cascade-chain. Along Des Chutes river the character of the country is such as to render it improbable that a practicable route can be found.

2. To make the necessary examinations and surveys to determine if a route practicable for a railroad exists crossing the Sierra Nevada, at or near the source of Carson river. This may furnish the most direct railroad route from San Francisco to the Great Salt Lake. The duty first assigned you having been completed, you will ascertain from the commanding officer, Lieut. Col. Steptoe, and others of the troops that may have crossed the Great Basin from Great Salt Lake and the Sierra Nevada, by the route near the sources of Carson river, all the details necessary to a knowledge of the character of the route traversed by them; and should the information which you may have gathered lead to the opinion that the route is practicable for a railroad, or that such route may be found in that region, you will proceed to make the examinations and surveys necessary to ascertain if such be the case. It will not, probably, be necessary to extend this examination beyond the eastern foot of the Sierra Nevada.

If you should not require the services of all your party, for this latter duty, you will direct such of your assistants as will not be wanted for the field, to proceed to Washington, with Lieut. Abbot, and under his direction prepare the maps and reports; or you may direct Lieut. Abbot, aided by the geologist and civil engineer, or such assistants as may be necessary, to make the examination, proceeding yourself to Washington with the other assistants.

The geological information is considered especially valuable in determining the character of the country, the nature of the difficulties to be encountered, and the quality and extent of the building materials to be found.

Your attention will be directed to the botany and natural history of the country, and to such other objects as tend to illustrate its present and future conditions.

To execute these orders, you are authorized to employ the following assistants, viz: a geologist, a civil engineer, a computer, a draughtsman, and a physician, who will, at the same time, perform the duties of naturalist or geologist, if an assistant surgeon cannot be assigned to duty with the escort, at rates not exceeding those proposed by you in your estimate.

They will receive, besides their stipulated compensation, the actual cost of transportation to and from the field, if the journeys or voyages have been actually performed, and they will have the privilege, while in the field, of purchasing from the subsistence department such provisions as may be necessary for their subsistence.

You are also authorized to employ such hands, packers, &c., as may be necessary; to purchase such of the instruments, named in your estimate, as cannot be obtained from the Topographical Bureau, and such smaller instruments, maps, books, camp and garrison equipage, animals, quartermaster's stores, provisions, &c., as may be necessary to the successful accomplishment of the objects of the expedition.

The commanding officer of the Pacific Department will be directed to furnish you with an escort of (100) one hundred men, with not less than three regimental officers and an assistant surgeon, if one can be spared from other duty, one of the former to act as commissary and quartermaster to the party; and to instruct the commanding officer of the escort to afford you such aid and assistance as will most tend to facilitate your operations. A large escort will be required to protect the exploring party in Oregon, but in the subsequent part of your surveys it may be diminished.

Lieutenant Henry L. Abbot, Topographical Engineers, will be ordered to report to you for duty.

The colonel of the Corps of Topographical Engineers will direct that such of the instruments named in your requisition, as are in depot at the Topographical Bureau, or at Benicia, California, and not required for other service, be supplied to you.

The quartermaster's department will furnish you with horses, mules, equipments, and such other public property as may be needed for the use of the expedition, if they can be spared; which will be returned to that department upon the completion of the field duties, payment being made for such animals as may have been lost, or as may be found unfit for use, and other public property lost or seriously damaged.

The commissary department will furnish you with such provisions and stores, if they can be spared, as you may need for the use of the expedition, to be paid for out of the appropriations for the survey, at cost prices at the place of delivery.

The ordnance department will furnish arms, accoutrements, and a mountain artillery forge, payment to be made for such arms, &c., as are lost or seriously injured.

You are authorized to purchase, for the purpose of trafficking with the Indians and compensating them for services, such articles of Indian goods as are most desirable for such purposes, provided the expenditures for these articles do not exceed ($300) three hundred dollars.

The sum of ($42,000) forty-two thousand dollars is set apart from the appropriations for the expenses of the survey entrusted to you.

With your assistants you will proceed without unnecessary delay to San Francisco, and there organize your party, unless upon your arrival you should ascertain that it would be preferable to organize it in Oregon; in which case you will proceed to Vancouver, and organize your party at the most suitable point to commence the survey from the Willamette valley.

The duties assigned to you being completed, you will discharge your party, dispose of your outfit to the best advantage, and proceed with your principal assistants to this place, and make out your report.

Should the views of the department be modified, you will receive further instructions.

You will make the usual monthly reports of the work done; and, besides, advise the department from time to time of the progress made in, and the results of the explorations.

Very respectfully, your obedient servant,

JEFFERSON DAVIS.
Secretary of War.

Lieut. R. S. WILLIAMSON, *Corps Topographical Engineers, Washington.*

OFFICE PACIFIC RAILROAD SURVEYS,
Washington, May 1, 1855.

SIR: By direction of the Secretary of War, you will report to Lieut. R. S. Williamson, Topographical Engineers, for duty on the explorations and surveys in California and Oregon, with which he is charged.

It is understood that you are second in rank of the party, and that, if sickness or any accident should disable Lieut. Williamson, so as to oblige him to relinquish the command, you will succeed to the charge and command of the party.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Captain Corps Top. Engineers,
In charge of office for Pacific Railroad Surveys.

Lieut. HENRY L. ABBOT,
Corps Topographical Engineers.

SYSTEM ADOPTED IN PREPARING THE REPORT.

In preparing the report of the explorations and surveys, made in accordance with the above orders, I have adopted the following system: Part I contains the general report, divided into seven chapters; of which the first contains a general description of the different regions traversed during the survey. This synopsis has been prepared partly to enable those wishing merely to obtain a general idea of the country, to dispense with reading a mass of details, and partly to render the railroad report more intelligible. The second chapter is devoted entirely to a discussion of the facilities offered for the construction of a railroad near the lines of survey. The third, fourth, and fifth chapters contain a narrative and itinerary of the expedition. An attempt has been made to give, in this portion of the report, a detailed description of the nature of the country examined; of the supply of wood, water, and grass near the trails; of the character of the Indian tribes; and of various other matters, interesting to those who wish to thoroughly understand the character of the regions explored. The sixth chapter contains a statement of the method used in computing altitudes from observations taken with the barometer. The seventh chapter contains an account of a former exploration of Lieut. Williamson, near a portion of our line of survey.

Parts II, III, and IV, contain geological, botanical, and zoological reports upon the regions explored.

The various appendices exhibit, in a tabular form, the astronomical and barometric observations, with the results deduced from them by computation.

MAPS ACCOMPANYING THE REPORT.

Two maps, constructed upon the polyconic projection, have been made to accompany this report. The first illustrates that portion of the survey which lay in California, and the second that in Oregon. The scale of each is one inch to twelve miles, or 1:760320.

The data, upon which these maps have been constructed, will be briefly stated. The distances travelled were measured by an odometer, until the wheels were necessarily abandoned among the Cascade mountains ; and then carefully estimated from the time and supposed rate of travel. The courses were determined by prismatic compasses. The latitudes of a large majority of the camps were fixed with considerable accuracy by astronomical observations. Several camps before camp 17 were connected with San Francisco by chronometric differences, and the longitude thus approximately determined. An unfortunate accident, in Canoe Creek valley, however, rendered the chronometers worthless for this purpose during the remainder of the survey, and compelled us to depend upon our courses and distances, checked by the latitudes of the camps, and by a system of triangulation among the prominent mountain peaks near the trail. The assumed longitudes of a few important points upon the route seem to require particular explanation.

As Fort Reading was the point from which we started to leave the settlements, great care has been taken to determine its longitude as correctly as possible. Col. J. C. Frémont, on his map of California and Oregon, places the point of Cow Creek, upon which the fort is now situated, in Long. 122° 6′ 50″ west from Greenwich. On the Land Office map of 1855, it is placed in Long. 122° 11′ 9″. On the map of Lieut. E. G. Beckwith, 3d artillery, illustrating his exploration for a Pacific railroad route near the 41st parallel of north latitude, it is placed in Long. 122° 5′ 8″. The four chronometers used on our survey apparently preserved their rates unchanged during our march up the Sacramento valley, as they all agreed very well with each other. The longitude of the fort, determined by their mean corrected difference from local time, was 122° 10′ 50″. As this differs only three-tenths of a mile from that given by the Land Office map, it has been adopted as correct. It places the fort 3.5 miles west of Col. Frémont's location, and 5 miles west of that of Lieut. Beckwith.

The following method has been adopted to fix the longitude near the northern terminus of the survey. The longitude of Salem has been determined with considerable care, under the direction of the surveyor general of the Territory, both by astronomical observations and by measuring a line to the coast, and thus comparing the result with the work of the United States Coast Survey. It is 122° 53′ 43″ west from Greenwich, as I was informed, when at Salem, by Mr. Hervey Gordon, deputy surveyor. He also told me that Mount Hood and Mount Jefferson had been carefully located by bearings taken from well determined points with the solar compass. I therefore made a preliminary plot of the northern portion of our survey, based upon the Land Office positions of these peaks as fixed points. As over fifty bearings had been taken to each mountain, many of which were from points where the latitude was astronomically determined, I was enabled to slightly correct the relative position of the two peaks. The map was next replotted with respect to these new positions. The result was highly satisfactory, as the compass work fitted admirably, and the longitudes of two points in Des Chutes valley, determined by Col. Frémont in 1843, by observing the occultations of Jupiter's satellites, were almost precisely the same as those of the corresponding points on the plot. It is thought that this coincidence renders it very improbable that any important error in longitude has been made.

The latitude of Fort Dalles was astronomically determined, and numerous bearings upon Mount Hood and the neighboring peaks enabled me to fix its longitude very closely. It was 120° 58′ 30″. This location is about three miles west of that found by Col. Frémont, by observing an emersion of Jupiter's second satellite, on November 5, 1843. He afterwards observed the emersion of Jupiter's third satellite, on November 20, 1843, at the same spot, and published the data obtained, without, however, giving the deduced longitude. I find, by computation, that this is about 121° 22′ 19″, which differs more than twenty miles from that deduced from the first observation. I have, therefore, adhered to the longitude given by my field work, which is intermediate between the two, but much nearer that to which Col. Frémont has given the preference.

The longitude of Fort Vancouver has been laid down as given on the latest Land Office map of Oregon Territory, because detailed surveys have been made between the fort and Salem, the position of which, as already explained, has been determined with approximate accuracy. This location of Fort Vancouver is about seven miles east of that of Capt. Wilkes, whose longitude has been adopted by Col. Frémont on his map of Oregon and California, and by Captain McClellan.

Considerable difficulty has been found in locating the Cascades of the Columbia with respect to longitude. Gov. Stevens adopted the position given by Capt. Wilkes, which is 21 miles further towards the west than that of Col. Frémont, who observed an occultation of Jupiter's first satellite, on November 11, 1843, at a point estimated at 15 miles below the Cascades. There is now a line of steamboats plying from Vancouver to the Cascades, and thence to Fort Dalles. Capt. W. B. Wells, the chief proprietor of the line, and all other persons whom I questioned about the matter, declared that the Cascades were about equally distant from Vancouver and the Dalles, by the course of the river. Col. Frémont has so indicated it upon his map; but Capt. Wilkes makes the distance from the Cascades to the Dalles nearly double that from the Cascades to Vancouver. Considering the great discrepancies between these two authorities, and believing that the many hundred trips of the steamboats must have enabled the owner to estimate the comparative distances with tolerable accuracy, I have placed, on the accompanying map, the Cascades midway between Vancouver and Fort Dalles by the course of the river. This location is 10 miles west of that of Col. Frémont and 11 miles east of that of Capt. Wilkes.

I have indicated on the map, positions for Mount Adams and Mount St. Helen's—the former given by eight and the latter by six good bearings from well determined points in the Des Chutes and Willamette valleys, and among the Cascade mountains. Each of these positions differs about 12 miles from that given by Gov. Stevens.

It has been considered desirable to make the maps as complete as possible, by indicating the topography of the country remote from our trail, whenever reliable information as to its character could be obtained. The Pacific coast has, therefore, been laid down as given on the latest United States Coast Survey maps. The most recent Land Office maps of Oregon and California have been adopted as authority for the settled portion of the country, except in the vicinity of our trails, where the topography is, of course, given from our own field notes, checked by astronomical observations.

The map of Lieut. E. G. Beckwith, 3d artillery, illustrating his explorations for a railroad route near the 41st parallel of north latitude, has been followed for the region bordering Pit river, below the mouth of Canoe creek.

The topography south of Suisun Bay has been taken from the map of a survey in California, made, in connection with examinations for railroad routes to the Pacific ocean, by Lieut. R. S. Williamson, Topographical Engineers, in 1853.

Summer lake, the northern and western shores of Upper Klamath lake, the chief tributary of Klamath marsh, and the Columbia river, east of the Dalles, have been laid down as given by Colonel J. C. Frémont on his map of Oregon and Upper California.

From Myrtle creek, in Umpqua valley, to Jacksonville, in Rogue River valley, our field work has been checked by a sketch of the military road, located in 1853 by Brevet Major B. Alvord, 4th infantry. This sketch, which I think was never published, was kindly furnished by Major Alvord.

The trail of Brevet Major H. W. Wessels, 2d infantry, on his expedition of 1852, from Sonoma to Humboldt Bay, and thence up Klamath river to the head of Scott's river, has been laid down from a rough copy of a sketch by George Gibbs, Esq., who accompanied the command as topographer.

The topography near Rogue river, for about twenty-five miles above the mouth, has been taken from a sketch made by Lieut. J. G. Chandler, 3d artillery, to show the routes followed by the command of Brevet Lieut. Col. R. C. Buchanan, 4th infantry, during his campaign against the Indians in 1856. I am indebted to Colonel Buchanan for this sketch, which is now published for the first time.

Lieut. Williamson formerly spent several years in California, attached to the staff of the commanding general. During this time he made many reconnaissances, the results of which were never published. Several of the trails have been laid down on our map from his original field notes. The latitudes of many points were fixed by astronomical observations, and the accuracy of the topography may be relied upon. They form a valuable addition to the map. His route from Yreka to Lower Klamath lake was surveyed in 1852, and that from Yreka, east of Shasta Butte, to the Sacramento valley, in 1851. The trail from Port Orford to Coquille and Rogue rivers, and thence to the settled portion of Rogue River valley, was examined in 1851 and 1852. A small portion of this trail was explored by Lieut. George Stoneman, 1st dragoons. In 1849, Lieut. Williamson accompanied Captain W. H. Warner, Topographical Engineers, on the disastrous expedition on which he was killed by the Indians, near Goose lake. Lieut. Williamson prepared a map of the regions traversed, and the upper portion of Pit river, with the vicinity, has been reduced from the original sketch upon our map.

PROFILES ACCOMPANYING THE REPORT.

Two sheets of profiles have been constructed to illustrate this report. They contain profiles of the most important portions of the routes travelled over by the surveying parties, and also of the most favorable railroad lines found in the vicinity of the trails. The horizontal scale of each profile is the same as that of the maps, being twelve miles to the inch, or 1:760320; the vertical scale is 1:15206.4. They are, therefore, distorted fifty times.

The altitudes of the different stations were all determined by barometric observations. The method by which they have been computed is fully explained in the sixth chapter of this report, and the original data are given in Appendix D.

It only remains to notice discrepancies between the results of this survey and those of former surveys with which it connects. Gov. Stevens gives 57.6 feet for the altitude of Columbia barracks above the level of the sea. That the fort should not be higher than this above the Columbia appeared incredible to me when there; and as it is situated nearly 100 miles above the mouth of the river, there can be, I think, no doubt that this altitude is too low. The height of Lieut. Williamson's camp, situated upon the river bluff opposite the barracks, and sixty feet above the water surface, was shown, by numerous observations, to be 105 feet. I have been unable to find, in any part of Gov. Stevens' report, the height of Fort Dalles. The altitude of 350 feet, however, is given in the Army Meteorological Register as that determined upon his survey. The altitude of the fort, resulting from our observations, is 476 feet. No correction for abnormal error appears to have been applied to Gov. Stevens' observations; and this omission would very naturally explain larger discrepancies.

Our altitude of Fort Reading differs 157 feet from that of Lieut. Beckwith; and as he had only six observations there, while we had a very large number, I think there can be no doubt that ours is the more reliable result. There are a few other discrepancies in altitudes deduced from his observations and ours, but none that might not be easily occasioned by abnormal oscillation, for which he was unable to obtain any correction in this vicinity. The general agreement between the results of the two surveys, is highly satisfactory.

PART I.

3 X

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

WAR DEPARTMENT.

ROUTES IN CALIFORNIA AND OREGON EXPLORED BY LIEUT. R. S. WILLIAMSON, CORPS OF TOPOGRAPHICAL ENGINEERS, AND LIEUT. H. L. ABBOT, CORPS OF TOPOGRAPHICAL ENGINEERS, IN 1855.

GENERAL REPORT.

WASHINGTON, D. C.:
1857.

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General description of the regions examined.

CHAPTER II.

Railroad Report.

CHAPTER III.

Narrative and Itinerary.—Route of the main command.

CHAPTER IV.

Narrative and Itinerary continued.—Routes of detached parties in charge of Lieut. Williamson.

CHAPTER V.

Narrative and Itinerary continued—Routes of detached parties in charge of Lieut. Abbot.

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LITHOGRAPHS.*

WOOD CUTS.*

* From original sketches made by Mr. John Young, artist of the Expedition.

CHAPTER I.

GENERAL DESCRIPTION OF THE REGIONS EXAMINED.

General topography.—Sacramento valley.—Pit river and its tributaries.—Plateau between Pit river and the Des Chutes valley.—Des Chutes valley.—Cascade range in Oregon Territory.—Willamette valley.—Calapooya mountains.—Umpqua valley.—Umpqua mountains.—Rogue river valley.—Siskiyou mountains.—Klamath river and its tributaries.—Shasta butte, and the mountain chains of northern California.

GENERAL TOPOGRAPHY.

There is a great similarity in the general topographical features of the whole Pacific slope. The Sierra Nevada in California, and the Cascade Range in Oregon and Washington Territories, form a continuous wall of mountains nearly parallel to the coast, and from one to two hundred miles distant from it. Where examined by our party, the main crest of this range is rarely elevated less than 6,000 feet above the level of the sea; and many of its peaks tower into the region of eternal snow, the lower limit of which is about 8,000 feet above the same level. This long chain of mountains forms a great natural boundary. To the eastward lies a plateau of which the average altitude is about 4,500 feet above the sea. The winds from the ocean deposit most of their moisture upon the western slope of the mountains, and reach the plateau dry. This, together with the volcanic character of the country, renders nearly the whole region an arid waste, unfit to support a civilized population.

West of the Sierra Nevada and Cascade Ranges, the character of the country is widely different. The Coast Range, another and parallel chain of mountains, but of a lesser altitude and of a more broken nature, borders the sea-shore. Between the two lie several large fertile valleys, elevated but slightly above the sea, and containing nearly all the arable land of the far west; of these valleys, the San Joaquin and Tulare, the Sacramento, the Willamette, the Umpqua, the Rogue river, and the Cowlitz are the chief; but the Gulf of California itself may be considered one of the great series, probably produced by a common cause, and differing from the rest only in being submerged.

In northern California and southern Oregon, the two great parallel chains of mountains approach each other; and several ranges, the chief of which are called the Siskiyou, the Umpqua, and the Calapooya mountains, connect them, thus separating the Sacramento and Willamette valleys by a line of transverse ridges. These ridges present the only serious obstacle to the construction of a railroad from the Sacramento valley to the Columbia river. Two routes between these termini were examined by our party. The first crossed the western chain of the Sierra Nevada at the head of the Sacramento valley, and, after passing over the comparatively level plateau of the interior until the transverse ridges had been turned, re-crossed the mountains near the source of the Willamette river, and followed the valley of that stream to the Columbia. The second lay over the transverse ridges. A general description of the region traversed by each of the routes will occupy the remainder of the chapter.

SACRAMENTO VALLEY.

No complete description of this valley will be attempted, as its general character is well known, and as Lieutenant Williamson, in his Railroad Report, has fully discussed its topographical features. A few remarks, however, relating to its climate and productions, may not be out of place.

Sheltered by the Coast Range of mountains from the moist and cool sea breezes, which render the summer climate of the sea-shore of northern California so delightful, much of the Sacramento valley is parched with excessive heat in the dry season. From the Army Meteorological Register, it appears that, at Benicia, where the influence of the sea breeze is felt, the mean summer temperature, for the years 1852, '53, '54, was 66°.3 Fah., while at Fort Reading, which is about two degrees of latitude further north, it was 79°.6 Fah., for the same years. Even at San Diego, situated seven degrees of latitude south of Fort Reading, the mean summer temperature was only 70°.9 Fah., for the above mentioned years.

The effect of this excessively high summer temperature is greatly increased by the want of rain. Very little falls during the months of June, July, August, September, and October. The mean fall, during these five months, for the years 1852, '53, '54, was 1.1 inches at Benicia, and 1.4 inches at Fort Reading. This tends to show that less than three-tenths of an inch of rain per month, for the five consecutive hottest months of the year, is to be expected in this valley. The result can be easily anticipated. Vegetation, except on the banks of the streams, is in a great measure destroyed, and the foliage of the trees furnishes almost the only green upon which the eye of the traveller can rest, when wearied with the glare of the sun, reflected back from the whitened plains.

During the rainy months, which are December, January, February, March, and April, the average fall is between 3 and 4 inches per month. The whole region is then clothed with luxuriant vegetation ; but the excess of rain often causes the streams to overflow their banks, and spread far and wide over the low lands. Much of this water remains stagnant, until evaporated by the heat of the sun, which is undoubtedly one of the causes that render intermittent fever so great a scourge of the valley.

Notwithstanding this unfavorable climate, the richness and fertility of the soil well repay the farmer for his labor ; and fine crops of barley, wheat, oats, potatoes, onions, &c., can be easily raised. A luxuriant growth of wild oats covers a large portion of the valley, and gives it an appearance of high cultivation. Grapes, which are a natural product, are also one of the very important staples of the region. The forest trees, which, in the valley, are confined to the banks of the streams, are chiefly oaks, sycamores, and cotton-woods. The foot hills of the Sierra Nevada are densely timbered with various species of oaks, pines, and firs.

PIT RIVER AND ITS TRIBUTARIES.

In 1849, Lieutenant Williamson accompanied Captain W. H. Warner, United States Topographical Engineers, on his ill-fated expedition to the sources of Pit river. As this was the only survey of this region which has ever been made, and as its results were never fully published, Lieutenant Williamson proposed to give a synopsis of them in this report. I have, therefore, compiled from his original field notes the following very brief description of the upper portion of Pit river.

A short distance above camp 23, where, in 1855, the party left Pit river, the stream passes through a broad cañon. The trail, which is a little rocky, follows its course, crossing it about a dozen times. In about 20 miles, the cañon widens out into a valley, varying from 3 to 12 miles in width, which extends to the vicinity of Goose lake. In some places, travelling is rendered laborious by cracks in the soil, which is very light and dusty, but the road is generally good. The region is not fertile, and grass is mostly confined to the banks of the river.

The party discovered a boiling spring about 6 miles above the upper end of the wide cañon, and at some little distance from the river, on its western bank. The basin was about twelve feet wide, and in the middle a jet three feet in diameter boiled up six inches above the general level. No gas escaped, but a slight smell of sulphur was perceptible. A column of vapor, thirty feet in height, ascended from the spring. Its waters were impregnated with salts, but no deposit was observed.

Near Goose lake, Pit river rises from springs in the hills, and does not issue from the lake, as has sometimes been supposed. Much obsidian is found near its sources.

While exploring the mountains in this vicinity, Captain Warner and others of the party were massacred by the Indians, and the survey terminated abruptly in consequence.

The portion of Pit river lying between Camp 23 and the mouth of Canoe creek, was examined on the recent survey. The whole region is volcanic in its character, and descends by successive plateaus towards the western chain of the Sierra Nevada. Each of the two great cañons is situated near the edge of one of these plateaus, and the descent of the stream is, consequently, very much greater in them than elsewhere in its course. From the summit of Stoneman's ridge, this peculiar terraced formation of the country can be very distinctly perceived. The descent of the tributaries, both from the north and the south, is very rapid.

Much of the region south of Pit river, lying at the eastern base of the western chain of the Sierra Nevada, consists of a rocky pedregal of scoriaceous trap, and Lieut. Williamson, who, in 1851, explored the country immediately south-east of Shasta Butte, found the same formation there. It is no uncommon thing in this region, for large streams to sink among fissures in the rocks, and for others to burst from the faces of precipitous ledges. Infusorial marls are common near Pit river.

Although there are a few fertile spots near the banks of the streams, the valley is generally barren, parched with drought during the summer, and unfit to support a civilized population.

Below the mouth of Canoe creek, Pit river forces its way through the western chain of the Sierra Nevada. Lieut. E. G. Beckwith, 3d artillery, surveyed this portion of its course in 1854, and he reports that the stream flows with a winding course among heavily timbered mountains, which rise abruptly to heights varying from 1,500 to 2,000 feet above the water surface.

PLATEAU BETWEEN PIT RIVER AND THE DES CHUTES VALLEY.

After leaving Pit river and before reaching the Des Chutes valley, our course lay over a plateau bordering the eastern base of the Cascade Range. There are occasional low mountainous ridges upon it, but the general surface, for about 150 miles, retains an elevation above the sea varying but little from 4,500 feet.

Most of the region is sterile, although occasional fertile spots are found. Pumice-stone, trap rock, and other volcanic products, strew the ground; and pine forests or sage plains cover the whole face of the country. The banks of the streams, however, are generally bordered with grass of good quality, and we experienced no difficulty in obtaining a sufficient supply for our large train of animals.

The system of drainage on this plateau is peculiar. There are numerous lakes, some of which have no known outlets, although they receive affluents. Wright and Rhett lakes were visited by our party. The former is surrounded by low hills, and, as far as our observation went, receives no tributary, although its waters are fresh. There may be, and doubtless are, springs among the hills, from which it draws its supply. In the rainy season it discharges its surplus waters by Lost river into Rhett lake, which has no known outlet. The level of this lake is 470 feet below that of Wright lake, although the distance between them, in a right line, is only about 6.5 miles.

The chain of Klamath waters is an interesting feature of this region. The highest point upon it visited by our party was near the northern end of Klamath marsh, but Colonel Frémont, in his expedition of 1843–'44, crossed the principal tributary of this marsh. He describes it as a stream thirty feet wide, and from two to four feet deep. It undoubtedly rises, as indicated upon his map, among the mountains east of Upper Klamath lake, and after flowing towards the north for a considerable distance, bends towards the south, and spreads out into Klamath marsh. When it emerges again, it is a large, deep stream, with a sluggish current. After passing through a cañon, four miles in length, the highest points of the sides of which are about 1,000 feet above the water surface, it again spreads out into a fine sheet of water, called Upper Klamath lake. This lake receives several smaller tributaries. The river leaves it near its southern point, and soon winds through a marsh, which forms the northern portion of Lower Klamath lake. Lieut. Williamson, with a detached party, examined this portion of its course, and his opinion was, that in seasons of high water the marsh is overflowed and the river can properly be said to flow through the lake. In the summer, however, its bed is very distinct, and it does not join the sheet of water forming the lake. After crossing the marsh it soon enters the cañon, by which it traverses the Cascade Range. Its subsequent course will be described, in the latter part of this chapter, under the head of "Klamath river and its tributaries." The portion of the plateau through which this chain of waters extends, is occasionally fertile and valuable for agricultural purposes, but most of it is utterly worthless.

DES CHUTES VALLEY.

East of Diamond Peak, the general altitude of the great plateau bordering the Cascade Range begins to diminish. There are many isolated hills and low ridges upon it, but in its general character it now becomes an inclined plain, sloping towards the Columbia river. It is drained by the Des Chutes river, which, flowing in a northerly direction near the foot hills, and receiving many tributaries from the mountains, at length discharges itself into the Columbia.

The Des Chutes river, near its source, flows through a narrow prairie, bordered by a forest of pine, fir and cedar, which occasionally closes in upon its banks. The soil is of a light pumice-stone character. This formation is changed to basalt in about latitude 44°. North of this point, as far as its course is known, the river flows through a deep cañon, broken by numerous rapids which have given it the name of Des Chutes. Its average descent in this cañon is about twenty-five feet per mile. We did not find its tributaries sunk in cañons until we reached about latitude 44° 35′, where we emerged from the foot-hills, and came upon the great basaltic plain, through which the river had been flowing for many miles. This plain is formed by successive layers of trap, of which I once counted as many as seven, interstratified with tufas and conglomerates. Although this stone is exceedingly hard under the hammer, it disintegrates rapidly when exposed to the weather. Not only have all the streams flowing through the plain worn down their beds to depths varying from five hundred to a thousand feet, but even the torrents of the rainy season have deeply furrowed its surface, and almost destroyed all traces of a level character in that portion lying between the mountains and the river. The plain is thinly dotted with clumps of bunch grass, sage bushes, and a very few stunted pines and cedars, but they are all more abundantly found in the cañons of the creeks.

This steppe is bounded on the north by a spur from the Cascade Range, called, by the white trappers, the Mutton mountains. After crossing the valley, in about latitude 46°, the ridge soon bends towards the south, and gradually disappears. It is in some places thickly wooded with pines and firs, and in others destitute of trees. The prevailing rock is a hard compact slate. North of this spur the sage bushes disappear, and a few post oaks begin to be seen.

At the northern base of the Mutton mountains there is a smaller plain, called Tysch prairie, elevated about 2,200 feet above the sea, and resembling the other in all important characteristics, except that it is much less furrowed by dry ravines. This prairie is bounded on the north by a low range of trap mountains, entirely bare of trees, and separated from it by Tysch creek, a fine little stream sunk in a deep cañon. In this part of Des Chutes valley there are many curious round mounds, from twenty to forty feet in diameter, and from two to six feet in height. They are still more numerous in the vicinity of Fort Dalles, and there has been much speculation concerning their origin. Some persons suppose that they were formed by colonies of ground squirrels in excavating their subterranean dwellings. If so, the race is now extinct, and it is difficult to conceive how the immense number necessary to make these mounds, could have found subsistence in so barren a region. An officer at Fort Dalles had one of the mounds excavated, but he found no trace of a burrow, nor anything else which could throw light upon its origin. They occur in vast numbers, upon the sides of steep hills as well as on plains, and the effect which they produce upon the landscape is not unlike that of the spots upon the skin of a deer.

Between Tysch creek and Fort Dalles, the character of the country undergoes a great change. Trap rock mostly gives place to marls. The road continually winds up and down steep, rolling hills, that are generally covered with fine bunch grass and destitute of trees. The valleys of the streams are all more or less settled, and they appear to be fertile and tolerably well supplied with timber, which is mostly oak. This section of the valley seems to be well suited to a pastoral population, but it can never compare, in fertility and importance, with that west of the Cascade Range. There are now two ferries across the Des Chutes river, one at its mouth and the other near Tysch creek.

Fort Dalles, the principal settlement in Oregon Territory east of the Cascade Range, is a military post and small frontier town on the southern bank of the Columbia, near the head of navigation. It is connected by a line of steamboats with Vancouver and the Willamette valley. It contains a few houses and stores, and will doubtless rapidly increase in size and importance, should the newly-discovered gold mines in Washington Territory prove profitable. A description of the Dalles of the Columbia will be found in Chapter V, under the date of September 10.

It will be seen that the Des Chutes valley is mostly a barren region, furrowed by immense cañons, and offering very few inducements to settlers. Its few fertile spots, excepting those in the immediate vicinity of Fort Dalles, are separated from the rest of the world by almost impassable barriers, and Nature seems to have guaranteed it forever to the wandering savage and the lonely seeker after wild and sublime natural scenery.

CASCADE MOUNTAINS, IN OREGON TERRITORY.

The Cascade Range, in Oregon, consists of a belt, from thirty to ninety miles in width, of pine and fir covered ridges, separated from each other by a network of precipitous ravines. A line of isolated volcanic peaks, extending in a direction nearly north and south through the Territory, rises from this labyrinth, and marks the extreme western border of the elevated plateau already described. The chief summits are Mount Hood, Mount Jefferson, Mount Pitt, and Diamond Peak; which, with the four buttes composing the group called the Three Sisters, tower high above the rest into the region of eternal snow, the lower limit of which is here about 8,000 feet above the sea. The other peaks, although quite prominent when seen from the plateau, are hidden by intervening ridges from the Willamette valley.

Westward from this line of volcanic peaks, an abrupt slope, mostly composed of ridges of very compact slate, separated by immense cañons, descends to fertile valleys, elevated but slightly above the sea level, and extending to the foot hills of the Coast Range.

Near the water-shed are numerous lakes, some of which discharge their waters towards the east, and others towards the west, by cañons so enormous that words fail to convey an adequate idea of their size. One, the side of which was so precipitous that we could only make the descent with the greatest difficulty, was found by actual measurement to be 1,945 feet deep.

A few small prairies covered with excellent bunch grass, lie hidden among the mountains. They are often surrounded by bushes bearing a kind of whortleberry, called "Oo-lal-le" by the Indians, who come in large parties in August and September to gather and dry them for winter use. Hence, it frequently happens that the explorer, while following a large trail which he hopes may lead across the mountains, suddenly finds it terminate in a whortleberry patch.

An examination of these mountains is very difficult. The ravines, filled with thick underbrush interlaced with fallen timber, are, many of them, utterly impassable; the ridges are very precipitous and rocky; generally the thick forest of pine, fir, spruce, and yew, quite conceals the surrounding country; and the great scarcity of grass for the animals is a source of constant anxiety. According to the best information which I could gather from Indians and settlers, the whole range is covered with snow during the winter.

There are six known passes through the Cascade Range, in Oregon Territory. It must be borne in mind that they are not simple gateways, but long winding courses through a labyrinth of ridges and ravines. They will be described in their order of succession, beginning at the most southern.

1. *Pass south of Mount Pitt.*—This pass, through which an emigrant wagon road has already been constructed, was not examined by our party. Lieutenant Williamson followed the road to the point where it enters the mountains, near Camp B, on Klamath river. It strikes Stewart creek, in Rogue River valley, not far from Camp 78 A. The air-line distance between these camps is only 32 miles, and the road is said to be very good, for a mountain route.

2. *Pass south of Diamond Peak.*—A wagon road has been constructed through this pass, also, by which Lieutenant Williamson crossed the range. The approach from the eastward is by a branch of Des Chutes river, that rises near the foot of the main ridge. About 20 miles after leaving this stream, the road strikes the middle fork of the Willamette river, the course of which it follows to the settlements. Where it passes over the main ridge, the road is very mountainous in its character, and in the ravine of the middle fork, it crosses the stream many times at deep and rocky fords. There is a scarcity of grass upon the route.

3. *New pass south of Mount Hood.*—This pass was discovered by the detached party in my charge. As I believe it to be more favorable for a wagon road than any of those previously known, I shall describe with considerable minuteness, both the pass proper, through the main ridge, and the approaches to it from the east and the west. This division is adopted simply for ease of description. By far the greatest difficulty in the passage of the range was encountered in the western approach to the pass.

About 20 miles south of Mount Hood there are two prominent peaks, called Nu-ah-hum by the Indians. At their northern base a remarkable depression is found in the main ridge. Near the western part of it there are two small lakes called Ty-ty-pa and Wat-tum-pa. The latter is the source of a branch of Tysch creek, which flows towards the east through the depression. From the point where we first struck this stream, to the lake, the hills slope gradually towards its bed, and there is no obstacle to the construction of an excellent wagon road, except the fallen timber. Between the two lakes there was a low hill, which could probably be avoided by following the course of a little tributary of Wat-tum-pa. West of Ty-ty-pa there was a steep rise of about 400 feet, conducting to the summit of the main ridge. I think this could be turned by keeping more to the north, but, at any rate, the ascent might be made very gradual by side location. The descent, of about 200 feet, into a great ravine, which borders the main ridge on the west, might be made without much difficulty. Through this entire pass, a distance of about 13 miles, a good road, almost free from hills, might be constructed by a little side cutting and the removal of a large quantity of fallen timber.

The eastern approach to this depression by my trail is excellent, and would require no labor of any kind, except a little side cutting and removal of logs in a place about 3 miles in length, between Wan-nas-see creek and Camp 58 A. There is not a single bad hill between Nee-nee springs and the entrance to the pass, a distance of about 24 miles. The distance from Nee-nee springs to Evelyn's rancho, on Tysch creek, which is the most southern settlement in Des Chutes valley, is about 19 miles; and a good road between them might be made with very little labor. It would cross the Mutton mountains by an open ravine, which one fork of the Indian trail now follows. This route, however, from the eastern entrance of the pass to the settlements, is very circuitous, and it is probable that a much shorter one might be found, either by following the branch of Tysch creek, flowing from Wat-tum-pa lake, or by taking an Indian trail which joined ours on Wan-nas-see creek, and which our guide said was very good. A similar description of it was also given to me by a half-breed, and its position, as indicated by him, is shown on the accompanying map. The almost inexhaustible supply of bunch grass near Nee-nee springs may, however, render the more circuitous route preferable.

The western approach to this pass is far less favorable than the eastern. An abrupt slope, furrowed by numerous cañons utterly impassable on account of fallen timber, conducts to the Willamette valley. To avoid the logs, we found it necessary to follow the dividing ridge between Clackamas and Sandy rivers, a route which is hardly practicable even for a pack train. From the source of Clackamas river, however, I could look down its ravine for more than 20 miles, and see the hills of the Willamette valley in the distance. The ravine appeared to be wide, straight, and free from lateral spurs; and I believe that a good road could be made in it by cutting through the logs. Near its head, it is connected with the great ravine bordering the main ridge, by a lateral cañon, into which we descended, and by which it is thought the road might reach the main ridge, in about 35 miles from Clackamas prairie, without encountering any bad hill. The total distance from Clackamas prairie to Evelyn's rancho, by way of Nee-nee springs, is about 90 miles.

It is probable that a route might be discovered from my pass through the main ridge, to the present wagon road down Sandy river. If so, the great labor and expense of cutting through the logs in Clackamas ravine would be avoided.

A more minute description of the trail of my party across the mountains will be found in Chapter V, from October 5 to October 14, inclusive; but it must be remembered that fallen timber compelled me, during the latter part of the way, to follow a course very different from that proposed for the wagon road.

4. *Foster's Pass, south of Mount Hood.*—This pass, by which an emigrant wagon road now crosses the range, is named from the settler whose house stands nearest to it in the Willamette valley. The following information concerning it has been derived from reliable sources. Starting from the Willamette valley, a short distance north of Camp 64 A, the road follows up the ravine of Sandy river nearly to the main ridge. After leaving the stream it crosses the Range, between my new pass and Mount Hood, by a route so mountainous that heavily loaded wagons can travel only in one direction. It strikes Tysch creek, in Des Chutes valley, near Evelyn's rancho. For about 70 miles there is no grass near the road.

5. *Pass near northern base of Mount Hood.*—This pass is rarely used by any but Indians. I am told that it is very mountainous in its character, and that there is a great scarcity of grass near the trail. It is considered hardly practicable, even for pack animals.

6. *Columbia River Pass.*—I travelled down the Columbia, from Fort Dalles to the Cascades, in a small steamboat, and made a reconnaissance of the river between these points. The following brief description of this portion of the pass has been prepared from information thus obtained.

The Columbia river forces its way through the Cascade Range by a pass, which, for wild and sublime natural scenery, equals the celebrated passage of the Hudson through the Highlands. For a distance of about fifty miles, mountains, covered with clinging spruces, firs, and pines, when not too precipitous to afford even these a foothold, rise abruptly from the water's edge to heights varying from one to three thousand feet. Some of the ridges are apparently composed of compact basaltic conglomerate; others are enormous piles of small rocks, vast quantities of which have been known to slide into the river, overwhelming everything in their course. Vertical precipices of columnar basalt are occasionally seen rising from fifty to one hundred feet above the water's edge. In other places, the long mountain walls of the river are divided by lateral cañons, containing small tributaries and occasionally little open spots of good land liable to be overflowed at high water. It is difficult to conceive how the river could ever have forced its way through such a labyrinth of mountains.

About 40 miles below the Dalles, all navigation is interrupted by a series of rapids, called the Cascades. Precipitous mountains, from two to four thousand feet in height, close in upon the stream at this spot, leaving a narrow channel through which the water rushes with great violence. During high water, the river bed is only about 900 feet wide at the narrowest place. The descent at the principal rapid was shown by my barometric observations to be 34 feet, and the total fall at the Cascades to be 61 feet. These quantities, however, vary with the different stages of the water, as, when it is high, the obstructions in the channel act like a dam, and greatly increase the depth above.

An attempt formerly made to build a road round these rapids on the southern bank, entirely failed, on account of the immense expense of the undertaking. The northern bank is favorable, and a portage, four and a half miles in length, has been constructed by the company owning the line of steamboats plying between the Dalles and Portland. Since my visit, this has been greatly improved by Lieut. G. H. Derby, United States Topographical Engineers, who has had charge of the construction of a military road from Vancouver to Fort Dalles.

Want of time compelled me to return to the Dalles without examining the river below the Cascades.

The following information relating to the navigation of the Columbia, I received from Captain W. B. Wells, the chief proprietor of the line of steamboats plying upon the river; a gentleman whose business has afforded him ample opportunity for observation. The river is at its lowest stage about the first of April, when it has a depth of between 9 and 10 feet up to the Cascades, and 9 feet thence to the Dalles. Above that point it is so much interrupted by rapids as to be unnavigable. It is highest about the first of July, when it has a depth of about 18 feet up to the Cascades, and of 39 feet thence to the Dalles. The disproportionate rise in the latter section is due to the stoppage of the water at the Cascades. There are no troublesome snags or floating timber at any time in the river, but often the shifting sand occasions trouble. The river very rarely freezes, and never for more than a day or two at a time.

As the Columbia has succeeded in forcing its way through the Cascade Range by this pass, it has naturally been supposed that a wagon road or a railroad could be constructed, at a moderate expense, upon its banks, and an appropriation of $25,000 was made for the former purpose by Congress. The officer in charge of the work, Lieut. G. H. Derby, United States Topographical Engineers, made a careful examination of the route, subsequent to my reconnaissance, and he has reported the road impracticable, without enormous expense. I think that a careful survey would show the same to be true with reference to a railroad. At present, the only land communication down the river is by two pack trails, which leave the Dalles on the southern bank. Both are generally well supplied with grass. I was informed that one, which can only be used when the river is low, is tolerably good; but that the other continually crosses rough spurs, and winds along the face of precipices, by paths so narrow, that even mules sometimes lose their foothold. By both trails it is necessary to cross to the northern bank of the river, above the Cascades, where the current is strong and the river wide.

WILLAMETTE VALLEY.

This valley, which forms the richest and most populous portion of Oregon, lies between the Cascade mountains and the Coast Range. It is about one hundred and fifty miles in length, and fifty in breadth. Its general elevation above the sea level is from two to eight hundred feet. Some parts of it are well timbered with oak, maple, cedar, fir, spruce, arbor vitae, and other valuable kinds of trees; other portions are open and fertile prairies. The soil is generally very rich, and produces in abundance wheat, oats, barley, potatoes, and other products of the eastern States. Indian corn, however, cannot be cultivated to advantage. The Willamette river, flowing through the valley, receives many tributaries from the east and west, which furnish an abundant supply of water. The navigation of this river is interrupted by rapids, near Oregon city, about twenty-five miles from its mouth. At the season of high water, however, it is navigable for small steamboats, from the upper end of these rapids to Corvallis, a distance of about one hundred miles by the course of the river. Numerous flourishing towns, and a few cities, are located upon its banks, and settlers' houses are now to be seen throughout nearly the whole of this beautiful valley, which has been appropriately called the Garden of Oregon.

Communication with the region east of the Cascade Range is principally carried on by small steamboats upon the Columbia river; but the pack trails upon the banks of this stream, and the wagon roads crossing the mountains near Mount Hood and Diamond Peak, are also used for this purpose. The land route to California is very mountainous, but a line of steamers connects Portland and San Francisco.

The climate of the valley is mild and salubrious. The following facts relating to this subject are taken from the Army Meteorological Register, published in 1855. The mean annual temperature is about 52°.5 Fah.; that for the summer being about 65° Fah., and for the winter, 40° Fah. The mean fall of rain is, in the spring, 10 inches; in the summer, from 2 to 6 inches; in the autumn, 10 inches; and in the winter, 20 inches. The mean annual fall varies from 40 to 50 inches.

CALAPOOYA MOUNTAINS.

This name is given to a chain extending from the Cascade to the Coast Range, and separating the Willamette and Umpqua valleys. It is composed of low ridges, most of which are heavily timbered with spruce, pine, fir, and oak. A kind of hard sandstone is the prevailing rock.

There are three wagon roads across these mountains. Two of these, the Applegate and Scott roads, pass over high and steep hills. The third, which is located between them, and which was not fully completed when my party passed over it, follows Pass Creek through the mountains without encountering a single hill.

UMPQUA VALLEY.

The principal branch of the Umpqua river, called the South Umpqua, rises in the Cascade mountains near Diamond Peak. At first its course is westerly. In longitude about 123° 15′, it bends abruptly towards the north, and after flowing about 75 miles in this direction, and receiving the waters of the North Umpqua river and Elk creek, it again turns towards the west, and discharges itself into the Pacific. The most valuable and populous portion of the valley lies near the river where its course is northerly. This region consists partly of small open prairies, and partly of rolling hills sparsely covered with oak, fir, and other kinds of trees. Much of the land is exceedingly productive. The valley, at present, contains many scattered houses, but very few towns.

UMPQUA MOUNTAINS.

Little is known of this chain of mountains, except that it extends westward from the Cascade Range nearly to the ocean. It consists of ridges, from 2,000 to 3,000 feet in height, covered with thick forests and underbrush. The rocks are mostly talcose in character. The only road through the chain follows the Umpqua cañon, which is fully described in Chapter V, under the date November 1. Cow creek rises south of the mountains, and flows through them to the South Umpqua, but its cañon, although followed by a pack trail, is reported to be too narrow and precipitous for a wagon road. The chain has been crossed at other places by parties with animals, and it is not improbable that a good pass might be discovered by a thorough exploration.

ROGUE RIVER VALLEY.

Rogue river rises in the Cascade Range, near Mount Pitt, and flows westward to the Pacific ocean, receiving on the way numerous small tributaries from the Umpqua and Siskiyou mountains. Some of these streams flow through fertile valleys, separated from each other by high and forest-clad hills. Others, especially those near the coast, are sunk in immense cañons. Most of the rich land lies near the California and Oregon trail. Gold digging is profitable in many places. Hornblende and granitic rocks predominate, but Table Rock, and other hills in the vicinity, are basaltic. Jacksonville is at present the only town in the valley, although there are many scattered dwellings.

SISKIYOU MOUNTAINS.

Very little is accurately known about this chain, although it has been much explored by gold seekers. It is a high and heavily timbered dividing ridge between the waters of Rogue and Klamath rivers, and its general direction is east and west. The prevailing rock is a hard kind of conglomerate sandstone. Near the summit, elevated about 2,400 feet above the base, we found the soil to be an adhesive clay, which, when wet, renders travelling very laborious. There are several pack trails across the chain, but no reliable information concerning them could be obtained.

KLAMATH RIVER AND ITS TRIBUTARIES.

Klamath river, as already stated, rises in the great plateau east of the Cascade Range. After flowing through Klamath marsh, and upper and lower Klamath lakes, it breaks through the mountains, near Shasta Butte, and following the southern base of the Siskiyou chain, discharges itself into the Pacific. Through the greater part of its course, it flows either through sterile table lands, or immense cañons. Gold is found in many places upon its banks. My party, while returning to Fort Reading, passed through the valleys of Shasta, Scott's and Trinity rivers, three of its most important tributaries. These will be described in the order in which they were examined.

Shasta valley is an undulating region, about 25 miles in length and 15 in breadth, which extends from the base of Shasta Butte, in a northwesterly direction, to Klamath river. A small stream, named from the Butte, traverses it. This valley is sterile, compared with most of those already described, but the thick growth of bunch grass renders it a fine grazing country. It is for its gold, however, that it is chiefly valuable. This metal is found in large quantities; but mining is difficult on account of the scanty supply of water. To remedy this deficiency, the miners are now digging a ditch from a point near the source of Shasta river, along the base of the hills which bound the valley on the southwest, to the river again near where it discharges itself into the Klamath. This ditch, which is called the Yreka canal, will be, when completed, between 30 and 40 miles in length. It derives its name from the great depot of the northern mines, which is situated in so rich a portion of the valley that gold is dug in the very streets of the city.

Scott's river flows nearly parallel to Shasta river, being only about 18 miles further to the west. The character of its valley, however, is widely different. Gold digging is not generally profitable in it, although some rich mining claims have been discovered; especially at Scott's Bar near the mouth of the stream. Most of the land is very productive, and a large portion of the valley is now divided into farms, the produce of which finds a ready market at Yreka and the mines. The greater elevation above the sea renders the climate much colder than that of the valleys further north. Frost has been known to occur here in every month of the year.

Trinity river rises near Mount Shasta, and, after making a great bend to the south, discharges itself into the Klamath river, of which it is the largest tributary. My party, starting from its head waters, followed down the stream for about one quarter of its length. It flowed through a deep ravine, bounded by high and timbered ridges. The bottom was so narrow that there was very little arable land. A short distance below the point where we left the river, it enters an immense cañon, which extends without much interruption to its mouth.

SHASTA BUTTE AND THE MOUNTAIN CHAINS OF NORTHERN CALIFORNIA.

Shasta Butte, by far the most striking topographical feature of northern California, rises abruptly to a height generally estimated at 18,000 feet above the sea. The peak is double, and both summits are rounded, massive, and loaded with eternal snow. Its white cloud-like form is distinctly visible from points in the Sacramento valley, more than one hundred miles distant.

This Butte is not only the largest and grandest peak of the long range which divides the sterile interior of the country from the fertile valleys of the Pacific Slope, but it is also a great centre, from which diverge the numerous chains that render northern California one mass of mountains. In approaching it by the Oregon trail, both from the north and the south, there is, independent of the high ridges, a gradual increase in the elevation of the country, for about 50 miles. The region near the base itself thus attains an altitude of about 4,000 feet above the sea; and it is an interesting fact, that most of the northern mines are found upon this vast pedestal of the giant Butte.

Great confusion exists in the nomenclature of the mountain ranges in the vicinity. The name, Cascade mountains, ceases at Klamath river, but the range in reality divides. One branch, called the Siskiyou mountains, bends westward nearly to the coast; the other, under the name of the Western Chain of the Sierra Nevada, winds to the southeast, and unites with the main Sierra Nevada. From the Butte, three steep and thickly wooded ridges called Little Scott's mountains, Scott's mountains, and Trinity mountains, extend to the westward. The two latter are branches of the Coast Range of California. Shasta Butte, although generally considered a peak of the Western Chain of the Sierra Nevada, is, in truth, the great centre from which radiate, besides several smaller ridges, the Cascade Range, the Coast Range, and the Western Chain of the Sierra Nevada.

CHAPTER II.

RAILROAD REPORT.

General summary.—Proposed railroad route from Benicia to Fort Reading.—Proposed railroad route from Fort Reading to Vancouver, east of the Cascade Range.—Route from camp 36, near the head of Des Chutes valley, to Fort Dalles.—Route from the Des Chutes to the Willamette valley, by the new pass near Mount Hood.—Proposed railroad route from Vancouver to Fort Reading, west of the Cascade Range.

GENERAL SUMMARY.

The detailed descriptions of the routes examined for a railroad will be prefaced by a few remarks upon the relation of the different lines to each other, and upon their general character.

The survey began at Benicia. From that place to Fort Reading, a distance of about 200 miles, but one route was examined. It lay through the fertile and settled valley of the Sacramento river, where bridges would form the only expensive item in the construction of a railroad. The supply of water and building material would be ample, and the average grade would not exceed 5 feet per mile.

Two routes, well supplied with water and building material, were examined, from Fort Reading to the Columbia river—one east and the other west of the Cascade Range. A brief description of each will be given.

1. *Route east of the Cascade Range.*—No insuperable obstacles were encountered on this route until the head of the Des Chutes valley was reached; but beyond that point it was utterly impracticable. A pass was examined, however, through the Cascade Range, near Diamond Peak, by which this valley could be avoided, and the Willamette river reached. The valley of this stream afforded a route to the Columbia river, very favorable to the construction of a railroad. This route from Fort Reading to the Columbia may be considered feasible. Its length is about 600 miles, of which 150 miles lie in a fertile and settled country, where the construction would be easy. The rest of the line traverses a wilderness, generally barren, and, for the most part, elevated from 4,000 to 5,000 feet above the sea. For about 200 miles of the latter section no very heavy work would be required, but for the remaining 250 miles the expense of construction would be very great. The chief obstacles would be encountered in crossing the western chain of the Sierra Nevada; in passing the two cañons of Pit river; in constructing the road along the shore of Upper Klamath lake; in following the cañon of Klamath river, between Upper and Lower Klamath lakes; and in crossing the Cascade Range to the Willamette valley.

It is thought that there would be danger of occasional obstruction from snow during a few months in the year, upon the portion of this route east of the mountains.

2. *Route west of the Cascade Range.*—The loss of the escort rendered it impossible to make any side examinations upon this line. Although the travelled route proved much better than had been anticipated, some portions of it were impracticable for a railroad. There are, however, good reasons for believing that by further examination these places could be avoided.

The length of the surveyed line was 470 miles. About 300 miles of it would be easy of construction, about 100 very costly and difficult, and about 80 impracticable at any reasonable expense. The routes by which the impracticable portions of the line could probably be avoided, will be fully explained in the detailed report. The chief obstacles would be encountered in passing from the Sacramento valley to Shasta valley, and in crossing the Siskiyou mountains, the Umpqua mountains, the Grave Creek Hills in Rogue River valley, and Long's Hills in Umpqua valley.

Should further examination show this route to be feasible, it would, for many reasons, be greatly preferable to that surveyed east of the Cascade Range. It traverses a region generally but little elevated above the sea, where the danger of obstruction from snow would be very much less than upon the high plateau east of the range. It passes through the richest and most populous portion of Oregon, while a large part of the other traverses a sterile, uninhabited waste. Besides the great amount of way travel always created by a railroad in a settled country, much freight would probably pass over this line, which would not be transported over the other. This is evident from the following considerations. There are in the Willamette, Umpqua, and Rogue River valleys areas of very productive land, which is uncultivated only because there is no market for the produce. No large rivers afford water communication with the ocean, and the mountains, which cover northern California, almost entirely prevent the transportation of supplies, by land, to that State. Oregon is, therefore, to a great extent, isolated, and dependent upon itself for a market. The construction of a railroad to the Sacramento valley, by this route west of the mountains, would enable the farmers in all these fertile valleys to send their produce to the mining regions of northern California and southern Oregon, where most of the country is unfitted for agricultural purposes, and where the price of provisions is now most exorbitant. The route east of the Cascade Range, on the contrary, would neither be accessible to freight from southern Oregon, nor traverse the mining region, where the most profitable market for the produce of the Willamette valley would be found.

The remainder of this chapter contains detailed descriptions of the different routes explored.

PROPOSED RAILROAD ROUTE FROM BENICIA TO FORT READING, SURVEYED BY LIEUT. WILLIAMSON.

Before Lieutenant Williamson's sickness, he had prepared the following report upon the route up the Sacramento valley. As he never revised it, I have made a few necessary verbal corrections, but have not, in the slightest degree, changed its import. It is to be considered entirely his report.

"The Sacramento valley is a vast plain, about two hundred miles long, and averaging fifty miles in breadth. Through the middle of it flows the Sacramento river, receiving numerous tributaries from the Sierra Nevada, but very few from the Coast Range. The valley is destitute of trees, except upon the river banks, and is covered with a luxuriant growth of wild oats. The soil, during the summer, is very dry, but in winter is so moist as to render travelling very difficult. There is not the slightest topographical obstruction to the construction of any kind of a road, in any part of the valley.

"In the examination of the valley, therefore, with reference to the construction of a railroad, the most important question seems to be the relative advantages presented by the east and west sides of the valley. I had previously been up and down the valley, on each side, and was well acquainted with its character.

"Only a very small quantity of water is drained from the eastern slope of the Coast Range; and most of that is absorbed by the soil at its base. Hence the almost total absence of tributaries, received by the river from the west, until we arrive near the head of the valley. The banks of the river, on that side, are generally bluff and unbroken; the east side, on the contrary, is intersected by numerous streams, coming from the Sierra Nevada; some, large enough to be entitled to the name of rivers; others, so inconsiderable as to be passed unnoticed by the traveller, in summer. These, however, are torrents in winter, and form an important item for consideration, in making a road.

"The distance from Benicia to Fort Reading, by the western side of the valley, by the ordinary road, which is very direct, is 178 miles; while by the eastern side, it is 200 miles. The former portion, however, is only inhabited along the banks of the river, whereas the tributaries from the Sierra Nevada, intersecting the latter portion, afford plenty of water, and numerous desirable locations for farms. The mining portion of the population is all on this side, and branch roads into the mines would be required. In order, therefore, to afford the means of discussing understandingly the relative advantages of these two portions, I determined to proceed to Fort Reading by the eastern side of the valley, and note particularly, the size and character of the beds of the water-courses that intersect it, that the extra expense of construction due to bridging, might be estimated.

"We left our camp near Benicia, on the 10th of July, and travelled thirteen miles, camping on a small stream known as Suisun creek, which is about thirty feet wide. This is the first place where a bridge would be required. From here we travelled on through the Suisun valley, by a road nearly level, but occasionally passing through low, rolling hills, until, thirty-two miles from Benicia, we came to Putos creek, which is a stream sixty or seventy feet wide. When we crossed it, the water in the creek was thirty feet below the top of the banks; but in winter it sometimes overflows them. This stream, at the most favorable point, would require a bridge 130 feet long.

"The only other stream, before reaching the Sacramento river, is Cache creek, which differs from Putos creek in occupying a broad bed with low banks. At the narrowest place I saw, the bed was 100 yards wide, with banks thirty feet high, and I am told that in time of freshet these are overflowed. Thus, but three bridges would be required between Benicia and the Sacramento river, and, if the road followed up the west bank, none other would be required for sixty miles. Above that, the river receives a tributary every fifteen or twenty miles.

"We crossed the Sacramento river at Frémont, a town of half a dozen houses, opposite the mouth of Feather river. The Sacramento was low, and 250 yards wide. In time of high water when the banks are not overflowed, it is 300 yards wide, but in time of freshet the country is overflowed for miles. I came down the river in December, 1852, when the sheet of water covering the country was fifty miles broad. Vast quantities of stock were destroyed. Sacramento city was overflowed, and much damage done to property there.

"From the crossing of the Sacramento, we travelled up the eastern side of the valley, all the way to Fort Reading, following Feather river for nearly fifty miles. The country was a level plain until within forty miles of the fort, when it assumed an undulatory character, but presented no serious obstacle to the construction of a railroad. The average grade from Benicia to the fort, is 2.6 feet per mile.

"In order to show the amount of bridging required for a road going up on the eastern side of the valley, I have constructed the following table, which gives a concise description of every stream crossed. This table includes all those which are dry in summer, but which must be bridged to allow a free passage for the water in winter. The height of the banks is given for low water."

Water-courses north of Frémont, on the route surveyed up the Sacramento valley.

Name of stream.	Dist. from Frémont.	Length of bridge.	Remarks.
	Miles.	*Feet.*	
Sacramento		300	Banks 30 feet high
Coon creek	13. 8	35	Banks 10 or 12 feet above water
Bear creek	17. 9	30	Banks low
Yuba river	29. 4	200	Banks 30 feet high. Bluffs
Feather river	30. 1	250	Well built wooden bridge
Dry gully	56. 0	75	
Dry gully	58. 0	25	
Dry gully	59. 7	12	
Dry gully	61. 7	12	
Dry gully	63. 0	10	
Dry gully	64. 4	10	
Dry gully	64. 6	15	
Dry gully	66. 1	15	
Butte creek	66. 8	50	Banks low
Little Butte creek	70. 3	20	
Dry gully	70. 8	30	
Dry gully	73. 7	10	
Chico creek	74. 1	30	Banks 25 feet above water
Dry gully	75. 5	20	Banks low
Dry gully	75. 9	10	Banks low
Dry gully	78. 5	12	Banks low
Dry gully	80 5	18	Banks low
Dry gully	81. 2	40	Banks low
Dry gully	85. 9	10	Banks low
Dry gully	86. 4	12	Banks low
Dry gully	87. 1	50	Banks low
Dry gully	88. 2	40	Banks low
Dry gully	90. 0	20	Banks low
Dry gully	91. 3	12	Banks low
Dry gully	92. 1	10	Banks low
Dry gully	92. 9	30	Banks low
Deer creek	93. 4	50	Banks low
Dry creek	93. 6	15	Banks low
Dry creek	96. 4	80	Banks low
Dry creek	97. 1	20	Banks low
Mill creek	101. 1	60	Banks low
Mill creek slough	102. 1	40	Banks low
Dry gully	102. 2	40	Banks low
Dry gully	104. 1	10	Banks low
Dry bed	104. 9	30	
Dry bed	106. 2	8	
Dry bed	107. 4	15	
Antelope creek	107. 7	45	
Gully with water	108. 1	30	
Gully with water	110. 4	36	

Water-courses—Continued.

Name of stream.	Dist. from Frémont.	Length of bridge.	Remarks.
	Miles.	*Feet.*	
Slough	112.2	20	These three sloughs are close together and dry
Slough	112.2	10	
Slough	112.2	15	
Creek with water	113.4	25	Name not known
Dry gully	113.7	90	
Dry gully	111.9	60	
Dry gully	111.9	30	
Dry gully	115.8	50	
Seven Mile creek	118.7	25	
Beaver creek	122.4	30	
Liver creek	129.8	20	
Battle creek	134.3	50	Near junction with Sacramento
Bear creek	137.9	20	
Cow creek	140.3	50	Fort Reading

PROPOSED RAILROAD ROUTE FROM FORT READING TO VANCOUVER, EAST OF THE CASCADE RANGE SURVEYED BY LIEUTENANT WILLIAMSON.

In preparing the following description of this route, I have been careful to express Lieutenant Williamson's ideas, as far as they are known to me. As, however, he seldom referred directly to the railroad, in his journal, I have sometimes been unable to ascertain definitely what his opinion was. In such cases, I have given my own.

With the exception of the Willamette valley and a small portion of the Sacramento valley, the regions traversed by this route are unsettled, and, as a general thing, barren in their character. The rocks are chiefly of volcanic origin. The few fertile spots are usually difficult of access, and the country is unfitted to support a civilized population.

Of the climate of the region east of the Cascade Range, traversed by this route, we have no definite knowledge, founded upon long continued observations; but it is well known that little or no rain falls during several months of the year, and that the whole region is often covered with snow in the winter. Colonel J. C. Frémont, in traversing it during the winter of 1843–44, found the snow occasionally three feet in depth, and the climate severe. In the latter part of August, water froze at night in our camps near the head of Des Chutes valley, at an elevation of only about 4,200 feet above the sea. In my opinion, there would be danger of occasional obstruction from snow, during a few months in the year, should a railroad ever be constructed on this plateau.

The supply of water, fuel, and building materials is almost unlimited, upon the whole route. The only place where there is any deficiency of timber in the immediate vicinity of the trail, is near Lost river and Rhett lake, and there it can be easily obtained from the neighboring hills. There is no lack of water, or good building stone, at any point upon the line. It only remains to describe the difficulties of actual construction. The grades will not, as a general thing, be mentioned in this report, as those upon the travelled route are given on profile No. 1, sheet No. 1, and those upon the proposed railroad line, on profile No. 2, of the same sheet, and also in

Appendix F. In constructing the latter profile, I have generally included the windings of the trail in the estimate of distances between stations. This has been done, partly because it would be impossible, in much of the region traversed, to speak with certainty of any of the country not actually passed over ; and partly, because the winding necessary to obtain uniformly easy grades, would generally render it impossible to materially diminish the travelled distances, although the general direction of the line might be more direct.

The first obstacle encountered after leaving Fort Reading, was the western chain of the Sierra Nevada. As Lieutenant E. G. Beckwith, 3d artillery, had surveyed in 1854, and reported favorably upon the Pit river pass, or, as he terms it, the Upper Sacramento river pass, through this chain, Lieutenant Williamson deemed it unnecessary to make any re-examination of it. He, therefore, took the more direct route by Noble's Pass to the plateau east of the mountains. Our profile of this pass does not differ very materially from that of Lieutenant Beckwith, who also examined the route ; but our barometric observations show the altitude of the summit to be 186 feet greater, and the altitude of Fort Reading to be 157 feet less, than was stated in his report. These discrepancies may be easily explained, as Lieutenant Beckwith was unable to obtain any correction for the abnormal oscillation of the barometric column, a correction which sometimes exceeds these differences in amount. Noble's Pass is certainly very unfavorable for a railroad, and I think that Lieutenant Williamson considered it impracticable, without a tunnel. The line down Canoe creek valley to Pit river, would also involve some very expensive work and heavy grades ; as will be seen by reference to the profile of our travelled route. In constructing the profile of the proposed railroad line, I have, therefore, adopted the route surveyed by Lieutenant Beckwith, from Fort Reading through the Pit river pass to the mouth of Canoe creek. Lieutenant Beckwith considers this route practicable, although it involves some very heavy work. A detailed description of it will be found in his report, which is contained in Vol. 2 of this series.

A short distance above the mouth of Canoe creek, the river passes through a cañon, 4.5 miles in length. The sides are so steep and so near the water, that Lieutenant Williamson was unable to enter on foot, at its mouth. His description of it will be found in Chapter III, under the date August 5. He considered it impracticable to construct a railroad through it, at any reasonable expense, on account of the vast amount of rock cutting and tunneling, which would be required. The distance between Camps 19 and 20, which were situated near the water level at the lower and upper ends of this cañon, was, by the course of the stream, 7.5 miles. The difference in their elevation was 520 feet. Hence the descent of the stream, and consequently the grade in the cañon, must be at least 69 feet per mile.

Although the pass which I examined through Stoneman's ridge, was unfavorable for a railroad, it is considered preferable to the cañon. By side location, the road could pass from Camp 19 to the foot of the main ridge, a distance of 3.5 miles, with an ascending grade of 168 feet per mile. It would then follow up the ravine for 2.3 miles, with a grade of about 200 feet per mile. A tunnel, half a mile in length, through trap rock would then be advisable; although, by very heavy grades, and winding to increase distance, it might probably be avoided. A descent of 89 feet would be required in the tunnel, which would pass 303 feet below the summit of the ridge. From the eastern entrance, the road, by side location, could reach Camp 20, with descending grades of 200 feet per mile for 0.8 of a mile, and 63 feet per mile for 4.4 miles.

The route examined between the two cañons, traversed a slightly undulating plain, and no heavy grades or expensive work would be required. In the last few miles, however, considerable cutting through trap rock might be necessary.

Lieutenant Williamson's notes on the upper cañon of Pit river, will be found in Chapter III, under the date August 7. He considered it practicable to construct a railroad in this cañon, at a reasonable expense; although much heavy rock cutting and numerous short curves would be required. The ascending grade would be 76 feet per mile, for the whole distance of 9.9 miles; and it is probable that numerous bridges would be necessary. It is my opinion, that a better location would be found, by further examination, upon the northern bank of the river. The trail, although very rocky in places, is generally good, and the hills are low. Although the river descends about 750 feet, from a higher to a lower terrace, in this cañon, I think that by proper side location, the necessary ascent might be made, and a line conducted round the cañon on this bank, with grades never exceeding 200 feet per mile. The expense of construction would probably be very much less than by the cañon route.

The road would next cross Round Valley to Camp 23. No difficulty of any kind would be encountered in this section.

Between Camps 23 and 24 the country was hilly, and considerable heavy cutting through cellular trap would be necessary. It is highly probable that the spring branch upon which Camp 24 was situated, discharges into Pit river. If so, the railroad should follow up its course.

Between Camps 24 and 25, the only serious obstacle would be the low ridge which borders Wright lake. It is very probable that these hills could be turned by passing to the west of Wright lake, and striking Rhett lake at once; but as this line was not examined, I have represented on the railroad profile the route by Wright lake, with the grades which could be readily obtained by side location, and an increase of distance of 2.5 miles. The railroad would gain the summit, with an ascending grade of 150 feet per mile for 3.5 miles, by winding towards the east, at the foot of the ridge. It would then descend to Camp 25, with a grade of 150 feet per mile, for 3.5 miles.

The first ridge crossed after leaving Camp 25, could be turned, with an increase of distance of about one mile, by locating the road further towards the north.

The next obstacle of importance, was the steep descent to the shore of Rhett lake. This could be overcome by winding towards the south, with a grade of 200 feet per mile, for one mile.

The road would then traverse a flat plain, to the Natural Bridge of Lost river. The stream, which is here deep and sluggish, is about 80 feet in width, with banks but little elevated above the water surface. A description of the Natural Bridge will be found in Chapter III, under the date August 13. Whether the stone arches are sufficiently strong to support a railroad, can only be ascertained by careful examination and measurement. Loaded wagons now cross, without danger. Trap rock and pine timber, for construction, could be readily obtained from the neighboring hills.

From the Natural Bridge to Upper Klamath lake, the only expensive work would be encountered in passing the low ridge which borders the lake on the south. A short cut of 23 feet, through trap rock, would be required. It is probable, that a portion of the upper part of Lost river valley, is occasionally submerged, in the rainy season, by water from the lake; but I think, that a location could be easily found, which would avoid this danger.

The railroad would next follow the lake shore to the point where our trail left it. Considerable heavy cutting through trap rock, and a few short bridges over springs and small arms of the lake, would undoubtedly be necessary.

The valley of Klamath river could be followed without expensive work, to the entrance of the cañon. This cañon, which is four miles in length, is a formidable obstacle, and would require an amount of cutting through trap and pumice-stone, which can only be estimated by a detailed examination. Lieut. Williamson expressed to me his opinion, that the route was practicable, but very expensive. A description of this cañon will be found in Chapter III, under the date August 20.

From the northern end of the cañon to Camp 34, the country is nearly level ; and the only difficulty would be to guard against an overflow of the waters of Klamath marsh, in the rainy season. A bridge, about 150 feet in length, would be necessary to cross Klamath river, for which an abundance of pine timber could be easily obtained.

From Camp 34 to Camp 35, the route was very favorable for the construction of a railroad. Thence to Camp 36, on Des Chutes river, no very expensive work would be necessary. The country, however, is undulating, and a large amount of cutting and filling through pumice-stone, and occasionally through trap rock, would be required. Of this portion of the route, Lieut. Williamson writes in his journal: "There is a dividing range not of mountains, but of hills, between Klamath marsh and the Des Chutes river. There are, apparently, several low places to cross it, through one of which the trail runs. There appears to be no topographical obstacle to the location of a railroad. The main difficulty would be the extreme lightness of the soil."

I crossed the Cascade Range by a different pass from Lieut. Williamson, and did not, therefore, traverse the remaining portion of this proposed railroad line, myself. I have, however, often conversed with Lieut. Williamson about it, and the following description is based entirely upon information thus obtained, and upon his recorded field notes.

From Camp 36, the railroad would follow up the branch of Des Chutes river, to Camp 44 W. The valley is open, and the construction would be easy for the whole distance.

The grades upon the route followed by Lieut. Williamson, from Camp 44 W. to Camp 45 W., were impracticable for a railroad, as will be seen by referring to profile No. 1, sheet No. 1. From the highest point of the pass, however, he could overlook the country towards the south, and see a route which he considered perfectly feasible. The dense forest, rising from a tangled mass of underbrush and fallen timber, rendered it impossible for him to actually traverse this route; but he was fully satisfied that practicable grades could be obtained without tunneling. He often expressed to me his opinion, that the immense amount of fallen timber would be the greatest obstacle encountered in constructing a railroad through the pass. He indicated the following course for the proposed railroad line. It would follow up the branch of Des Chutes river, and gain the summit of the main ridge, between two prominent peaks east of the lake which forms the source of the Middle Fork of the Willamette. The altitude of the summit appeared to be considerably less than it was where he crossed the ridge, but, as he had no means of estimating the difference with accuracy, he thought it best to assume, on the profile, the same altitude. The grades in reality, therefore, are rather more favorable than represented on profile No. 2, sheet No. 1. From the summit, the line would descend by side location to the lake, and then follow down the Middle Fork to the vicinity of Camp 45 W. Both the eastern and western sides of the ridge appeared to be free from small ravines, so that a side location could be made without great expense in cutting and filling; but Lieut. Williamson apprehended great difficulty in following the Middle Fork from the lake to where his trail struck it. His notes upon the pass will be found in Chapter IV, under the date September 29.

From Camp 45 W to the Willamette valley, the railroad would follow the course of the Middle Fork. Occasional heavy cutting through lateral spurs would be required, but no very costly work.

A discussion of the facilities offered for the construction of a railroad in the Willamette valley, will be given in connection with my return route from Vancouver to Fort Reading.

ROUTE FROM CAMP 36, NEAR THE HEAD OF THE DES CHUTES VALLEY, TO FORT DALLES. SURVEYED BY LIEUT. ABBOT.

As the route down the Des Chutes valley to the Columbia river is considered utterly impracticable for a railroad, it is deemed only necessary to state the grounds upon which this opinion is based. The whole difficulty consists in obtaining suitable gradients. The supply of water is abundant, and good timber for ties and fuel can always be obtained, at a slight cost, from the neighboring mountains, when it is not found near the trail.

The road could be built at a moderate expense, with a descending grade of 13 feet per mile, from the place where we first reached the Des Chutes river, to the point where my party rafted it, a distance of about 29 miles. The stream was here about 150 feet wide, and flowed with a rapid current over a rocky bed. It could have been forded, but not without wetting the packs. The nature of the banks would render it necessary that a bridge should be at least 200 feet in length. A short distance below this point, the river enters the great cañon. It is not considered practicable, without enormous expense, to construct a railroad from this place to the Dalles, either in this cañon, or upon the eastern or western side of the valley. The obstacles to be encountered on each of these three routes will be briefly stated.

The cañon, which in many places is more than 1,000 feet in depth, extends, without doubt, to the mouth of the river ; a distance of about 140 miles. It abounds in rapids and short bends, which would render numerous tunnels and deep cuts through a kind of basaltic rock of exceeding hardness, indispensable. There would also be constant danger of avalanches of earth and stone, from the precipitous sides. The average descent of the river in the cañon, is about 25 feet per mile.

Of the eastern side of the valley below the rafting place, comparatively little is accurately known. Much of it appears, when seen from a distance, to be a bare, sterile plateau, some portions of which are level, and others broken by rolling hills. As the river undoubtedly receives most of its tributaries from the Cascade Range, it is possible that the numerous lateral cañons, which furrow the western bank and render it impracticable for a railroad, might not be encountered on the eastern. But, even if this should prove to be the case, in order to reach the navigable portion of the Columbia river, it would be necessary to cross the Des Chutes cañon by an embankment or bridge, nearly a mile in length and from 500 to 1,000 feet in height, and then, before reaching the Dalles, to overcome other obstacles involving equal expense.

The western side of the valley was thoroughly explored by my party. As insurmountable difficulties were subsequently encountered, it is sufficient to state of the section extending from the rafting place to Camp S on Why-chus creek, a distance of about 34.4 miles, that the construction of a railroad through it would be rendered very expensive, by the necessity of crossing numerous ravines from 100 to 200 feet deep, and of cutting through several high, rocky spurs. An average descending grade of 26 feet per mile, would be required. The country north of Why-chus creek was very carefully examined, both near the river and near the mountains. The best route which could be found for a railroad, lay through a level prairie around the western base of a prominent conical butte, to the cañon of Mpto-ly-as river; which could be entered by a wide, open ravine. This stream, the cañon of which is the first impassable obstacle to the road, rises among the peaks south of Mount Jefferson. After flowing towards the north for a few miles, it takes an easterly course, and discharges itself into the Des Chutes. The depth of its cañon varies from 800 to 2,000 feet, and the width at the top, from two miles to half a mile. There is no pass between it and Mount Jefferson. It would be necessary, after entering the cañon from the south, to keep up the grade by locating the railroad high upon the eastern side, although there would be many small lateral ravines to bridge. After about 18 miles of this difficult and very costly construction, it would be necessary to cross the river, near its most northern point, by an embankment about a mile long, and 1,200 feet high; and thus reach the top of the great basaltic plateau. A line from the snowy summit of Mount Jefferson, eastward to the Des Chutes river, was carefully examined; and this is the best route to this plateau which could be found. It is thought, that the impracticability of the road is made sufficiently manifest, by stating without further detail, that by the most favorable location from this point to the Dalles, a distance of about 75 miles, there would be, beside smaller obstacles, seven cañons to cross, similar to that of the Mpto-ly-as river although not quite so deep, and a difficult spur from the Cascade Range, called the Mutton mountains.

By this description it will be seen, that, at the head of the Des Chutes river, the railroad coming from the south, should either cross the Cascade Range to the Willamette valley, or bend towards the east, and, avoiding entirely the Des Chutes valley, reach the Columbia, above the head of navigation, by some as yet unexplored route.

ROUTE FROM THE DES CHUTES TO THE WILLAMETTE VALLEY, BY THE NEW PASS NEAR MOUNT HOOD. SURVEYED BY LIEUTENANT ABBOT.

The most unfavorable feature of this route for a railroad, is the difficulty of access to the new pass. To reach it on the western side of the Des Chutes valley, either from the north, or the south, is utterly impracticable. As, however, it appears to be a better railroad pass through the Cascade Range, than any surveyed further south; and, as there is a bare possibility that it may be reached from the eastern side of the valley, it is deemed advisable to describe it with considerable minuteness.

The crossing of the Des Chutes cañon would be a most difficult and costly undertaking; but, if it could be accomplished near the Mutton mountains, I think Nee-nee springs might be easily reached. Between that point and the pass, a distance of 24.3 miles, no great obstacle would be encountered. The grade is less than 100 feet per mile, except at three places, where it is for half a mile 206 feet, for two miles 141 feet, and for one mile 125 feet, per mile. At these points it could be easily reduced, by side location, to 100 feet per mile.

From the entrance of the pass, the line would follow the course of a branch of Tysch creek to Wat-tum-pa lake, a distance of 6.2 miles, with an ascending grade of eighty-five feet per mile. A little side cutting, and the removal of a great number of logs, would be requisite in this section. West of the lake the trail passed over a steep hill, which could be avoided by following the course of a small tributary. Ty-ty-pa lake could thus be reached with an ascending grade of 109 feet per mile, for 3.8 miles. The trail next passed over a steep ridge which formed the true summit of the pass. Its altitude above the sea level, was 4433 feet. The ascent from Ty-ty-pa lake to the summit, by the trail, was 416 feet; and the descent to a great ravine, about 200 feet. It is thought that this ridge might be crossed at a much lower point, a little further to the north, but, even if this should not prove to be so, both the ascending and descending grades could be reduced, by side location and an increase of distance, to less than 200 feet per mile. This could be easily done, as the ridge is not furrowed by many ravines. The removal of a large quantity of timber would be the principal difficulty.

From the summit of the pass to the Willamette valley, the railroad would follow a route which we could not travel over, on account of an immense number of logs that completely blocked up the way. We passed along ridges, however, from which we could overlook it, and see that the fallen timber was probably the only serious obstacle. The great ravine extending north and south could be crossed, and Clackamas ravine entered by a lateral cañon and followed, apparently without any obstruction from bends or side spurs, to the valley. The approximate distance would be thirty-eight miles, and the approximate grade, for most of the way, 125 feet per mile. It would be less than this, near the summit.

Throughout the whole distance, the supply of timber, water and stone is abundant. Occasionally a little heavy rock and earth cutting would be required, but the chief difficulty, in preparing the road bed, would be to clear away the mass of timber, logs, and underbrush, which now renders portions of the route utterly impassable. During the winter, it is probable that the pass is blocked up with snow, to a depth of 20 or 25 feet, but concerning this, nothing is known with certainty.

PROPOSED RAILROAD ROUTE FROM VANCOUVER TO FORT READING, WEST OF THE CASCADE RANGE. SURVEYED BY LIEUT. ABBOT.

The party which examined this route, was deprived of its escort, by the officer commanding the Columbia River and Puget Sound District. As this loss caused the survey to be made under great disadvantages, and prevented certain important side explorations, it has been deemed proper to state, in full, the circumstances of the case, and to give a detailed account of the Indian disturbances, which greatly embarrassed the party in the performance of the duties assigned to it by the War Department. This has been done in Chapter V, under the date October 19, and between the dates October 30 and November 5, inclusive.

The result of the survey showed the route to be much more favorable to the construction of a railroad, than had been anticipated, and, although certain portions of the line actually examined were found to be very unfavorable, it is thought that a way to avoid these places would have been discovered by further exploration, had not this been prevented by the loss of the escort.

The climate of the regions through which this route passes, is mild. The mean winter temperature, for the two years 1853 and 1854, was 33°.78 Fah., at Fort Jones, which is situated upon the coldest portion of the line. At Fort Reading, for the same years, it was 46°.12 Fah., and at Fort Vancouver, for the four years, 1850, '51, '52, '53, it was 39°.54 Fah. This information is derived from the Army Meteorological Register, published in 1855. Unpublished records of the medical department show that the mean temperature at Fort Lane, for the winter of 1856, was 38°.89 Fah. It appears from these data, that, should a railroad be constructed upon this route, there will be little danger of serious obstruction from snow.

An unlimited supply of wood, water and stone, for railroad purposes, is found in the immediate vicinity of this line, throughout its whole extent. It only remains, therefore, to consider the route with reference to the actual difficulties of construction.

It may be well to state, that, as the grades upon the route travelled are given on profile No. 1, sheet No. 2, and those upon the proposed railroad line, on profile No. 2, sheet No. 2, and in Appendix F, they will not, as a general thing, be repeated in this report.

For about 150 miles after leaving the Columbia river, the route lies in the Willamette valley. This region is admirably adapted to the construction of a railroad. The surface is level, or gently undulating, the streams, although numerous, are small, and the settled character of the country would render it easy to obtain supplies of every kind for the working parties. An average grade of about ten feet per mile would be required, and it is thought that the maximum grade would not exceed fifty feet per mile. Two routes from Oregon City to Eugene City were examined: Lieut. Williamson followed the hill road, upon the eastern side of the valley; I took the most direct road from Oregon City to Salem, and after crossing the Willamette at that point, passed up its western side. Although it would be perfectly practicable to construct a railroad in the immediate vicinity of either of these routes, a better location could, without doubt, be found between them on the eastern bank of the river.

The following tables give an approximate idea of the amount of bridging necessary upon each of the surveyed lines.

Table of water-courses in the Willamette Valley, upon Lieutenant Abbot's route.

Name of stream.	Distance from camp near Vancouver.	Length of bridge.	Remarks.
	Miles.	*Feet.*	
Slough	1	30	Banks 15 feet high.
Creek	12	30	Banks 20 feet high.
Small creek	14	10	Banks low.
Clackamas river	18	130	Banks 30 feet high.
Small creek	25.5	10	Banks low.
Small creek	25.6	10	Banks low.
Mollalle river	30	80	Banks 30 feet high.
Small creek	34.3	10	Banks low.
Pudding river	36.5	70	Banks 20 to 30 feet high. Bridge.
Slough	49.6	40	Banks 20 feet high, with gradual slope.
Marsh	52.7	600	Banks miry.
Small creek	60	40	Banks 20 feet high.
Willamette river	60.7	300	Banks 40 feet high, with gradual slope.
La Creole river	66.3	20	Banks low.
Small creek	71	10	Banks low. Bridge.
Lackimute river	77	40	Banks 40 feet high. Steep.
Slough	82	10	Banks low.
Mary's river	94	60	Banks 20 feet high, with gradual slope.
Long Tom creek	108.5	50	Banks 30 feet high. Bridge.
Small creek	154.6	10	Banks low.
Small creek	155.3	10	Banks low.

Table of water-courses in the Willamette Valley, upon Lieutenant Williamson's route.

Name of stream.	Distance from camp near Vancouver.	Length of bridge.	Remarks.
	Miles.	*Feet.*	
Slough	1	30	Banks 15 feet high.
Creek	12	30	Banks 20 feet high. Bridge.
Creek	14	10	Banks low.
Clackamas river	18	130	Banks 30 feet high.
Small creek	23. 2	10	Banks low.
Small creek	25. 3	5	Banks low.
Mill creek	28. 6	20	Banks 10 feet high.
Mollalle river	31. 0	60	Banks low.
Main Rock creek	37. 4	----------	
Branch of Rock creek	39. 5	10	Banks 8 feet high.
Butte creek	41. 8	10	Banks low.
Alberqua creek	44. 4	40	Banks 20 feet high.
Small creek	45. 6	15	Banks low.
Silver creek	46. 6	100	Banks 15 to 20 feet high. Bridge.
Small creek	50	10	Banks low.
Small creek	50. 8	20	Banks low.
Small creek	52. 1	10	Banks low.
Small creek	54. 3	10	Banks low.
Small creek	58. 2	5	Banks low.
Slough	64. 3	25	Banks 10 feet high.
Small creek	64. 6	15	Banks low.
Small creek	64. 7	10	Banks low.
North fork of Santiam river	64. 8	130	Banks 15 feet high. Bluffs.
Thomas Fork	69. 4	60	Banks 20 to 30 feet high. Bridge.
Crabtree creek	72. 4	50	Banks 20 to 30 feet high. Bridge.
South Beaver creek	73. 5	10	Banks low.
South fork of Santiam river	75. 3	100	Banks low.
Slough	81. 5	----------	Banks low.
Small creek	89. 9	20	Banks 10 feet high. Bridge.
Calapooya creek	91. 8	15	Banks 15 to 20 feet high.
Dry gully	98. 7	10	Banks low.
Mud creek	103. 0	20	Banks low.
McKenzie's Fork	112. 3	120	Banks low. Sporc's Ferry.
Slough	112. 4	25	Banks low. Bridge.
Middle Fork at Eugene City	117. 8	about 100	

The distance from the camp opposite Vancouver, to Camp 71 A. near the head of the Coast Fork of the Willamette, is, by my route, 157.5 miles, and by that of Lieut. Williamson, which joins mine at Eugene City, 142.8 miles. There are a few low hills upon each of these lines, but, as a railroad could be located between them over an almost level plain, a more detailed description is not considered necessary.

The Willamette and Umpqua valleys are separated by the Calapooya mountains. An excellent pass was found through this range. From Camp 71 A. the line would follow up a small branch of the Coast Fork of the Willamette to a little meadow, elevated 863 feet above the sea. This meadow is also the source of a small tributary of the Umpqua river, called Pass creek. The railroad would follow the course of this stream through the Calapooya mountains. Several short bridges would be required, with a little cutting through earth, and, for a few feet, through a hard kind of sandstone. No sharp curves would be necessary. The maximum grade would be sixty-seven feet per mile, for 4.9 miles.

To cross the divide between Pass and Elk creeks, an earth cut of forty feet at the summit, with an ascending grade rendered by side location eighty-seven feet per mile for 3.8 miles, and a descending grade of 211 feet per mile for 0.9 of a mile, would be requisite. By winding, the last grade would be reduced to 173 feet per mile, for 1.1 miles.

Elk creek would be crossed by a bridge about forty feet in length. The line would then follow the eastern bank of a small tributary for 3.7 miles. From this point an ascending grade, rendered, by location upon the eastern side of the valley, about 186 feet per mile for four miles, would conduct to the summit of Long's hills, where an earth cut of forty feet would be advisable. The descent might be made by winding towards the east for about three miles, with a grade of about 214 feet per mile, but I have no doubt that a little examination would show a much better pass through this line of hills. Having reached the valley at the southern base of the ridge, the railroad would turn towards the west, and after striking the trail of my party, would follow it to the North Umpqua river near Winchester. A bridge about twenty feet in length over a small creek would be necessary on the way. The total increase of distance over that of the travelled road, produced by the above location, would be about 3.3 miles.

The North Umpqua river is about eighty feet in width, and a bridge at least one hundred feet in length would be required. The current is rapid, and the bottom rocky. The stream is unfordable and bordered by low bluffs.

From Winchester the railroad could be located upon the surveyed route to Cañonville, except that it would avoid the high ridge near Roseburg, by following the South Umpqua river. I was informed that this could be done without difficulty, with an increase of distance of about nine miles.

Although no very serious obstacle exists on this route through the Umpqua valley, still some expensive work and heavy grades would be required; and, before a railroad should be actually located, the route by Pass creek to Elk creek, and down that to Umpqua river, and then up the river to the vicinity of Cañonville, should be examined. It is probable that very easy grades might be thus obtained, although the distance would be increased, approximately, forty miles.

Cañonville is situated at the northern base of the Umpqua mountains. This range is a formidable obstacle to the road. The route surveyed through it follows the Umpqua cañon. Near the summit of the divide, elevated 1,963 feet above the sea level, two streams head, one of which flows into Cow creek, and the other into the South Umpqua. The cañon is very narrow, its sides are precipitous and from one to two thousand feet in height, and heavy cutting, or short tunneling, through earth and talcose slate, would be required to obtain practicable curves. In ascending, the grade would be 207 feet per mile for seven miles, and in descending 192 feet per mile for two miles. The latter, however, could be considerably reduced by side location. Numerous short bridges across the stream would be necessary in reaching the summit from the north.

It is probable that a better railroad route through these mountains would be found by following Cow creek cañon. This stream rises south of the range, and, after making a great bend to the west, flows through it to the South Umpqua. The approximate length of the stream from its mouth to the point where we crossed it, in Rogue River valley, is thirty-five miles. The difference of elevation between these points is about 887 feet. The average ascending grade would, therefore, be only about twenty-five feet per mile. The increase of distance by this route over that by the Umpqua cañon, would be about seventeen miles. According to the best information which I could obtain, Cow creek cañon would require no sharper curves than the Umpqua cañon, and it is a cause of regret, that the want of a proper escort rendered its examination by my party impossible.

Having reached the southern base of the mountains, by the Umpqua cañon road, the divide between Cow and Wolf creeks could be passsed, by crossing Cow creek with a bridge about thirty feet in length, two miles before reaching the usual ford, and then gaining the summit by side location, with an ascending grade of about 143 feet per mile, for three miles. The descending grade to Wolf creek could be reduced, by side location, to 187 feet per mile for four miles. I have no doubt that a lower point could be found in this divide a short distance further to the north, and the above grades thus be reduced.

The route examined from Wolf creek to Rogue river was found to be very unfavorable for the construction of a railroad, on account of the Grave Creek hills. These hills separate Grave creek from Wolf creek on the north, and from Jump off Joe creek on the south. They are densely timbered, and, for reasons fully stated in the Itinerary, they could not be thoroughly examined by the party under my command. The hills north of the creek were between 500 and 600 feet in height, and those south between 800 and 900 feet in height, where we crossed them. I believe that a practicable railroad route through both ridges could be found by a little exploration; but, if this should not prove to be the case, the line could follow Wolf creek to Grave creek, and that to Rogue river, and then turn up the latter. Very easy grades could thus be obtained to Evans' ferry, where we crossed the river, with an approximate increase of distance of about thirty miles. According to the best information which could be obtained, no insuperable obstacles would be encountered on the way.*

Should favorable passes through the Grave creek hills be discovered by future examination, a bridge about twenty feet long would be required at Grave creek, and another of about the same length at Jump off Joe creek. From the latter bridge, the line could either follow the trail of my party to the next creek, with the grades indicated upon profile No. 2, sheet No. 2, or, by an increase of distance of about four miles, follow down Jump off Joe creek to the mouth of this tributary, and then take a nearly straight course to Evans' ferry. The grades would be comparatively easy, and the work light, upon the latter route. The little tributary, where we crossed it, was about ten feet in width.

* This is the route indicated on profile No. 2, sheet No. 2, for the proposed railroad line. The approximate altitude of the mouth of Wolf creek, and of the point of striking it, were determined in the following manner. The distance from Evans' ferry to the mouth of Rogue river is about ninety miles by the course of the stream. The altitude at Evans' ferry is 913 feet. Hence, the average descent of the river is about ten feet per mile. This result is confirmed by my observations at Fort Lane. My camp there was about 150 feet above the river, and 1,202 feet above the level of the sea. The water surface near it was, therefore, about 1,052 feet above the sea. Being fourteen miles above Evans' ferry, it should be 1,057 feet, were the estimated descent of ten feet per mile correct. The slight difference of five feet between the observed and computed heights, shows that this estimated descent may be assumed for this river without material error. The mouth of Wolf creek is, approximately, thirty miles below Evans' ferry, and its altitude is, therefore, about 613 feet above the sea. Its distance from Camp 75 A, which is elevated 1,151 feet above the sea, is about twenty-five miles. Hence, the descent of Wolf creek is about twenty-one feet per mile. As the railroad would not come down to the level of the water, before reaching a point about two miles below Camp 75 A, the altitude of this point would be, at the above rate of descent, about 1,109 feet.

At Rogue river, near Evan's ferry, a bridge about 120 feet in length would be necessary. The water flowed with a rapid current over a rocky bed. It was not generally more than three feet in depth near the ferry, but deep holes rendered it dangerous to attempt to ford the stream. The banks were bordered by bluffs from five to fifteen feet in height, and wood and stone for the construction of a bridge were at hand.

From this point a railroad could follow the line of survey to Fort Lane, and thence up the valley of Stewart creek to Camp 78 A, near the foot of the Siskiyou mountains. An average ascending grade of thirty-eight feet per mile, would be required. The labor of construction would be light.

It is considered that a railroad from Vancouver to Camp 78 A, is practicable in the immediate vicinity of the route examined by my party. The construction, for a portion of the line, would be very costly, but the expense would doubtless be greatly reduced by further examination. From Camp 78 A to Fort Reading, however, the obstacles encountered were very great, and although it is highly probable that a practicable line, which can even be approximately located, exists, still no such route was actually surveyed. If, however, a connection could be made between this camp and the route surveyed east of the Cascade Range, some of the most difficult and expensive work upon that line would be avoided, and the settlements in southern Oregon be benefited by the road. The lateness of the season, and the loss of the escort, rendered any survey of the Cascade Range, near the head of Stewart creek, impossible; but there are very good reasons for believing this connection to be eminently practicable. There is a low pass between Mount Pitt and Klamath cañon, by which a good emigrant road now crosses the range and strikes Stewart creek near Camp 78 A. Several persons well acquainted with its character informed me that, according to their judgment, the pass was very favorable for a railroad. Lieutenant Crook, the quartermaster of our expedition, had travelled through it; and his opinion was, that it presented no greater obstacles to the construction of a railroad than many other portions of the route, which actual survey demonstrated to be practicable. This wagon road crosses Lost river at the Natural Bridge, and the connection with the route east of the mountains would be made by the railroad near this place. The approximate distance from Camp 78 A, to the Natural Bridge, is seventy miles. Of this distance about thirty-eight miles were examined and found to be practicable for a railroad, by Lieutenant Williamson, while passing with a detached party round Lower Klamath lake. The altitude of his camp B, near the entrance of the pass, was 3,733 feet. That of Camp 78 A, was 2,195 feet. The distance between these camps is about thirty-two miles, in a direct line; but the windings of the road would probably increase the travelled distance to about forty miles. Hence an approximate average rise of about thirty-eight feet per mile would be necessary, without taking into account that required to pass the dividing ridge.

The first obstacle encountered on my route from Camp 78 A to Fort Reading, was the Siskiyou mountains. The pass surveyed through this chain was very unfavorable for a railroad. From the camp the line would follow a branch of Stewart creek for 3.7 miles, with an ascending grade of 120 feet per mile. A tunnel, about six miles in length, would then be necessary. The surface rock is a conglomerate sandstone. An ascending grade of about 137 feet per mile would be required in the tunnel, which would pass 1,461 feet below the summit of the mountain. A modification of this grade, so as to form a summit near the middle of the tunnel, might be advisable, in order to insure drainage during the excavation. For 1.1 miles from the northern, and for 1.3 miles from the southern entrance, shafts of less than 600 feet in depth could be sunk.

For 3.6 miles between these points, every shaft would necessarily be deeper than this. From the southern entrance there would be a descent of 1,268 feet to Klamath river. By the route travelled two small ridges were crossed in the descent. The grades given on profile No. 2, sheet No. 2, could be obtained by side location near the line of survey; but it is probable that the small creek which was struck soon after leaving the summit, might be followed to Cottonwood creek, and that to Klamath river. The heavy grades would be thus avoided, and the approximate descending grade, from the southern entrance of the tunnel to the river, reduced to about eighty feet per mile, for about sixteen miles.

There is every probability that by further examination a pass much better than this might be discovered through the range. In fact, I was informed that one was already known, further toward the east, which was much more favorable for a railroad. The loss of the escort rendered its examination impossible.

At Klamath river a bridge about 150 feet in length would be requisite. The banks were from ten to twenty feet in height. The current flowed very rapidly, over large rocks. The stream was not generally more than two or three feet in depth, but there seemed to be many deep holes.

From Dewitt's ferry over Klamath river to Yreka, a distance of 17.5 miles, a railroad could be located with an average ascending grade of twenty-two feet per mile. Part of the route passes over a slightly undulating country, but neither heavy grades, nor deep cutting, would be required.

At Yreka the proposed railroad line diverges from my travelled route. The loss of the escort, and of the quartermaster and commissary of the expedition, who was detained at Fort Jones by the commanding officer of that post, rendered it necessary to abandon the idea of surveying the Sacramento river route to Fort Reading, which promised to be favorable for the construction of a railroad, and compelled me to pass over the Trinity trail, which proved, as had been anticipated, utterly impracticable for this purpose.

Before considering the proposed railroad line, the obstacles upon the Trinity trail will be briefly described. By reference to profile No. 1, sheet No. 2, it will be seen that three prominent ridges were crossed upon the route, besides some hills near Shasta. The first, Little Scott's mountains, can probably be turned by following down Klamath river to the mouth of Scott's river, and then passing up the valley of that stream. The approximate increase of distance from Dewitt's ferry to Fort Jones, over that of the travelled road, would be twenty miles. Heavy rock cutting through lateral spurs would undoubtedly be necessary in many places, but the construction in Scott's valley would be easy. The second ridge, Scott's mountains, could only be passed by a tunnel, about ten miles long, excavated through granitic rock. The tunnel would pass about 2,000 feet below the summit. In Trinity valley much heavy stone cutting and numerous bridges would render the construction very expensive. The third ridge, Trinity mountains, would require a tunnel through granitic rock about four miles in length, passing 2,000 feet below the summit. The hills near Shasta could probably be turned by following Clear creek to the Sacramento river; but the cost of the two tunnels in the mining region, where the price of labor is very high, would be too enormous to estimate.

Another route from Yreka to Fort Reading, which is unquestionably practicable for a railroad, is to follow an easterly course until a junction is effected with our line of survey east of the Cascade Range, and then to follow that route to the Fort. In 1852, Lieutenant Williamson explored the country which the line of connection would traverse, and found it a nearly level plateau, which would present no serious obstacle to the construction of the road. This route would be very circuitous, however, making the distance from Yreka to the Fort between 250 and 300 miles, while, in a right line, it is only about 90 miles.

It is believed that this detour could be avoided by striking the head-waters of the Sacramento river west of Shasta Butte, and then following the course of the stream to Fort Reading. I was prevented, for the reasons above stated, from surveying this line; but a party of gentlemen from Shasta recently examined it with reference to the construction of a wagon road, and made a favorable report,* estimating the expense at $50,000. I had a personal interview with one of these gentlemen. He stated, that, although some sharp curves and deep cuts would be necessary, he had no doubt that a railroad could be constructed upon the route at a reasonable expense.

* It has been deemed advisable to subjoin this report in full as it appeared in the Yreka Union of November 3, 1855.

Wagon road from Yreka to Shasta.

YREKA, *October* 29, 1855.

We, the undersigned, who left Shasta on the 25th instant for the purpose of examining the route for a wagon road to Yreka, *via* the Sacramento river, arrived at this place on Sunday morning last.

The entire length of the road will probably reach one hundred and ten miles. The general course is directly north, and no deflections from a straight line occur, except in those places where the short bends of the river must be followed. All the difficulties to be overcome, and work necessary to render the entire route practicable for heavily loaded wagons, lies between Spring creek and the Soda spring, a distance of about sixty-nine miles. More or less grading, bridging, etc., will be necessary upon about fifty miles of this distance. The remaining fourteen is taken up by level plateaus from a half to five miles in length, many of them being fine arable land, with a deep, rich soil.

The most important obstacles to be overcome are two long ascents. The first is encountered immediately after crossing Sugar Loaf creek, twenty-five miles from Shasta, and the other at Potato hill, nine miles further on. Both these can be passed without much difficulty by taking a circuitous course around the hill, and attaining the summit by a succession of easy gradients, alternating with occasional short benches, made level to relieve the ascent. With the exception of these two hills, and three or four minor ones, the whole road can be made comparatively level.

It is our opinion that about thirty miles will require heavy excavation. This occurs at various points along the entire distance from Spring creek to the Soda spring. The points we have referred to are where the road is thrown upon those portions of the river bank which are steep. Those places are generally from half a mile to a mile in length, and between them we have level flats or slightly undulating ridges, where but little work would be necessary, except to bridge the creeks which are generally met with at those points.

Fine timber grows near at hand for all the wood work which will be needed, and two saw mills are already constructed, the one at Spring creek, and the other at Squaw creek. Between Pistol and Sugar Loaf creeks more or less blasting will be required upon two miles of the route, none of which, however, is of a serious character.

Beyond the Soda springs all obstacles vanish. All that will be required is to clear the way through a level, timbered country as far as the huckleberry patch at the head of Shasta valley; from thence into Yreka an excellent wagon road already exists. More work will be necessary to construct a wagon road by this route than was at first anticipated by us; but on the other hand we are satisfied that it is the most direct course, and that when the road is once built, it will be the easiest and most substantial mountain route in California. Following, as it does, the course of a river until it arrives at its source, it then enters a level plain, and no dividing ridges are to be crossed separating stream from stream, as is the case with nearly all the wagon roads which have been constructed in like cases.

It will probably be expected that we should make some rough estimate of the cost of this route. It is with extreme reluctance that we enter upon any such calculation, as we are aware, that in making our estimate of the distance, we are liable, in many instances, to be grossly deceived; for in many places where the trail we were travelling upon passes over the hills, the road would continue level along the bank of the river.

We are of opinion, however, that our errors in this respect are on the right side, and that the route of the road will prove when marked out and measured, to be considerably shorter than the distances given by us. We believe that the sum of fifty thousand dollars, or near that amount, will be required to perform the grading and erect the numerous bridges necessary to construct a good, easily travelled, and substantial wagon road, up the Sacramento river, from Shasta to Yreka. A recapitulation of the numerous creeks, the different points to be encountered, and the various distances, we consider unnecessary to be here stated, as those items would render our report too lengthy, and, from our limited means of observation, would not possess a sufficient degree of exactness.

It is our candid opinion that this undertaking cannot be at once accomplished by private contributions. An attempt to do so would, we fear, result in disappointment, and perhaps a failure of the whole enterprize. We would, therefore, suggest

It is proper to state why the altitude of the divide between Sacramento and Shasta rivers has been assumed at 3,500 feet, on profile No. 2, sheet No. 2, upon which the Sacramento river route is indicated for the proposed railroad line. This is only an approximation to the truth; but I believe it worthy of some reliance for the following reasons. It will be noticed in the report upon the wagon road from Yreka to Shasta, contained in the last note, that this passage occurs: "Following, as it (the proposed wagon road) does, the course of a river (the Sacramento) until it arrives at its source, it then enters a level plain, and no dividing ridges are to be crossed separating stream from stream, as is the case with nearly all the wagon roads which have been constructed in like cases." On profile No. 1, sheet No. 2, representing the surveyed line, it will be seen that Shasta Butte rises from a natural eminence, which extends many miles both north and south of the mountain. The greatest altitude upon this pedestal of the Butte, where we crossed it, is, without taking into account isolated ridges, 3,457 feet. These two facts have led me to assume an altitude of 3,500 feet for the divide. This altitude gives an average descent of more than forty feet per mile to Shasta river, and to the Sacramento river above Johnson's ferry; descents, which, in my opinion, are very much greater than the appearances of the streams justify. Any less altitude would, of course, render the route more favorable to the construction of a railroad.

As soon as the open portion of the Sacramento valley should be gained, there would be no further difficulty in reaching Fort Reading with easy grades. The total distance from Yreka to the Fort, by this route, is 120 miles.

that a stock company be formed, and a charter applied for at the next session of the legislature. This plan will insure the early completion of an enterprize which will open an exhaustless mining region, now nearly untouched, and place the town of Yreka, and the whole northern portion of the State, now so difficult of access even by pack trains, within five or six days' travel, by loaded wagons, of the different depots in Sacramento valley.

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JOHN J. TOMLINSON.
WM. A. MIX.
R. A. McCABE.
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J. TYSON.

CHAPTER III.

NARRATIVE AND ITINERARY.—ROUTE OF THE MAIN COMMAND.

PREPARATIONS.—ORGANIZATION AND OUTFIT OF PARTY.—SUISUN VALLEY.—PUTOS CREEK.—CACHE CREEK.—SACRAMENTO RIVER.—FEATHER RIVER.—MARYSVILLE.—MIRAGE.—DIGGER INDIANS.—THEIR HUTS.—THEIR MODE OF GAMBLING.—GRIZZLY BEARS.—TWO ROUTES EXAMINED FROM ANTELOPE CREEK TO FORT READING.—FORT READING.—OFFICERS THERE.—THE ESCORT.—BAROMETER LEFT WITH DR. HAMMOND.—GUIDE EMPLOYED.—START.—DISAGREEABLE CAMP.—MCCUMBER'S FLAT.—NOBLE'S PASS.—VIEW FROM SUMMIT.—LOST CREEK.—COLD.—INDIAN SIGNS.—CANOE CREEK.—PUMICE-STONE.—PEDREGAL OF TRAP ROCK.—ACCIDENT TO CHRONOMETERS.—DIFFICULT TRAVELLING.—PRECIPICE.—PRAIRIE WITH SPRINGS.—PIT RIVER INDIANS.—THEIR HABITS.—THEIR BOWS AND ARROWS.—INDIAN TRAIL.—LARGE RIVER GUSHING FROM THE ROCKS.—EXPLORATION BY LIEUT. WILLIAMSON.—PIT RIVER.—LIEUT. SHERIDAN.—EXPLORATION OF LOWER CAÑON OF PIT RIVER.—LIEUT. HOOD'S RETURN.—STONEMAN'S RIDGE.—ROUTE BETWEEN THE CAÑONS.—FIRE IN CAMP.—UPPER CAÑON OF PIT RIVER.—CART BROKEN.—INDIANS.—THEIR MODE OF KINDLING A FIRE.—THEIR LOVE OF TOBACCO.—THEIR ORNAMENTS.—LIEUT. WILLIAMSON'S NOTES ON THE CAÑON.—GRASS VALLEY.—PITS DUG BY INDIANS.—EXPLORATION IN ADVANCE BY LIEUT. WILLIAMSON.—SPRING BRANCH.—BAKED ANTELOPE'S HEAD.—SAGE PLAIN.—WRIGHT LAKE.—RHETT LAKE.—EMIGRANT ROAD.—LOST RIVER.—NO FUEL.—PARTY FROM YREKA.—DIVISION OF THE PARTY.—NATURAL BRIDGE.—RATTLESNAKE UNDER A BLANKET.—UPPER KLAMATH LAKE.—INDIAN SIGNS.—SNAKES.—FIRE IN CAMP.—ARRIVAL OF LIEUT. WILLIAMSON.—ROUTE NEAR EASTERN SHORE OF LAKE.—BALD EAGLES.—ACCIDENT.—KLAMATH RIVER.—CAÑON.—FOG.—KLAMATH MARSH.—INDIANS.—THEIR RANCHERIAS.—THEIR CANOES.—THEIR GRAVES.—GRAVE OF A CHIEF.—PILES OF STONES.—INTERCOURSE WITH THE INDIANS.—THEIR HORSES.—PARTIAL VOCABULARY OF THEIR LANGUAGE.—CROSSING OF KLAMATH RIVER.—DIVIDE BETWEEN KLAMATH MARSH AND DES CHUTES RIVER.—WATER HOLES.—PUMICE.—DES CHUTES RIVER.—TWO TRAILS.—TROUT.—OLD WAGON TRAIL.—DIFFICULTY IN TAKING ASTRONOMICAL OBSERVATIONS.—SICKNESS.—DIVISION OF PARTY.—ICE IN CAMP.—INGENIOUS METHOD OF REPAIRING CHRONOMETER.—GOLD SEEKERS FROM UMPQUA VALLEY.—ORDERS FROM LIEUT. WILLIAMSON.—BRANCH OF DES CHUTES RIVER.—RAFTING OF STREAM.—ENTRANCE OF GREAT CAÑON.—RAPID.—JUNCTION WITH LIEUT. WILLIAMSON'S PARTY.—RAIN.—SNOW PEAKS IN SIGHT.—WHY-CHUS CREEK.—CAMP NEAR "FORKS OF THE INDIAN TRAIL."—BERRIES.—DIVISION OF THE PARTY.—SKETCH OF SUBSEQUENT OPERATIONS.

ON May 5th, 1855, Lieut. Williamson, with the civilian assistants and myself, sailed from New York, and on May 30 arrived at San Francisco. Here he organized the surveying party. On July 9, 1855, the command was in depot camp, near Benicia, and ready to commence field work on the following day.

The party consisted of Lieut. R. S. Williamson, Topographical Engineers, in charge of the expedition, with myself for his principal assistant; Dr. J. S. Newberry, geologist and botanist, Mr. H. C. Fillebrown, assistant engineer; Dr. E. Sterling, physician and naturalist; Mr. C. D. Anderson, computer; and Mr. John Young, draughtsman. There were also eighteen men, under the immediate supervision of Mr. Charles Coleman, the pack master.

As much of the survey was to be made in a mountainous, unexplored region, Lieut. Williamson decided to transport all the supplies by a pack train. The only vehicle was a light two-wheeled cart, designed solely to carry the instruments. These consisted of two Gambey sextants, two artificial horizons, four box chronometers, three prismatic compasses, one surveyor's chain and pins, one odometer, four Green's cistern barometers, with a case of extra unfilled tubes, four thermometers, two reconnoitring glasses, one aneroid barometer, and several smaller instruments.

July 10.—We left camp about noon. The road, at first, led over low rolling hills to the marshy edge of Suisun bay. After following this for a short distance, it passed over a nearly level country, to a small creek with slightly brackish water. It then crossed a level plain, bordered by low hills and dotted with a few oaks, to Suisun creek, where we encamped. Much of the soil near the road to-day was rich and under cultivation.

July 11.—The road was at first slightly hilly, and bordered by a few scattered oaks. It then crossed a level plain, bare of trees, where the heat was very oppressive. We found a little lake on this plain, and the dry beds of two small streams, which were evidently tributaries in the rainy season. Towards the end of the day's march, the country again became undulating. We encamped on a small creek, near a collection of two or three houses called Vacaville.

July 12.—To-day, we travelled among the low foot hills of the Coast Range to Putos creek, where there were several fine oak, peach, and fig trees, and a vineyard. The hills could be avoided by keeping further towards the east. Lieut. Williamson made the following note upon Putos creek, in his journal: "Putos creek, at the most favorable point, requires a bridge 130 feet in length. The bed of the stream is now 20 feet below the banks, and the water less than a foot deep. In the winter and spring, the banks are nearly reached by the water. The stream, I am informed, was named after a tribe of Indians which lived upon its banks, and which were known to the Spaniards as the Putos Indians; the word 'putos', being masculine, means a lazy, worthless vagabond. Hence the creek was called Rio de los Putos. It is, however, generally called Puta creek, and sometimes Pewter creek."

The road next crossed a dry, dusty plain, several miles in width, where every breath of air felt like the blast of a furnace, so intense was the heat. We then entered a fine oak forest, which skirted the banks of Cache creek. We encamped at the lower ford of this creek, after having crossed at the upper. The following extract is from Lieut. Williamson's journal.

"This stream has, in many places, a bottom as much as a half mile wide. The width of the stream itself, at the narrowest part I saw near the upper crossing, was, I should think, about 300 yards. At the lower crossing, it was much narrower, being only about 100 yards wide, with banks 30 feet high. I am told that in times of freshet it rises so much as to overflow these banks."

July 13.—Early this morning, we reached the Sacramento river at Knight's rancho, and, finding that the most direct road to Marysville was impassable on account of mire, followed down the river to Frémont. Here we crossed by a ferry. The water was low, the river being only about 250 yards in width. At season of high water it is at least 100 yards wider, and during freshets it sometimes overflows its banks for miles. It is bordered by a dense growth of willows, sycamores and oaks. We followed up Feather river for about 8.5 miles, and encamped near Nicholas. The road to-day was level, and often led through noble forests of oak. There was little or no underbrush, and the country resembled a grand old park in appearance. Many large squirrels were seen among the trees.

July 14.—For a few miles this morning, the road continued to be bordered by the noble oak forest. The extreme shortness of their trunks gave the trees the strange appearance of having been pressed down into the ground. On leaving the forest, we travelled over a dry, dusty plain, which continued to Marysville, a fine little city, containing several brick stores and houses, and presenting a very thriving appearance. It is situated near the junction of the Yuba and Feather rivers. We encamped opposite it, on the former stream, which was turbid from the gold washing carried on near its sources. The sediment deposited by it is having a marked effect upon the navigation of Feather river.

July 15.—To-day we forded the Yuba river, and after passing through Marysville crossed Feather river by a good wooden bridge. The first stream was about 200, and the second 250 feet in width, and both were bordered by low bluffs. Lieutenant Williamson decided to make a short march to-day, as it was necessary to repair the pack saddles. We accordingly travelled only 5.8 miles, through a level, dusty country, and encamped on Feather river.

July 16.—After travelling over a very dusty, level road bordered by scattered oaks, we encamped at Hamilton. The heat was very oppressive during the day.

July 17.—The road to-day left Feather river, and struck across a dry, dusty plain, to Niel's rancho, on Butte creek. The phenomenon of mirage was very distinctly seen during the early part of the march. We crossed Butte creek and Little Butte creek, about three miles beyond it, and encamped on Chico creek. The country was flat and uninteresting. Near camp was a rancheria of Digger Indians. Their huts were partly excavated in the ground, and roofed over with sticks plastered with mud. When we visited them, at about sunset, the women were sitting on top of their houses, engaged in shelling out grain which they had gleaned from the neighboring fields. The men, nearly naked, were congregated in a large hut, gambling. A few burning sticks in the centre of the group threw a flickering light over the scene. The game was played by four men, who were seated in pairs, on opposite sides of the fire, while the background was filled up with eager spectators. Before each party was a pile of straw. One couple continually twisted up, and threw into the air, wisps of this straw, managing at the same time to conceal in it two pieces of white wood or bone. The other couple anxiously watched their movements, keeping up a monotonous, guttural cry. Whenever they thought they had detected the locality of the sticks, they clapped their hands violently, and their rivals immediately shook open the suspected wisp. If the sticks were there, the successful guessers received them, and began in their turn to throw them up; if not, the first couple continued. The excitement occasioned by this simple game was intense. The perspiration poured in streams down the naked bodies of the players, and their eyes glared in the dim fire-light like those of demons. Their voices were so hoarse as to be hardly articulate, and yet they kept on, without a moment's cessation. They might well be excited, for, as I was informed, they stake everything, even their women and children, on the result of the game.

July 18.—To-day the road lay mostly over dusty plains, destitute of timber. Dry gullies, which in the rainy season are undoubtedly the beds of streams of considerable size, were numerous. We encamped on Deer creek. During the evening quite an excitement was created by the report that a grizzly bear was in the bushes near us; but the monster proved to be only a burnt log. Grizzly bears are sometimes found in this part of the valley.

July 19.—We travelled over a slightly undulating country to Antelope creek, where we encamped. The road crossed several places where there were sudden descents, of about twenty feet, from a plateau to a lower level; and, in distances varying from a few yards to half a mile, corresponding ascents again. These places did not resemble the beds of creeks. There was but little timber near the road during most of the day's march.

July 20.—This morning Lieut. Williamson gave me instructions to cross the Sacramento river, at Red Bluffs, with the instrument cart, and follow the ordinary route to Fort Reading; while he proceeded with the main party to examine the eastern bank. This I did, without any incident worthy of note. The country, which was slightly undulating, and occasionally timbered, differed in no important particulars from the portion of the valley traversed during the last few days by the main party. The following description of Lieut. Williamson's route to the Fort is compiled from his note book.

"After following a road over the hills, for about ten miles, this morning, we discovered that it led to a pinery among the mountains. We, therefore, turned nearly at right angles to our former course, and struck across the hills to Beaver creek, which we found flowing in a small cañon. We then crossed a rocky plain to Liver creek, where we encamped. The hills may be avoided by keeping nearer the bank of the Sacramento.

"*July* 21.—As far as Battle creek we found the road pretty rough. At first it crossed a ridge, which might be avoided, with some rock cutting, by passing around the bluff. The rest of the road to the Fort was good, a few short, steep slopes excepted."

Fort Reading is situated on the northern bank of Cow creek, a little stream which discharges itself into the Sacramento, about a mile and a half below the post. There are dry, elevated plains northwest, and a steep bluff conducting to a higher plateau, east of the Fort. The buildings are mostly made of adobes; but some are of wood. The locality is unhealthy in the summer, on account of the prevalence of fever and ague.

We were courteously received and hospitably entertained by Major F. O. Wyse, 3d artillery, and the other officers stationed at the post. The escort here joined us. It consisted of Lieut. H. G. Gibson, 3d artillery; Lieut. George Crook, 4th infantry, commissary and quartermaster of the expedition; Lieut. J. B. Hood, 2d cavalry; and 100 men, twenty being dragoons, and the remainder artillery and infantry soldiers. Mr. J. Daniels was quartermaster's clerk, and Mr. J. B. Vinton pack master of the escort.

Various causes of delay prevented Lieut. Williamson from continuing the survey until the twenty-eighth of July. Dr. J. F. Hammond, United States army, the surgeon of the Fort, very kindly volunteered to have a series of barometric observations taken at the post, during the continuance of the field work. Lieut. Williamson accordingly left one of the barometers in his charge. His observations proved of very great value in the subsequent computation of altitudes upon the route, as is fully explained in the chapter of this report devoted to that subject.

At the recommendation of Major Reading, Lieut. Williamson employed as guide and scout an old hunter, named Bartee, but usually known as "Old Red." He proved a valuable addition to the party.

July 28.—To-day we left Fort Reading, and began our journey towards the wild region east of the western chain of the Sierra Nevada. Lieut. Crook, with the foot soldiers and the escort train, had left Fort Reading two days before our departure, and encamped at McCumber's Flat, distant 30 miles from the post. Lieut. Williamson, being detained by necessary business, sent forward his train this morning, and started about noon to follow it with his assistants, accompanied for a short distance by Dr. Hammond. We crossed Cow creek at a good ford, where the stream was about 50 feet in width, and then abruptly ascended to a level plateau, elevated about 200 feet above the Fort. We travelled 3.5 miles over this plain to the crossing of Bear creek, a branch about 30 feet in width; and then began a gradual ascent. The road soon entered a thick pine and oak forest, varied by occasional clumps of manzanita bushes. Grizzly bears are often found in this vicinity. Our train had taken a wrong road, and we were compelled, in consequence, to encamp without blankets or cooking utensils, near the small rancho of Mr. Asbury. A rather cold and uncomfortable night was spent by most of us.

July 29.—To-day we started early, and continued our course through a thick pine and fir forest, many trees of which bore long, graceful bunches of black and light colored mosses, with an occasional bough of misletoe. We crossed two small streams, the first, Ash creek, about ten feet, and the second, Mill creek, about twenty feet in width. The water of the latter was very cold, its temperature being 47° Fahrenheit, while that of the air was 79° Fahrenheit.

At both creeks saw mills were in operation. The ascent to-day was much steeper than that of yesterday. We reached Lieutenant Crook's camp at McCumber's Flat, on Battle creek, at about 1 p. m., and our missing train arrived in the course of the afternoon. We had gained an elevation of about 3,600 feet above Fort Reading, and the clear, cool air of the mountains was delightful, when compared with the burning, sickly miasma which we had left behind. The seeds of intermittent fever, however, implanted while passing through the Sacramento valley, remained, and a large majority of the party suffered from this disease before the end of the survey.

McCumber's Flat is a small opening, thickly carpeted with grass, and surrounded by a dense pine and fir forest. Battle creek, after passing through it, disappears among the trees, and with a sullen roar struggles furiously down its rocky bed. A more pleasant camping place could hardly be desired.

July 30.—To-day, we crossed the western chain of the Sierra Nevada, by Noble's Pass. The road, which was very steep, rocky, and bordered by pine timber, followed up a branch of Battle creek. In some places it was difficult to drag even the light instrument cart up the precipitous ridges. After leaving the creek, a very steep rise conducted to a long, gently ascending slope, bare of trees, but covered with a dense growth of manzanita bushes. This slope led to the divide, which was perceptible, although by no means steep. Its elevation above the sea was 6,260 feet. A fine view was obtained from a point near the road. Lassen's Butte with its snowy crest, rose proudly above the surrounding mountains on the south. Far distant to the westward was a long line of peaks, belonging to the Coast Range, while at our feet lay the Sacramento valley. But we turned gladly from its parched plains to scan the rough country towards the east, which we were next to traverse. The course of Pit river, as it came from the dim distance, and wound out of sight among the mountains on the north, could be indistinctly traced; while dark timbered ridges, with occasional plains, filled up the rest of the picture.

The descent from the summit was at first gentle, but soon became precipitous. The Indians had recently set fire to the woods, and the smoke, mingling with the clouds of dust raised by our animals, was stifling. Near the foot of the ridge, we struck a small stream about fifteen feet in width, called Lost creek. After leaving the road and following down this creek about half a mile, we encamped with good grass and water. The forest was more open on the eastern than on the western slope of the mountains, and it was now almost entirely composed of pine. A deer had been killed on the march, and we had our first venison to-night.

July 31.—This morning, at half past five o'clock, the thermometer indicated 40° Fahrenheit, a great change in temperature from the Sacramento valley, where it had generally stood at about 65° Fahrenheit at this hour. We retraced our steps to the emigrant road, and after bidding farewell to Dr. Hammond, who returned to Fort Reading, followed it through an open and nearly level valley to the next stream, which was about twenty feet in width and called Hat creek. Both this and Lost creek are branches of Canoe creek. After crossing the stream, we left the road, and followed down the valley, without any trail. Light smoke, rising from the summits of the neighboring hills, informed us that our advance was discovered by the watchful savages, although we had seen none of them as yet. The route was good at first, although somewhat obstructed by manzanita bushes, which delayed the little cart. As we advanced, however, we had to pass several rocky ledges. The creek at length divided into two channels, enclosing a small island. This we crossed, and following the western side of the stream soon came to where it cañoned through a ledge, nearly vertical on one side, and gently sloping on

LASSENS BUTTE FROM VICINITY OF CAMP 18.

the other. Crossing this with difficulty, we again struck the stream, and re-crossed it over another island to the eastern bank. The soil became light, like ashes, and our animals sank over the fetlock at every step. The hills soon closed in upon the creek, and we encamped with good water and grass. Lieutenant Williamson sent the guide forward to examine the route for a short distance in advance. On his return he reported it very rocky and destitute of grass. A barometer was broken to-day by the jolting of the cart.

August 1.—This morning we entered a rocky pedregal of scoriaceous trap, which taxed our patience to the utmost. It was difficult to advance with the mules, but far more so with the cart. We were forced to make long halts before a way could be found, and then to almost carry the vehicle along by hand. Once it overturned, and the shock rendered the chronometers useless for the determination of longitude for the rest of the survey. Instead of improving, the road became worse ; and, at length, we turned towards the timbered hills which bounded it on the east, and travelled among them for a short distance with more ease. Before long, however, we found ourselves on the summit of a precipice of trap rock, at least one hundred feet in height, which conducted to the lava field again. The cart was let down by hand ; and we toiled on, near the ledge which continued to bound the valley, until we suddenly came to a beautiful, grassy spot, intersected by numerous brooks. Here we encamped, after a most laborious march, having advanced only about 4.5 miles on our journey. A branch of the stream gushed from the face of the precipice near our camp, and, after falling about twenty or thirty feet vertically, united with another which flowed at the base of the ledge. The following note upon these springs I extract from Lieut. Williamson's journal.

"A portion of the water of the brooks gushed from a spring in the mountain side. It is highly probable that the main part comes from a cañon in the hills to the northeast, but of this we have no positive proof. About a quarter of a mile below camp, all the streams, after uniting in one, disappear entirely, flowing into chasms in the scoriaceous trap. Whether it re-appears, or not, is not known. The united stream is about twenty feet wide, and belly-deep to the mules."

While examining the vicinity of camp with one of the party, I came suddenly upon an Indian, evidently reconnoitring. He was nearly naked, and armed with bow and arrows. With considerable difficulty we prevailed upon him to enter camp. After throwing him into paroxysms of delight by the sight of his ugly countenance in a small mirror, we sent him on his way rejoicing, appareled in a white shirt, and gnawing a huge piece of salt pork.

August 2.—This morning our visitor returned with about twenty of his nearly naked friends, all of whom gave us to understand that they were enduring agonies of hunger. After giving them food, we left the miserable wretches collecting the offal which remained near the cook's fire. The Pit river Indians are very treacherous and bloody in their dispositions and disgusting in their habits. They are armed with bows and arrows, which they make with great skill. The bows are sticks of soft wood, about three feet in length, backed with deer sinew. The bow string also is of sinew. The arrows are made in three parts. The head is generally of obsidian, which abounds in portions of the valley. It is carefully shaped into the usual barbed form, and lashed by deer sinew to one end of a small stick of hard wood about ten inches long. The other end of the stick is inserted into the extremity of a reed and also lashed with sinew. The reed is tipped with feathers, attached by the same kind of fastening. This weapon inflicts a dangerous injury ; as the blood immediately softens the sinew, and, on attempting to extract the arrow, the reed separates from the hard wood stick, and that from the arrow head, which thus remains at the bottom of the wound. It is said that these savages sometimes poison their arrows by exposing a piece of liver to the repeated bites of a rattlesnake, and, after burying it for a short time, smearing the point with the half decomposed mass.

For about five miles to-day, the pedregal continued to be as rough as it was yesterday, and we could advance only with great difficulty. At length, however, we entered a pine forest, and soon after struck an Indian trail, which rendered travelling very much easier. It conducted us to the bank of Canoe creek, which we found flowing through a fine, grassy meadow. Again entering the forest, and continuing our course for a few miles further, we discovered a second fine valley, carpeted with grass and clover. Near the northern side of it flowed a tributary of Canoe creek, at least five times the size of the main stream. We encamped near the junction of these creeks, with an abundant supply of wood, water, and grass.

August 3.—Some little doubt had arisen whether the large tributary on which we were encamped was not Pit river, and Lieut. Williamson determined to leave the main party in camp to-day, and go himself, with the dragoons, to explore. He returned about noon, having followed down Canoe creek to where it discharged into Pit river. It flowed between precipitous banks, with many cascades and rapids. At its mouth it was eighty or ninety feet in width. It received no important tributary below our camp, except a branch from Lake Freaner, which flowed into it over a trap dike about fifteen feet in height.

In the afternoon, Lieut. Williamson sent one of the party to follow up the large tributary of Canoe creek. On his return, the man reported that, about two miles above camp, the water gushed furiously from some fifteen crevices in the rocks, thus forming brooks, which united and formed the stream. He walked entirely round its sources, and returned dry shod on the bank opposite the one on which he started.

August 4.—This morning the party separated. Lieut. Williamson started with the dragoons, to explore the lower cañon of Pit river, giving me directions to advance, with the main party, to a point on the river near the mouth of Canoe creek. After leaving camp, we soon found ourselves among thick pine timber and underbrush, which greatly delayed the cart, and rendered it necessary to carry most of the instruments by hand. In some places the trail followed along the side of steep hills, and several men were constantly employed in preventing the vehicle from overturning. At length, in attempting to run over a manzanita bush in one of these places, it turned completely over; so that the mule lay on his back, struggling violently in the thick underbrush. After crossing one smaller branch, we finally succeeded in reaching a fine, grassy meadow on the bank of Pit river, about two miles above the mouth of Canoe creek. Here we encamped.

Lieut. P. H. Sheridan, 4th infantry, overtook the party to-day, with orders to relieve Lieut. Hood, who was instructed to return to the eastern States and join his regiment without delay.

The following extract from Lieut. Williamson's journal shows the result of his exploration to-day.

"We followed nearly the same trail as yesterday for about five miles, and then took a trail running east, which led to Stoneman's ridge. I went to the highest point, and obtained bearings to Mount Shasta, Lassen's Butte, and other peaks. I then ordered Bartee to follow the ridge towards the south until he found a low depression, and then to endeavor to find a good route from it to the river near Canoe creek. This he did. I next went to the entrance of the cañon. We found it impossible to go through it on foot, on account of the precipitous

MOUTH OF FALL RIVER NEAR CAMP 20

sides, which came down abruptly into the water. The north side was black rock, inclined about 45°. The south side was infusorial earth, inclined from the horizon 60° or more. Not being able to follow the summit of the precipice, I returned down the river to camp, near the mouth of Canoe creek."

August 5.—Lieut. Hood started this morning with a small escort, on his return to Fort Reading, much to the regret of the whole party. Lieut. Williamson, with the dragoons, went to follow the river bluff, directing me to take the train through the pass found yesterday by Bartee. The trail led over several small, rocky hills, heavily timbered with pine. After passing along the western foot of Stoneman's ridge for nearly two miles, we crossed it at a low point, and followed down a gentle slope to the river. The soil was mostly light volcanic ashes, but the trail was occasionally rocky. After riding a short distance near the stream, which was deep and sluggish, we passed the spot where Fall river, after breaking in cascades and rapids over a bluff about 30 feet in height, plunges into Pit river. About half a mile further on, we found Lieut. Williamson encamped near a small brook, a tributary of Pit river. Its water was much colder than that of the river, which had a marshy taste. Wood and grass abounded in the vicinity. Lieut. Williamson had succeeded in following the river bluff. Where the stream emerged from the mountains, and for about a mile above, he found the banks about 150 feet in height, and very precipitous. The cañon was so narrow at its mouth that he could not enter it on foot.

After reaching camp, I re-filled two barometers which had been broken. During the night a mule was stolen by the Indians.

August 6.—This morning, to avoid a bend, Lieut. Williamson left the river and struck across towards the upper cañon. At first, the trail passed through pine timber, but it soon entered a nearly level prairie, in some places rocky, and in others dusty. There were numerous gopher holes in it, which were dug so near the surface that our animals often broke through into them. After reaching the river again, the trail became quite rocky, and we were compelled to cross numerous sloughs, as well as the main stream twice. At length we encamped near the entrance of the upper cañon. A fire soon broke out among the dry grass and bushes, which was extinguished, with difficulty, by the united exertions of the whole command. Another barometer was broken and re-filled to-day. At night the Indians stole a mule, but it was traced, found tied in one of their rancherias, and recovered by our packers.

August 7.—To-day Lieut. Williamson followed along the northern edge of the cañon, directing me to take the route among the hills with the main party. On leaving camp, we crossed the river at a shallow but very rocky ford, and immediately climbed the river bluff, which was more than 100 feet in height, and so steep that it required twenty men to pull up the instrument cart. The chief obstacle to travel to-day was a vast amount of trap rock, which covered the ground in many places. In others, the heat of the sun had baked the earth, and made it crack in a manner which rendered travelling laborious. We saw but little timber on the road; and the hills were generally low, and not very steep. In passing over the rocks, one spring and the axle of the cart were broken. I succeeded in transporting it to camp, but there found it to be irreparably injured. The body was abandoned, but the axle was mended sufficiently to hold the wheels together, in order to continue the use of the odometer.

Several Indians came into camp in the afternoon, and I saw one of them kindle a fire by rubbing two pieces of wood together. A block of cedar, about six inches square and one inch thick, perforated with a small hole, formed the lower piece. One Indian held this firmly on a horizontal rock, after having placed a little tinder under the hole. A second took a round stick, apparently of elder, about six inches long and a quarter of an inch in diameter, and, inserting one end in the hole, rolled it very rapidly between the palms of his hands. In a few moments sparks of fire fell down upon the tinder and ignited it. These savages have a fondness for smoking tobacco, which I have never seen equalled. They inhale the smoke, and, after retaining it as long as possible, force it through their nostrils in an ecstasy of pleasure. They mark their faces with black, as a sign of mourning, and with red, for ornament; but I have never seen both colors used at once. Many of them perforate the nose, and insert a straight piece of bone about an inch and a half in length.

Our camp to-night was on the river bank near the eastern entrance of the cañon, where we found an abundant supply of excellent grass. I extract the following remarks upon the cañon, from Lieut. Williamson's note book.

"The river itself was shallow throughout the whole cañon, and always had a space between the water and bluff wide enough for a wagon road. No falls were noticed, and I saw nearly the whole of the cañon. The bluffs were from 100 to 700 or 800 feet in height, and of basaltic trap. The slope was generally of the debris from the rock, but often vertical columns of the basalt were seen. In one place I noticed veins of a red material, the color of cinnabar."

August 8.—After fording the river, which was about forty feet in width, we continued our course through a level, grassy valley, bare of trees. Several grouse, duck and curlew were shot on the march. We passed many pits about six feet deep and lightly covered with twigs and grass. The river derives its name from these pits, which are dug by the Indians to entrap game. On this account, Lieut. Williamson always spelled the name with a single t, although on most maps it is written with two. We encamped on the bank of the river, which here flowed between bluffs, from twenty to thirty feet in height, bordered by bushes. Large quantities of obsidian were found in the vicinity. The river was about thirty feet in width.

Lieut. Williamson made the following note on the day's march.

"To-day we had a level, good, but tedious ride. Opposite the middle of the valley, to the west, is an opening in the hills of considerable breadth. This looks as if the hills south of the opening were the northern slope of the range north of Fall River valley. Opposite the head of the valley the hills appear again. Near our evening camp, I went on a ridge and found hills to the westward, not at all formidable in appearance, but which would still require work to make them passable for a railroad."

August 9.—Lieut. Williamson directed me to remain in camp with the main party and observe for latitude, &c., to-day, while he, with Lieut. Sheridan and the dragoons, explored the road in advance. The heat was oppressive, but the bushes near the river bank afforded a thick and pleasant shade.

The following extract from Lieutenant Williamson's journal shows the result of his examination.

"We followed the Lassen trail for 2.5 miles, to where it crossed the river at the mouth of a small, dry branch. We here left the road to take the old Oregon trail, which was very distinct. It led north up the branch to the divide, and thence on, in the same direction, until we struck a spring branch in pine timber, about seven miles from the river. I went on top of a partially bald hill and had a view of the country. The hills followed to the north, probably inclining to the east. The rest of the country east of the meridian line appeared to be rolling, or slightly hilly, and covered with open pine timber. I was sorry I could not ascertain if the spring branch had a continuous bed to Pit river. Its course near its source was westerly;

but there is no reason to suppose that it did not bend toward the south, and discharge into Pit river about ten miles below our camp. I feel pretty sure either that it sinks, (that is, has no continuous bed,) or that it goes to Pit river. In the latter case, the railroad should follow it up."

August 10.—To-day, we travelled over the route examined by Lieutenant Williamson yesterday, and encamped at what he termed the "spring branch." It was a little creek about ten feet in width, which flowed through a small opening bordered by pine timber. The stream was so choked up with bushes, that, in many places, it could only be reached by cutting them away. Towards the lower part of the opening, the brook spread out into a little swamp. Frogs of a very peculiar species were found in the creek and swamp, in great numbers. An antelope was shot near camp.

August 11.—The party was aroused at three o'clock this morning, by Lieutenant Williamson's order; as it was very uncertain how far we might be obliged to travel before reaching water. The head of the antelope killed yesterday, had been baked by allowing it to remain all night buried among hot stones, and it furnished an excellent breakfast. We followed the wagon road through an open pine forest for about six miles, and then, finding that it inclined too much to the west, left it, and endeavored to keep, by compass, a course N. 20° W. After travelling several miles on nearly level ground through the forest, we emerged from it, and found ourselves on a rocky plain covered with sage bushes. This we crossed in about six miles, and, on reaching the summit of a line of low sandstone hills capped with trap, saw below us Wright lake. It was a fine sheet of water, about eleven miles long and four miles wide, bordered by tule. The banks were so miry that we were compelled to travel more than a mile before reaching a place where the animals could drink. We encamped in the edge of the tule, near some green willow bushes which supplied us with our only fuel, as even sage bushes had disappeared after crossing the hills.

August 12.—Our course, at first, lay along the southwestern shore of the lake, where the hills occasionally terminated very abruptly at the water's edge. The horn of a mountain sheep, weighing several pounds, was found near the trail. After crossing the low hills which border the lake, we travelled through a gently undulating region, dotted with sage bushes, for about seven miles. We then found ourselves on the edge of an abrupt descent of 200 feet, which conducted to the shores of Rhett lake. This lake was about fourteen miles long and eight miles broad. It was bordered by a wide belt of tule, the home of vast numbers of water-fowl, which rose in clouds at our approach.

On the bluff the trail joined an emigrant road, which followed down a narrow ravine to the level of the lake. This ravine was once the scene of a bloody massacre. A party of Indians lay in ambush, until an emigrant train reached the middle of the descent, and then attacked and killed nearly the whole party. Rhett lake is a secure retreat, where the savages can escape among the tule, in their light canoes, and defy a greatly superior force.

The line of hills which borders the lake on the northeastern side, is separated from the tule by a narrow strip of land, elevated but little above the water. This was covered with grass, the rich green of which presented a refreshing contrast to the sickly blue of the sage plain over which we had been travelling. The clouds of dust ceased, and we journeyed on through a much more pleasing region. After riding a few miles from the bluff, we left the road, and encamped on Lost river near where it discharges itself into the lake by several mouths. It was a deep, unfordable stream, flowing with a very sluggish current. The banks were abrupt like the sides of a canal. A few sage bushes and "bois des vaches" supplied the only fuel.

We found, encamped near the stream, a party of men that had come from Yreka to meet and escort an expected emigrant train.

August 13.—Lieut. Williamson determined to pass around the western side of Lower Klamath lake, with Lieut. Sheridan and the dragoon detachment, to examine the route, and to ascertain whether Klamath river flowed through the lake or not. He gave me instructions to proceed with the main party to Upper Klamath lake, and, after selecting a good camping place near its southern extremity, to await his arrival. Nine of the foot soldiers were sick, and they accompanied Lieut. Williamson, to be sent, in charge of a non-commissioned officer, through the pass south of Mount Pitt to Fort Lane.

My party left camp first. We followed up the eastern bank of Lost river, through a dusty sage plain almost destitute of grass, to the Natural Bridge. The river was here about eighty feet wide and very deep; but it was spanned by two natural bridges of conglomerate sandstone from ten to fifteen feet in width, parallel to each other, and not more than two rods apart. The water flowed over both of them. The top of the most northern one inclined down stream, but it was only covered to a depth varying from six inches to two feet. The other was nearly horizontal, but the water, being unusually high, was too deep for fording. There are probably hollows under both arches, through which the river flows. Emigrants cross here with their loaded wagons. There is no ford for a considerable distance above, and none below. We passed over without difficulty, and followed a well marked Indian trail towards the north, through a level valley dotted with sage bushes and a few clumps of bunch grass. The river, which was full of short bends, was often sunk as much as thirty feet below the plain. There was apparently a good ford 4.5 miles above the Natural Bridge. The valley was about three miles wide, and bordered by high hills; those on the east being well timbered with pine, and those on the west nearly bare. The bunch grass became more abundant as we advanced, and the sage bushes fewer in number. After travelling twelve miles from the Natural Bridge, we reached a place where the river issued through a cañon from the hills to the eastward; and, although the valley continued towards the north, it was entirely destitute of water. As the distance to Klamath lake was unknown, we left the trail and encamped near the mouth of the cañon. The general surface of the plain was here about forty feet above the water; but it was connected by a bench, about 200 yards in width, of not more than half that height. This formed a good camping ground; being covered with fine bunch grass, while bushes and small trees for fuel were found in abundance near the edge of the stream.

August 14.—This morning some excitement was created in camp by the discovery of a huge rattlesnake coiled up under a blanket. The reptile was killed; but, as we all slept without tents on the ground, unpleasant ideas were suggested by the incident. Our course lay towards the north, through a narrow valley thinly covered with sage bushes and clumps of bunch grass. It was bordered by timbered hills which gradually closed in upon the trail. We crossed several dry beds of streams, and also the bottom of what, in the rainy season, was undoubtedly a small lake. It was now dry, and covered with a white efflorescence. After travelling 9.5 miles we reached a low line of hills, which formed the northern boundary of the valley. Klamath river forced its way through the ridge by a narrow cañon, and, after flowing along the western side of the valley for a short distance and spreading out into a small lake, disappeared among the hills towards the west. On reaching the summit of the very low divide, composed of trap rock, we saw outspread before us Upper Klamath lake. It was a fine sheet of water, thirty miles long and twelve miles wide, bordered by timbered ridges with an occasional narrow belt of tule. Light clouds of smoke rising from signal fires upon several of the hills satisfied us that watchful

UPPER KLAMATH LAKE FROM CAMP 28

eyes were measuring our advance. We had struck a small arm of the lake, from which Klamath river issued. Following along the eastern side, we crossed a grassy meadow, and encamped at the extremity of a hilly promontory which projected into the lake. Excellent bunch grass, with bushes and small trees for fuel, abounded in the vicinity. East of the promontory, a wide field of tule prevented approach to the water; but the western shore was rocky and bold. Snakes of various kinds were very plentiful. Several large rattlesnakes were killed before we had been in camp an hour; and I counted nearly a dozen cast off skins lying within a rod of each other. Two squaws came into camp in the afternoon, with a few fish which they had caught in the lake. We gave them some presents, and they paddled rapidly away in their canoe to spread the news. The water taken from the lake had a dark color and a disagreeable taste, occasioned apparently by decayed tule.

August 15.—We remained in camp to-day, waiting for Lieut. Williamson. Several good observations were obtained for latitude and altitude.

About midnight a sudden alarm aroused camp. The cook's fire had spread, by some dead roots, to the dry grass and bushes; and a general conflagration was prevented only by the most vigorous exertions. It was at first supposed that the Indians had kindled the fire, to engage our attention while they stampeded the mules, and this idea did not tend to lessen the excitement and confusion of the scene.

August 16.—To-day was spent in taking astronomical and barometric observations, while waiting for Lieut. Williamson. A thick haze which covered the lake, entirely concealed the opposite shore. The taste of the water was so disagreeable that several vain attempts were made to discover a spring in the vicinity.

August 17.—Lieut. Williamson with his escort came into camp at noon, having made a satisfactory examination of Lower Klamath lake. A description of his route will be found in Chapter IV. Three broken down mules of the escort train were shot to-day, and every preparation was made for an early start to-morrow.

August 18.—The ridges on the eastern side of the lake, which were composed of vesicular trap, appeared to run parallel to each other in a northeast and southeast direction, and to terminate abruptly at the water's edge. A well marked Indian trail followed along the shore; but members of the party who had explored it for a short distance reported it very rocky, and impassable for "the little cart," as the odometer wheels still continued to be termed. Lieut. Williamson had observed several Indian trails diverging to the right on his last day's march; and he therefore determined to follow a southeast course, hoping to discover some good pass by which he could cross the ridges, and thus avoid the rocks and bends of the shore. After travelling about three miles in this direction through a wooded country, he thought it best to cross abruptly a steep and rocky ridge to the east. We thus reached a narrow valley, lying between two steep ranges of hills, and filled with open pine timber. There was a large Indian trail in it, which conducted us to the lake. A precipitous and rocky ridge rose abruptly from the water, leaving barely sufficient room to pass along the bank. After travelling a short distance, we reached a point where several springs gushed from the hill side, and disappeared among thick bushes surrounded by luxuriant grass. The water was clear and pure, and Lieut. Williamson at once encamped. Elder and service berries were found in abundance. A thick haze prevented astronomical observations, and concealed the western shore of the lake. Snakes, as usual in this region, were very numerous, and one of them glided suddenly among our dishes, as we were sitting down on the ground to eat.

August 19.—This morning the trail, for three or four miles, wound along the rocky side of the ridge which bordered the lake, and was, in consequence, very rough. Huge rocks, piled near the water's edge, prevented the passage of "the little cart" by that route. The hill side was sparsely covered with scattered pines, but near the lake shore springs were numerous, and the growth of bushes was often dense. Bartee, the guide, shot three bald eagles with his rifle, as we passed along the base of the crags upon which they were fearlessly resting.

In riding under the projecting limb of a tree, Mr. Daniels was knocked from his mule and quite severely injured. The country had recently been burnt over, and the want of grass compelled Lieut. Williamson unwillingly to continue the march. The trail soon diverged from the lake shore, and after passing over a dry plain entered an open pine forest. In a short time we found ourselves on the banks of Klamath river, which was flowing through a fine, grassy bottom, marked by a few clumps of willow bushes. Here we encamped. The river was about 150 feet in width, and apparently quite deep. There was a ford, however, a short distance below. Every requisite for a good camp ground was found in abundance in the vicinity.

August 20.—Mr. Daniels was much better this morning and able to ride his mule.

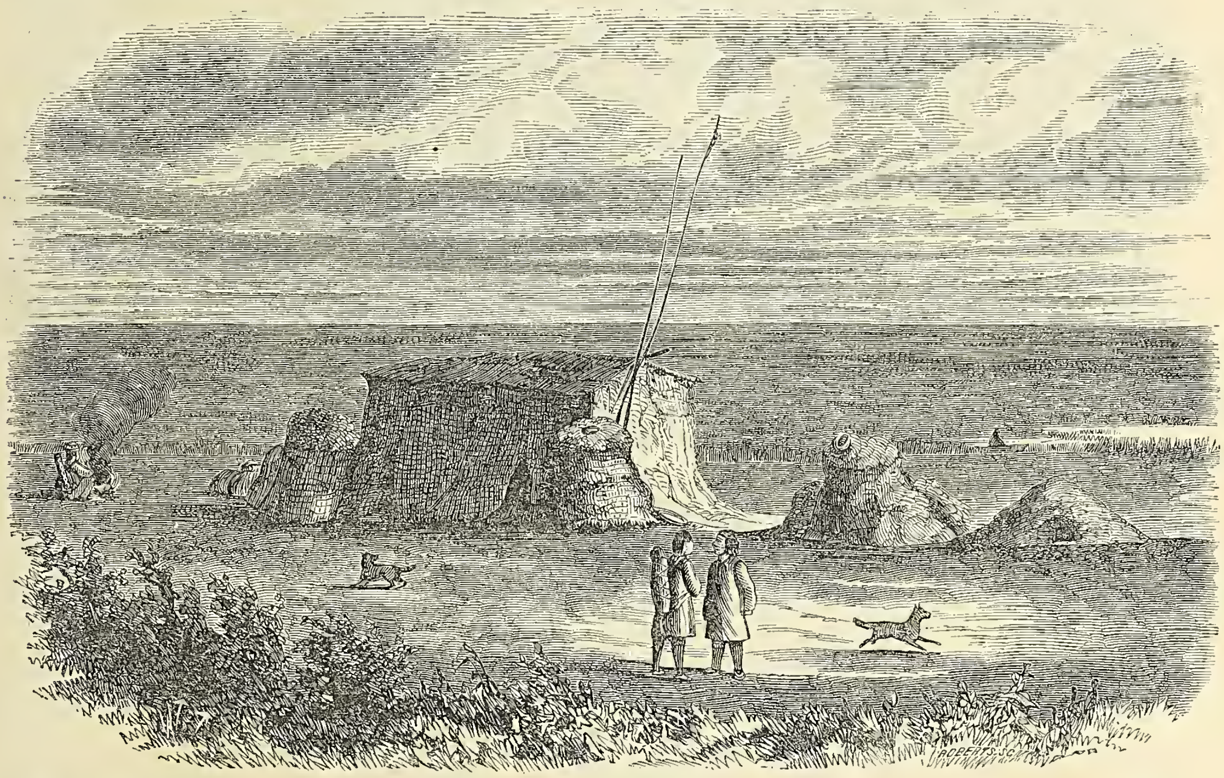
As had been usual of late, a dense fog obscured the view for two or three hours after starting. Our course lay up the eastern side of the beautiful valley of Klamath river. The bottom was at first open, covered with green grass, and bordered by low timbered hills. We passed several cliffs of basaltic breccia, from twenty to fifty feet in height, and occasionally ornamented with rude, Indian paintings. The current of the stream was not very rapid, and there appeared to be several fords. The trail crossed one large and fine tributary which flowed swiftly over a rocky bed. After travelling twelve miles from camp, we reached the mouth of a cañon from which the river emerged. The sides were of basaltic rock and pumice-stone, and very steep. Lieut. Williamson estimated their height at 1,000 feet at the highest points. We followed the trail over the ridge on the eastern side of the river, and several times looked down into the cañon. Its course appeared to be straight in the main, but small bends were numerous. The ridge was heavily timbered with pine. The forest was on fire, and an occasional heavy crash reverberating for miles, warned us to beware of falling trees. The cañon was about four miles in length. A short distance beyond its northern entrance, we emerged from the forest and entered a lovely meadow, covered with clover and fine green grass. The ground was miry near the river, which was deep and sluggish, and we encamped at the edge of the timber. The meadow appeared to be an arm of Klamath marsh, and was evidently flooded at seasons of high water.

August 21.—This morning at daybreak, the fog was so dense that we could not see fifty yards in advance, but the sun soon caused it to melt away. The trail led us over a thickly timbered ridge which projected into the meadow. The soil was light pumice-stone dust, and fallen trees rendered travelling somewhat difficult. At the northeastern base of the ridge we reached the shore of Klamath marsh. This was a strip of half submerged land, about twelve miles long and seven miles broad. It was covered by clumps of tule and other aquatic plants separated by small sheets of water. Thousands of ducks, plover, and other water birds, made it their home. They were so tame that they would hardly fly at the report of a gun, but it was useless to shoot them, as the deep mud rendered it impossible to secure them afterwards. We surprised two Indians on the shore, and endeavored to make them understand that we were friendly; but they evidently distrusted our professions, and escaped as soon as possible.

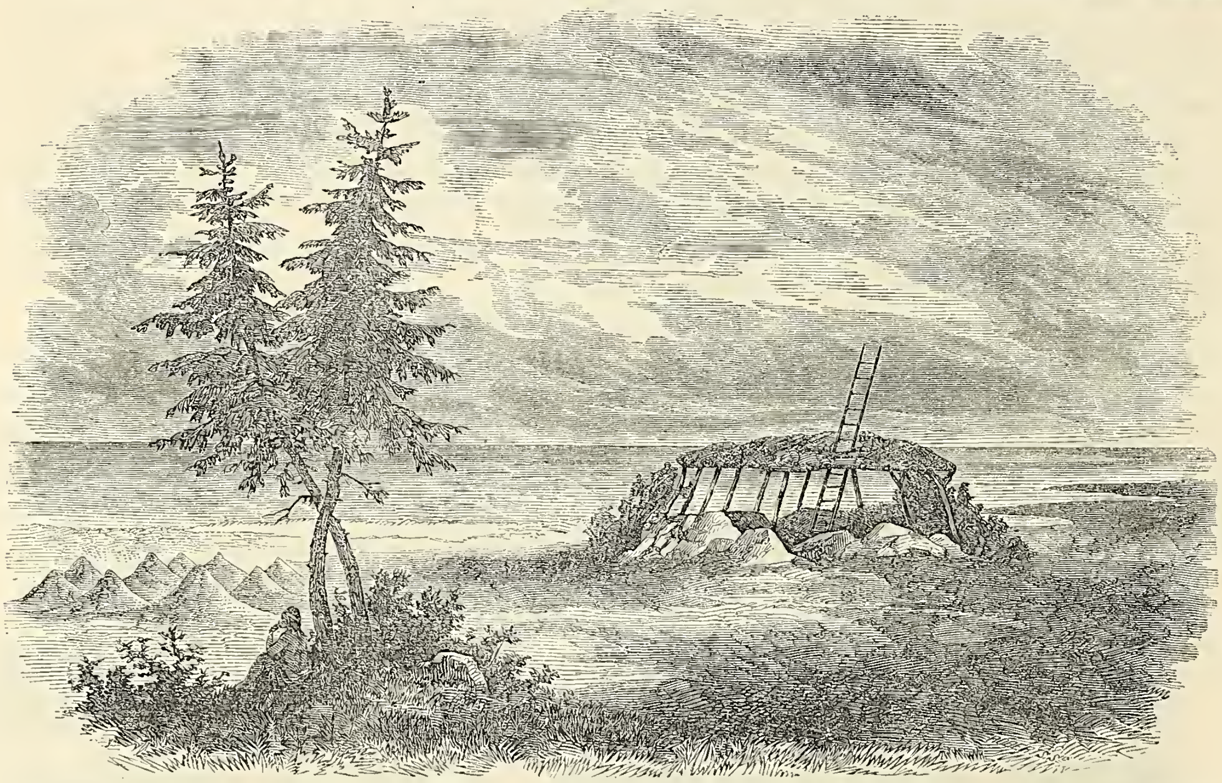
Lieut. Williamson decided to follow the eastern shore of the marsh. We soon reached a collection of Indian huts built near the edge of the water. Our two friends had evidently been there before us, for the rancheria had been very recently deserted. Large quantities of food,

MOUNT PITT, KLAMATH RIVER & UPPER KLAMATH LAKE, FROM CAMP 30.

consisting mostly of seeds of water plants and dried fish, several canoes made of hollowed logs, many baskets formed of reeds curiously woven together, and divers other valuables, were scattered around in wild confusion. The fires were burning in front of the huts, of which there were three distinct kinds. The summer lodges had vertical walls supporting flat roofs. They were composed of a framework of sticks, covered with a matting of woven tule. The winter huts were shaped like bee-hives, and made of sticks plastered with mud. We noticed only one of the third kind, which was apparently used for a council house. A hole, about four feet deep and ten feet square, had been excavated, and the earth heaped up around the sides. Large sticks planted in this mud wall supported a roof made of cross poles covered with earth. The entrance was by a flight of mud steps that conducted to the roof, from which a rude ladder led through a hole to the floor below. Each of these structures is represented in the accompanying wood cuts, together with some conical graves described below.



The dusky inmates of the rancheria had betaken themselves to their canoes, and retreated among the tule to what they considered a safe distance. They now stood, yelling like fiends and shaking their weapons at us in impotent rage. Strict orders had been given that none of their property should be injured; and we passed rapidly along the shore of the marsh, surprising a new rancheria at almost every turn. The number of these savages is very large; and nature has given them so secure a retreat, that only a greatly superior force provided with boats, could attack them to advantage. They paddled through openings among the tule, and thus accompanied us, uttering hideous howls when the labor of working their passage did not keep them quiet. We passed on the way one of their burial places. The bodies had been doubled up, and placed in a sitting posture in holes. The earth, when replaced, formed conical mounds over the heads. Near the other graves, but on a slight eminence, stood a new wall-tent, such as is used in our service. It was regularly pitched and the front tied up. On looking inside, we saw a large mound about two feet in height, the base of which covered the whole space enclosed by the walls. A new blanket was spread over the top. Here, doubtless, was the grave of some great chief; but how the savages became possessed of the tent remains a mystery. Along the whole chain of Klamath waters we noticed, in many places, large



stones laid one upon the other, forming piles from two to six feet in height. Some of the party thought that these were marks to show the trail when the ground was covered with snow; but the vast numbers of them sometimes found within a few feet of each other, and their frequent proximity to trees which could easily have been blazed, rendered this hypothesis rather improbable.

After travelling about sixteen miles from the place where we first struck the marsh, we reached a part where it was not more than a mile wide. Seeing several mounted Indians hastily driving a number of horses across, we attempted to follow, but found the ground too miry for pack animals. As it was almost sundown, Lieut. Williamson decided to encamp near some trees on the shore. The only water was that found stagnant on the surface of the marsh. The grass was good, but it had been eaten quite short by the Indian horses. As we had been careful to do the savages no injury, they began to doubt our hostile character, and sent in a few squaws as an experiment. As they were dismissed with presents, large numbers of men entered camp, and made great professions of friendship. We distrusted them, however, and kept a close watch upon the animals during the night.

August 22.—This morning many Indians came into camp. They were all well dressed in blankets and buckskin, and were armed with bows and arrows and a few fire-arms. Their intercourse with the Oregon settlements had taught many of them to speak the Chinook, or Jargon language, and one had a slight knowledge of English. They owned many horses, some of which were valuable animals. No offer would tempt them to sell any of the latter, although they were eager to dispose of a few miserable hacks too worthless to purchase.

The idea, which prevails in Oregon, that all Indian horses are of an inferior breed, doubtless arises from the fact that such only are brought to the settlements for sale. Near Klamath marsh we saw a few animals of a piebald color, whose graceful forms and clear, piercing eyes showed very superior blood. It may be that their genealogy extends back to the Barbary steeds introduced by the Spaniards into Mexico, and supposed to be the progenitors of the wild horses of the prairies.

Near the spot where we were encamped, the marsh was not more than a mile in width; but it extended an indefinite distance towards the east, and the Indians informed us that the journey round it was very long, and without water. They volunteered to show us a natural causeway to the other side; but it proved too miry for pack mules. Our new friends all declared that the best trail to the Des Chutes valley led round the western side of the marsh; and Lieut. Williamson finally decided to turn back and try that route. We followed almost the same trail as yesterday, and encamped near the southern point of the marsh.

A large number of Indians accompanied us, one of whom Lieut. Crook had formerly seen in Yreka. These savages were intelligent, and in every way superior to those of Pit river. By questioning them in Chinook, Lieut. Williamson, assisted by Lieut. Crook, obtained the following partial vocabulary of their language.

VOCABULARY OF THE KLAMATH LANGUAGE.

English.	Klamath.	English.	Klamath.
Acorn	stup-ultz	Feet	patz
Alive, life	muk-lux	Fingers	spal-o-wish
Arm	shish-am-e-ny	Fire	lo-lux
Arrow	ky-ish	Fire-wood	an-co
Autumn	schoh	Friend	tit-si
Axe, hatchet	schlak-ote	Girl	na-watz'-ka
Bad	ko-its	Good	titch-i
Bark	ntsh-atz	Grass	ksoon
Beard	smokl-smankl	Great, big	ah-tay-ne
Bird	yoke-ul	Green	ma-ax
Black	wush-push-li	Hair	lak
Blood	tcha-co li	Hand	nap
Blue	ketch-ketch-o-li	Hat	tsho-nash
Bone	ka-ko	Head	nos
Bow	ty-ish	Heart	sty-mas
Boy	kitch'-ca-ne	Hill	kin-ka-ny
Bread	sap-pe-lill	House	lat-sus
Canoe	wountz	Indian shoes	wuk-schu
Chief	lak-i	Infant	mu-kak
Cold	kah-ti-kah	Iron	wah-ti-ti
Cow	mus-a-mus	Kettle	po-ko
Day	uy-i-ta	Knife	wah-ti
Dead, death	klah'-ka	Leaf	ta-pac
Deer	lil-hunx	Leg	tsoak
Ear	mo-mo-watz	Lightning	lu-i-pols
Earth, land	kshun	Man	hish-watz
Evening	lit-kah	Money	dollar
Eye	lolpe	Moon	sa-pas
Father	ptic-up	Morning	po-sant

Vocabulary of the Klamath language—Continued.

English.	Klamath.	English.	Klamath.
Mother	kis-up	Star	ktsol
Mountain	whal-lacc	Stick	kose
Mouth	shum	Stone, rock	kty
Nails	staks	Squirrel	tsutz-tsac
Neck	ne-is	Summer	pa-ta
Night	pshin	Sun	wy-tah
Nose	pshish	Thou	naw
Old man	chick-ah	Thunder	le-mais
Pipe, calumet	pa-ux-pox	Tobacco	kotz-kul
Pistol	an-co	Toes	spal-o-wish
Rain	klote-sus	Tongue	pa-watz
Red	tak-tak-o-li	Tooth	tote
River	ko-kah	Town, village	to-me lat-sus
Saddle	kok-lus	Tree	wah-ko
Salmon, fish	tchi-altz	Warm	walks
Sea	an-pu-al-la	Water	am-bo
Shirt	tsho-lish	White	pol-pol-i
Sky, heaven	pit-eye	Wind	scla-wa-is
Small, little	wik-a-ne	Winter	lol-dum
Snake	kah-is′	Woman	schnah-watz
Snow	cha-ish	Yellow	kak-kak-o-li
Spring	schoh		

August 23.—This morning we started with a large retinue of savages. The trail led through open pine timber for about a mile, and then entered a fine, grassy meadow which extended towards the north to Klamath marsh. About three miles from camp we reached Klamath river, here a sluggish stream divided into two branches by a narrow island. The water rose to the backs of the smaller mules, and Lieut. Williamson employed the Indians to transport the packs across in canoes. This the squaws, who perform all the work, did by paddling round the northern end of the island. After paying their husbands with red blankets, beads, and vermilion, which they appear to highly prize, we continued our course through the grassy meadow until we reached a clear, ice-cold stream flowing through open timber. Here we encamped. The brook rose in springs about a mile from where we struck it, according to the report of the guide, who shot three antelopes near its source in the afternoon.

August 24.—This morning the Indians left us. We followed a large but crooked trail through a thick pine forest. Fallen timber of small size somewhat obstructed the way, but there were no hills. The soil was light volcanic ashes, in which the animals sank nearly to the knee if they left the beaten trail. The dust was stifling. About 13.5 miles from camp, we reached the dry bed of a stream which was fringed with willows but entirely destitute of water. About five miles further on we came to a water hole, and, as it was nearly sundown, Lieut. Williamson decided to encamp, although there was no grass. The water was good, but the hole filled slowly, and the supply was scanty. Two more holes were dug a short distance further up the ravine, but most of the animals passed the night suffering from both hunger and thirst.

August 25.—To-day we continued our march through a country similar, in all respects, to that traversed yesterday, except that it became slightly undulating. The dense clouds of dust raised by our animals from the ashy soil were suffocating. After riding about 18.7 miles from camp, we suddenly emerged from the dense forest, and found ourselves in the beautiful grassy bottom of the Des Chutes river. It was here a fine stream about thirty feet in width, and fordable although the current was rapid and the bed stony. We immediately encamped. At the water hole, this morning, two trails diverged. We followed the more easterly one; but two of the party by mistake took the other, which was equally large. It conducted them to a point further up stream, and was doubtless a trail leading to the wagon road across the Cascade Range, which Lieut. Williamson subsequently examined. The supply of grass to-night was abundant, and of fine quality; the water was cold, and the position in every respect excellent for a camp. Large numbers of delicious trout, marked with red longitudinal stripes, were caught with great ease in the river.

August 26.—This morning we left the bank of the stream, and followed the trail for about seven miles through a pine forest. It passed over several low hills, upon which the soil was light and ashy. As it wound considerably towards the east, Lieut. Williamson was afraid that it might leave the river entirely, and lead to the Wallah-Wallah country. He therefore abandoned it, and turned again towards the stream, which was reached in about 1.5 miles. We crossed it at a good ford, and, to our great surprise, came upon an old nearly effaced wagon trail. This we followed with difficulty for a short distance, when it seemed to disappear in a thick growth of young trees and underbrush. After struggling forward for a short distance, we recrossed the river and again struck the wagon trail, which must have crossed to the eastern bank, near where we entered the bushes. We followed it down the river. The soil during the whole day's march was light and ashy. The country had been recently burned over by the Indians; and we were beginning to despair of obtaining forage for our animals, when a sudden bend revealed a portion of the river bottom thickly carpeted with luxuriant grass. Here we encamped under a few small trees. The river, which was about forty feet in width, flowed through a grassy bottom bordered by low bluffs, distant about 200 yards from the stream. The current was rapid, and the water clear and cold. Trout were abundant and easily caught.

August 27.—To-day we remained in camp, and Lieutenant Williamson made preparations to start to-morrow with Lieutenant Sheridan and the dragoon detachment, to begin the examination for a pass through the Cascade Range to the Willamette valley. The soil was so light that I found it impossible to take astronomical observations near camp. The ordinary movements of the men and animals caused a continual shaking of the ground, which disturbed the mercury of the artificial horizon, although surrounded by a trench nearly two feet in depth. It was consequently necessary, for every observation at this camp, to carry the instruments about an eighth of a mile to the bluffs above the river bottom. In the night, Lieutenant Williamson and others of our mess were taken violently sick. It was supposed by some that we had been poisoned by eating trout caught in the river; but I think that the sickness was probably occasioned by some carelessness of the cook.

August 28.—Although Lieutenant Williamson was quite unwell this morning, he started with Lieutenant Sheridan and the dragoons for the mountains. An itinerary of his trip will be found in Chapter IV. The main party remained under my charge in camp, where the customary observations were taken. Many crawfish, which when cooked were scarcely inferior to lobsters, were caught in the river.

August 29.—As the supply of grass began to fail, I moved camp about 3.3 miles down stream this morning, to a point where the river bottom spread out into a fine prairie, carpeted with an abundance of rich bunch grass. To reach this prairie, we passed through a nearly level country covered with pine forest. We encamped near some small trees on the river bank, where we found all the requisites for an excellent camping place. During the night, ice of considerable thickness formed in the water vessels, and just before sunrise the thermometer stood at 15° Fahrenheit.

August 30.—The day was spent in taking observations and computing. The glass crystal of one of the chronometers was unfortunately broken; but Mr. Coleman pounded a piece of tin until he gave it the requisite curvature, and thus supplied an admirable substitute. He had previously repaired a watch in the same manner.

August 31.—We remained in camp taking the usual observations. Early in the morning the air was quite uncomfortably cold, and the thermometer ranged below the freezing point until nearly nine o'clock. The altitude of the camp above the sea was only 4,129 feet.

September 1.—To-day we were greatly surprised by the arrival of a party of gold seekers from the Umpqua valley, who were journeying to the Coleville mines. They had crossed the Cascade Range by the wagon road south of Diamond Peak, which Lieutenant Williamson subsequently examined. After remaining a few moments with us, they continued their march. In the afternoon a corporal and two men arrived, bringing me orders from Lieutenant Williamson to join him on the second tributary of the Des Chutes river below camp.

September 2.—Our course this morning lay through a fine prairie, from half a mile to two miles in width, and bordered with pine timber. The river wound through the middle of the open space, concealed from view by a line of willows, and the trail followed its general course. The soil was mostly of a pumice-stone character, but there was an abundance of fine grass. After travelling 13.5 miles we found, by the greatly increased size of the stream, that it had received a tributary from the mountains. As the bushes were too thick to admit of riding near the water's edge, I walked back, and in about a quarter of a mile reached the junction of the two branches. The new tributary was too large to ford, and the depth and swift current of the main river threatened to give us much trouble in crossing. Beavers were very numerous in this vicinity. Continuing our march we soon reached a place where the trail crossed to the other bank; but the ford was so deep that the water rose to the backs of our largest mules. After searching in vain for a more shallow place, I decided to make rafts, rather than wet the packs and endanger the animals by driving them loaded into the swift current. The men worked hard, and at sunset all our packs and instruments had been transported to the western bank in safety, on a raft formed by lashing dry logs together. The escort were not quite so successful, and some of their property remained on the eastern bank until morning. The river was about 150 feet in width; the bottom was hard and free from boulders, and the banks were low and firm. The depth of the water and the swift current alone prevented fording.

September 3.—In examining the vicinity of camp this morning, I found the remains of an old Indian rancheria, surrounded by numerous deer and elk horns. A little above the crossing place on the western bank, several springs gushed from the rocks and united to form a stream nearly fifteen feet in width, which discharged itself into the river.

We started at about eight o'clock. The trail led near the river bank, through a pumice-stone region covered with pine timber. There were a few hills, and they gradually increased in height and steepness as we advanced. The river abounded in short bends. About five miles from camp, trap rock suddenly took the place of pumice-stone, and the stream entered the great cañon, which undoubtedly continues, without much interruption, to its mouth. The descent of the river in this cañon is shown by our barometric observations to average about twenty-five feet to the mile. A bend in the trail soon brought us to the summit of a cliff above the water, and revealed a scene wild and beautiful in the extreme. The opposite bank was composed of huge masses of trap rock, piled one upon the other in wild confusion. About fifty feet below us, the river was leaping, with a low murmuring sound, from crag to crag and apparently descending one hundred and fifty feet in less than three hundred yards. The dark pines around us, and the remains of a deserted Indian rancheria, harmonized well with the scene.

After crossing several steep ridges, separated by small ravines, the trail left the river and passed over an elevated plain densely timbered with pine. A few miles further on, we descended abruptly into a narrow gorge, which conducted us to a small tributary. Here we found Lieut. Williamson in camp, and an abundant supply of good grass and water. The bottom was bordered by bluffs, about one hundred feet high, which approached each other and increased in height, both above and below camp. Immediately after our arrival it began to rain, for the first time on the survey. Some of the party, who had followed down the river beyond the point where I left it, arrived thoroughly wet, a short time before sunset. They reported their route execrable.

September 4.—This morning, after riding a few miles, we emerged from the forest, and traversed an elevated plateau, dotted with cedars and sage bushes, and marked by a few low ridges and ravines extending in a northeast and southwest direction. None of these ridges were over 300 feet in height. The air was uncommonly clear and pure. The white summits of several snowy peaks began to appear in the distance, and we pressed rapidly forward. After travelling 17.5 miles from camp, we reached Why-chus creek, near the place where Lieut. Williamson had encamped on September 1st. It was a fine stream, about 30 feet in width, flowing rapidly over rounded rocks. Its waters were slightly turbid. There was an inexhaustible supply of fine grass in the vicinity, but Lieut. Williamson decided to travel on, and encamp near the "forks of the Indian trail." We passed through an open forest for the whole distance, and encamped on a little brook which, a few miles below us, sank among the rocks. From a slight eminence above camp, the snowy peaks of the Three Sisters appeared quite near. A large meadow, which Lieut. Williamson had previously seen, and upon which he depended for grass, proved to be a cranberry swamp and utterly impassable. A sufficiency of excellent bunch grass, however, was found among the trees. Whortleberries, elder berries and service berries abounded in the vicinity.

September 5.—To-day we remained in camp, and I repaired the barometer which had been broken on the recent trip among the mountains.

Lieut. Williamson instructed me to proceed to Fort Dalles to obtain provisions, and to examine the Des Chutes valley, while he continued the exploration of the mountains in the vicinity. As I had charge of a detached party during the remainder of the survey, it may be well to give a brief synopsis of the movements of each division of the command, in order to render the subsequent part of the report more intelligible. Lieut. Williamson continued his explorations among the mountains while I went to Fort Dalles. I rejoined him at Camp S, near Why-chus creek, and we again separated. He returned to the head of the Des Chutes valley; examined the pass south of Diamond Peak; proceeded to Vancouver, and thence by water to San Francisco. I explored the vicinity of Mount Jefferson; returned nearly to the Dalles; and then, crossing the Cascade mountains by a new pass south of Mount Hood, went to Vancouver. From that post I proceeded, by way of Fort Lane and Fort Jones, to Fort Reading, where the field work ceased. The next chapter contains itineraries of the routes followed by Lieut. Williamson.

CHAPTER IV.

NARRATIVE AND ITINERARY CONTINUED.—ROUTES OF DETACHED PARTIES IN CHARGE OF LIEUT. WILLIAMSON.

Exploration near lower klamath lake.—Party.—White stone.—Lower klamath lake.—Klamath river.—Letters.—Cañon.—Passage of river through lake.—Upper klamath lake.—Raft.—Junction with main party.—First exploration among the cascade mountains.—Party.—Fine meadow.—Snow peaks.—Lakes.—View from mountain.—Indian trail.—Cascade.—Extinct crater.—Summit of divide.—Three men sent back.—Indians.—Forks of trail.—Why-chus creek.—Junction with main party.—Second exploration among the cascade mountains.—Party.—Extended view.—Snow.—Lakes.—Trail disappears.—Cañon.—Compelled to turn back.—Depot camp again.—Second start.—Difficult route.—Extended view.—Trail disappears.—Route impassable.—Compelled to turn back.—Rain.—Indians.—Barometer broken.—Return to depot camp.—New route.—Elk killed.—Astronomical observations.—Route from camp S on why-chus creek to vancouver.—Final division of party.—Start.—Wagon road.—Main divide.—Lakes.—Middle fork of willamette river.—Route in ravine.—First settlement.—Spore's ferry.—Broken down horses left behind.—Fences.—South fork of santiam river.—North fork.—Oregon city.—Fort Vancouver.—Subsequent movements of Lieut. Williamson.

These itineraries have been compiled entirely from Lieut. Williamson's field notes, as I did not accompany him on the expeditions. As his journal was written hastily and without any view to publication, considerable revision has been necessary—so much, indeed, as to preclude the use of quotation marks. I have, however, been careful to adhere to his own words as far as possible.

EXPLORATION NEAR LOWER KLAMATH LAKE.

August 13.—I started this morning with Lieut. Sheridan and the dragoons to follow round the western side of Lower Klamath lake, having directed Lieut. Abbot to pass with the main party up the eastern side, and rejoin me near Upper Klamath lake. I crossed Lost river at the Natural Bridge, and then proceeded on the Yreka trail to where the Oregon trail diverged from it. We travelled to-day about twenty miles and encamped on a stream, ten feet wide, which flowed from springs at the foot of a neighboring hill.

August 14.—About a mile from camp I saw a white spot on the road, and found that the ground became white as I approached it. On the spot itself were fragments of a white, soft stone, apparently clay. A piece was preserved for examination. About four miles from camp we crossed a fine spring branch, rising at the foot of hills within one hundred yards of the trail, and apparently joining the one on which we had encamped, near Lower Klamath lake. Three miles further on we crossed another spring branch emptying into the lake. About two or three miles further on we skirted the western side of the lake. The body of water was small, but a large marsh extended for about ten miles towards the north. We soon entered pine timber, and after crossing a pretty high divide reached Klamath river, a short distance from the lake. The sick men were better. I prepared letters for the War Department, to send by them to Fort Lane.

August 15.—Within half a mile of camp, the river came through hills forming a cañon. We were obliged to ascend the ridge, and follow it for about six miles. We then descended, forded the river, and soon reached the edge of the marsh. Our course thus far to-day had been nearly parallel to that of yesterday. After taking several compass bearings, we followed a northerly course to a spring on the edge of the marsh, where we encamped. The river comes into the marsh, curves through it, and passes off to the cañon, without any visible connection with the main body of water in the lake, which lies further to the southward. Doubtless, in the rainy season, the water covers the whole marsh, and then the river literally passes through the lake. Several deer were killed to-day; one of which, a very fat buck, was supposed to weigh over two hundred pounds. The sick men were sent this morning, through the pass south of Mount Pitt, to Fort Lane.

August 16.—We started this morning to follow up the Klamath river. Much to our surprise, we came at noon to an arm of a large lake from which the river flowed. This proved to be Upper Klamath lake. It was difficult to say where the connecting river ended and the lower lake began. Where the tule ceased, the river ran rapidly between low hills backed by higher ridges and was full of rapids. In one place there were falls from five to ten feet high. We found the river everywhere too deep to ford. At the rapids, where many rocks rose above the water, there were numerous deep holes; and near where it emerged from the lake it was twenty feet deep. We fortunately found two old canoes, and lashing them together, formed a raft upon which we carried our baggage across. The animals swam over without accident. We encamped near the spot.

August 17.—This morning the sentinel did not arouse camp at the time ordered, and it was about eight o'clock before we were ready to start. We soon reached the main party, which we found in camp on the lake shore. They had been waiting for us two days.

FIRST EXPLORATION AMONG THE CASCADE MOUNTAINS.

August 28.—I left Camp 37 this morning, accompanied by Lieutenant Sheridan and the dragoons, to explore the Cascade mountains near the head of the Des Chutes valley, leaving the main party in Depot camp. We carried provisions for seven days. We were compelled to descend the river about a mile before we could find a ford. Having crossed, we took a course a little north of west, and in five miles struck the main river, which was sometimes one hundred yards wide, and not fordable. Before reaching it, the trail gradually ascended, and then abruptly descended to the water's edge. After following the river for a short distance, we made an early camp, as I felt quite sick.

August 29.—Bartee, the guide, had followed up the creek yesterday, and found that, by going towards the base of a mountain southwest of us, we could shorten the distance. We therefore struck through the timber, and came to the river again in about five miles. The stream had diminished so much in size that we inferred it had forked. In following it down to ascertain the fact, Bartee killed a deer. I made a short halt, and sent a small party ahead to look for the branch. They found it, and reported it larger than the one upon which we were. We therefore struck across, and reached it at a point about a mile above the junction. It was not always fordable, but we soon succeeded in crossing. A few miles from the junction we came to a meadow, five or six miles in diameter, in which the stream again forked, both branches being too deep to ford. We followed up the north branch to the timber, and encamped. It was too cloudy to take astronomical observations to-night.

August 30.—We tried to cross the branch this morning at various places, but did not succeed until we had travelled 1.5 miles. Before crossing we came in sight of several snow peaks; and the stream was so large, and the view towards the peaks presented a prospect so favorable for a good pass, that we determined to follow the north branch, leaving the other, although it was the larger of the two. Our course lay sometimes through open meadows, and sometimes among a dense mass of young trees and fallen timber, until we reached a lake a mile in diameter, which received no tributary and was evidently the source of the stream. A short distance beyond was another and larger lake with no outlet. We encamped on the small lake, and Lieutenant Sheridan and myself ascended a bald hill, about three miles distant, the summit of which was nearly two thousand feet above camp. We had an extensive view. To the westward was a low ridge connecting with the snow mountains. This ridge may be the crest of the Cascade mountains, but there were successive ranges beyond it, some of which appeared to be very high, and thirty miles off. There was no snow on them. Between two overlapping ridges we saw a faint line of mountains, indefinitely distant and scarcely visible. To the northward were the snow peaks, which we afterwards found to be the Three Sisters. Two only were distinctly visible, but peaks of others were seen behind them, apparently separated by low depressions. Between us and the nearest ridge were several lakes, nearly a dozen in all. It afterwards proved that others were hidden from our view. To the southward we saw a large lake at the base of a saddle peak. It was six miles or more in diameter, and was evidently the source of the other fork of the stream which we had been following. To go to the westward among the mass of mountains, I saw would require more time than I could spare, and I finally determined to cross the divide among the snow mountains, which might prove to be the crest of the Cascade Range. We returned to camp a little after sunset.

August 31.—Our course to the depression between the two snow peaks was nearly north. The ground was covered with volcanic rock in ridges and masses, with steep irregular ravines between. About ten miles from camp, we reached a good sized lake at the base of the snow peaks. We here struck an old Indian trail which led us to the depression. In ascending, we came to a beautiful little valley with a stream flowing through it towards the lake. This stream issued from the hills with a vertical fall of about thirty feet. We at length reached the summit of a ridge, which we supposed to be the culminating point. Its height above the sea was 6,303 feet. We then descended to a series of small lakes, one or two hundred feet below the crest just passed, and lying immediately at the base of the snow peaks. The trail again began to ascend, and, at length, reached the summit of a ridge about five hundred feet higher than the first. On looking back we saw plainly that we had crossed an extinct crater, which had thrown to the southward the immense streams of lava we had passed over. Descending on the Indian trail, we encamped on a little brook with a red earth bottom. Its valley was small, but there was a little grass. The night was cold and windy, and the sky obscured by clouds. I sent a corporal and two men back with instructions to Lieutenant Abbot to move camp to the second branch below.

September 1.—To-day we resumed our march on the trail. We soon overtook two mounted Indians, a male and a squaw. The latter disappeared as soon as possible, but the man proceeded with us a short distance, and then went off at a gallop to join his comrade. He spoke a little Chinook, and gave us to understand that the trail soon forked—one branch going to the Dalles, the other to the Willamette valley. About nine miles from camp we reached the forks. After riding a short distance on the northern branch, we left it to follow down a small brook which we had seen near the forks. This soon became dry, but its rocky bed conducted to a considerable stream, a branch of the Des Chutes, called by the Indians Why-chus. Here we encamped. Our barometer was unfortunately broken to-day.

September 2.—This morning we crossed over to the next branch, where we expected to meet Lieut. Abbot, but he was not there. The road was good, and practicable places could be found

CASCADE RANGE WITH MOUNT JEFFERSON, MOUNT HOOD AND MOUNT ADAMS, FROM PASS WEST OF CAMP 40.

for a railroad ; but still there were low ridges, with gullies between them running northeast, which would have to be crossed. None of them were more than 200 or 300 feet in height.

September 3.—To-day the main party arrived, having been delayed by the necessity of rafting the river.

SECOND EXPLORATION AMONG THE CASCADE MOUNTAINS.

September 6.—I left Camp 40 to make a second exploration among the mountains this morning, accompanied by Lieutenant Sheridan, Messrs. Fillebrown and Young, Dr. Newberry, Bartee, and the dragoons. Lieutenant Abbot started with a small party for Fort Dalles, and the main body of the escort remained in Depot camp.

The trail passed to the north of the northernmost snow mountain, and crossed the divide at a point much higher than some others visible a few miles further to the north. We had a fine view of Mount Jefferson, Mount Hood, and Mount Adams. Southward, two of the four snow peaks forming the Three Sisters, loomed up quite near us. There was snow on the trail near the divide. The ascent was steep, and impracticable for a railroad. Looking to the north and east, however, the prospects were more favorable. A high, lone mountain, six or eight miles north of us, interrupted the view, but it was evident that by going northwest from "Camp I," on Why-chus creek, and skirting the northern base of the mountain, the divide could be reached at a much lower point, and the long sweep would decrease the grade. The distant view we had would not leave a doubt as to the perfect practicability of this route ; but a closer examination might reveal many unexpected obstacles. It, however, seemed to be the only feasible line between the Three Sisters and Mount Jefferson ; and it looked more favorable than the route south of the Three Sisters.

Looking westward, we saw mountains beyond mountains, one mass without any apparent regularity or design, except that we saw the ordinary illusion of a system of ranges perpendicular to the line of vision. Whether we were on the main ridge of the Cascade Range, when on this divide, I do not know. Four small lakes lay to the westward, between the ridge upon which we stood and another, parallel to it but much lower. There seemed to be a water-course from these lakes towards the north, but it may have been an illusion. A little south of west was the deep ravine of a stream which received a branch from Mount Jefferson and one from the south.

From the divide we descended by a gradual slope, and encamped near the lakes. The grass was poor and scanty, and a much better camping place had been passed a mile or two back.

September 7.—The trail led towards the west, this morning, over the low ridge that borders the lakes. A dry water-course, which we crossed before ascending, wound towards the north, and may or may not conduct to the Des Chutes. The strong probability is that it does not. On the crest of the ridge I halted the command in a whortleberry patch, while I went up on a small eminence, from which I could see the cañons of the rivers, apparently about five miles off. The only grass in sight was in a meadow in the main cañon, near the junction of the two branches. After advancing a short distance, the trail gave out where there was some grass and a few small lakes. It seemed probable, either that the trail led to this spot merely for pasturage, or that it was a branch from a main trail which we had missed near our last camp. While advancing towards the cañon, we became entangled in fallen timber and thick forests, and were compelled to cross several steep ravines, in one of which we found water. Finally, on reaching the edge of the cañon, we saw the river flowing more than 1,000 feet below us. To descend the precipice proved to be impossible, although we tried at several places. Abandoning all hope of obtaining grass, we at length turned back to encamp in the ravine where we had seen water. It was after dark when we succeeded in reaching our destination.

September 8.—As the animals were suffering from want of grass, and as it was impossible to advance, we went back as far as the whortleberry patch and encamped there. I took a different route, hoping to find it better, but I was disappointed.

September 9.—In order to make a thorough examination for the Indian trail, if any existed, I determined to remain in camp to-day while Bartee went in search of it. He returned at night, and reported that he had found a trail leading north from the lake on which we had encamped on the evening of the 6th. He had followed it for several miles. As there was no other course to pursue, I determined to examine this trail to-morrow.

September 10.—We followed the trail which Bartee found yesterday. In five or six miles it joined our trail from the summit of the main ridge to the lakes. We continued on and encamped at Camp 40, where we had all separated. We found that Lieut. Crook had moved the Depot camp to Why-chus creek.

September 11.—I remained in camp to day, and sent to Lieut. Crook for more provisions. My plans for the future were to follow the trail toward the south and take any fork leading to the west, in the hope of reaching the Willamette valley.

September 12.—This morning I followed the old trail towards the south, crossed the divide among the Three Sisters, and encamped on the mountain brook.

September 13.—This morning we followed the Indian trail, with a general southwest course, and crossed the divide of the Cascade Range. Many ridges and ravines rendered the route utterly impracticable for a railroad. In the afternoon the trail forked; we took the right hand branch, and encamped on a little brook bordered with grass. Directly east of our camp the summit of the main ridge was very much lower than where we crossed. The night was cloudy.

September 14.—This morning the trail led towards the northwest. From a hill covered with whortleberry bushes we obtained a fine view, and saw that our course from the snow mountains had been winding around the heads of some very deep, steep ravines. We descended from this hill to a ravine, and then ascended the opposite ridge, upon which the trail seemed to partially give out. We therefore descended to two little ponds in the midst of a grassy spot, and waited while Bartee searched for it. As he returned unsuccessful, I encamped, and sent him again to make a thorough examination. Upon his return, he reported that the trail entirely gave out, and that the country to the west was one mass of rocks and ravines, which were apparently impassable even to Indians.

September 15.—I returned to-day to the forks of the trail, in order to try the other branch. It rained all day, sometimes quite violently, and we encamped near the forks.

September 16.—It rained furiously, and we remained in camp.

September 17.—It rained, and we did not leave camp. In the afternoon three Indians, with a squaw and horses, arrived from the south. They told us that the trail we had followed, only went a short distance. Beyond were precipices and fallen timber, which could not be crossed, and the only route in this vicinity, to the Willamette valley, was by the wagon road south of Diamond Peak. I determined to follow the left branch of the trail, and try to reach the wagon road.

September 18.—It was cloudy this morning, with every prospect of rain. While packing to continue our march, the barometer was found to be broken. As it was useless to explore

THREE SISTERS AND CAÑON OF M^c KENZIES FORK OF WILLAMETTE RIVER FROM CAMP P

without this instrument, I determined to return to the depot camp. We encamped at a small lake.

September 19.—We attempted this morning to shorten distance by following down Why-chus creek, instead of taking the Indian trail. The road proved to be very bad, and nearly as long as the other. There were miry places at which we had to unpack the mules, and travelling was very slow and difficult. During our absence, Lieutenant Crook had killed a large elk.

We remained in camp until September 23, when the party arrived from Fort Dalles. They had been delayed by the necessity of sending to Vancouver for provisions. While waiting, I made many astronomical observations, for the purpose of testing the sextant.

ROUTE FROM CAMP S, ON WHY-CHUS CREEK, TO VANCOUVER.

September 23.—I gave Lieutenant Gibson official information that I now only required an escort, composed of Lieutenant Crook, the quartermaster and commissary of the expedition, and Lieutenant Sheridan with the dragoon detachment. After giving Lieutenant Abbot directions to explore, if possible, a route which should cross the Cascade Range, between Mount Hood and Mount Jefferson, I made every preparation for starting to-morrow myself for the wagon road south of Diamond Peak.

September 24.—I started after ten o'clock this morning, with Lieutenants Crook and Sheridan, Messrs. Fillebrown and Young, and the dragoons. We encamped where the trail crosses and leaves Why-chus creek.

September 25.—We crossed the divide of the spur from the Three Sisters, and then tried a new route, which proved to be longer and no better than the former one. We encamped near the river, just below our old Camp G.

September 26.—To-day we continued our course, and encamped near the junction of the two main forks of the second branch of the Des Chutes river.

September 27.—This morning we followed down the stream to our former Camp E. We then took a course a little south of east, and struck the south branch, probably about six miles above Camp 37. We next followed the wagon road up the river, and encamped at the place where we had crossed the first time.

September 28.—This morning we followed up the branch, which must have forked, although we saw no tributary. We did not see Camp 36, and the road for half of the distance was on the right bank. I suppose that the branch of the stream which we followed must have been a north fork. We encamped at what appeared to be a general camping place, and which proved to be the point where the road leaves the Des Chutes waters for good. A mile or two below camp, the stream apparently received a tributary from the north.

September 29.—To-day we crossed the main divide. After leaving camp we ascended a collateral ridge with a moderate slope, and followed it on an undulating trail until we ascended the main ridge, which it joined just south of Diamond Peak. North of this collateral ridge, and at its base, was a large lake, about ten miles long and two or three broad. This lake must be the source of the tributary which we saw a mile or two below this morning's camp. The summit is attainable at a moderate grade, by winding, as the hill sides appear practicable. In descending we saw to the south of us a large lake, five or six miles in diameter, which is the source of the Middle fork of the Willamette. We descended on a ridge, in many places impracticable for a railroad; but a descent could be made to the lake, by side location and winding to gain distance. Thence the route would follow down the Middle fork, possibly through a cañon, and doubtless through an immensely difficult ravine. Grass was very scarce. Several streams coming from hills north of us were crossed by the trail.

September 30.—We continued to follow the trail, and soon came to the main stream, which we crossed twelve times during the day, and half crossed twice. The road is good for a mountain road, if travelling west. This afternoon the descent was more gradual; we made a long day's march in order to obtain grass.

October 1.—We continued on the trail, which was pretty bad. It crossed the river eight times, where it was belly-deep to the mules; I noticed oak for the first time since we left Pit river, excepting a few scattered trees near Klamath lake. We marched until sunset, when, at last, we came to some poor grass. Bartee killed four deer on the way.

October 2.—In a little more than a mile from camp we came to an unoccupied house; half a mile further on we reached a residence. The grass was poor, but we encamped and purchased some oats. Several animals had broken down on the road.

October 3.—We remained in camp, and all the animals were recovered, except one dragoon horse.

October 4.—We started this morning for Spore's ferry at McKenzie's fork, leaving three privates and a corporal with the broken down horses, to rejoin Lieut. Gibson on his arrival. We found the country generally level, with a few rolling hills. McKenzie's fork was deep where we crossed, and appeared to contain much more water than the Middle fork. We encamped near Spore's house, where we purchased forage, as there was no grass in the vicinity.

October 5.—The road to-day was excellent, but greatly interrupted by fences.

October 6.—We made a good march to-day, following along the base of the foot hills. We crossed the south fork of the Santiam river, and found a beautiful valley between that and the north fork, on which we encamped.

October 7.—We encamped to-night at a house between Butte and Rock creeks. The road lay among the foot hills to-day, which were mostly timbered.

Lieut. Williamson's journal was not continued after this date. On the following day he passed through a slightly undulating, wooded region to Oregon City, where he encamped on a bluff above the town. On October 9, he proceeded to the bank of the Columbia river, through a country similar in character, and encamped opposite Fort Vancouver, where his field-work terminated. He left his party with orders to join mine on my arrival, and sailed for San Francisco himself, to make preparations for the second survey near the sources of Carson river.

DIAMOND PEAK AND RAVINE OF MIDDLE FORK OF WILLAMETTE RIVER, FROM CAMP 48 W.

CHAPTER V.

NARRATIVE AND ITINERARY CONTINUED.—ROUTES OF DETACHED PARTIES IN CHARGE OF LIEUT. ABBOT.

FIRST EXPLORATION IN DES CHUTES VALLEY.—PARTY.—ACCIDENT.—QUE-Y-EE BROOK.—DRY CAÑON.—WILD VIEW.—CAÑON OF MPTO-LY-AS RIVER.—LATE ARRIVAL IN CAMP.—STRANGE CHARACTER OF THE CAÑON.—INDIAN GRAVE.—ASCENT OF CAÑON SIDE.—PSUC-SEE-QUE CREEK AND CAÑON.—CHIT-TIKE CREEK AND CAÑON.—WAM CHUCK CAÑON.—GOLD HUNTERS.—INDIANS.—A SURPRISE.—HOT SPRINGS.—WILD LATERAL GORGE.—CAVES.—BASIN.—MOUNTAIN.—NEE-NEE SPRINGS.—MUTTON MOUNTAINS.—TYSCH PRAIRIE.—TYSCH CREEK AND CAÑON.—FIRST SETTLEMENT.—EVELYN'S RANCHO.—POTATOES.—INDIANS.—DEAD BODY.—BREAD OF KOUS ROOT.—WAGON ROAD.—TYSCH MOUNTAINS.—FIFTEEN MILE CREEK.—EIGHT MILE CREEK.—FIVE MILE CREEK.—FORT DALLES.—OFFICERS THERE.—CHINOOK WILLIAM AND COLONEL FREMONT'S SUPPOSED TRAIL.—DALLES OF COLUMBIA.—SALMON.—TRIP TO CASCADES OF COLUMBIA.—CAPTAIN WELLS.—MR. COE.—INDIAN BURIAL PLACE.—WIND MOUNTAINS.—SUBMERGED FOREST.—CASCADES.—BAROMETRIC OBSERVATIONS TO DETERMINE DESCENT OF RIVER.—BURIAL PLACE.—PETRIFACTIONS.—SALMON FISHING.—WILD EVENING WALK.—MEASUREMENT OF WIDTH OF COLUMBIA AT CASCADES.—RETURN TO FORT DALLES.—START TO RETURN TO DEPOT CAMP.—DIFFERENT ROUTE.—RAIN AT NIGHT.—RUMOR OF GOOD PASS TO WILLAMETTE.—LARGER HOT SPRING NEAR WAM CHUCK RIVER.—INDIANS AND SALMON IN MPTO-LY-AS CAÑON.—PAPER ON TREE.—JUNCTION WITH MAIN PARTY.—LUNAR RAINBOW AND HALO.—SECOND EXPLORATION IN DES CHUTES VALLEY AND CROSSING OF THE CASCADE MOUNTAINS.—PLAN.—PARTY.—PREPARATIONS.—DIVISION OF PARTY.—START.—TRAIL DISAPPEARS.—DIFFICULTIES.—LOVELY VIEW.—WATER BY DIGGING.—BRIGHT MOONLIGHT.—RAIN.—SURPRISE.—IMMENSE CAÑON.—VIEW.—DIFFICULT DESCENT.—PEDREGAL.—TRAVELLING ON FOOT.—CRATER.—RETURN TO RIVER.—EXAMINATION OF SECOND CAÑON.—OLD INDIAN TRAIL.—PRECIPICE.—CASTLE ROCK.—BAROMETER BROKEN.—TRAVELLING DOWN A CAÑON.—DES CHUTES CAÑON.—PLATEAU.—STRANGE HILL.—CAÑON GATE.—TRAP COLUMNS.—MOUTH OF CHIT-TIKE CREEK.—INDIANS.—RE-EXAMINATION OF WAM CHUCK RIVER CAÑON.—JUNCTION WITH MR. COLEMAN'S PARTY.—BAROMETER REPAIRED.—DR. NEWBERRY SICK.—TYSCH CREEK AGAIN.—INDIAN WAR.—DISAGREEABLE PREDICAMENT.—KOK-KOP.—REPORTS ABOUT PASS.—RAINY NIGHT.—INDIAN COUNCIL.—NEW GUIDE.—RETURN TO NEE-NEE SPRINGS.—START FOR WILLAMETTE VALLEY.—WIL-LA-WIT SPRINGS.—INDIAN SIGNS.—WAN-NAS-SEE CREEK.—FALLEN TIMBER.—YAUGH-PAS-SES MEADOW.—"KILL THE CART."—GREAT DIFFICULTY FROM FALLEN TIMBER.—NEW ORDER OF MARCH.—BRANCH OF TYSCH CREEK.—WAT-TUM-PA LAKE.—OO-LAL-LE BERRIES.—DELAY.—LU-AH-HUM-LU-AH-HUM PRAIRIE.—TY-TY-PA LAKE.—GAME.—MOUNT HOOD.—RAIN.—TRIANGULATION.—HORSE ABANDONED.—TRAIL DISAPPEARS.—INDIAN BLAZING.—PRECIPICE.—HIGH MOUNTAIN.—EXTENDED VIEW.—MAGNETIC VARIATION.—VERY BAD TRAIL.—VIEW OF THE WILLAMETTE VALLEY.—CAÑON.—DISAPPOINTMENT.—SPRING OF WATER DISCOVERED.—STEEP DESCENT INTO ANOTHER CAÑON.—LAKE AND INDIAN "STONE HOUSE."—DIFFICULT ASCENT.—UNPLEASANT INFORMATION.—WATER AND GRASS REACHED.—RAIN.—ANXIETY.—EARLY START.—EXECRABLE TRAIL.—VIEW OF THE WILLAMETTE VALLEY.—PEDREGAL.—FALLEN TIMBER.—CAMP WITHOUT WATER OR GRASS.—MULE LOST.—SETTLEMENT.—NEWS ABOUT INDIAN WAR.—MR. CURRIN.—MULE RECOVERED BY SAM.—OREGON CITY.—LIEUT. WILLIAMSON'S PARTY.—NEWS.—LOSS OF THE ESCORT, WITH CORRESPONDENCE UPON THE SUBJECT.—EXTRACT FROM OREGON STATESMAN.—GOV. CURRY.—ROUTE FROM VANCOUVER TO FORT READING, WEST OF THE CASCADE MOUNTAINS.—START.—SALEM.—MR. GORDON.—CORVALLIS.—EUGENE CITY.—PASS THROUGH CALAPOOYA MOUNTAINS.—WINCHESTER.—INDIAN WAR AND VOLUNTEERS.—MAJOR MARTIN.—CAÑONVILLE.—DESPATCH FROM THE BATTLE FIELD.—UMPQUA CAÑON.—TRACES OF INDIAN DEVASTATION.—RETREAT.—ESCORT FROM CAPTAIN SMITH.—INDIAN DEVASTATIONS.—HEROISM OF A WOMAN.—FORT LANE.—TABLE ROCK.—VALLEY OF STEWART CREEK.—HOT SPRING.—SISKIYOU MOUNTAINS.—KLAMATH RIVER.—YREKA.—LITTLE SCOTT'S MOUNTAINS.—FORT JONES.—LIEUT. CROOK DETAINED.—DISAPPOINTMENT.—SNOW.—SCOTT'S VALLEY.—SCOTT'S MOUNTAINS.—TRINITY VALLEY.—TRINITY MOUNTAINS.—CLEAR CREEK.—FRENCH GULCH.—SHASTA.—FORT READING AGAIN AND TERMINATION OF FIELD WORK.—LIEUT. WILLIAMSON.—ORDERS FROM WAR DEPARTMENT.—SUBSEQUENT MOVEMENTS, ETC.

FIRST EXPLORATION IN DES CHUTES VALLEY.

September 6.—I left Camp 40 to-day, with instructions from Lieut. Williamson to proceed to Fort Dalles for provisions, and to examine the Des Chutes valley, north of the Three Sisters. My party consisted of Mr. Anderson, who greatly assisted me in the astronomical and barometric observations, Dr. Sterling, Mr. Coleman, and eight packers. Lieut. Gibson with Messrs. Daniel and Vinton accompanied me with a train, to procure provisions for the escort, which remained behind in Depot camp to await our return. My instruments consisted of a Gambey sextant and mercurial horizon, one of Green's cistern barometers, No. 1089, a thermometer, and a prismatic compass.

As we were about to start, a horse, becoming entangled in the cords of the office tent, threw it down and broke the barometer. I sent the rest of the party forward, and Mr. Anderson and Dr. Sterling remained with me to repair it. As this detained us about two hours, we were compelled to travel rapidly to overtake the train, already considerably in advance. Our course lay through a thick pine and fir forest. The land gradually descended for about ten miles, when we reached a fine open prairie, half a mile wide, lying at the foot of the black conical butte, which Lieut. Williamson had selected as a connecting point for our surveys. A little stream, called by the Indians Que-y-ee, trickled through the prairie, and then disappeared in a small meadow to the eastward. Fine bunch grass was very abundant in this vicinity, and it would have been an excellent camping place. After passing down the stream about a mile we left it, and, again entering the thick forest, followed for about nine miles the western base of a ridge east of the black butte. It conducted us to the dry bed of a stream. We afterwards found a little water, about two hundred yards below the place where the trail left this bed. About three miles from this point we suddenly found ourselves upon the edge of a ravine, then dry, but doubtless, in the rainy season, the bed of a mountain torrent. The banks were about 300 feet high and very steep. It was about two miles wide, and in places thickly timbered. We crossed it, and climbing up the other side soon beheld a prospect whose wild beauty I have seldom seen equalled. The sun was just setting behind the snowy peaks on our left; before us lay an immense cañon, the sides of which were rough with basalt, and heavily timbered with pine and fir. In the dim twilight, which had already settled in its bottom, we could occasionally see, between the trees, the waters of a large river, called by the Indians Mpto-ly-as. But we had no time to admire the scenery, for the train was still an unknown distance in advance. We hurried our mules as fast as possible down the rocky side of the cañon, which, by actual measurement, was subsequently found to be 1,200 feet deep. It soon became dark, and we were beginning to anticipate the pleasures of spending the night without food or blankets, when a sudden bend in the trail revealed the cheerful light of the camp fires shining before us on the river bank.

September 7.—We were encamped in a narrow part of the cañon, and as its steep sides were crowned by vertical walls of columnar basalt, it would have been impossible for a pack mule to get out of it, in most places. There was but little grass near camp. As a plain although very bad Indian trail led out of the cañon on the south side, we followed it for about three miles, hoping that it might lead to a better ford; but finding that it turned to the south, we returned to our camp; crossed the river, which is a rushing torrent that swept away and nearly drowned one of the mules; and then followed down the cañon, trying to find a place where we could ascend its northern side. This river cañon is very remarkable. Its sides vary from 800 to 2,000 feet in height. The river has cut down its bed to this immense depth through successive strata of basalt, with occasionally a deposit of infusorial marl and volcanic tufa, which has sometimes hardened into a kind of conglomerate sandstone, ten or twenty feet in thickness, and of a white, gray, or reddish color. Often, as the banks have gradually receded, a slender column of this deposit, capped by a huge piece of basalt protecting it from the weather, has been left projecting high above the mass of detritus around it, its sides washed smooth and often worn into fanciful forms by the rains of ages. It required but little imagination to see, in these light colored figures, giants and monsters guarding the dark, frowning sides of the cañon. The entire absence of all signs of life, the dull sound of the river rushing over its rocky bed, and the dark green of the stunted cedars and pines, clinging to the precipices which confined it,

CAÑON OF PSUC-SEE-QUE CREEK NEAR CAMP 41 A.

united with these wild unearthly figures to give a gloomy desolation to the scene, which was not a little heightened by a solitary Indian grave. It was marked by a pile of stones, a short stick with a piece of white cloth attached to it, and the skeleton of a horse, shot upon the last resting place of his master.

We followed down this cañon for about five miles, when a rocky spur cut off all further progress, and compelled us to attempt the ascent. This, with great difficulty, we accomplished, and found ourselves on a plain, thinly dotted with sage bushes and clumps of grass. We continued our course, and, after crossing the bed of a torrent of the rainy season, came to a very small stream called Psuc-see-que by the Indians. It was sunk in a cañon about 500 feet deep, cut through successive strata of basalt, infusorial marl, tufas, and conglomerate sandstone like that found in the Mpto-ly-as cañon. There was a little grass in the narrow bottom and on the sides, and some small cedars, willows, and bushes near the water's edge. Here we encamped, after a laborious day's march, which had brought us but very little nearer the end of our journey. The view from our camp was wild and beautiful. Looking up the cañon, we could see the snowy summit of Mount Jefferson closing the narrow vista; while the steep banks, with their strongly contrasting colors of black, white, blue, pink, and red, gradually approached each other below our camp, until they formed a narrow gateway, through which we had a glimpse of a little opening in the ravine beyond.

September 8.—This morning our course lay through a lateral defile, opening out of the Psuc-see-que cañon by a narrow gate, about half way up its northern side. The general character of the country was similar to that through which we passed yesterday. In about six miles we reached a fine stream called Chit-tike, which was sunk in an enormous cañon, 900 feet deep, very much resembling that of the Psuc-see-que, except that it had a wider bottom and more bushes on the water's edge. The grass in the bottom was coarse and not very nutritious; but on the sides there was a little excellent bunch grass, as is generally the case in these river cañons. We crossed it and entered a narrow gorge which led into a valley, about two miles wide, nearly parallel to the cañon that we had left, and covered with scattered sage bushes and a few stunted cedars. This we crossed, ascended by a steep rise into a small basin surrounded by hills and considerably elevated above the valley, climbed another steep hill, and found ourselves on the summit of the northern divide of Chit-tike creek. Before us lay a gradual descent, appearing to reach to the foot of a low ridge, which, after extending in an east and west direction about ten miles, abruptly terminated at each extremity. Portions of the sides of this range were of a brick red color, which gave it a strange appearance at a distance. As we approached, we found that a cañon 300 feet deep, with steep sides of basaltic rock and red earth, separated us from the foot of the range. It contained a stream of considerable size, called Wam Chuck. In the cañon we were much surprised to see a party of twenty or thirty white men, who were vainly searching for gold. They had started to explore this barren region, in the hope of discovering new mines; but, as yet, had met with no success. There were also several Indians, who crowded around us with great surprise and interest. They were delighted beyond measure at a ludicrous accident which happened to one of our party; who, being very thirsty, and seeing a beautiful, clear spring bubbling from under a rock near the trail, jumped from his mule, and lying on the ground eagerly filled his mouth with the tempting liquid. He instantly ejected it, however, with looks of wild astonishment, and many grimaces indicative of anything but satisfaction. It was a hot spring with a temperature of 140° Fah.

Wam Chuck river flows with a rapid current over a bed of large rounded rocks, which render the ford a little difficult. There are a few stunted cedars in the cañon, but very little grass where the trail crosses it. Its banks are often very precipitous, and composed of basaltic rock, and earth of various reddish shades. The water of the river is clear and cold; and it derives its name, Wam Chuck or Mil-lil-le Chuck, signifying warm water, from several hot springs upon its banks. Some of them give off an odor of chlorine, and are partly covered with a thick green scum containing soluble silica. Others seem perfectly clear and pure. The former class is generally bordered by a white solid deposit from the water. Large rocks in the vicinity are sometimes incrusted with the same substance. The springs often contain cooked grasshoppers, bugs, and snakes, that have unwittingly taken a warm bath.

The trail leaves the cañon by a narrow lateral gorge, with sides in many places vertical or even overhanging, and from one to three hundred feet in height. There are large caverns high up in these cliffs, to which access without ropes would be impossible. The pass is a vast, narrow gateway, whose wild beauty defies description. It preserves this character for about a mile, and then suddenly expands into a little basin surrounded by low mountains, and abounding in very interesting varieties of silicious rock. This basin contains good grass and a spring of pure water, thus forming a better camping place than the river cañon. We crossed it, and toiling up a rocky mountain, until we gained an elevation above the basin of about 1,600 feet, wound round its eastern side near the edge of a deep ravine, into which, in many places, a single mis-step would have precipitated us. After gaining the northern side, we passed over low, rolling hills for about two miles, and then crossed the dry bed of a stream in a small ravine. Passing over an elevated country for about three miles, we next came to a place where there were a few small water holes, apparently excavated by the Indians. About two miles beyond was a very small stream called Nee-nee, or Willow springs. Here we encamped under a few fine trees. There was an abundance of good bunch grass, and our animals fared better than they had since we left the main party. The Indians fully appreciate the excellence of this kind of grass for their horses, and Nee-nee is one of their favorite resorts. We found near camp a large deposit of fine red and white sandstone, which was beautifully stratified.

September 9.—After riding this morning among low, rolling hills for about two miles, we reached another moist spot called by the Indians Hy-as Nee-nee, or Great Willow spring. Here the trail forks. We took the right hand branch, which led us, by an ascent of about 200 feet, to the northern border of the elevated spur upon which we had been travelling since we left Wam Chuck cañon, and which is named, by the white traders, the Mutton mountains. About 1,900 feet below us lay a sterile, treeless, basaltic plain, elevated 2,200 feet above the sea. It is called Tysch prairie. The thickly timbered foot hills of the Cascade Range marked its western border. About thirteen miles north of where we stood, a smooth ridge, yellow with dried grass and unmarked by a single tree, rose abruptly; and, after extending about thirteen miles in an eastern and western direction, suddenly terminated at each extremity. To the eastward, beyond the enormous cañon of the Des Chutes river, which we could distinctly trace, the plain became broken by rolling hills, extending as far as the eye could reach. The descent to the prairie was very steep, and we afterwards found that the left branch of the trail at Hy-as Nee-nee, was much the better of the two; since it followed the gradual slope of a ravine, and joined the other soon after gaining the prairie. This ravine, although entirely dry in the summer, is, in the rainy season, the bed of a torrent, whose rocky course, near the base of the Mutton mountains, we found bordered by stunted oaks, the first we had seen for many miles. After

MOUNT HOOD FROM TYSCH PRAIRIE.

crossing Tysch prairie we reached the edge of the deep cañon of a creek of the same name, which washes the base of the spur forming its northern boundary. We crossed the stream a short distance above the junction of two branches, the first of which was turbid with sand, but the second clear and pure. Both fords were good. There was considerable grass on the sides of this cañon, and a narrow strip of good land in the bottom, and we saw before us, with a feeling of strange pleasure, a settler's log cabin and a fenced field. This rancho, together with a ferry across the Des Chutes river, near the mouth of Tysch creek, belonged to Mr. Evelyn, formerly of Cleveland, Ohio, who treated us with great kindness, both at this time and subsequently. We encamped on the creek, and feasted sumptuously on some fine potatoes, which were fully appreciated, as the want of fresh vegetables had begun to cause scurvy among the party.

There was, near our camp, a large rancheria of Indians, among whom a disease resembling the cholera had been raging. About thirty had recently died; and, in accordance with their customs, the relations of the deceased spent their nights among the rocks of the cañon sides, shrieking and howling in lamentation. These sounds, now near, and now remote, were very mournful and impressive as we lay around our camp fire. We felt less sympathy for their affliction, because one of our party, who had found a dead body lying in the bushes near us, had been told rather disdainfully by an Indian to whom he pointed it out, that it was only a prisoner, not worth burying. The ground near the rancheria was strewed with *kous*, a root from which they make a kind of very hard bread called "sup-pal-le." It had belonged to their dead, and had, on this account, been thrown away as ill-omened.

September 10.—The trail this morning followed up the creek a short distance, and entered a wagon road leading from the Dalles to the Willamette valley. It is very mountainous, and bad for wagons. We had a good specimen of its character while toiling up the range of low trap mountains north of Tysch creek, where the road gained an elevation of about 1,500 feet above the stream, by an ascent in many places so steep, that it was difficult to conceive of heavily loaded wagons passing up or down. After reaching the summit, our course lay over a gently undulating country covered with bunch grass. About ten miles from camp we crossed a small, dry ravine. In about seven miles more we entered, by a lateral defile, a fine open valley, containing several ranchos on the banks of a small, clear stream, called Fifteen Mile creek. The road now became very hilly. Between four and five miles further on, we crossed another stream, called Eight Mile creeek; and in two miles more, another, called Five Mile creek. Two miles more brought us to a beautiful valley, and on climbing the hills beyond, a noble panorama burst upon our view. The grand snow peaks of Mount Adams and Mount Hood, connected by dark fir-covered ridges, formed the background. In the distance, the broad Columbia wound through a terraced valley, and disappeared among the mountain gorges; while in the foreground, our national flag waving over the little town of the Dalles showed us that the wished for goal was won.

The fort is pleasantly situated on a small creek, about a mile south of the town, and is considerably elevated above it. We were received with great kindness by Major Haller, Captain Auger, Lieutenants Forsythe, Macfeely, and Dearing, of the 4th infantry, and Dr. Hammond, the officers then stationed at the post. Everything which could contribute to our comfort was thoughtfully supplied during our stay. I am also indebted to Major Haller for giving me much valuable topographical information about the country in the vicinity of the Dalles.

While waiting for provisions from Vancouver, I had an interview with William, a Chinook

Indian whom Colonel Frémont carried, in 1843, to the eastern States to be educated. I asked him very particularly about a summer trail up the Des Chutes valley, which Colonel Frémont was informed lay nearer the Cascade mountains than the one he followed. The Indian assured me that there was no such trail, and that, "if I wanted to take my pack mules through that region, I must go first with pick and shovel and make a trail, and then return for the animals." Although I questioned many white men and Indians about this trail, I could never find one that had even heard of it, and I am satisfied, from my own subsequent explorations, that none such exists. Colonel Frémont was, undoubtedly, misled by false reports; and the trail seen by him on December 4, 1843, probably terminated, like many which disappointed us in the same vicinity, in a whortleberry patch.

At the Dalles of the Columbia, situated a short distance above the town, the river rushes through a chasm only about 200 feet wide, with vertical basaltic sides rising from 20 to 30 feet above the water. Steep hills closely border the chasm, leaving, in some places, scarcely room on the terrace to pass on horseback. The water rushes through this basaltic trough with such violence, that it is always dangerous, and in some stages of the water impossible, for a boat to pass down. The contraction of the river bed extends for about three miles. Near the lower end of it, the channel divides into several sluices and then gradually becomes broader, until, near the town where it makes a great bend to the south, it is over a quarter of a mile in width. The Dalles is a favorite fishing resort for the Indians; and we saw, on the river bank, many piles of salmon which they had preserved for winter use. There are many fine specimens of columnar basalt in this vicinity, and the banks rise in low basaltic terraces, which, on the northern side opposite the town, are very rough and broken.

Our provisions arrived from Vancouver on September 16, and my men immediately began to prepare them for transportation on the pack mules.

September 17.—To-day I went, by steamboat, to make a rough reconnaissance of the river as far down as the Cascades, and to determine its descent there, leaving orders with Mr. Colcman to start for the Depot camp as soon as the provisions were ready. A small steamboat runs from the Dalles to the Cascades, where there is a land portage four miles and a half in length. From its lower terminus, another steamboat runs to Vancouver, and thence to Portland in the Willamette valley. I feel under great obligations to Captain W. B. Wells, the chief proprietor of this line of steamboats, and to Mr. L. W. Coe, an artist by profession, but now connected with the company, for their personal kindness, and for the valuable topographical information which they furnished.

In passing down the Columbia from the Dalles, the natural scenery was of the most magnificent description. The river soon entered a gorge of the Cascade Range, and wound through a wilderness of mountains, whose silent grandeur was truly impressive. In about ten miles we passed the narrow entrance of the cañon of Klik-a-tat river, a mountain stream flowing from the north. Soon afterwards we passed the Mam-a-loos islands, the lonely resting place of a departed nation of red men, whose bones lay bleaching in the sun. The method of burial had been very simple. Four stakes, interlaced with twigs and covered with brush, formed a tomb, which had been gradually filled with dead bodies, and then abandoned to the wind and rain. Ten miles more brought us to Dog River valley, a little, fertile spot extending towards Mount Hood, and forming a pleasing contrast to the savage mountains by which it was bordered. Nearly opposite was the mouth of White Salmon river, which struggled through a narrow gorge opening towards Mount Adams. About ten miles further on, we passed on the northern bank Wind mountain, a round isolated peak so steep that to ascend it from the river side would probably be impossible. Near its base is the mouth of a small stream called Wind river, which appeared to be formed by the junction of two branches behind the mountain. On the opposite bank the ridges, rising very abruptly from the river, seemed to be formed of loose stones, which would render excavation for a road very difficult and dangerous.

It is in this vicinity that the celebrated submerged forests are mostly found. They consist of numerous dead trees, stripped of their smaller branches, but still standing upright in the deep water near the river banks, and presenting every appearance of having grown there. As these trees could never have grown under water, their present position has given rise to much speculation. It has been suggested that they may have been transplanted from the neighboring mountains by vast avalanches. It is possible that this may be true in a few places, but not in all, as they are sometimes found where the position of the mountains precludes the idea. Another theory, which I think much more plausible, is, that formerly a great slide occurred at the Cascades, about fifteen miles below Wind mountain, and formed a dam; which, by raising the water above it, submerged and killed the forests growing on the banks. The appearance of the Cascades tends to confirm this idea. For four miles and a half the river rushes through a gorge, bordered by high and very precipitous ridges, and only about nine hundred feet wide in the narrowest part. Above, it expands into a kind of lake, about a mile and a half in width, containing several islands.

We reached the landing above the Cascades early in the afternoon, and were much pleased to find that it was not raining there, as it very often does in September. I took a careful reading of the barometer at the water's edge near the landing, and another at the foot of the principal rapid, about a quarter of a mile below; subsequent calculations give a difference of level of 34 feet between these stations. I then walked with Captain Wells to the lower landing, about four miles and a half from where we first went on shore, and took a third reading; from which the total descent in that distance was afterwards found by computation to be 61 feet. During high water the portage is much shortened, as the boats can ascend nearly to the foot of the principal rapid.

The wild grandeur of this place, for which Rapids would be a more appropriate name than Cascades, surpasses description. The river rushes furiously over a narrow bed filled with boulders and bordered by mountains, which echo back the roar of the waters. The path, winding through a thick forest on the northern bank, suddenly crosses an Indian burial place, where whitened bones strew the ground on every side, and fill one with amazement at the vast numbers of the dead. Petrifactions are abundant; and stumps closely resembling those of trees recently cut, are often found to be solid rock, with bark and woody fibre perfectly preserved. Salmon pass up the river in great numbers; and the Cascades, at certain seasons of the year, are a favorite fishing resort with the Indians, who build slight stagings over the water's edge, and spear the fish, or catch them in rude dip nets, as they slowly force their way up against the current. I passed through a rancheria of these savages, on my return in the evening from the lower landing. Their hideous faces, strongly painted on the darkness behind them by the flickering light of the fire around which they were crouching, and their mournful howls blended with the baying of their dogs at my intrusion, harmonized well with the ceaseless roar of the river, and the gloom of the forest cemetery, among the dry bones of which I turned to grope my way.

September 18.—This morning I returned by steamboat to Fort Dalles, after measuring the width of the river, by triangulation, in two places near the principal rapid. It proved to be 967 feet, in one place, and 1,811 feet in the other. As my train had already started for the depot camp, I settled all accounts, and made every preparation for following it on the next morning. Dr. Sterling here left the party.

September 19.—Starting alone this morning to overtake the train, I travelled over the same road as in coming, as far as Fifteen Mile creek, and then followed a pack trail up a long and gently sloping ravine. In about 10 miles it conducted to the wagon road again, 3 miles from Tysch mountains. By a little side cutting, a road could be made in this ravine, shorter and better than the one at present used. I overtook my party at Tysch creek, and encamped there. We slept, as usual, without tents, and a shower in the middle of the night gave us an unpleasant surprise. It was but a poor consolation to reflect that they might now be expected at any time, as the rainy season had commenced.

September 20.—This morning a half-breed informed me that there was a good pass to the Willamette valley, through a slight visible depression in the mountains near Mount Hood. This information had an important effect upon our future movements. To-day we continued our journey back over the trail by which we had come, and encamped at Nee-nee springs.

September 21.—At Wam Chuck river I examined a warm spring larger than any I had seen before. The great flat rock through which it rose, seemed unstable, for stepping on it caused the water to bubble up more freely. The spring seemed to flow from a number of small holes in a place 15 or 20 feet in diameter, and its temperature was 145° Fahrenheit. It was on the northern bank of the river, about a quarter of a mile above the point where the trail crossed. Access to it was rather difficult, on account of the narrow character of the cañon, but it well repaid the trouble of a visit. We encamped on Chit-tike creek.

September 22.—To day we encamped, at the same place as before, in the Mpto-ly-as river cañon. Here we met a party of Indians, with their squaws and children, travelling north. They caught several salmon in the river; one of which, weighing about twenty-five pounds, we bought. They spear the fish with barbed iron points, fitted loosely by sockets to the end of poles about eight feet long. When the point pierces the fish, it separates from the end of the pole, but remains strongly secured to it by a thong about twelve feet in length. This prevents the salmon from breaking the pole in his struggles. A member of our party shot with a pistol and secured one of these fish, of which there were many in the river. Our animals suffered from want of grass to-night.

September 23.—To day we followed the old trail to the "black butte," where we found a paper on one of the trees, stating that the main party was in camp on Why-chus creek, about seven miles towards the south. We struck through the woods, and soon saw the white tents in an open prairie covered with grass and bordered by fine timber. Near it, the brook Que-y-ee, after spreading out into a meadow, disappeared. This little opening, amid forest-clad mountains and grand snow peaks, furnished a camping place, the wild beauty of which I have seldom seen equalled. This was enhanced, in the evening, by a magnificent lunar rainbow, and a beautifully tinted halo round the moon; both of which appeared at the same time in different quarters of the heavens. It is a singular coincidence that Col. Frémont, the only explorer who ever preceded us in this region, saw the same rare phenomenon of a lunar rainbow, within about twenty miles of this spot, in 1843.

MOUNT JEFFERSON AND BLACK BUTTE FROM CAMP 5.

SECOND EXPLORATION IN DES CHUTES VALLEY, AND CROSSING OF THE CASCADE MOUNTAINS.

September 24.—The party again separated at Camp S on Why-chus creek. Lieut. Williamson dispensed with the future services of all the escort, except Lieut. Sheridan, with his dragoon detachment of twenty-five men, and Lieut. Crook, the quartermaster and commissary of the expedition. Accompanied by this small party, with Messrs. Fillebrown, Young, Bartee, and three packers, he started to cross the mountains near Diamond Peak, and follow down the Willamette valley to Vancouver. Lieut. Gibson, with the rest of the escort, started for Fort Lane. Dr. Newberry, Mr. Anderson, Mr. Coleman, and fourteen packers, with all the spare animals and most of the baggage, remained with me in camp. My orders were to explore the mountains to the north; cross them where I best could; and rejoin Lieut. Williamson at Vancouver. Not anticipating any Indian troubles, we considered my party sufficiently strong for this purpose. The day was spent in recruiting the animals, and in repairing a broken barometer.

September 25.—In the morning we travelled about eight miles towards the base of the "black butte," and encamping on Que-y-ee brook, near where we had crossed it in going to the Dalles, spent the rest of the day in completing our arrangements. I had already seen that no railroad could be built in the valley near the Des Chutes river. It now remained to explore the region near the eastern base of the foot hills. Having about eighty animals, many of which were almost broken down, I decided to divide my command, and examine the unknown region with a light scouting party, while Mr. Coleman, in charge of the rest of the train, should return by our former trail to Nee-nee springs, and recruit the animals on the excellent bunch grass there, until I should join him.

The brook Que-y-ee, near camp, was clear and cold, but rendered difficult of access by thick bushes, and in some places by miry banks. There was plenty of bunch grass in the vicinity, but the dense forest which surrounded us rendered the loss of animals probable.

September 26.—This morning we separated. My little party consisted of Mr. Anderson, Dr. Newberry, myself and eight men. We took eleven days' provisions, and twelve pack mules loaded with only seventy-five pounds each, as I anticipated many difficulties on our unknown route. We followed our old trail to the point where it forked, about nine miles from camp, hoping that the western branch might lead to the foot hills; but it almost immediately terminated in an old Indian rancheria, near which there was a little water in the bed of the creek that we had found dry at the fork. Disappointed in the trail, I endeavored to take a northwest course by compass. The pine forest was very thick; the pumice-stone soil was so light that our mules sank over the fetlock at every step; and the fallen timber and thick underbrush continually obstructed our way. We toiled slowly up a long, gradual ascent, now turning to the right and now to the left to avoid the fallen timber, until we were forced, by some impenetrable underbrush, into a slight ravine, in which were a few pools of water. Fighting our way with great difficulty among the logs which filled the bottom, we climbed its northern side, and entered a small open space dotted with a few clumps of grass. The men were directed to herd the jaded animals in this breathing spot, while Dr. Newberry and I crawled over the dead trees into another ravine, northeast of us, to search for water. Finding none, we all struggled on towards the west, fully expecting, as the sun was low, to encamp in the forest without water or grass. Before halting, however, we suddenly reached the summit of a slight precipice; at our feet lay a fine little prairie, about a quarter of a mile long, covered with the richest bunch grass, and bordered on every side by thick forests of pine and fir. Beyond it, the sun, which had nearly set behind Mount Jefferson, crowned his snowy head with crimson and gold, and threw an indescribable glory over the tangled mass of mountains at his feet. We descended, and began eagerly to search for water; but found none. Still, as it was too late to go further, we encamped; and, by digging a hole about three feet deep in a moist spot, succeeded in obtaining enough muddy water for ourselves, but not for the animals. The little prairie was evidently, in the rainy season, a meadow in which a tributary of Mpto-ly-as river heads. Mr. Anderson in following down its bed through the forest found a little water, about a quarter of a mile from camp; but it was dark before he returned. The moon seemed very bright in the pure mountain air, and I easily wrote my journal by its light.

September 27.—This morning it rained. After following a westerly course through the wet bushes for about a quarter of a mile, we suddenly saw the light breaking through the dense forest before us, and, hoping that we were approaching another prairie, pressed eagerly forward. We soon stopped in blank amazement on the verge of an immense cañon, which was found by subsequent measurement to be 1,945 feet deep. Far below us we heard the roar of a mountain torrent. Opposite rose, steep and black, and hitherto unseen by civilized man, the naked base of Mount Jefferson, while around it clustered gloomy, fir-covered mountains, whose tops were hidden in rolling masses of clouds. The cañon side below us was so steep and rocky that we feared the descent would be impracticable. I directed the animals to be herded, and sent three men to explore it, while Dr. Newberry and I followed along the edge about half a mile to a projecting cliff, from which we could obtain a better view of the country. It had ceased raining, and the heavy clouds which shrouded the opposite mountains rose slowly until a noble panorama lay outspread before us. The river came from the south in an enormous cañon, and, after washing the base of Mount Jefferson, disappeared in a northerly direction. Into this cañon two others opened in front of us, one containing a small tributary from the west, the other winding out of sight towards the north, apparently in the direction which we wished to explore. The bottom of the latter appeared to be free from trees, and to rise with a very gentle slope. Much elated by the prospect of escaping from fallen timber, we returned to the rest of the party, and began the descent to the river. Slowly and with great difficulty we forced our animals, now along narrow ledges of dark gray slate, where a mis-step would have precipitated them to instant destruction, now down steep slopes of loose rocks of the same character, masses of which, becoming dislodged, rolled down the precipice, and starting others in their course filled the cañon with reverberating echoes. After winding about in this manner for nearly three quarters of a mile, we at length reached the bottom in safety. It was about three hundred yards wide, bordered by pines and thickly carpeted with fine bunch grass. A river, which I knew must be the Mpto-ly-as, flowed through it, apparently unfordable from its depth and velocity. Its banks were abrupt and lined with willows, and its bed was full of boulders. After riding up the cañon about a half a mile, we at length discovered a very bad rocky ford, but some of the animals mired in getting out of the water. We then turned towards the north, and crossing the western cañon near its mouth, found in it a small stream with very miry banks, and an old Indian trail. On reaching the second lateral cañon we found, to our bitter disappointment, that the absence of trees in its bottom was due to a mass of comparatively modern lava, divided in every direction by deep fissures, which rendered it totally impassable to our animals, and almost so to ourselves. It had flowed from the eastern side of Mount Jefferson, and had cooled so rapidly as to leave a narrow strip of the valley, on each side,

CASTLE ROCK IN CAÑON OF MPTO-ILY-AS RIVER NEAR CAMP 53 A.

uncovered. These strips were about ten feet lower than the surface of the lava field, and densely filled with firs and pines. Ice-cold brooks, from the melting snow on Mount Jefferson, washed the edges of the pedregal, and occasionally spread into narrow swamps extending to the steep sides of the cañon, and completely choked with bushes. Hoping to be able to force our way through these obstacles, we struggled desperately up the southwestern edge for about three miles. A projecting spur here closed in abruptly upon the lava, and rendered further advance impossible. Leaving the rest of the party with the jaded animals, I crossed the stream on a natural bridge formed of an old log, climbed up the side of the lava field, and sometimes leaping over yawning fissures, sometimes winding around them, gradually advanced about a quarter of a mile to what appeared to be a small crater. It was nearly circular in form, and about two hundred yards in diameter, with the lower side partly broken away. A more utterly desolate spot cannot be conceived. No sign of life was visible. Rough masses of dark lava lay piled around like the waves of a stormy sea. Fir-clad mountains reared their inaccessible summits on every side, apparently cutting off retreat; while Mount Jefferson, without one intervening ridge, towered high above all, rugged with precipices and capped with glittering snow. It was a spot where, in all probability, no human foot had ever before intruded, for even the wild children of the forest abandon it to the fiends and demons of their traditions.

A high ridge from Mount Jefferson terminated the cañon, and rendered further exploration unnecessary, as well as impossible. I returned to the party, and we retraced our steps to the little stream flowing from the westerly cañon, and encamped there, with an abundance of fine grass and ice-cold water.

September 28.—Being unwilling to leave without examination the western cañon, where we had seen the Indian trail, Mr. Anderson and myself, with two men, started to explore it this morning, leaving the rest of the party in camp. We soon struck the trail, and followed it for about four miles up a little wooded gorge, which gradually turned towards the south.

Here we found that our "black butte" was in sight, and that the trail apparently led to the prairies near it, through a straight and level valley. We accordingly turned back, fully satisfied that the only way of advancing to the north was to travel down the Mpto-ly-as cañon. On breaking up camp we followed the old trail, which took this course. It led us below the lava field, across the two brooks which had flowed by its sides, and then up a long, gentle slope, through an open forest of pine, larch, and fir. We were beginning to congratulate ourselves on the excellence of the trail, when, about six miles from camp, we were suddenly stopped by another precipice bordering the river, and more than 1,000 feet deep by measurement. From the summit, I could see that the ridge, which I had already observed extending from Mount Jefferson to a black peak, continued beyond it, and, without any marked depression, now formed the north side of the river cañon, which began to turn towards the east. With much difficulty gaining the river bottom, which was here filled with a tangled mass of small trees and bushes, we toiled on for about three miles further, and then encamped in a narrow strip of fine bunch grass. Both sides of the cañon were here about 1,500 feet high; and opposite us, some 800 feet above the water, was a large mass of gray conglomerate sandstone, so much resembling the ruins of an old castle that we could hardly believe it the work of nature. It rose abruptly from the dark foliage around it, with its battlements, turrets, and towers, bathed in the light of the setting sun—a fitting home for the presiding genius of this wild torrent of the mountains.

September 29.—After travelling a few miles down the cañon to-day, the barometer began to leak badly from a crack in the glass cistern. As all the materials for properly repairing it were with Mr. Coleman, I decided, rather than to run the risk of ruining it by transporting it in its present condition, to remove the mercury, and replace it after rejoining him.

Abandoning, therefore, my intention of leaving the river as soon as possible and further exploring for a railroad pass near the mountains, which the loss of the barometer rendered inexpedient, I followed down the cañon about eleven miles, to where we had crossed it in going to the Dalles. The trail was rendered execrable by numerous steep spurs, which ran out to the very water's edge, and compelled us to toil up sometimes as high as 500 feet, and then abruptly descend again. We began to find concretes and tufas on the sides of the cañon as we approached our old camping place; but there was none of this formation near Mount Jefferson. At one place there were a few rude pictures of men and animals scratched on the rocks by some wandering savage. On the march to-day we shot and secured one of the fine salmon which abound in the river, and which are highly prized by the Indians for winter food. Three streams, flowing in deep cañons, entered the river from the north. One of them showed, by the milky color of its water, that it came from the melting snows of Mount Jefferson, and thus proved that the country between us and Chit-tike creek was furrowed by at least one enormous ravine, which could not be headed. After reaching our old trail, we followed it to Psuc-see-que creek, and encamped there after sunset; having travelled twenty-one miles to-day over a most difficult route.

September 30.—As it was highly desirable to determine accurately the position and character of the cañon of the Des Chutes river, I started this morning, with one man, to follow down the creek to its mouth, leaving the rest of the party in camp. Having yesterday experienced the pleasures of travelling in the bottom of a cañon, I concluded to-day to try the northern bluff. It was a dry, barren plain, gravelly and sometimes sandy, with a few bunches of grass scattered here and there. Tracks of antelopes or deer were numerous. After crossing one small ravine, and riding about five miles from camp, we found ourselves on the edge of the vast cañon of the river, which, far below us, was rushing through a narrow trough of basalt, slightly resembling the Dalles of the Columbia. We estimated the depth of the cañon at 1,000 feet, but I think it would be found to be deeper, if measured. On each side, the precipices were very steep, and marked, in many places, by horizontal lines of vertical basaltic columns fifty or sixty feet in height. The man who was with me rolled a large rock, shaped like a grindstone and weighing about 200 pounds, from the summit. It thundered down, for at least a quarter of a mile, now over a vertical precipice, now over a steep mass of detritus, until, at length, it plunged into the river with a hollow roar, which echoed and re-echoed through the gorge for miles. By ascending a slight hill which rose from the plain, I obtained a fine view of the surrounding country, and many valuable bearings to the mountain peaks. The generally level character of the great basaltic table land around us was very manifest from this point, although, near the trail, it is marked by a continual succession of deep ravines. Bounded on the west by the Cascade mountains, and on the north and east by the Mutton mountains, the plain extends far towards the south, a sterile, treeless waste. At the mouth of the Psuc-see-que cañon there is a singular hill isolated from the plain. Its top is a nearly circular floor of basalt, surrounded by vertical precipices about forty or fifty feet deep, and then by a collection of detritus, sloping down at an angle of about 45° to the level of the river.

In returning to the camp, we tried the cañon of the creek, which we found very narrow and stony, and often so obstructed by bushes as to compel us to climb along its steep sides. About a mile below camp it narrowed into a wild, natural gateway, the top of which, elevated about 500 feet above the creek, was formed of two vertical precipices of columnar basalt, each about

100 feet deep, and separated 800 feet from the other. From these precipices, piles of detritus sloped down at an angle of 45° to the little silver thread of water winding between them. The huge rocks in the bottom compelled us to climb about half way up this slope to effect a passage. The line of columns on the top of the northern side was strangely bent and distorted, as if, while they were in a semi-fluid state, a huge crag had fallen among them; those on the southern bank were very straight and vertical.

We travelled to-day to Chit-tike creek, and encamped there. Dr. Newberry and I followed its bed, on foot, about two and a half miles, to the Des Chutes river. We found it a deep, swift stream, 80 yards wide, and still sunk in the enormous cañon, which, I have no doubt, extends about 140 miles above its mouth. The Chit-tike cañon is much wider than that of Psuc-see-que, and there is a good trail leading to the river in its bottom. It was dark before we rejoined the party; and the camp fires, shining among the bushes, formed a striking contrast to the gloom of the cañon as we approached.

October 1.—On reaching Wam-Chuck river this morning, we found a large number of Indians encamped there, who were very desirous to trade potatoes for matches and ammunition. Sending the party forward to join Mr. Coleman at Nee-nee, Dr. Newberry and I stopped to examine more fully this most interesting locality. Had we known that these savages were on the point of joining in a general war against the whites, we might have felt less curiosity. As it was, we visited the warm spring, which I had seen on September 21; examined the lateral gate cañon; collected several interesting geological specimens; and then climbing to the summit of the mountains, round the eastern side of which the trail winds, obtained a very extensive view of this strange, picturesque valley. The great number of compass bearings that I took from this and many other commanding points, cover the whole region with a net work of triangles, which, I think, cannot fail to render the accompanying map of this section quite accurate.

We reached Nee-nee springs a little while before sunset, and found Mr. Coleman and his party awaiting us. He had met with no difficulty, except in transporting the battered pair of wheels to which our odometer was attached, and which, out of compliment to its former estate, still retained the name of the "little cart." Much credit is certainly due to him, considering the small number of his party, for getting even this up and down some of the precipitous cañon sides on the route. He reported that the jaded animals had been greatly benefited by the rich bunch grass, which abounded in this vicinity.

October 2.—To-day we remained in camp. I succeeded in repairing the cistern of the barometer by covering the crack with Husband's adhesive plaster, and then applying a coat of sealing wax dissolved in alcohol, to protect it from moisture. I re-filled the instrument, and had no further trouble with it on the survey. I also obtained good observations of the sun today. In the afternoon Dr. Newberry, who had been suffering for some time from fever and ague, was taken dangerously ill. We were all quite anxious on his account, as a bottle of arsenic had been broken in the medicine chest, and none of us, excepting himself, had any knowledge of the healing art.

October 3.—This morning Dr. Newberry was much better, and able to ride, with two men and myself, to Tysch creek. Lieutenant Williamson had authorized him to proceed to Vancouver by water, to examine certain coal mines in Washington Territory. I proposed to return on the following day to my party, after obtaining, if possible, a guide acquainted with the new pass near Mount Hood, of which the half-breed had spoken. On reaching Mr. Evelyn's house, we heard some astounding news. A general Indian war had broken out; the Indian agent of Washington Territory and several other whites had been murdered; and Major Haller, with a large force of United States troops, had gone to meet the hostile tribes. All the settlers south of the Dalles had already fled from their ranchos, except Mr. Evelyn, and he had sunk his ferry boat, and was about to follow them the next morning. The situation of our little half-armed party, consisting of only seventeen men, now that Dr. Newberry was about to leave us, was anything but enviable. Encumbered with a large number of jaded animals and considerable baggage, we suddenly found ourselves among hostile and well-armed Indians, to whom our train would render us a tempting prey. A difficult and almost unknown range of mountains, now liable at any time to be blocked up with snow, separated us from the Willamette valley. Each of the three known passes across it seemed almost impracticable for us; that of the Columbia river, on account of the impossibility of obtaining a flat-boat to cross to the northern bank above the Cascades, while the war was raging in the immediate vicinity; and the wagon road, and the pack trail north of Mount Hood, on account of the entire absence of grass, which would render the loss of a large number of our almost broken down animals inevitable. I had a long conversation with the half-breed about the new pass. He said it was much more level than either of the others, and was well supplied with grass, but that the trail was so slight, and had so many forks leading to whortleberry patches, that a guide would be absolutely necessary. He positively refused to accompany me himself, being, as he said, afraid of the Indians. Feeling very much inclined to attempt the exploration of this pass, which, should the description prove true, would be very valuable for a wagon road, if not for a railroad, I inquired of Mr. Evelyn whether none of the little band of Indians, whose rancheria was near his house, could be trusted as a guide. He told me that, although they had not yet joined the hostile tribes, they had stolen several of his horses lately, and were growing rather insolent. Still he thought that their old chief, named Kok-kop, might be trusted a little while longer. As Major Haller had mentioned this Indian in high terms to me, I resolved to see him. To my surprise, he said that he knew nothing of this pass, and had never heard of it. This threw discredit upon the whole story, especially as half-breeds are noted for their strong imaginations. It was now evening. To guard against any sudden attack, I had the animals carefully tied to a strong fence; and dividing the night into three watches, took one myself and gave one to each of the men. It was very dark and cloudy, with occasionally a few drops of rain, and I could not but feel that our prospects were rather gloomy.

October 4.—This morning Kok-kop informed me that he had found a young man of his tribe who had been through this pass, and who would go as guide. As our chance of getting safely through the mountains with our animals, except by steamboat, which my instructions expressly forbade, was nearly desperate, I decided to trust him, and gratify my desire of exploring the pass. After the long and ceremonious council which Indians always require on great occasions, I succeeded in hiring the young man, on reasonable terms; or rather in bargaining with his chief for him, as he himself had no voice in the matter. The interview terminated by Kok-kop giving him strict orders to be obedient to me, and by my presenting Kok-kop with a red silk handkerchief.

Leaving Dr. Newberry to go to the Dalles with Mr. Evelyn, we returned to the rest of the party, with the new guide whose name was Sam An-ax-shat. He was about eighteen years old, and a very intelligent, neat, and, as the result proved, trustworthy Indian. For natural intelligence, he would compare very favorably with most white men. He spoke no English, but, fortunately, I had acquired some knowledge of the Chinook language, and we were able to converse with considerable ease. After reaching camp, which we found undisturbed, we made every preparation to start to-morrow for the Willamette valley.

October 5.—This morning we followed a westerly course, near the southern slope of the Mutton mountains, through a slightly undulating region, covered with bunch grass and destitute of trees. After crossing a large trail leading from Tysch creek to Wam Chuck river, we passed over a slight spur from the Mutton mountains, and winding round the northern base of a prominent hill called Wah'-nit-ched, came upon a fine open prairie. Before long the trail suddenly turned towards the north round a steep hill, and we entered the forest, which extended almost without interruption to the Willamette valley. To-day it was open, without any fallen timber or bushes, and it consisted mostly of pine and larch. After travelling about twelve miles from camp, we reached, in the midst of the forest and at a short distance from the trail, a small spring called Wil-la-wit. There was good bunch grass near it among the trees. The guide said that we could not reach the next stopping place before dark, and, rather unwillingly, I concluded to encamp, taking every possible precaution against a surprise. We had found much silica on the road during the day, and here we obtained fine specimens of several varieties.

October 6.—There were indications of Indians around camp last night, and this morning, as we were about starting, one of them came to us and used insolent and threatening language. No attack or attempt to stampede our animals was made, however. Our course lay through a nearly level country, covered by an open pine forest offering no obstacles to travel. In about six miles we came to a little tributary of Wam Chuck river, called Wan-nas-see. It flowed in a small ravine, which the trail followed without obstruction for about a mile, to where a trail from Tysch creek entered it by a lateral cañon. At this spot the ravine became narrower, and fallen timber began to retard our progress. It grew worse as we advanced, until it was almost impossible to get the "little cart" over the huge logs. We toiled on, with much labor and difficulty, for about four miles further to a little open meadow, about a mile long and a quarter of a mile wide. It was called Yaugh-pas-ses, the Indian name for cranberries, which were plentiful in the vicinity. The Indians, when travelling from Tysch creek to their whortleberry patches near Mount Hood, choose this spot for the first camping place. They come, of course, by the trail which enters ours on Wan-nas-see creek, and which the guide said was a good one. I was very desirous to go further to-day, but Sam said that the fallen timber was very bad ahead, and the camping place a long distance off. We might possibly reach it about sundown, but I must certainly, as he expressed it in Chinook, "*mam'-uk mam'-a-loos ten'-as chik'-chik*"—that is, "kill the little cart." As most of the train was still struggling among the fallen timber in the rear, I concluded to encamp, and to adopt on the morrow a new order of march, better adapted to a country blocked up with logs and underbrush. I also decided, much against my will, to "kill the little cart." The men took the spokes for picket pins, and in this form, our old friend continued to accompany us to the end of the survey. We found many common varieties of silex on the route from Nee-nee to this point, but none afterwards. The grass of the meadow was coarse and not very nutritious, and water lay on the surface in many places. We encamped in the driest place we could find, and took all possible precautions against a night attack.

October 7.—To-day we had to struggle through a tangled forest of spruce, yew, fir, and pine, with many fallen logs crossing, and sometimes even piled up on the trail. On both sides of it, they would have rendered an advance, without cutting a way with axes, impracticable. Driving about sixty loose animals through this forest was no easy task, as when the leaders were delayed by the logs, those behind would leave the trail on both sides, and crowd into places where it was impossible to advance and nearly so to retreat. Our usual order of march had been for the gentlemen of the party, with a man riding the bell horse, to form an advanced guard; while the packers, in charge of Mr. Coleman, brought up the rear of the train. The fallen timber now compelled me to separate the men among the animals, giving a certain number in charge to each man. This scattered our little party over a space of more than half a mile, and rendered a successful defence against a sudden attack almost hopeless.

Yaugh-pas-ses meadow is drained by a small brook that discharges itself into a branch of Tysch creek, which we crossed a little more than a mile from camp. It was a clear rapid stream, about fifteen feet wide, flowing in a small ravine near the northern base of two prominent peaks, called Nu-ah-hum by the Indians. We followed along the side of this narrow valley about seven miles, to the source of the stream. It was a mountain lake called Wat-tum-pa, which was more than a mile long, bordered by a little meadow grass and surrounded with thick forests. Its banks were so miry that our animals could with difficulty drink. Here we were compelled to encamp; our mules had spent the day in jumping over or creeping under logs, and the men in strugging after them and repairing broken packs. We were all fully convinced that wandering amid "forests primeval" in poetry, and among the Cascade mountains, are two essentially different things.

We began to find among the trees a few mountain whortleberries, called Oo-lal-le by the Indians, who gather them in large quantities and dry them for winter food. There were two varieties, one large and black, growing on bushes about six feet high, and the other much smaller, of a blue color, and found on bushes of about half that height. Both were delicious when fresh. We also noticed that we had passed beyond the region of bunch grass, and that its place among the trees was supplied by a very coarse, deep green species, which none of the animals would taste.

October 8.—Last night a few of our animals strayed off into the forest, and we were delayed some hours in searching for them; by the great exertions of Mr. Coleman they were at length all found, and we started. The trail lay on a ridge, having a ravine parallel to it on each side. The fallen timber was not so troublesome as yesterday, but the forest, which was composed of huge trees of yew, fir and spruce, and some pine, was very dense. In about a mile we crossed a small stream with no grass near it. A mile further on we reached an open prairie, about one mile long and half a mile wide, covered with a coarse kind of grass; it was called by the Indians Lu-ah′-hum-lu-ah′-hum, and appeared to be sometimes occupied by the savages as a camping place. Doubtless there must be water near it, but we found none. There were several large trails here, but our guide, after hesitating a few moments, took a very small one leading west, through a thick forest of young trees and bushes. In about two miles we came to a beautiful mountain lake, called Ty-ty-pa. It had a narrow border of rich grass, separating it from the dense forest around; but the whole open space was only about half a mile long. This is the second camping place of the Indians when travelling from Tysch creek to the Willamette by this trail. It is also a favorite resort for gathering whortleberries, which we found growing in very great abundance. The ground had been dug over by bears in many places, and large numbers of ducks and a few wild geese were swimming in the lake. The forest concealed the surrounding country, but the Indian said that it was level for a long distance, both north and south, and filled with deer. He also said that the next water was very far off, and the trail bad, and that we ought to encamp here. As it was now past noon, we did so. The grass had been eaten quite short by the Indian horses, but it was of a nutritious quality, and the animals fared pretty well. Mount Hood towered high above us, and his huge, snow-capped head, now appearing and now disappearing among drifting masses of clouds, gave a wild grandeur to the little camping place, which will be long remembered.

October 9.—To-day it rained furiously in the morning, and as I was very desirous to have a good view of the surrounding mountains when I crossed the dividing ledge, and as the animals greatly needed a day of rest, I decided to remain in camp. Towards evening it cleared off, and I measured by triangulation, as accurately as circumstances allowed, the distance to the summit of Mount Hood, the bearing of which, by the compass, was N. 4° E.; the resulting distance, about 14 miles, agrees very well with that given by our courses checked by latitude. In the evening, as usual, I obtained good astronomical observations.

October 10.—This morning the weather was clear. We started early, abandoning a horse that could travel no further. On leaving camp we ascended a steep hill about 400 feet high, and then gradually descended, for about a mile and a half, by a succession of pitches connected by narrow terraces. They conducted to a small brook, flowing north through a ravine destitute of grass. Continuing a southerly course for about two miles further, we found ourselves in a small dry prairie, where the trail suddenly seemed to disappear. Thus far to-day we had been very little troubled by fallen timber. Our guide dismounted, and, directed by signs too slight for our eyes, led us across the open spot to a place where the Indians had blazed the trees for a few rods into the forest, but where no trail on the ground was visible. We had before occasionally seen blazing, and sometimes twigs broken in the direction of the trail. The blazing generally consisted of a simple cut, laying bare the wood; but sometimes we found a rude image of a man marked in the bark. This always indicated that much fallen timber was to be expected. The object of the blazing, in the present instance, was simply to indicate a direction, for it soon ceased, and even Sam could see no trail. By carefully preserving the course it had pointed out, however, he led us about a mile up a gentle slope, covered with much fallen timber, to the brink of an enormous precipice, which seemed vertical. There was a trail near the edge, which conducted us up a gradual ascent to the foot of a very steep mountain, composed of basalt and compact metamorphic slate, whose summit was bare of trees. After climbing it with much labor, and the loss of a mule that rolled down the precipitous side, a magnificent panorama burst upon our view. At an elevation of 5,000 feet above the sea, we stood upon the summit of the pass.* For days we had been struggling blindly through dense forests, but now the surrounding country lay spread out before us for more than a hundred miles. The five grand snow peaks, Mount St. Helens, Mount Ranier, Mount Adams, Mount Hood, and Mount Jefferson, rose majestically above a rolling sea of dark, fir-covered ridges, some of which the approaching winter had already begun to mark with white. A yawning ravine, into which we had gradually and unconsciously descended this morning, came from the north, near Mount Hood, and winding to the south round the mountain on which we stood was lost in the dim distance. Another, heading near us, wound out of sight towards the west. On every side, as far as the eye could reach, terrific convulsions of nature had recorded their fury, and not even a thread of blue smoke from the camp fire of a wandering savage, disturbed the solitude of the scene.

Near this mountain we noticed an extraordinary local variation of the magnetic needle, which numerous bearings to well known peaks enabled me to measure with considerable

*This is the summit by my trail. It is 500 feet higher than that of the proposed wagon road.

accuracy. At places about two miles from the mountain, both before reaching and after leaving it, the variation, as usual in this region, was about 18° east. At the top of the great precipice encountered about a mile before reaching the mountain, it was only 11° east, while on the summit it was 16° west. The needle was thus actually disturbed 34° by some abnormal cause. It, however, settled readily. The mountain was principally composed of slate and basalt, like those around it, and we could see no indication of iron or other local cause of disturbance in the vicinity.

During the remainder of the day's march, the trail followed a knife-like ridge between two great cañons east and west of us, to avoid the fallen timber in them, and it was very mountainous in its character. After a steep descent we toiled up another peak, two miles distant from the first and very similar to it. From the summit we could look many miles down the great westerly ravine, and distinctly see the blue hills of the Willamette valley beyond its mouth. This peak was separated from the next one of the ridge by a cañon connecting the two great ravines. This we crossed with difficulty, and continued to follow the narrow ridge, toiling up and down several more steep peaks rising from it, until the sun was only a few minutes high. Some of our exhausted animals were far behind, and the Indian said that we were still a long way from the "Stone House," where he had expected to encamp. He knew, however, a spring not far off, where we could get water, but no grass. We reached it on the steep eastern side of the ridge just as the sun set. Its bed was dry. We were all feverish from fatigue and thirst, and it was a bitter disappointment; still, to advance was impossible, and our animals were unpacked and tied to the trees as they gradually came in. Two had broken down entirely, and been abandoned on the way. In the meantime the Indian had disappeared. When he returned he quietly remarked that he had discovered water. We rushed to it, and found a little spring, which flowed almost drop by drop from under a rock in the thick bushes. There was enough for the men, but none for most of the suffering animals, and their cries from hunger and thirst were incessant through the night.

October 11.—This morning we took a westerly course, which led us over the ridge that we had been following, into a third great ravine heading near us and winding out of sight to the northwest. The descent was about seven hundred feet, and very abrupt. In the ravine we found a fine stream of water and a small lake, bordered by some good grass, which, however, had been eaten so short by Indian horses that our animals could get none. This place Sam called the "Stone House." The origin of its name I could not discover, but probably there is a cave in the vicinity. It is a great Indian whortleberry camp, and we found the bushes still loaded with berries. The lake is doubtless the source of a branch of Sandy river. Disappointed in finding grass for the animals, we toiled up a steep precipice of compact slate, 1,000 feet in height, to the summit of the western side of the ravine, and obtained an extended view of the surrounding country. On every side nothing could be seen but fir-clad ridges and frightful cañons; most of our animals were on the point of giving out from fatigue and hunger; and, to crown our misfortunes, Sam quietly informed me that he had only travelled between the "Stone House" and Willamette valley once, and that was when he was a child. He had a vague recollection of many mountains and a great scarcity of grass on the way. Under these happy auspices we pushed desperately on towards the west. After following a narrow ridge thinly covered with trees, until we had travelled a little more than six miles from camp, we fortunately found a small opening, in which the ground was wet from numerous springs and thinly dotted with grass. We had hardly encamped, when a rain storm that had been threatning all the morning, suddenly burst upon us, causing great anxiety lest it should change into snow. Sam and I explored the vicinity on foot, and I was fortunate enough to obtain a good bearing to Mount Hood through the clouds. It was N. 40° E. We were on a narrow ridge, with an immense cañon on each side of us, and the supply of grass was very limited. The number of whortleberries was so great that we could strip them from the bushes by handfuls.

October 12.—All last night and to-day, a cold and steady rain poured down, chilling our animals and rendering the trail slippery and dangerous. Although I greatly feared snow, I decided to remain in camp and recruit the animals, as many must have given out had we proceeded. To eke out their scanty supply of grass, I issued a small quantity of hard bread, which most of them ate eagerly. We collected heaps of pine knots and logs in different parts of the opening, in order to pack the mules by fire-light on the following morning, and thus get a very early start. In the night it cleared off, and Mr. Anderson and I left our beds, and obtained good observations for latitude.

October 13.—We had reveillé at two o'clock this morning, and started as soon as it was light enough to see the trail. It followed a continuous ridge, varied by a succession of steep peaks, slippery from the rain. After slowly climbing over them for about three miles, we encountered one so steep that the ascent seemed impossible. We, however, carefully urged the animals along a narrow ledge, which wound up the face of the tremendous precipice, and at length gained the summit. The blue Willamette valley, marked by a line of fog rising from the river, lay below us, and the word "settlements," shouted down the line, inspired every one with new life. From this point we began a rapid descent to the level of the valley. At the foot of the mountain there was a small grassy swamp, around which the trail wound in nearly a semi-circle. Beyond it we crossed a rocky pedregal, and then followed another ridge less mountainous than the former one. It gradually disappeared, and left us among thick fallen timber. A very few clumps of bunch grass again began to appear among the trees. This trail had been used by the Indians of the Willamette valley to reach the whortleberry patches, and they had cut through many of the logs. Still vast numbers were left, and we were obliged, in several places, to clear a path with axes. We slowly worked our way on, in this manner, until night overtook us, and compelled us to encamp in the dense forest without either water or grass. During the night the cries of the half starved animals were very distressing. We also suffered much ourselves from thirst, which a diet of musty hard bread did not tend to allay.

October 14.—Yesterday, one of our best mules, with a valuable pack, was lost on the way, and I sent two men back this morning to search for him. The fallen timber diminished in quantity as we advanced, and the trail soon became excellent. Pressing rapidly forward we reached, about five miles from camp, a little log cabin on the edge of the forest, and, with a feeling of inexpressible satisfaction, found ourselves at last in the long wished for Willamette valley.

The owner of the cabin was in great fear and trouble. News had come by water from the Dalles, that all the Indians east of the mountains had banded together against the whites, and that Major Haller had been defeated, and his party of United States troops nearly cut off. The Governor of the Territory had called for volunteers, and great alarm was felt lest the Indians should cross the mountains, and attack the frontier settlements of the Willamette valley. This man was just starting to go to one of the large towns for protection. He expressed the greatest astonishment at our having succeeded in crossing the mountains, which had always been considered utterly impassable in this vicinity. He told me that the nearest place where I could obtain forage, was at the rancho of Mr. Hugh Currin, about four miles distant.

Continuing our course through a slightly undulating, well wooded country, we soon reached our destination, and encamping near a little stream by the house, succeeded in obtaining good pasturage, and an abundant supply of oats. Mr. Currin, to whom we are indebted for many acts of kindness, was the owner and first settler of Clackamas prairie, a fine little opening situated on the eastern bank of the Clackamas river. It was through the cañon of this stream, that we had first seen the Willamette valley. The non-appearance of the two men whom I had sent back for the mule rendered us all quite anxious to-night.

October 15.—To-day both the men came in, after an unsuccessful search. As this was an excellent place for our animals to recruit, I resolved to send Sam back for the mule, and to wait three days for his return. Many of the settlers were abandoning their ranchos, from fear of an Indian attack, and a general panic prevailed. We had the rare pleasure of reading in the newspapers an account of our own massacre in the mountains. At the expiration of the three days Sam returned with the mule. He had traced it, with an Indian's instinct, to where it had wandered from the trail, descended a deep ravine for water, knocked off the pack against a fallen tree, and then forced its way back over the logs to our camp near the "Stone House." His principal difficulty had been to replace the pack, but he had finally succeeded in lashing it to the animal's legs, neck, and tail, in such a manner that it was hard to conceive how the poor brute could have advanced a single step.

Having heard that Lieutenant Williamson's party was at Oregon City, we immediately prepared to rejoin it. I gave Sam his pay, with a few presents, and a supply of provisions for his journey back to his tribe. As he was very much afraid of some of the white settlers who had threatened to kill him, he started in the night. I have little doubt that we all owe our lives to the fidelity of this Indian.

October 19.—This morning we rode in a drenching rain to Oregon City, a distance of about sixteen miles. The country near the road was gently undulating in its character, and much of it heavily timbered. We saw on the way several good dwelling houses, cultivated fields, and other indications of civilization and prosperity. Oregon City is a thriving town on the eastern bank of the Willamette, built on a narrow plateau between the high river bluff and the water. We found Lieut. Williamson's party encamped near it, in charge of Lieut. Crook; and soon learned that our difficulties were not yet over. Lieut. Williamson had been compelled, by the lateness of the season, to return by water to San Francisco, in order to prepare for our contemplated exploration in the Sierra Nevada. He had left orders for me to take command of the party and make an examination and survey of the route to Fort Reading, by way of Fort Lane and Fort Jones. Major G. J. Rains, 4th infantry, notwithstanding the urgent remonstrance of Lieut. Williamson, had decided to detain our escort, now consisting of only eighteen dragoons, commanded by Lieut. Sheridan. Since Lieut. Williamson's departure, an Indian war had broken out in Rogue River valley, through which our route lay, and all communication between Fort Lane and the Umpqua valley was now cut off, except for strong and well armed parties. Ours consisted of Lieut. Crook and myself, Messrs. Fillebrown, Anderson, Young, Bartee, Coleman, and Vinton, with twenty packers, ten of whom were Mexicans. Several of our number were entirely unarmed, and others had only pistols. There were, I think, but five rifles in the whole command.

Two days were spent in making preparations for our survey. Finding myself thus unexpectedly deprived, at a time when its services were greatly needed, of an escort ordered by the War Department and detailed by General Wool, I first proceeded to Fort Vancouver, a distance of about nineteen miles, and addressed a written remonstrance to Major Rains, who was then at or near Fort Dalles. No reply, either to this or to that made by Lieutenant Williamson, was ever received. I have considered it incumbent upon me to communicate the whole correspondence; as the loss of the escort, besides occasioning great trouble, prevented some examinations very important to the determination of the practicability of the route for a railroad, and thus defeated, in part, the object for which a large appropriation of Congress had been set apart by the War Department. Before any of our escort left Vancouver, and before Major Rains' final orders in the case were issued, intelligence was received of the safe arrival of Major Haller's party at Fort Dalles.

Letter of Major G. J. Rains, Fourth Infantry, to Lieutenant R. S. Williamson, United States Topographical Engineers.

HEADQUARTERS, COLUMBIA RIVER AND PUGET SOUND DISTRICT,
Fort Vancouver, W. T., October 10, 1855.

SIR: From current rumors and the opinion of the Superintendent of Indian Affairs in Oregon, and from the report of Brevet Major Haller, in the field, with more than 100 men checked and surrounded by Indians, the lives of our citizens and even the safety of the military being in question, the services of every available man are required for the emergency. The body of nineteen dragoons, brought as your escort to this post, we are, therefore, obliged to detain for the time being—a kind of force most required.

I regret being thus compelled to break in upon any of your arrangements, and may be enabled, perhaps, in a few days to dispense with their services.

Very respectfully, your obedient servant,

G. J. RAINS,
Major, Fourth Infantry, Commanding District.

Second Lieutenant R. S. WILLIAMSON,
Topographical Engineers.

Letter of Lieut. R. S. Williamson, United States Topographical Engineers, to Major G. J. Rains, Fourth Infantry.

FORT VANCOUVER, W. T., *October* 10, 1855.

SIR: I have received your letter informing me of your intention "to detain for the time being" the body of eighteen dragoons which form the escort to my party. I conceive it my duty to lay before you the circumstances of the case, thinking that your instructions may be modified when the embarrassed position in which I shall be placed, without an escort, is made fully apparent.

The Secretary of War, in my instructions, says that the commanding officer of the department of the Pacific will detail 100 men, with not less than three commissioned officers, one of the latter to act as commissary and quartermaster to the expedition, to form the escort of the party; and, in obedience to these instructions, General Wool made the detail accordingly. Upon leaving the valley of the Des Chutes, I informed Lieutenant Gibson, commanding the escort, that I should have no further need of the services of his command, excepting Lieutenant

Sheridan and the dragoon detachment, thus reserving only such portion as I deemed indispensable. Lieutenant Crook would still be required as commissary and quartermaster. Accordingly, Lieutenant Gibson, with the remainder of the men, proceeded to Fort Jones and Fort Reading, from which places they were drawn. It now becomes necessary, in the prosecution of the duties assigned to me, to proceed to California, where I am instructed to make further surveys. The road leads through the Umpqua, Rogue river, and Siskiyou mountains, which are filled with hostile Indians. But three days ago I received intelligence of five men being murdered on the main road in the last mentioned mountains, and the newspapers for the last two months have been filled with accounts of Indian depredations in that vicinity. Without an escort, I shall incur the risk of losing my animals, and perhaps placing my men in a critical position.

The animals of the dragoons have been travelling in the field for nearly three months, subsisting upon grass, and the officer commanding the escort reports them unfit for service in any expedition where they will have to make other than short marches and cannot be provided with grain. Three animals have already completely given out, and had to be left at the head of the Willamette valley. These animals can go to Fort Lane, on a good road, where forage can be obtained every day, and there I expected to exchange them for fresh ones, with which to prosecute the other surveys; but they are incapable of being applied to the use for which you require them. The small number of men will be of great service to me, and they will not materially increase your forces in the field. Should I increase my party by hiring citizens, or should I lose my animals, in consequence of not having a proper escort, I shall incur expense which will fall upon an appropriation designed for a different object, and a deficiency in the amount to be devoted to the survey and office work may materially diminish the value of the results of the expedition, for which so large an amount has already been expended, and the importance of which, as estimated by the War Department, may be judged by the large appropriation ($42,000) and the large number of men devoted to obtaining the information desired.

I have the honor, &c., &c.,

R. S. WILLIAMSON, *U. S. Top. Engs.*

Maj. G. J. Rains, *4th infantry, U. S. Army,*
Commanding Columbia River and Puget Sound district.

Letter of Lieutenant Henry L. Abbot, United States Topographical Engineers, to Major G. J. Rains, Fourth Infantry, United States army.

Vancouver, Washington Territory,
October 21, 1855.

Sir: I have the honor to report to you that I have arrived here with my detached surveying party, and have found that Lieutenant Williamson has returned to California by steamer, and left me in command of his whole party, with orders to proceed at once and survey the route from Vancouver, by Forts Lane and Jones, to Fort Reading. I deem it my duty before starting to explain to you the very embarrassed state in which the loss of my escort places me, thinking this may induce you to modify your previous instructions, and allow the eighteen dragoons, with Lieutenant Sheridan, to rejoin me.

As Lieut. Williamson, in his letter to you of the 10th inst., has explained very fully the circumstances of the case, as far as they were then known to him, I shall only mention the additional reasons which, at present, render an escort so necessary.

My whole party, including Lieutenant Crook, myself, and the scientific corps, consists of 28 men, of which 10 are Mexican packers, and perfectly unreliable in case of an attack. Many of the party are unarmed. I think there are only five rifles in the whole command. I have about 120 animals, to herd which would fully occupy all the men in case of attack. I have with me all the notes of the whole survey, so that, if my party were cut off, the whole expedition would have been useless. According to the latest accounts, the Indians are very hostile, and are in the field in so large a force as to have cut off all communication with Jacksonville, and to have murdered 22 families. I enclose a copy of a despatch,* the original of which is in my possession, which shows the state of affairs on the road. As we have to make a second survey in the Sierra Nevada before winter, I am forced to advance at once with my small unprotected party, although it is the very general opinion that we may not reach Jacksonville without an escort. The time which would be required for me to see you in person would create so great a delay as to probably prevent the second survey in the Sierra Nevada, particularly as my animals are in so jaded a condition that I shall necessarily move slowly. I shall, therefore, start to-day for Fort Reading, and if you should decide to modify your previous instructions and restore the escort, a man will be at Vancouver, ready to ride express to inform me of the fact. Please direct to me at Vancouver, and the man will bring me your letter.

I am sir, very respectfully, your obedient servant,

HENRY L. ABBOT,
Lieut. U. S. Topographical Engineers.

Major G. J. Rains,
4th Infantry, U. S. A, commanding Columbia river and Puget sound District.

I next went to Portland, and had an interview with Gov. George L. Curry, of Oregon Territory, to whom I feel under great obligations. He issued a general order, directing any volunteer officer to supply me with an escort, if practicable; and used his influence to aid me in every possible way. I feel that the success of the expedition is, in a great measure, due to his kind assistance.

I then returned to our camp at Oregon City, and, after discharging two men at their own request, completed the preparations for our return to Fort Reading.

* *Extract from an extra of the Oregon Statesman,*

"Corvallis, *Sunday, October* 14.

"At noon, to-day, Mr. S. B. Hadley arrived at this place, express messenger, bearing a petition to Governor Curry for five hundred volunteers to repel the hostilities of the Shasta and Rogue river Indians, who are represented to be in a state of war towards the whites. The petition is signed by about 150 of the citizens of Umpqua valley. Among the names we recognize a number of prominent settlers there. The petition represents that some *twenty* or *thirty families have been murdered!* and dwellings burned; and that an attack upon the Umpqua settlements is feared. The houses burned and families murdered, thus far, were between Grave creek and Rogue river.

* * * * * * * * * * *

All communication with Jacksonville was cut off, and we hear nothing from the citizens there. It is conjectured, however, that the town is fortified. The mail-carrier was shot at and driven back. The families between Grave creek and the cañon have been brought into Umpqua, for safety. There is no communication beyond the cañon now.

"Mr. Hadley says that Judge Deady, who had been holding court in Jackson county, with Mr. Drew, deputy marshal, confirm the intelligence, and say that from the mountains they could see the burning dwellings south of them."

ROUTE FROM VANCOUVER TO FORT READING, WEST OF THE CASCADE MOUNTAINS.

October 22.—To-day we left Oregon City, travelled about eighteen miles over an excellent road, and encamped on Pudding river. The country was level or gently undulating, and much of it covered with timber. We found the ford of the Molalle river rather deep. A ferry-boat is required at this crossing during the season of high water. Numerous houses and fine farms were passed on the way; and the land appeared fertile and valuable.

October 23.—This morning we crossed Pudding river by a toll-bridge, and then travelled about twenty-four miles to Salem. Our course lay through a level country called French Prairie, the fertility and thickly settled character of which strongly contrasted with the barrenness and solitude of most of the Des Chutes plateau. At Salem I saw the surveyor general of the Territory, and Mr. H. Gordon, deputy surveyor. To both of these gentlemen I am indebted for much valuable information and personal kindness.

October 24.—This morning it rained. We passed over the Willamette river at Rice's ferry, where the stream is deep and wide and the current rapid. One of our mules was drowned in attempting to swim across. We found difficulty in keeping our proper course to-day, on account of numerous forks in the road. There is also a very annoying custom, in this part of the valley, of enclosing by fences portions of the road, with the land on each side; thus rendering large circuits unavoidable. Soon after leaving Salem, we passed through a small collection of houses named Cincinnati, and crossed a little stream called La Creole river. The country was level or slightly undulating for the whole of the day's march. We encamped on Lackimute creek, having travelled about seventeen miles.

October 25.—The route to-day, which was in some places well timbered with oak, cedar, fir, and spruce, lay over a narrow and nearly level plain, bordered by high hills. We passed through Corvallis, a little town, consisting principally of one street lined by several stores and dwelling houses. It is built on a small stream called Mary's river, which rises near a peak of the Coast Range, bearing the same name, and discharges itself into the Willamette. We travelled 32 miles, and encamped on Long Tom creek.

October 26.—To-day we continued our course through the same narrow, level prairie, for 24 miles, to Eugene City, a small village near the junction of the Coast and Middle forks of the Willamette. A short distance north of the town, a line of low rolling hills, the principal peak of which is called Spencer's Butte, crosses the valley, and connects the Cascade and Coast Ranges.

October 27.—Our road to-day followed up the Coast fork of the Willamette, and we encamped near its head-waters, after a day's march of about 25 miles. The valley had become narrow and we occasionally crossed low hills. The soil was very fertile, and much of it cultivated. We experienced no little difficulty, however, in obtaining forage for our animals, as the Indian war in Rogue River valley had caused it to be in great demand.

October 28.—To-day we crossed, by the Pass creek road, the Calapooya mountains, which separate the Willamette and Umpqua valleys. Pass creek rises in a little meadow, which is also the source of a tributary of the Coast fork of the Willamette, and flows through the Calapooya mountains to Elk creek, a branch of the Umpqua river. This pass had only been known for a short time, and the wagon road was not fully completed when my party travelled over the route. Nothing but a few short bridges and a little grading, however, was wanting to make it a good and level road through the mountains. Having reached the Umpqua valley, we crossed a small divide between Pass and Elk creeks, and travelled towards the south through a narrow prairie bordered by rolling hills. The soil was fertile, and the neatly painted houses, surrounded by cultivated land, greatly resembled those of the eastern States. We encamped near the end of this prairie, after a day's march of about 19 miles.

October 29.—On starting this morning, we passed over a steep hill with a flat and nearly level summit, and then travelled to Winchester, distant about 19 miles from camp. Our course lay through an undulating and very fertile country, varied with an occasional growth of oak and pine. Winchester is a little town situated on the southern bank of the North Umpqua river, at this point, a rapid stream about 80 feet in width, flowing over a very rocky bed. We crossed it in a ferry-boat, and encamped in the village during a heavy fall of rain, which continued through the night.

October 30.—We learned, upon good authority, that the reports from Rogue river had not exaggerated the Indian disturbances there. None but strong parties could pass through the valley, and most of the houses north of the river were burned. A large force of regular and volunteer troops was already in the field, and two additional companies were about starting to reinforce them. The election of field officers was to take place immediately at Roseburg, and we remained in camp to-day to await the result, before applying for an escort to Fort Lane. I repaired a barometer.

October 31.—This morning the road lay through a nearly level and very fertile valley to Roseburg, where I saw Major Martin, the elected commanding officer of the volunteers. He informed me that the troops were now fighting with the Indians, near the Umpqua cañon; and that he intended to join them on the following morning, with two more companies at present in camp at Cañonville. He kindly proposed to escort my party through the cañon, and I accepted his offer.

We continued our course up the valley of the South Umpqua river, and encamped with the volunteers near the northern entrance of the Umpqua cañon, at Cañonville, which consists only of one house and a barn. The road followed the stream for the greater part of the way, and the valley, although narrow, was settled, and much of it apparently very fertile. The hills on each side were lightly timbered with oak and fir. Several specimens of a hard variety of talcose slate were found during the day. The distance travelled was about twenty-six miles. In the evening a despatch was received from the battle field, stating that the troops were greatly in want of food and powder, and urging on the reinforcements. In the night it rained.

November 1.—This morning we followed the volunteers through the cañon, a difficult pass through the Umpqua mountains. Two small creeks head near the divide, and flow, one towards the north to the south fork of the South Umpqua, and the other towards the south to Cow creek. The bottom of the gorge is exceedingly narrow, and the precipitous sides, covered with a thick growth of trees, rise at least 1,000 feet above the water. We found in the cañon a species of yew-tree which we did not notice elsewhere west of the Cascade mountains. The ascent from the camp to the divide was 1,450 feet, and we were compelled, after crossing the creek about thirty times, to travel part of the way in its bed. A few resolute men might hold this defile against an army; and it is wonderful that the Rogue river Indians, who are intelligent, brave, and well armed with rifles, have never, in their numerous wars, seized upon it, and thus prevented the approach of troops from the Umpqua valley. This pass is about eleven miles in length, and communication through it is sometimes interrupted by freshets. The road over which we travelled was constructed in 1853, by Brevet Major B. Alvord, United States army, and it is the best route known through the Umpqua mountains.

We had hardly left the cañon when we began to see traces of the Indian devastations.

Blackened and smoking ruins, surrounded by the carcasses of domestic animals, marked the places where, but a few days before, the settlers had lived. We passed a team on the road; the oxen lay shot in the yoke, and the dark blood stains upon the seat of the wagon told the fate of the driver. Even the stacks of hay and grain in the fields had been burned. After leaving the cañon, we followed the narrow but fertile valley of Cow creek for a few miles, and then crossing a steep divide between it and Wolf creek, encamped on the latter stream. Major Martin intended to proceed, in the morning, to join in the battle which was going on among the mountains, at a distance from the road variously estimated to be from five to twelve miles. As he could not spare us an escort, we determined to press forward as rapidly as possible towards Fort Lane, trusting that the Indians would be too busy to attack our party. In the evening, however, stragglers from the fight began to come in. They reported that the provisions were entirely exhausted, and the powder nearly gone; that the Indians were numerous and very strongly posted; that several white men had been killed and many wounded; and that it had been thought best to fall back, for the present, and wait for supplies. The regular troops were on their way to Grave creek, and the volunteers were coming to our camp as fast as they could transport their wounded. The Indians did not follow them, and they all arrived before morning. The forage on the route had been burned, and our animals suffered much from want of food to-night.

November 2.—This morning Major Martin, escorted by a volunteer company, went to Grave creek to see Captain A. J. Smith, 1st dragoons, commanding the United States troops in the valley. He offered us the benefit of his escort, and we accompanied him accordingly. This gentleman, together with Captain Mosher and other volunteer officers, assisted us in every way in their power; and without this accidental aid our party would have found it very difficult to cross the valley.

Wolf and Grave creeks are separated by high and steep hills, covered with thick timber and underbrush. On reaching Wolf creek we found Captain Smith in camp, near a house surrounded by a small stockade. His supply of forage had failed, and he was forced, on this account, to prepare to return to Fort Lane as soon as a few men, who had died of their wounds, could be buried. Lieut. Gibson, formerly in command of the escort of our party, was among the wounded. Being compelled by want of forage to press forward as fast as possible, I applied to Capt. Smith for an escort. He gave me one so promptly that in less than fifteen minutes we were again on our way.

Between Grave and Jump off Joe creeks the road passed over a steep and heavily timbered divide. The Indians had killed two men in charge of a pack-train on this hill, and the half burned remains of their wagon and packs were still to be seen. Near this place Major Fitzgerald, 1st dragoons, had overtaken with a scouting party and killed several of the savages. At Jump off Joe creek, a man driving swine had been murdered, and a large number of his animals lay dead in the road. On leaving this creek, we passed through an undulating and fertile country, sometimes open and sometimes thinly covered with a growth of oak, sugar maple, and a little pine and hemlock. After travelling until nearly sun down, we encamped at a building which had been preserved from the general ruin by the heroism of a woman named Harris. After her husband had been murdered and her daughter wounded, she had made a desperate and successful defence by shooting at the savages from between the crevices of the log house. The traces of her bullets upon the trees, which had shielded the Indians, and the marks of the tragedy within the dwelling, were plainly visible. Soon after dark a small party under the command of Lieut. Allston, 1st cavalry, arrived with the wounded and encamped. Captain Smith, with a few men, passed us on his way to Fort Lane. The length of our day's march was about fourteen miles.

November 3.—To-day we travelled about twenty-five miles to Fort Lane, crossing Rogue river at Evans' ferry. His house, and others south of the river, were now protected by a few soldiers. The disturbance had been confined to the northern side of the valley; but a few murders had been committed on the Siskiyou mountains, and the settlers were in great alarm. The road was gently undulating until we arrived at the ferry; but from that point it followed the level bank of the river nearly the whole distance to Fort Lane. The land appeared to be rich and valuable. The hills were thinly covered with oak, pine, and other kinds of trees. A short time before reaching the fort we passed a salt spring, at which the animals drank eagerly.

November 4.—To-day we remained in camp to recruit the animals, which had suffered very much from fatigue and hunger during the last few days. We were treated with every possible kindness and attention by the officers stationed at the post.

Fort Lane, at present a cavalry station, is pleasantly situated on the side of a low hill, near the junction of Stewart creek with Rogue river. The barracks and officers' quarters are built of logs plastered with clay. Much of the surrounding country is fertile and settled, but destructive Indian outbreaks are not unfrequent. On the opposite bank of Stewart creek there are some peculiar basaltic hills, with flat tops and precipitous sides, somewhat resembling those of the Des Chutes valley. The principal one, which is about five hundred feet high, is called Table Rock. Good observations were obtained at the fort, by which the altitude above the sea was found to be 1,202 feet, and the latitude 42° 25′ 56″.

November 5.—This morning we continued our journey without an escort, as no Indian outrages of importance had been recently perpetrated on the route. We found many houses deserted, however, and great alarm prevailing among the settlers. After travelling about 26 miles up the valley of Stewart creek, we encamped at the house of Mr. Smith, near the foot of the Siskiyou mountains. The road was level, and the general appearance of the country was similar to that near the source of the Willamette river. The rolling hills that shut in the valley, were sometimes bare and sometimes thinly covered with trees. We passed, on the way, a hot spring, the temperature of which was about 100° Fahr. A continual escape of gas through the water gave it the appearance of boiling.

November 6.—This morning we crossed the Siskiyou mountains. At first the ascent was gradual; but the road soon began to wind up a steep slope, portions of which were rendered very slippery by clay and rain, until, at length, the summit, elevated 2,385 feet above camp, was attained. Here the mountain was densely timbered, but near the base there were comparatively few trees. The descent, for a short distance, was very abrupt; but it soon became gentle, and broken by a few hills. A pile of stones by the roadside marked the boundary between Oregon and California. When we passed this spot it was raining; but in the valley below, clouds of dust gave evidence of a long continued drought. The rainy season begins earlier in Oregon than in California; and it happened in several places that the first rain of the season occurred on the night of our arrival. Nature seems to have preceded legislation in making the Siskiyou mountains a boundary; for, after passing them, the appearance of the country immediately undergoes a change. Rounded and nearly bare hills, not unlike those of the Sacramento valley, near Benicia, began to appear; and a few scattered sage bushes reminded us of the plateau east of the Cascade Range. The general altitude above the sea, also, had increased between one and two thousand feet since leaving Rogue river. We crossed Klamath river at Dewitt's ferry, and encamped on its southern bank, after a day's march of about twenty-four miles.

November 7.—To-day we travelled about seventeen miles to Yreka, through a rolling prairie country. Most of the hills were covered with bunch grass, and entirely devoid of trees. We passed several houses near the road, and a saw mill on Shasta river, a small but deep stream crossed by a bridge. Yreka is beautifully situated in a little basin surrounded by high hills. Near it, Shasta Butte, the largest and grandest peak of the Cascade Range, rises abruptly from the valley, and, with its double summit, towers far into the region of eternal snow. This little city, which already contains several brick stores and dwelling houses, is a great depot of the northern mines, and gold digging is actually carried on in its streets. It is, however, divided from the settled portion of the Sacramento valley by such precipitous mountain chains that all its supplies are transported by pack trains; and until very recently a wagon road to Shasta has been considered impracticable. Two routes have lately been found, however, which, it is thought, will prove to be feasible.

November 8.—This morning we followed the course of a little tributary of Shasta river, through a rather stony, gold-bearing plain, to Little Scott's mountains, the divide between Shasta and Scott's valleys. The ascent and descent were very abrupt for a wagon road. After crossing the ridge, we soon struck a small branch of Scott's river, and passed down its valley; which, although not more than a mile in width, has a rich and fertile soil. We encamped at Fort Jones, distant about sixteen miles from Yreka. The fort is finely situated in an open valley surrounded by high and wooded mountains; the buildings are made of logs. The soil abounds in silica, but gold has not been discovered in the immediate vicinity in sufficient quantities to pay for working. The altitude of the post above the sea, determined by careful observations, is 2,887 feet. The latitude is 41° 35′ 42″.4.

November 9.—To-day we remained in camp to recruit the animals, and to transact business with Lieut. Crook, the quartermaster and commissary of the expedition, who had been detached by Captain H. M. Judah, 4th infantry, commanding the post. This officer, who passed us on his way to Fort Lane, ordered Lieut. Crook to remain at Fort Jones, on account of the exigencies of the public service. I greatly regretted this order; for it obliged me to discharge the duties of quartermaster and commissary, both for my topographical party and for Lieut. Crook's train, which accompanied me to Fort Reading. This circumstance prevented me from leaving the command, and examining, with a detached party, the Sacramento river route; which, it is thought, might have been shown to be practicable for a railroad. The want of an escort, and the great uncertainty of obtaining forage, rendered it impossible to travel over this route with the whole train of nearly broken down animals; and the design of surveying it was necessarily abandoned.

November 10.—Last night it snowed. We remained in camp again to-day to finish the business with Lieut. Crook. John Mellen, one of our best men, was discharged at his own request.

November 11.—This morning we travelled about twenty-three miles up Scott's valley, and encamped at the foot of the high mountain chain which separates it from Trinity valley. Scott's valley is a very beautiful and fertile opening, lying among forest-clad ridges about two thousand feet in height. It varies from one to eight or ten miles in width, and is nearly destitute of timber, except on the banks of the stream. The soil is rich, and gold is found in some localities. It rained a little in the valley, and snowed upon the mountains during the day.

November 12.—To-day Scott's mountain, the highest summit upon our return route, was crossed by a pack trail. We toiled up a steep and rocky ascent covered with trees, until an

SHASTA BUTTE AND SHASTA VALLEY FROM A POINT NEAR CAMP 70 A.

elevation of 2,141 feet above camp was gained. The snow was about four inches deep upon the top. In the winter it sometimes renders the trail impassable. A sudden descent conducted to the head-waters of a branch of Trinity river, which flows, in a deep and narrow ravine, between heavily timbered ridges. We were compelled to cross and re-cross this stream eleven times at bad fords, which became more and more rocky as they grew deeper. At length we encamped near a public house, after a hard day's march of twenty-four miles. This very bad trail, is, at present, the most travelled route between Yreka and the settled part of the Sacramento valley.

November 13.—To-day we continued our course down the narrow valley, crossing the stream five times more at very rocky fords. It received several small tributaries, which increased its size to nearly a hundred feet in width and about three feet in depth. The current was rapid. At the point where the river first bends abruptly toward the west, the trail leaves it and crosses Trinity mountains, the divide between it and Clear creek. A spur from the main ridge, lying between two immense ravines, extends about six miles towards Trinity river. The trail winds up the steep end of this spur, until an elevation of nearly 2,000 feet above the water is gained, and then follows along the top to the main ridge, through a forest of pine and oak. The descent of 2,543 feet to Clear creek is exceedingly abrupt. Although much labor has been expended upon the trail, this mountain is a very great obstacle to travel. We encamped at the first house we reached in the valley, after a hard march of about twenty-four miles.

November 14.—This morning we followed a pack trail about five miles down the narrow ravine of Clear creek to a mill, which is the terminus of the wagon road from Shasta. A few miles further on, we reached French gulch, a celebrated place for gold washing. The valley of the creek was here about a quarter of a mile in width, and the water had been conducted through it in every direction, by ditches. As many as a hundred men were engaged in digging and washing gold when we passed, and quite a little village had sprung up near the road. I was told that although the ground had been dug over several times, the amount of gold seemed to be undiminished.

We continued to follow the narrow valley of Clear creek, occasionally crossing low spurs from the sides to avoid bends, until we reached a few houses called Whiskey town. At this place the road left the stream, and passed through an open, rolling country to Shasta, one of the principal towns in northern Californa. Here we encamped, after travelling about twenty-one miles.

November 15.—To-day we arrived at Fort Reading, distant about seventeen miles from Shasta, and thus completed the field work of the survey. The road between the town and the Sacramento river, which we crossed at Johnson's ferry, led through an open and undulating region. From the ferry to the fort, it passed over a nearly level plateau, in some places well wooded, and in others entirely destitute of trees. We were received with great kindness and attention by the only officers at the post, Major F. O. Wyse and Lieutenant D. R. Ransom, both of the 3d artillery.

Lieutenant Williamson arrived from San Francisco a few days afterwards. He considered the season so far advanced as to render it inexpedient to attempt any exploration of the Sierra Nevada, near the sources of Carson river, before the ensuing spring, particularly as the most important examinations contemplated had been already anticipated by the State. Orders were soon received from the War Department, directing him to dispose of the outfit and return at once to Washington to prepare the report, maps, profiles, &c., of the survey already completed. The party reached the city in the latter part of January, 1856, and immediately entered upon office work.

CHAPTER VI.

COMPUTATION OF ALTITUDES FROM BAROMETRICAL OBSERVATONS.

PRELIMINARY REMARKS.—INSTRUMENTS.—INSTRUMENTAL ERRORS.—INTERPOLATION, AND APPROXIMATE TEST OF ACCURACY IN OBSERVER.—CORRECTIONS PREPARATORY TO COMPUTATION: 1. FOR TEMPERATURE OF MERCURY; 2. FOR INSTRUMENTAL ERRORS; 3. FOR HORARY OSCILLATION; 4. FOR ABNORMAL OSCILLATION.—METHOD OF COMPUTATION, WITH REMARKS: 1. ON THE READING OF THE BAROMETER AND THERMOMETER AT THE LOWER STATION; 2. ON THE READING OF THE THERMOMETER AT THE UPPER STATION.—EXAMPLE.—TEST OF THE COMPARATIVE ACCURACY OF THE DIFFERENT METHODS OF COMPUTATION, WITH TABLES SHOWING THE RESULTS OBTAINED.—HEIGHT OF FORT READING.—EXPLANATION OF TABLES OF BAROMETRIC OBSERVATIONS IN APPENDIX D, ETC.

PRELIMINARY REMARKS.

To insure accuracy in the old method of determining altitudes by the barometer, it is theoretically necessary that the observations at the upper and lower stations should be simultaneous. In obtaining the data for constructing the extended barometric profiles of the recent Pacific railroad surveys, many causes have rendered it impossible to comply, even approximately, with this condition. A new method of computation, based upon different principles, has therefore been required. Successive improvements have been introduced in computing the altitudes determined on the different surveys, until this object has been, in part at least, attained. Although several references to the subject have been made in the reports, the new system has never, to my knowledge, been published in a form sufficiently detailed for practical use. Partly to supply this deficiency, and partly to explain my reasons for believing that certain other slight changes in the old system are advisable, I have decided to describe in full the method used in reducing the field notes of our survey.

INSTRUMENTS.

On starting from Benicia we had four cistern barometers, Nos. 1060, 1061, 1068, and 1089, made to order, by James Green, of New York, on the same pattern as those used by the Medical Department of the army, but with scales graduated for greater altitudes, and with verniers reading to thousandths of an inch. We also had an aneroid barometer, but it proved to be so inferior an instrument that the few observations taken with it were rejected. We were likewise provided with four extra unfilled glass tubes.

The barometers proved to be admirably adapted to mountain work; but they had three defects, which gave us no little trouble. There were no portable tripods connected with them, which made it very inconvenient to take observations when there were no trees near the trail. Their verniers did not read higher than five hundredths of an inch, which rendered it necessary to look at both the scale and the vernier, and often to perform additions to determine the hundredths of the reading. This is very objectionable, as it renders mistakes almost inevitable, when the observations are taken during the hurry of the march. Lastly, the small pieces of wood to which the ivory points and the glass tubes were attached, were a little too large, and, in two cases, expanding from moisture while the glass cistern contracted from cold, actually cracked it, and thus broke the barometer in a way very difficult to repair. It was successfully accomplished, however, by putting a little of Husband's adhesive plaster on both sides of the crack, and then covering it with sealing wax dissolved in alcohol, to protect it from the air.

INSTRUMENTAL ERRORS.

In order to eliminate the effect of capillary attraction, of minute bubbles of air which cannot be entirely excluded from a tube unprovided with Daniell's protective ring, and of other causes of instrumental error, the scales of all the barometers were so adjusted by the maker that the instruments agreed precisely with Smithsonian standard on leaving New York. On reaching Fort Reading, from a mean of over two hundred observations, taken with great care by the gentlemen of the party, Nos. 1060 and 1061 were found to agree exactly with each other, while both Nos. 1068 and 1089 differed slightly from them. It was assumed that the two former had remained unchanged; and corrections to make each of the others agree with them were deduced from the above mentioned observations, after the temperature of the mercury had been reduced to 32° Fahrenheit. Subsequently, whenever a barometer was broken and re-filled, a similar correction was deduced. The following table exhibits these corrections.

Barometer No. 1060.

Date.	Inches.
July 10 to September 18	.000
September 19 to September 29	+ .022
September 30 to October 15	+ .026
October 16 to October 29	+ .042
Subsequent to October 29	+ .191

Barometer No. 1061.

Date.	Inches.
July 10 to August 5	.000
Irreparably broken on August 5	

Barometer No. 1068.

Date.	Inches.
During whole survey	— .009

Barometer No. 1089.

Date.	Inches.
July 10 to August 5	+ .015
August 6 to September 4	+ .044
Subsequent to September 4	+ .035

INTERPOLATION, AND APPROXIMATE TEST OF ACCURACY IN THE OBSERVER.

Before proceeding to discuss the determination of altitudes, I shall explain the mechanical method used in examining and studying observations taken at a fixed station. It is to represent them, the temperature of the mercury having been reduced to 32° Fahr., by a curve, of which the abscissas denote the times of the observations, and the ordinates the corresponding height of the mercurial column. By this means any great error in observation can be readily detected by an abrupt change in the curve, and a very clear and comprehensive idea can be obtained of the relations of the different observations to each other. This also furnishes the best method of interpolating properly for intermediate readings.

CORRECTIONS PREPARATORY TO COMPUTATION.

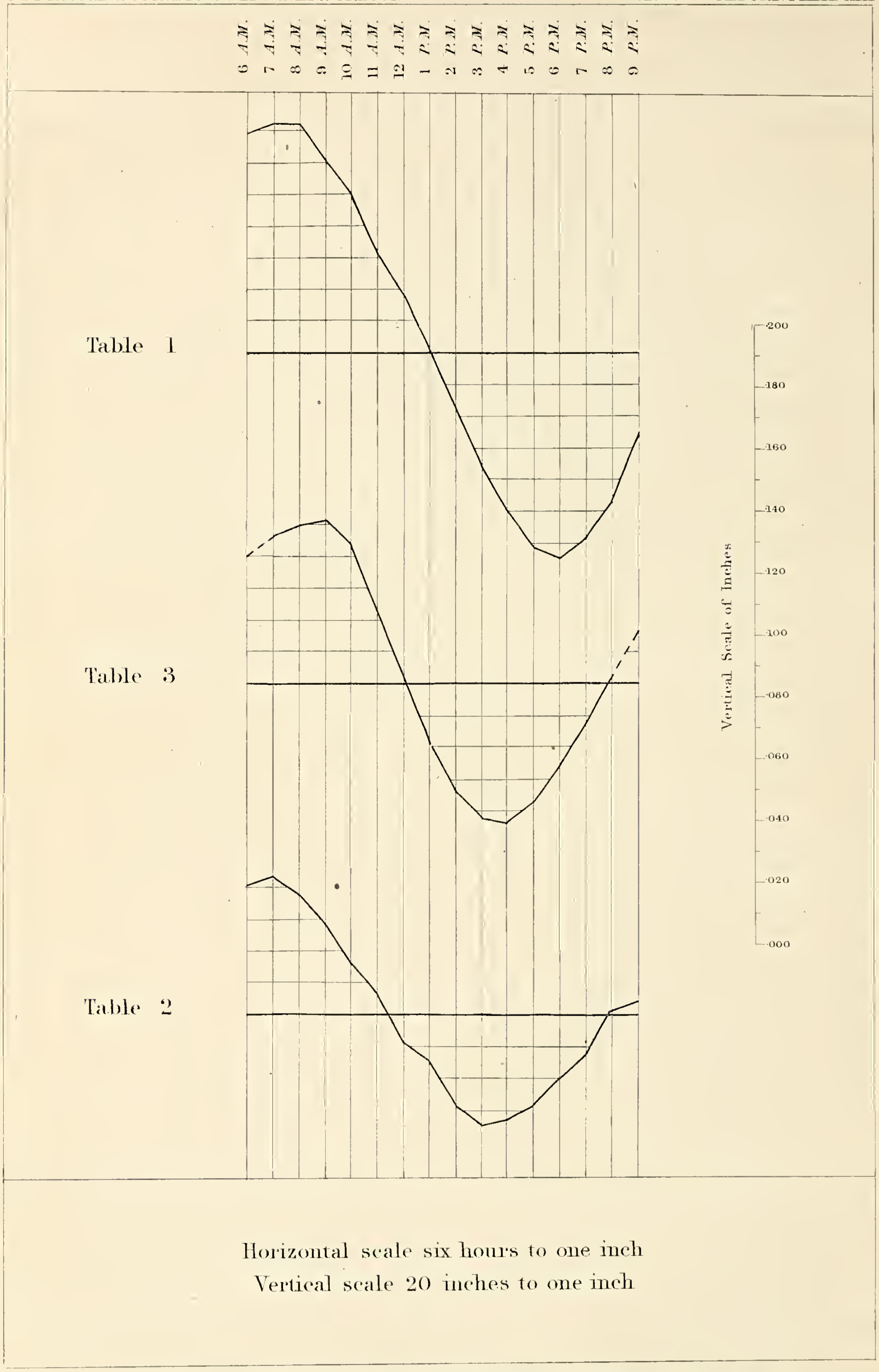
1. *For temperature of mercury.*—In preparing observations for computation, the first step taken was to reduce the observed readings of the barometor to what they would have been had the temperature of the mercury been 32° Fahr. For this purposo the tables of Mr. A. Guyot, published by the Smithsonian Institute, were used.

2. *For instrumental errors.*—The correction for instrumental errors was then applied, and, when more than one barometer had been observed, a mean of the readings thus corrected was taken, to eliminate, as far as possible, errors of observation.

3 *For horary oscillation.*—The next step was to correct for the oscillations of tho mercurial column, due to the ever varying weight of the atmosphere. Of these there are two kinds, the normal and abnormal. Although a monthly and a yearly normal oscillation, and also one depending on the amount of moisture in the atmosphere, are supposed to exist, still, we practically know but one, called the horary variation. This is a kind of daily atmospheric tide, caused principally by the heat of the sun, but greatly affected by the altitude and latitude of the place, and, doubtless, by other circumstances. It is far from constant, even at the same locality, as will be clearly shown by the result of our observations made at Fort Reading, in July and November.

Observations for the construction of a table of horary corrections should be taken hourly with very great care, and continued, if possible, for a long period of time; but this is not absolutely necessary. A good ono may be constructed from observations taken even for a single day, when the mean temperature does not differ much from that of the season, and when there is little or no abnormal oscillation. The latter condition is generally fulfilled when the reading of tho barometer, with the mercury reduced to 32° Fahr., is the same, or nearly the same, at the last observation, as it was at the same hour on the preceding day. Even when observations are taken for several days, the latter of these conditions must not be neglected; that is, the last observation, with the temperature of the mercury reduced to 32° Fahr., should always be very nearly the same as that taken at the corresponding hour immediately preceding the first observation used. This is manifestly necessary, as an abnormal change affects the horary curve. For instance, if the mercury should, beside the horary chango, uniformly descend for one entire day and ascend for the next to the same height as before, the descending portion of the horary curve on the first day will be lengthened, and the ascending shortened, and *vice versâ* on the second day. In a mean curve for the two days, these errors will balance each other.

To construct a table of horary corrections, the observations, after the temperature of the mercury has been reduced to 32° Fahr., should be represented by a curve, as already explained, and examined to detect any errors of observation and to reject any portion in which the effect



CURVES ILLUSTRATING THE TABLES OF HORARY OSCILLATION DEDUCED FROM OBSERVATIONS TAKEN ON THE SURVEY.

of abnormal error is not balanced. Should one of the hourly observations be wanting on any day, a value, interpolated as correctly as possible by comparing the character of the curve between the hours preceding and following it on other days, should be substituted. A moment's consideration will show the necessity of this interpolation when there is any abnormal change from day to day. Still the great mistake of omitting it has often been made.

The observations having been prepared as explained above, a mean of all the observations at each hour is taken, and a curve plotted to represent these mean results. It should be a smooth curve, generally with two maximum and two minimum points in the twenty-four hours, the exact times of which vary somewhat. Should this curve not be smooth, some error of observation or calculation has been made. It now only remains to find the mean reading for this mean day, and to take the difference between it and each mean hourly reading, affecting the result with the positive sign when the hourly reading is the less, and with the negative when it is the greater. The correction from this table, applied with its sign to an observation taken at any hour, eliminates the error due to horary oscillation.

It may be well to remark, that it is a very good test of the value of a table of horary corrections to apply it to the curve representing observations taken for a few days at a depot camp. If a more sweeping line is produced, without a daily recurrence of any peculiar form, the table may be considered good for observations taken in the vicinity, where the mean temperature is about the same.

From the observations taken on our survey, the following tables of horary corrections were deduced. They proved to be well adapted to the peculiar characteristics of the different tracts of country through which we passed. The manner in which they were computed is fully shown in Appendix E.

Corrections for Horary Oscillation.

Hour.	Table 1.	Table 2.	Table 3.	Hour.	Table 1.	Table 2.	Table 3.
	Inches.	*Inches.*	*Inches.*		*Inches.*	*Inches.*	*Inches.*
6 a. m.	— .069	— .040	----------	2 p. m.	+ .017	+ .028	+ .033
7 a. m.	— .072	— .042	— .045	3 p. m.	+ .034	+ .034	+ .041
8 a. m.	— .072	— .037	— .049	4 p. m.	+ .048	+ .033	+ .043
9 a. m.	— .060	— .028	— .051	5 p. m.	+ .061	+ .029	+ .038
10 a. m.	— .050	— .016	— .043	6 p. m.	+ .064	+ .020	+ .026
11 a. m.	— .032	— .007	— .022	7 p. m.	+ .058	+ .013	+ .011
12 m.	— .018	+ .008	+ .001	8 p. m.	+ .047	+ .001	— .003
1 p. m.	— .002	+ .014	+ .020	9 p. m.	+ .027	— .004	----------

The curves on Plate XIII illustrate these tables. They represent the oscillation of the barometer as twenty times greater than it actually is, in order to clearly show its character.

Table No. 1 was deduced from six days' observations, taken in the latter part of July, at Fort Reading, at an elevation between five and six hundred feet above the level of the sea, and a mean temperature of 83° Fahr. The condition above stated was very well satisfied, and the table was applied to the observations taken in the Sacramento valley, where the mean temperature was very high.

Table No. 2 was deduced from five days' observations, taken in the latter part of August, near the head of Des Chutes valley, Oregon Territory, at an elevation of ab t four thousand feet above the level of the sea, and a mean temperature of 50° Fahr. We were again fortunate in having little abnormal error, and the table was admirably adapted to the observations taken on the elevated plateau east of the Cascade range.

Table No. 3 was deduced from three days' observations at Fort Reading, taken about the middle of November, with a mean temperature of about 50° Fahr. Here a barometric storm rendered it necessary to reject four days' careful observations, to avoid the effect of abnormal error. During the three days, however, there was very little atmospheric disturbance; and the table was useful for the observations taken on my route from Vancouver, where the temperature was uniformly low and the elevation generally inconsiderable.

It is very interesting to compare these tables, especially the two for Fort Reading. As the Des Chutes curve was obtained from observations at a place differing widely from the others in altitude, mean temperature, and latitude, it is impossible to decide what part of its peculiarities is due to each of these causes of variation. The Fort Reading curves, however, are deduced from observations taken at the same spot, with a change of mean temperature only; and it is fair to suppose that the differences between them are due principally to this cause. These differences are, that the November curve has a more rounded form and departs less from the horizontal line representing the mean of the day, and that its points of maximum and minimum are nearer together by about three hours. These results are precisely what we should expect, from the great difference of 33° Fahr. in mean temperature, assuming the heat of the sun to be the cause of the horary oscillation; and they show conclusively that the horary variation is by no means constant, even at the same locality, for all seasons of the year. For some hours, the difference between the corrections in these two tables would affect the computed height of a station more than forty feet. This clearly proves the great error, which has sometimes been committed, of applying a table of horary corrections to observations taken at places of very different mean temperatures, and far distant from the spot for which it was computed.

4. *For abnormal oscillation.*—The abnormal oscillations of the barometric column are principally caused by general movements in the atmosphere, which are shown by repeated and numerous observations to extend rapidly and progressively over very large tracts of country. In the first volume of the third edition of Professor J. F. Daniell's Treatise on Meteorology, will be found a very interesting article upon these oscillations. It is illustrated by diagrams, constructed as explained above, which represent numerous barometric observations taken under the direction of the Meteorological Society of the Palatinate. For Europe, at least, they conclusively prove this most important principle of rapid and wide extension. In the third volume of this series of reports upon Pacific Railroad Explorations, will be found diagrams, prepared by Captain A. W. Whipple, United States Topographical Engineers, to represent barometric observations taken at different military posts by the Medical Department of the United States army. They show that the same principle is true for our western country. Slight local storms do not appear to produce much effect upon the height of the barometric column. The observations taken on our survey agree perfectly with these well known facts. One of our barometers, No. 1068, was left at Fort Reading during our field work, with Dr. J. F. Hammond, United States army, who kindly volunteered to have observations taken daily every third hour, from 6 a. m. to 9 p. m. I obtained a corresponding set of observations taken at San Diego, distant over six hundred miles, and one month's observations at Benicia, distant about two hundred miles from Fort Reading. Both sets were taken under the direction of medical officers of the

army stationed at these posts. They agreed very well in all important abnormal changes with Dr. Hammond's Fort Reading observations, and with those made at permanent camps on our route; the only difference being that the oscillations at San Diego were not so great as those at Fort Reading and Benicia. Hence, as we were never more than four hundred and fifty miles in a direct line from Fort Reading, it is fair to suppose that the abnormal oscillation over the whole region traversed during our survey, was practically the same as that measured by the stationary barometer at the fort.

The method taken to form a table of corrections for abnormal oscillations was this: all the observations taken at Fort Reading, San Diego, and Benicia, during the time that we were in the field, were reduced to what they would have been, had the temperature of the mercury been 32° Fahr. They were then corrected for the horary variation; those at Fort Reading by the tables deduced from our own observations; those at Benicia by one constructed by Lieutenant W. P. Trowbridge, Corps of Engineers, from a set of observations taken there by the Medical Department of the army; and those at San Diego by one kindly furnished me by Lieutenant J. G. Parke, United States Topographical Engineers, constructed from observations taken on his recent survey in that vicinity. The observations thus corrected were plotted, forming curves which represented the abnormal oscillations alone at the different places, and which, as already stated, were found to exhibit a remarkable correspondence. As both San Diego and Benicia were south, and the country surveyed by us north, of Fort Reading, I considered the curve constructed from observations taken there preferable to a mean of the three. I, however, used the other two to detect errors of observation, and sometimes, when the surveying party was at a considerable distance from Fort Reading, to determine the approximate velocity of a storm. Observations were taken at 6 and 9 p. m. and 6 a. m. at our camps, and, when we remained stationary, at many other hours during the day. These observations, corrected as above stated, also furnished an excellent check, by showing the direction of the abnormal curve where we were. It was found to agree remarkably with that at the permanent stations. I then made a laborious examination of the Fort Reading curve, carefully correcting it by the above mentioned checks. Three times, where the observations had been interrupted for a few days, the blank was filled by reference to the other curves. The resulting curve represented the abnormal oscillations affecting the observations on our route, and to form a table of corrections, it only remained to find its mean reading, and to take the difference between this and each of its three-hourly readings, affecting the result with the positive sign when the mean was the greater, and with the negative when it was the less. The values for intermediate hours were found by interpolation. The correction from this table, applied with its sign to any observation taken at the corresponding day and hour on the survey, eliminated the error arising from abnormal oscillation, by reducing it to the mean reading for the period for which the table was constructed. The importance of this correction may be seen from the fact that several times it affected the computed height of a station between two and three hundred feet, and, as it sometimes increased and sometimes diminished it, relative errors, amounting to between five and six hundred feet, would have resulted had it been neglected.

METHOD OF COMPUTATION.

After undergoing the four corrections above mentioned, the observations were ready for computation. The tables of Professor Elias Loomis were used for this purpose, the calculation being somewhat shortened by the method of preparing the observations. These tables are exceedingly convenient, and, by not introducing logarithms, greatly diminish the liability to mistakes. The values assumed for a few of the quantities in the formula require notice.

1. *Reading of barometer and thermometer at lower station.*—The mean reading of the barometer at the level of mean tide at Suisun bay, near Benicia, was uniformly assumed for the reading at the lower station. Its value was determined by computation from very numerous observations taken by the Medical Department of the army, at the United States hospital, near the water's edge. It may be well to state that the altitude of the hospital above the level of mean tide, given as 64 feet in the returns sent to the Surgeon General's office, is erroneous, and that the more accurate altitude of 81.5 feet was found, by careful measurement in 1854 by Lieutenant W. T. Welcker, Ordnance Corps, United States army, at the request of Lieutenant Williamson. This altitude was used in computing the barometric reading at the level of mean tide from that at the hospital. It is 30.057 inches, the temperature of the mercury being 32° Fahrenheit, and of the air 64° Fahrenheit. It was considered better to refer all the observations to this fixed base, partly because, by computing from camp to camp or station to station, all errors would be propagated through the whole succeeding work, and partly because the great principle of this method of computation being to reduce the observed to the mean reading, it would seem better to take for the lower station a mean reading very well determined than one deduced from a few observations, and depending for its accuracy upon the correctness of the horary and abnormal tables. This reasoning was verified by the test of the Cañada de las Uvas observations, which will be fully explained in a subsequent part of this chapter.

2. *Reading of thermometer at upper station.*—It only remains to notice the air temperature at the upper station. As our method of computation differs in this from that of any of the Pacific railroad surveys yet published, I shall fully state the reasons which decided me to adopt the change. It had already been found that if, in this new method of computation, the observed air temperature was used, bad results were obtained, the very high temperatures giving too great altitudes, and the very low not great enough. To correct this source of error, Mr. L. Blodget constructed an empirical table of corrections, by comparing the results of a spirit level and a barometric survey of some passes in the Sierra Nevada, made by Lieutenant Williamson in 1853. Although the results obtained by using this table are doubtless more accurate than those given by the observed air temperature without this correction, still I cannot feel satisfied either with it or with the reasoning advanced to support it, based upon the difference between the "surface temperature" and that of the main body of the air. I think the source of the difficulty lies deeper, and that it may be anticipated from the very principle upon which the new method of computation is based. To understand this fully, it is necessary to refer to the formula used in computing altitudes from barometric observations, the temperature of the mercury at both stations being the same. It contains, beside terms depending upon the geographical positions of the stations, two compound independent variables, each of which consists of two mutually dependent variables. These are the height of the mercurial column and the corresponding air temperature at each station; and it must be carefully borne in mind that they are not four independent variables. The theory of the old method of computation was that, by taking simultaneous observations at both stations, all causes of error would affect them equally, and that by substituting these observed values for the variables, the formula would give a correct difference of altitude between the stations. This is slightly erroneous, for, as the ratio of the barometric readings enters into the formula, any error in them, even although it should affect both equally, would vitiate the result. A greater objection to the method is, that

all causes of error do not affect the observations at both stations equally, particularly when distant from each other. This has rendered it necessary, in preparing our extended profiles, to adopt a new method founded upon a different principle. This is, to substitute for the variables in the formula their mean values for the whole time occupied by the survey, which is supposed to be long enough to insure great accuracy in absolute altitudes. At any rate, relative errors are thus eliminated. These mean values are found for the lower station by long continued observations ; for the upper station, the mean barometric reading is obtained by applying to the observed reading the horary and abnormal corrections, which reduce it to the mean for the desired period. The error of using with this value the observed air temperature is now apparent. It is virtually making the formula indeterminate, as, if the tables are correct, we shall have precisely the same values for all the other variables for every additional observation taken, and perhaps a different air temperature for each of them. But this algebraic result is as it should be, for the height of the mercurial column and the air temperature are, as above stated, mutually dependent variables requiring corresponding values. Hence, the theory of this method of computation, supposing the tables to be correct, plainly indicates that the mean air temperature for the time employed in the survey should be used in the formula. There is, however, a slight error in the abnormal table which modifies this result in practice. The horary table undoubtedly corrects the mercurial column for the effect produced by the changes in the heat of the sun during the day ; but, although the abnormal curve is slightly affected by the difference in mean temperature from day to day, we cannot suppose that this change, depending so much upon local causes, extends uniformly over a large tract of country. Hence the abnormal table does not correct for it satisfactorily. This, together with the fact that we travelled over regions having widely different mean temperatures, which could not be determined from our few observations, led me to use, in all cases, the mean daily air temperature. It was found by taking a mean of the observations at 7 a. m., 12 m., and 10 p. m., or of those at 7 a. m., 2 p. m., and 9 p. m.; either method being well known to give a closely approximate value.

It is interesting to see how Mr. Blodget's empirical table suggests the use of a mean temperature in the formula, although he bases upon it a widely different theory, and one which, however applicable it may be in particular cases to the old method of computation, appears to me to entirely fail in showing the cause of the error resulting from using the observed temperature in the new method. This table reduces the temperature, when between 35° and 60° Fahr., to about 67° Fahr.; and when between 75° and 95° Fahr., to about 77° Fahr. Thus it not only approximates towards giving a mean temperature, but it even indicates a higher mean temperature when the weather is warm than when it is cold. As this table is entirely empirical, being deduced by comparing altitudes found by the barometer and the level, it is by no means necessary to consider that it sustains the "surface temperature" theory. It seems to me to confirm, as fully as could possibly be expected, considering the small number of observations from which it was deduced, the idea that the mean daily temperature should be used.

In computing altitudes, the practical importance of an error in the air temperature at the upper station greatly depends upon its height above the lower ; an error of 1° Fahr. vitiating the result about one foot for each thousand feet of this height.

The following example is introduced to illustrate the method of computation above described:

EXAMPLE.

Data for determining the altitude of Camp 22, near upper end of upper cañon of Pit river.

Date.	Hour.	No. of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.
1855.			*Inches.*	°	°
August 7	6 p. m.	1060	25.990	77.0	75.0
	6 p. m.	1089	25.957	77.0	75.0
	9 p. m.	1060	25.990	63.5	65.0
	9 p. m.	1089	25.953	63.5	65.0
August 8	6 a. m.	1060	26.025	48.0	47.0
	6 a. m.	1089	25.981	47.5	47.0

Corrections applied before computation.

	6 p. m., August 7.		9 p. m., August 7.		6 a. m., August 8.	
	Bar. 1060.	Bar. 1089.	Bar. 1060.	Bar. 1089.	Bar. 1060.	Bar. 1089.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
Barometric reading	25.990	25.957	25.990	25.953	26.025	25.981
Correction for temperature of mercury	—.112	—.112	—.081	—.081	—.045	—.044
Correction for instrumental errors	.000	+.044	.000	+.044	.000	+.044
Correction for horary oscillation	+.020	+.020	—.004	—.004	—.040	—.040
Correction for abnormal oscillation	+.075	+.075	+.075	+.075	+.040	+.040
Corrected readings	25.973	25.984	25.980	25.987	25.980	25.981

Mean of corrected readings, 25.981 inches.

Mean daily air temperature, about 67° Fahrenheit.

Computation by Loomis' tables.

$H = 30.057$ $H' = 25.981$

$t = 64°$ $t' = 67°$

Part I gives for $H = 30.057$	27659.2
Part I gives for $H' = 25.981$	23851.8
Approximate altitude a	3807.4
$\frac{a}{900}(t + t' - 64) = \frac{3807.4}{900} \times 67$	283.4
Second approximate altitude A	4090.8
Part III gives for A = 4090.8 and L = 41° 50′	1.8
Part IV gives for A = 4090.8	11.1
Altitude of station in feet	4103.7

TEST OF THE COMPARATIVE ACCURACY OF THE DIFFERENT METHODS OF COMPUTATION.

On a former survey in Southern California, Lieutenant Williamson surveyed two passes, the Tejon and the Cañada de las Uvas, with a spirit level and a barometer, for the purpose of testing the latter instrument. It was from these observations that Mr. Blodget deduced his empirical table referred to above. In accordance with Lieutenant Williamson's request, I took the original notes of the Cañada de las Uvas survey, which he considered rather more accurate than the other, and carefully tested by them these various methods of computing altitudes from barometric observations. Before referring to the results obtained, a slight description of the pass will be given.

The Cañada de las Uvas is a pass from the Tulare valley, in southern California, through the Sierra Nevada to the basin east of the range. A better place for experimenting with the barometer could not have been found, had this been the sole object of the survey. The stationary barometer was observed in a brush hut, at a depot camp situated near the head of the wide and open Tulare valley, at an elevation of 1,447 feet above the level of mean tide at Suisun bay, near Benicia, and distant 12.8 miles from the entrance of the pass. For about six miles this pass is a narrow gorge, bordered by ridges several hundred feet in height. It then becomes an open valley, from half to three-quarters of a mile in width. This character is preserved nearly to the first summit, a distance of about 5.5 miles. The road then crosses several branches of the Santa Clara, a river discharging into the Pacific, gains the summit of a second divide, and descends to the basin, which is elevated about 1,500 feet above the head of the Tulare valley. From the first summit to the basin, a distance of about 12 miles, the trail is bordered by low rolling hills; but the high ridges of the Sierra Nevada intervene between it and the Tulare valley.

By this description it will be seen that some of these test observations were taken in a narrow gorge, others in a wide valley, and others in an open undulating country, separated by a high range of mountains from the stationary barometer. The altitudes of the stations varied from 192 feet to 2,809 feet above Depot camp; and their distances, from 12.8 miles to 36.4 miles from the same place. A greater diversity in their positions could not have been desired.

The observations in the pass were taken with one of Green's cistern barometers, similar to those used on our survey. At the depot camp, another barometer of the same kind was used, together with two syphon barometers, which, although greatly inferior instruments, furnished a useful check upon errors of observation.

In making the test computations, I prepared the table of abnormal corrections from the observations at the depot camp. The table of horary corrections used was the one already mentioned, deduced from Lieutenant Parke's observations on his recent survey in the vicinity. The altitudes were first computed by the old method, with Lee's tables, using the carefully interpolated simultaneous readings at the depot camp for the barometric and thermometric readings at the lower station. To prevent the slight error arising from taking the ratio between two equally erroneous barometric readings, the corrections for horary and abnormal error were applied to the observations at both stations. The altitudes were then computed by the new method, first using the observed, and then the mean daily air temperatures. As the results were the heights of the stations above mean tide at Suisun bay, near Benicia, the altitude of the depot camp above that level was subtracted from each in order to institute a comparison between them and those determined by the spirit level and by the old method of computation; both of which were referred to the level of the camp itself. The following tables exhibit the original data and the results deduced by each of the three different methods of computation. It will be seen that the altitudes of forty-eight stations were determined, the highest of which was 2,809.5 feet above, and the most distant 36.4 miles from, the depot camp. Assuming the altitudes found by the level to be correct, a little calculation will show that the old method, the new method with observed air temperature, and the new method with mean daily air temperature, give mean errors of 29.3, 28.9, and 9.2 feet; maximum errors of 142, 119.1, and 31.9 feet; and minimum errors of 1.8, 1.5, and 0.8 feet, respectively; and also, that about two-thirds of the altitudes determined by the last named method differ from the true heights less than nine feet.

COMPARISON OF THE DIFFERENT METHODS OF COMPUTING ALTITUDES FROM BAROMETRIC OBSERVATIONS, BASED UPON DATA OBTAINED IN THE SURVEY OF CAÑADA DE LAS UVAS, BY LIEUTENANT R. S. WILLIAMSON, UNITED STATES TOPOGRAPHICAL ENGINEERS, IN 1853.

Data.—Observations in Depot camp during survey of Cañada de las Uvas.

Date.	Hour.	Reading of barometer.	Att. therm.	Det. therm.	Date.	Hour.	Reading of barometer.	Att. therm.	Det. therm.
1853.	*h. m.*	*Inches.*	°	°	1853.	*h. m.*	*Inches.*	°	°
Sept. 28	6. 00 a. m.	28. 660	58. 5	59. 0	Oct. 2	5. 30 p. m.	28. 730	76. 0	76. 5
	9. 00 a. m.	28. 690	71. 5	71. 0		8. 40 p. m.	28. 752	77. 0	77. 0
	12. 00 m.	28. 666	79. 0	79. 5	Oct. 3	6. 00 a. m.	28. 755	62. 5	63. 0
	3. 00 p. m.	28. 623	84. 0	83. 0		9. 00 a. m.	28. 813	85. 0	84. 0
	5. 35 p. m.	28. 595	72. 0	72. 0		12. 00 m.	28. 782	95. 0	95. 5
	8. 05 p. m.	28. 610	66. 0	68. 0		3. 30 p. m.	28. 732	96. 0	95. 5
Sept. 30	6. 00 a. m.	28. 609	59. 5	60. 0		5. 30 p. m.	28. 710	86. 0	85. 0
	9. 00 a. m.	28. 680	80. 5	80. 0		7. 30 p. m.	28. 720	75. 0	74. 5
	12. 00 m	28. 674	95. 0	94. 0	Sept. 29	5. 30 p. m.	28. 560	77. 5	77. 0
	3. 00 p. m.	28. 650	94. 0	94. 0	Sept. 30	6. 00 a. m.	28. 609	59. 5	60. 0
	5. 30 p. m.	28. 615	83. 0	82. 5	Oct. 1	6. 00 a. m.	28. 688	65. 0	66. 0
	8. 10 p. m.	28. 656	80. 0	80. 0	Oct. 4	5. 30 p. m.	28. 680	80. 0	80. 5
Oct. 1	6. 00 a. m.	28. 688	65. 0	66. 0	Oct. 5	6. 00 a. m.	28. 724	73. 0	72. 5
	9. 00 a. m.	28. 759	85. 0	84. 0	Oct. 2	6. 00 a. m.	28. 728	63. 0	65. 0
	12. 00 m.	28. 758	94. 5	93. 5		5. 30 p. m.	28. 730	74. 0	76. 5
	3. 00 p. m.	28. 715	96. 0	95. 0	Oct. 3.	6. 00 a. m.	28. 755	62. 5	63. 0
	5. 30 p. m.	28. 690	83. 0	83. 0		9. 00 a. m.	28. 813	85. 0	84. 5
	8. 00 p. m.	28. 710	80. 0	80. 0		12. 00 m.	28. 782	95. 5	95. 0
Oct. 3	6. 00 a. m.	28. 728	65. 0	63. 0		3. 30 p. m.	28. 732	96. 0	95. 5
	9. 00 a. m.	28. 792	81. 5	81. 0		5. 30 p. m.	28. 710	86. 0	85. 0
	12. 00 m.	28. 758	93. 0	92. 0	Oct. 4	6. 00 a. m.	28. 751	73. 0	73. 0
	3. 00 p. m.	28. 750	94. 0	93. 5					

Data.—Observations in Cañada de las Uvas.

Date.	Station.	Hour.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Altitude by spirit level above depot camp.	Distance from depot camp.
1853.		*h. m.*	*Inches.*	°	°	*Feet.*	*Feet.*
September 28....	37 & 58	5.00 p. m.	28,425	86.0	85.0	193.4	67,740
	56	4.15 p. m.	28,240	87.0	84.0	384.3	70,879
	49	3.15 p. m.	27.900	79.0	79.0	720.4	75,971
	40	2.15 p. m.	27,718	77.5	77.0	917.4	79,237
	34	1.20 p. m.	27,600	81.5	81.0	1,055.8	81,474
	27	0.30 p. m.	27,520	85.0	81.0	1,158.6	83,561
	22	12.00 m.	27,420	75.5	75.5	1,260.8	85,312
	18	11.00 a. m.	27,305	78.0	77.5	1,387.0	87,719
	14	10.00 a. m.	27,240	71.5	71.5	1,466.6	89,394
	7	9.00 a. m.	27,080	66.0	65.5	1,628.0	91,996
September 30....	1	7.40 a. m.	26,922	72.0	70.0	1,774.4	95,369
	3	8.00 a. m.	26,898	74.0	70.0	1,809.7	97,732
	6	8.20 a. m.	26,861	75.0	73.0	1,874.0	99,873
	9	8.45 a. m.	26,810	77.0	74.0	1,931.1	102,424
	10	9.00 a. m.	26,790	81.0	75.0	1,967.7	104,574
	12	10.00 a. m.	26,744	83.0	79.0	2,045.0	108,557
	15	11.05 a. m.	26,640	82.0	81.0	2,160.0	112,167
	18	1.25 p. m.	26,364	85.0	83.0	2,372.5	121,382
	22	2.30 p. m.	26,152	85.0	84.0	2,618.6	125,860
	27	3.15 p. m.	25,960	82.0	82.0	2,809.5	128,834
October 1....	31	10.30 a. m.	26,137	84.0	84.0	2,758.0	132,021
	33	11.40 a. m.	26,428	83.0	82.0	2,435.2	135,885
	38	1.10 p. m.	26,557	84.0	84.0	2,280.2	140,390
	40	3.00 p. m.	26,684	86.0	86.0	2,131.4	146,095
	45	4.30 p. m.	26,726	86.0	78.0	2,068.4	153,300
October 2....	47	10.15 a. m.	26,710	86.5	84.0	2,172.0	156,200
	51	11.00 a. m.	26,838	86.0	85.0	2,002.7	158,704
	53	12.00 m.	26,930	90.0	89.0	1,909.7	161,175
	55	0.30 p. m.	26,910	93.0	90.0	1,914.4	163,885
	58	1.30 p. m.	26,950	90.0	90.0	1,874.7	167,988
	61	2.30 p. m.	26,882	91.0	89.0	1,922.3	175,360
	64	4.00 p. m.	26,930	91.5	87.0	1,869.6	179,932
October 3....	66	8.30 a. m.	27,070	88.0	80.0	1,817.7	182,796
	68	9.00 a. m.	27,128	86.5	86.5	1,750.4	186,053
	74	10.45 a. m.	27,196	90.0	89.0	1,678.5	192,315
September 29....	Camp.	6.00 p. m.	26,835	67.0	67.0	1,764.0	95,369
30....	Camp.	6.00 a. m.	26,860	56.0	58.0	1,764.0	95,369
October 1....	Camp.	6.00 a. m.	27,000	67.0	65.5	1,764.0	95,369
October 4....	Camp.	6.00 p. m.	26,987	70.0	70.0	1,764.0	95,369
October 5....	Camp.	6.00 a. m.	26,973	49.0	51.0	1,764.0	95,369
October 2....	Camp.	6.00 a. m.	26,965	44.0	45.0	1,772.4	192,315
	Camp.	6.00 p. m.	27,018	75.0	76.0	1,772.4	192,315
October 3....	Camp.	6.00 a. m.	26,990	47.5	48.0	1,772.4	192,315
	Camp.	11.30 a. m.	27,090	88.0	87.5	1,772.4	192,315

Data.—Observations in Cañada de las Uvas—Continued.

Date.	Station.	Hour.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Altitude by spirit level above depot camp.	Distance from depot camp.
1853.		*h. m.*	*Inches.*	°	°	*Feet.*	*Feet.*
October 3	Camp.	12. 00 m.	27,087	88. 0	88. 0	1,772. 4	192,315
	Camp.	3. 00 p. m.	27,025	86. 0	87. 0	1,772. 4	192,315
	Camp.	6. 20 p. m.	26,965	62. 0	62. 0	1,772. 4	192,315
October 4	Camp.	6. 00 a. m.	26,975	48. 5	50. 0	1,772. 4	192,315

Results obtained by computation.

Date.	Station.	Hour.	Altitude by barometer above depot camp, computed by— Old method, using Lee's tables.	New method, using observed air temperatures.	New method, using mean daily air temperatures.	Differences between altitudes determined by barometer and spirit level. Old method, using Lee's tables.	New method, using observed air temperatures.	New method, using mean daily air temperatures.
1853.		*h. m.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Sept. 28	37 & 58	5. 00 p. m.	219. 9	213. 7	195. 2	— 26. 5	— 20. 3	— 1. 8
	56	4. 15 p. m.	403. 2	401. 8	383. 1	— 18. 9	— 17. 5	+ 1. 2
	49	3. 15 p. m.	724. 7	718. 9	707. 9	— 4. 3	+ 1. 5	+12. 5
	40	2. 15 p. m.	928. 3	906. 3	899. 1	— 10. 9	+ 11. 4	+18. 6
	34	1. 20 p. m.	1078. 6	1064. 7	1046. 8	— 22. 8	— 8. 9	+ 9. 0
	27	0. 30 p. m.	1189. 0	1175. 7	1157. 2	— 30. 4	— 17. 1	+ 1. 4
	22	12. 00 m.	1271. 0	1251. 1	1248. 4	— 10. 2	+ 9. 7	+12. 4
	18	11. 00 a. m.	1420. 0	1407. 8	1396. 9	— 43. 0	— 20. 8	— 9. 9
	14	10. 00 a. m.	1473. 0	1455. 9	1463. 3	— 6. 4	+ 10. 7	+ 3. 3
	7	9. 00 a. m.	1621. 3	1596. 7	1623. 3	+ 6. 7	+ 31. 3	+ 4. 7
Sept. 30	1	7. 40 a. m.	1783. 6	1755. 5	1781. 6	— 9. 2	— 11. 1	— 6. 7
	3	8. 00 a. m.	1818. 0	1788. 5	1815. 1	— 8. 3	+ 21. 2	— 5. 4
	6	8. 20 a. m.	1867. 8	1844. 9	1861. 8	+ 6. 2	+ 29. 1	+12. 2
	9	8. 45 a. m.	1935. 4	1914. 3	1928. 1	— 4. 3	+ 16. 8	+ 3. 0
	10	9. 00 a. m.	1970. 6	1946. 7	1964. 5	— 2. 9	+ 21. 0	+ 3. 2
	12	10. 00 a. m.	2032. 9	2054. 3	2049. 5	+ 12. 1	— 9. 3	— 4. 9
	15	11. 05 a. m.	2138. 3	2168. 3	2157. 4	+ 21. 7	— 8. 3	+ 2. 6
	18	1. 25 p. m.	2440. 6	2389. 7	2370. 3	— 68. 1	— 17. 2	+ 2. 2
	22	2. 30 p. m.	2673. 8	2541. 4	2601. 2	— 55. 2	+ 77. 8	+17. 4
	27	3. 15 p. m.	2870. 1	2828. 0	2810. 6	— 60. 6	— 18. 5	— 1. 1
Oct. 1	31	10. 30 a. m.	2798. 1	2767. 1	2762. 9	— 40. 1	— 9. 1	— 4. 9
	33	11. 40 a. m.	2463. 4	2399. 5	2403. 3	— 28. 2	+ 35. 7	+31. 9
	38	1. 10 a. m.	2308. 8	2277. 0	2273. 2	— 28. 6	+ 3. 2	+ 7. 0
	40	3. 00 p. m.	2144. 5	2013. 1	2102. 5	— 13. 1	+ 18. 3	+28. 9
	45	4. 30 p. m.	2066. 6	2049. 8	2067. 6	+ 1. 8	+ 18. 6	+ 0. 8
Oct. 2	47	10. 15 a. m.	2165. 5	2187. 0	2175. 9	+ 6. 5	— 15. 0	— 3. 9
	51	11. 00 a. m.	2024. 7	2012. 4	1998. 4	— 22. 0	— 9. 7	+ 4. 3

Results obtained by computation—Continued.

Date.	Station.	Hour.	Altitude by barometer above depot camp, computed by—			Differences between altitudes determined by barometer and spirit level.		
			Old method, using Lee's tables.	New method, using observed air temperatures.	New method, using mean daily air temperatures.	Old method, using Lee's tables.	New method, using observed air temperatures.	New method, using mean daily air temperatures.
1853.		*h. m.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Oct. 2	53	12. 00 m.	1937. 9	1911. 7	1884. 7	— 28. 2	— 2. 0	+25. 0
	55	0. 30 p. m.	1971. 1	1934. 0	1903. 8	— 56. 7	— 20. 2	+10. 6
	58	1. 30 p. m.	1917. 7	1906. 5	1876. 1	— 43. 0	— 31. 8	— 1. 4
	61	2. 30 p. m.	1986. 2	1943. 3	1916. 0	— 63. 9	— 21. 0	+ 6. 3
	64	4. 00 p. m.	1921. 5	1895. 1	1874. 8	— 51. 9	— 25. 5	— 5. 2
Oct. 3	66	8. 30 a. m.	1809. 8	1811. 8	1811. 8	+ 7. 9	+ 5. 9	+ 5. 9
	68	9. 00 a. m.	1772. 7	1765. 2	1744. 2	— 22. 3	— 14. 8	+ 6. 0
	74	10. 45 a. m.	1692. 1	1703. 9	1675. 3	+ 13. 6	— 25. 4	+ 3. 2
Sept. 29	Camp.	6. 00 p. m.	1752. 1	1716. 4	1752. 3	+ 11. 9	+ 47. 6	+11. 4
Sept. 30	Camp.	6. 00 a. m.	1746. 6	1727. 7	1793. 7	+ 17. 4	+ 36. 3	—29. 7
Oct. 1	Camp.	6. 00 a. m.	1716. 1	1690. 1	1757. 1	+ 47. 9	+ 73. 9	+ 6. 9
Oct. 4	Camp.	6. 00 p. m.	1719. 3	1700. 0	1738. 8	+ 44. 7	+ 64. 0	+25. 2
Oct. 5	Camp.	6. 00 a. m.	1691. 7	1649. 1	1749. 7	+ 72. 3	+114. 9	+14. 3
Oct. 2	Camp.	6. 00 a. m.	1630. 4	1653. 3	1771. 0	+142. 0	+119. 1	+ 1. 4
	Camp.	6. 00 p. m.	1768. 1	1755. 7	1768. 8	+ 4. 3	+ 16. 7	+ 3. 6
Oct. 3	Camp.	6. 00 a. m.	1707. 7	1679. 4	1784. 5	+ 64. 7	+ 93. 0	—12. 1
	Camp.	11. 30 a. m.	1794. 0	1784. 7	1760. 2	— 21. 3	— 12. 3	+12. 2
	Camp.	12. 00 m.	1780. 2	1778. 2	1752. 4	— 7. 8	— 5. 8	+20. 2
	Camp.	3. 00 p. m.	1797. 0	1776. 2	1754. 4	— 24. 6	— 3. 8	+18. 0
	Camp.	6. 20 p. m.	1740. 2	1707. 8	1766. 6	+ 32. 2	+ 64. 6	+ 5. 8
Oct. 4	Camp.	6. 00 a. m.	1714. 6	1670. 7	1775. 3	+ 57. 8	+101. 7	— 2. 9

No trial was made of Mr. Blodget's empirical table, for, as it was deduced from these very observations, they would not give a fair idea of its value. As has been already mentioned, the method was tested of using successively each place of observation for the lower station, with the next above it for the corresponding upper; but, as might be expected, errors were found to be propagated, and to be very considerably greater than when the sea level was constantly used for the lower station.

The result of this investigation, confirming so fully the accuracy of the new method of computation, cannot but be satisfactory. When it is remembered that two nice adjustments are required in reading the barometer, it must be considered that a mean error of 9 feet, amounting to only about nine thousandths of an inch of the mercurial column, is a wonderfully close approximation, when the difference of the altitudes computed amounts to nearly 3,000 feet. That this method has slight causes of inaccuracy, even in theory, is not denied; but this result tends strongly to show that practically their effect is unimportant. It is not supposed that the mean error in the altitudes on our survey is so small as 9 feet; but that the profile is sufficiently correct for all the purposes of a preliminary reconnaissance, I have not the slightest doubt.

Whenever water-courses gave practical checks upon the relative altitudes of different stations, as was often the case, the profile bore the most careful study in a perfectly satisfactory manner, and confirmed, without exception, the use of the mean daily air temperature, instead of the observed, in the computation.

HEIGHT OF FORT READING; EXPLANATION OF TABLES OF BAROMETRIC OBSERVATIONS, ETC., IN APPENDIX D.

The great number of observations taken at Fort Reading has enabled me to compute its altitude in two different ways; one of which is independent of the tables of horary and abnormal correction. We had very careful hourly observations taken from July 22 to July 26, and from November 17 to November 22, inclusive. It is well known that a mean of the observations at 7 a. m., 2 p. m., and 9 p. m., differs very little from the mean barometric reading for the whole twenty-four hours; and, as five of the days on which the above mentioned observations were taken were in the dry, and six in the rainy season, it is probable that a mean of their mean readings thus found may approximate to that of the year. It is 29.506 inches. The corresponding mean air temperature, found by taking a mean of the observations at 7 a. m., 12 m., and 10 p. m., for the eleven days, is 62°.3 Fah. The altitude given by these data is 518 feet.

By the second method, I applied the tables as in other cases, and found the corrected mean of all our observations at the fort, which were about 600 in number, and, with the corresponding mean air temperature, computed the altitude. It is 544 feet, differing only 26 feet from the other. I have adopted the first result on the profiles, as it is obtained from observations taken with very great care, while many of the others are less reliable.

The tables in Appendix D exhibit the original data for the construction of our profiles, and the altitudes deduced from the observations. It must be remembered that all the altitudes are referred to the level of mean tide at Benicia, as the barometric reading at the sea level north of that place is not known. The column headed "corrected barometric reading" gives the height of the mercurial column, after the corrections for reduction to 32° Fahr., for instrumental error, and for horary and abnormal oscillation, have been applied. The very slight difference between these corrected readings, when there are several taken at the same camp, confirms the accuracy of the horary and abnormal tables.

CHAPTER VII.

ROUTE FROM SHASTA VALLEY, EAST OF SHASTA BUTTE, TO FORT READING; EXPLORED BY LIEUT. R. S. WILLIAMSON, UNITED STATES TOPOGRAPHICAL ENGINEERS, IN 1851.

Explanation.—Party.—Yreka in 1851.—Start.—View of two passes.—Wright lake.—Water hole.—Porcupine killed.—Turned back.—Pass.—Extended view.—Pumice-stone.—Difficult travelling.—No water or grass.—Natural bridge.—Pedregal.—Water in fissure.—Branch of fall river.—Fall river.—Ford.—Indians.—Pit river.—Tule raft.—Expedient.—Pass through western chain of sierra nevada.—Battle creek.—Cow creek.—Settlements.

As Lieut. Williamson proposed to add a short description of this expedition to his report, I have compiled the following sketch from his field notes.

The exploration was made in accordance with instructions from Major P. Kearney, 1st dragoons. Lieut. Williamson's party consisted of twenty civilians, one of whom was Mr. Freaner, subsequently killed by the Pit river Indians near the lake that now bears his name. The expedition started from Yreka, then a little town called Shasta Butte city, and composed of about forty houses made of canvas and wood. The population may be estimated from the fact that five hundred and ninety-nine votes were polled for alcalde when Lieut. Williamson was there. On July 3, a depot camp was made on Willow creek, about sixteen miles from the town, and the preparations for the exploration commenced. A prismatic compass, with a sextant and artificial horizon, were the only available instruments.

July 8.—To-day we started, and, after travelling about fifteen miles over a good route, encamped near Sheep Rock.

July 9.—After passing over a gentle divide northeast of Sheep Rock, the road skirted a plain evidently covered with water in the rainy season. We travelled about nine miles in a northeast direction, and then turned southward, over low hills. In about ten miles we struck a fine little stream in a prairie, and encamped. The grass was excellent; and wild onions were abundant in the vicinity.

July 10.—Ice, half an inch thick, formed last night. After travelling towards the east for about five miles, we came to a shelf of black rock, fifty feet high, from which we had a fine view. There seemed to be two breaks in the hills; one towards the southeast, near a prominent conical butte, and the other and lower one towards the northeast. Thinking our course to be intermediate between the two, I selected the latter. We soon reached a second shelf, higher than the other; and a short distance beyond crossed a small creek flowing through a prairie. Here we struck a trail, which we followed up a mountain southwest of the pass, until it disappeared. We continued our course to the summit. A large sheet of water, supposed to be Rhett lake, lay about twenty miles distant, in a northeast direction. A level, timbered valley, bordered by hills, extended to the shore. We continued our course, and in about seven miles encamped near a water hole. We killed a bear and porcupine on the route, and had already deer, antelopes, and mountain sheep in camp.

July 11.—Thinking that we were gaining too much distance towards the east, I turned back, and struck for the pass near the conical butte. After winding about in a dense mass of bushes and small trees, and gradually ascending a long slope, we found ourselves within about half a mile of the base of the peak. Turning towards the south we soon reached the summit of the pass. The conical butte rose on our left, and a higher round hill on our right. Leaving the train, Mr. Freaner and myself went to the top of the latter, and obtained an extended view in every direction, except the northeast. We saw Mount Pitt, Klamath lake, and Shasta valley; but Rhett lake was hidden by the pine trees on the conical butte. Southward, as far as the eye could reach, the country was densely timbered, and apparently tolerably level, but broken by occasional low ridges. Lassen's butte was distinctly visible. Toward the southeast we saw a strip of yellow, which appeared like a prairie with two or three small lakes in it. This was supposed to be Fall River valley, distant about forty miles. While waiting for us, the men found a little snow on the conical butte. We started to proceed in the direction of Fall River valley, but it was impossible to keep a straight course, on account of the many obstacles encountered. The country was covered with pumice-stone, and a few bare hills were merely heaps of this substance. During the afternoon we searched for water constantly, but in vain. We encamped after sunset, without either water or grass, having travelled about twelve miles from the pass.

July 12.—We started before sunrise, and followed a very winding course, on account of rocks and manzanita bushes. At one place we came to a fissure 40 feet in width and still more in depth, which it was necessary to cross. Fortunately we discovered a natural bridge, supported by a very perfect arch, which afforded us a safe passage. While struggling forward, one of the men in the rear of the train discovered water in a deep hole, and we at once encamped. Having watered the animals and prepared breakfast for ourselves, we again started, and forced our way, with great difficulty, over a rocky pedregal to the foot of a hill, where we found a better road. I went with Mr. Freaner to the summit, and saw the valley ten or twelve miles distant, and separated from us by a densely timbered region, broken by low ridges. We continued our course, and soon reached a little prairie covered with flowers and grass, where we encamped, and obtained water by digging.

July 13.—We started early this morning, and followed a winding course to avoid, and yet to keep near, the rocky pedregal on our left. In about six miles we struck a small branch of Fall river, flowing west of south. Crossing it, we soon found an Indian trail near its bank. In about three miles the stream made a bend towards the east. We followed it, and in about 3.5 miles reached Fall river, flowing southeast. After passing down its bank for about four miles, we encamped. The valley was open and covered with grass below camp, but above, timber concealed the view.

July 14.—This morning we followed down the river to its mouth, a distance of seven miles. About two miles below camp it was one hundred yards wide. We crossed it above the rapids, near its mouth, at what would have been a good ford had the banks been cut down a little. There was a large Indian rancheria near, and we were joined by several of its inmates, who professed themselves friendly. After giving them a few presents, we descended a steep bluff to Pit river, and passing over it on a tule raft encamped on the southern bank. My mercury had been lost in crossing the pedregal, but I obtained a good observation of the sun for latitude by using water instead.

This camp of Lieutenant Williamson was in nearly the same spot as our Camp 20. On July 15, he followed almost the same trail that we subsequently did, through Stoneman's ridge, and encamped on Canoe creek, between our Camps 18 and 19. The following extracts from his journal describe his route from this camp.

July 16.—We started early, and followed a westerly course. The road was good, although occasionally rocky. After travelling about ten miles, and ascending two high ledges, we found ourselves in a little prairie, in which there were two Indian rancherias. A small creek, rising among the hills, flowed through the prairie, and after spreading out into several branches probably sank. Turning our course towards the south, we travelled about five miles to the foot of a steep ascent. We gained the summit in about three hours, and encamped near the sources of Battle creek, with an abundant supply of excellent grass and water. Lassen's Butte was in plain sight towards the southeast.

July 17.—We started early this morning to follow a westerly course, and for several hours were winding about among hills, rocks, and thick bushes. The road, however, was occasionally good. At the expiration of this time we had reached the foot hills, which extend for a considerable distance into the Sacramento valley. Soon afterwards we struck the main branch of Cow creek, which we crossed without difficulty. We encamped upon its banks, about a mile from the crossing, after a hard day's march. The grass was excellent in the vicinity. We felt very sensibly a great change in temperature, due to the difference in elevation between the morning and evening camps.

July 18.—We travelled about sixteen miles down the creek to its junction with another branch, and then turned towards the south. In a short distance we struck Lyon's trail, which we followed to the Sacramento river. We crossed the stream, and encamped on Cotton-wood creek, about two miles from Major Reading's house.

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GEOLOGICAL REPORT.

WASHINGTON, D. C.
1856.

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GEOLOGIST AND BOTANIST OF THE EXPEDITION.

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BY J. S. NEWBERRY, M.D.
GEOLOGIST OF THE EXPEDITION.

CHAPTER I.

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GENERAL FEATURES.

The configuration of the country in the vicinity of San Francisco has been given by two principal, and nearly parallel lines of upheaval, one passing between the city and the Pacific, forming the barrier through which the Golden Gate has been cut, the other that of the Contra Costa mountains. These, with several subordinate axes, which exert a local influence on its structure, properly belong to the compound chain of the coast mountains, have the same geological structure, and are doubtless of the same age. They are composed of serpentine or trap at centre, flanked by heavy beds of shales and sandstones of the tertiary period.

The general trend of these ranges is northwest and southeast, and they belong to the same system of elevation with that which has given the general outline and direction of the coast from Cape St. Lucas to Cape Mendocino. The islands which are scattered along the coast of California within the limits specified apparently lie in the lines of some of the axes of this system.

The Bay of San Francisco and the valley south of it occupy the synclinal trough which lies between the two axes I have mentioned. This depression, geologically considered, forms but a single area, which should be viewed as a whole, and which may properly be termed the valley of San Francisco bay. Of this area the valley of San Juan forms the southern, San Francisco bay the middle, and the western half of San Pablo bay and Sonoma valley the northern portion. Towards its southern extremity it is enclosed between the San Francisco or Coast Range and the Diablo mountains, with which the Contra Costa range here unites. Near its northern end the Contra Costa range may be said to terminate, permitting San Pablo bay to stretch eastward to the base of the Diablo mountains, thus adding the eastern half of this bay and Napa valley to its area.

The subordinate axes which traverse this valley have produced the island of Yerba Buena, the east and west shores of the straits connecting San Francisco and San Pablo bays, Point San Pedro, &c. Through the most westerly of these axes the Golden Gate is opened as a narrow strait, of great depth, and bounded by rocky, and in some places, precipitous walls. Through the most easterly the straits of Carquines pass, presenting the same general characters.

LOCAL GEOLOGY.

San Francisco range.—This range, in the vicinity of the city of San Francisco, forms low mountains or hills, none of which exceed 2,000 feet in height. They are composed of shales, sandstones, serpentine, and trap.

Trap.—This forms the lowest and central portion of the range, where it is cut by the Golden Gate, and is only exposed low down in the cliff which forms the north wall of this strait.

A few miles further north, in the same range, trap has been poured out in abundance, but it has apparently not burst through the overlying strata anywhere in the vicinity of San Francisco. The trap of the Golden Gate is dark brown in color, and more compact than that which has reached the surface in the vicinity of Petaluma.

Serpentine.—Overlying the trap on the north side of the gate, and on the south side forming the axis and nucleus of the chain, are heavy beds or masses of serpentine. Here, as wherever found in the vicinity of San Francisco, it is grayish green in color, and varies considerably in hardness and texture; the weathered portion being rendered friable by numerous joints, of which the surfaces are more or less covered with a white, probably magnesian, stain. At Fort Point, the best exposure of this rock which I saw, some portions of it are very compact and homogeneous, while others are somewhat foliated. The position which it occupies, and the relations which it sustains to the accompanying strata, seemed to me to indicate that it is an erupted rock. It forms the centre of the ridge, bearing on either side the inclined and convoluted strata of sandstones and shales, which cover and embrace it.

It is, perhaps, possible that it is a metamorphosed form of one of the group of stratified deposits with which it is associated, but the sandstones and shales, fossiliferous or barren, which, with trap, serpentine, and granite, go to make up the mass of the Coast Mountains, are scarcely capable of assuming this form under any phase of metamorphic action with which we are familiar; nor is there a dolomite or other magnesian rock on the western coast, which might be supposed to exhibit the unchanged state of the serpentine.

My own observations would therefore lead me to consider it an intruded rock, whatever inferences as to the origin of serpentine might be drawn from other localities, till new facts shall be brought to light, which will offer a more plausible explanation of the phenomena.

As the origin and composition of serpentines have recently afforded interesting subjects of inquiry to geologists and chemists, and as it has been suggested that the serpentine of California, as has been proved of some of the eastern (so called) serpentines, was, perhaps, not a magnesian rock, I submitted a specimen from the vicinity of San Francisco to Dr. J. D. Easter, for analysis, and upon it he has made the following report:

Massive serpentine from California.

The specimen was somewhat decomposed, of a mottled grayish-green color, and apparently an aggregate of several magnesian minerals. The following is the result of a very careful analysis:

Silica	39.60
Chromic iron	0.20
Alumina	1.94
Protoxide of iron and manganese	8.45
Magnesia	36.90
Water and loss	12.91
	100.00

From this analysis it will be seen that this is a true serpentine, and not unlike, in composition, much of the serpentine of the Atlantic States.

Sandstones and shales.—Upon the serpentine lies a deposit of sandstones and shales, several hundred feet in thickness. They are somewhat interstratified—their strata conformable, and apparently belonging to the same geological epoch, being members of a group widely spread over the Pacific coast, and to which, under the name of San Francisco group, I shall frequently have occasion to refer.

The sandstone, where it has been long exposed to the action of the weather, is light brown in color; is soft and easily worked, having considerable resemblance, both in color and consistence, to the sandstone of which the older public buildings at Washington, D. C., are constructed. From its color, and the facility with which it yields to atmospheric action, out-cropping ledges of this stone closely imitate the brown and irregularly rounded masses of protruded trap, which are so common in California and Oregon; and it has often happened to me to be, at first sight, deceived by the similarity. When, however, this rock has been penetrated to a considerable depth, it is found to become much harder and darker, being grayish-blue in color, and exceedingly dense and resistent, again resembling an erupted rock.

No analyses have been made of these varieties to determine the nature of the chemical change which gives rise to the obvious differences in physical character, but I suspect it is due to the removal, by solution, of the soluble salts which it contains, and especially to the oxidation of the salts of iron. It is also probable that, where it is most dense, it has in some degree experienced the metamorphic action of the igneous rocks which it covers. Both sandstones and shales generally effervesce with acids, and probably contain both lime and magnesia.

This sandstone forms the slopes of the axis lying between the Bay of San Francisco and the ocean, and the rocky basis upon which the city of San Francisco rests. It is quarried near water-level, at the foot of Telegraph hill; and is found skirting the shores of the bay on both sides of the entrance to the Golden Gate, as well as the strait leading into San Pablo bay. It forms the greater part of the islands of Yerba Buena, Alcatraz, and, as I am informed, the western declivities of the Contra Costa mountains.

Shales.—The shales, to which I have referred, are fully exposed in the excavations made in cutting the streets through the elevations which occur in the upper part of the city. They are greenish or yellowish-brown in color, and contain varying proportions of clay and sand. Where laid open in the upper part of the city, they are very friable and easily removed; but in localities where less affected by the action of the air, they are considerably more compact, and closely resemble some of the older clay slates.

I was not able to detect in the immediate vicinity of San Francisco, either in the sandstone or shale, any other fossils than small particles of carbonized vegetable matter; but on San Pablo bay this group is highly fossiliferous, and, on the Pacific side of the San Francisco axis, great numbers of an extinct species of *Scutella* (*S. interlineata*) are washed out by the waves from a sandstone similar, in its lithological characters, to that underlying the city. I have little doubt that the sandstones which flank the serpentine axes of southern California, and which contain great numbers of *Scutellae*, *Ostreae*, *Pectens*, and other shells, regarded by Mr. Conrad as Miocene, are of the same age, and, perhaps, continuous with the sandstones and shales of San Francisco.

The sandstone which I have described is the only rock which will furnish a material suitable for architectural purposes in the immediate neighborhood of this city. As a building stone it does not rank high. The softer portions, though easily worked, are too friable to retain any ornament or inscription, or to resist the crushing force of great weight; while that which is quarried from a greater depth, though hard, tough, and handsome, when first taken out, will be liable to fade, and, probably, to a comparatively rapid decomposition. The demand for a good building material which now exists in the city, and which will hereafter be more sensibly felt, can, however, be fully supplied from the stores of granite, porphyry, trachyte, and trap, which are to be found in the Coast Ranges and Sierra Nevada in the greatest abundance, and at points neither remote nor inaccessible.

Jasper.—In a great number of localities in the vicinity of San Francisco, ridges and masses of red jaspery rock are seen. It crops out in the vicinity of the Presidio, on the south side of the Golden Gate, and exists in large quanties at Point Diablo, and thence to Saucilito, on the north side. It is also found in Raccoon straits, and on the southwest side of Angels' Island forms Red Rock, and also occurs at various points further northward. It frequently occurs in ridges, having the appearance of an erupted rock, protruded along lines of upheaval. It is red, yellow, or green in color, but oftenest blood-red, or some intermediated shade between that and pink, being usually somewhat mottled, clouded, or striped.

Veins of white quartz, generally small, traverse it in every direction, and, where it is weathered, it is often peculiarly cellular, ragged, and rough. Where stratified, the laminae which it exhibits are twisted and contorted in all possible directions, and whatever is the history of the material of which it is composed, whether it is thrown up from below or, as is more probable, it is a metamorphosed form of the associated rocks, it is evident that it has been subjected to a high degree of heat. These jaspery rocks are, equally with the serpentines, a marked feature of the geology of the Coast Ranges, from the Gulf of California to the Columbia.

Surface geology.—The hills about San Francisco are covered with loose and, in some places, drifting sand, which has, apparently, in greater part, been derived from the shore of the Pacific, whence it has been driven by the strong and ever-blowing westerly winds. Along the shore of the bay, in many places, alluvial deposits, consisting of sands and clays containing vegetable matter, have collected to a considerable depth. They have probably been formed by the washing down of the higher grounds, and belong altogether to the present epoch.

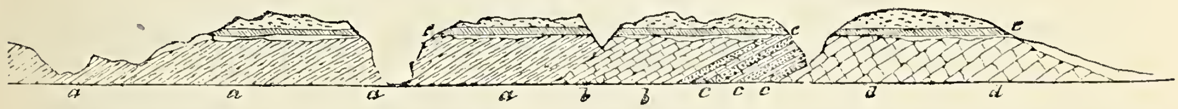
SHORES OF SAN PABLO BAY.

As we go north from San Francisco, passing through the straits leading into San Pablo bay, we find the shore on either hand composed of sandstone, forming elevated ridges, which have been produced by subordinate lines of upheaval, having the same general trend as those which include them. In the channel stands "Red Rock," a mass of jasper, to which allusion has already been made, at the entrance to San Pablo bay. Bird island is a mass of sandstone, as are the points on both sides.

Passing the low land above point San Pablo, and going eastward toward the straits of Carquines, along the south shore of the bay, a most interesting section of strata is exposed, having a thickness of at least 3,000 feet. These strata have an inclination of from 30° to 35°, dipping to the east, apparently from the axis which forms the eastern shore of the straits connecting San Francisco and San Pablo bays.

Sandstone.—The most westerly and lowest member of the series is a somewhat massive, but softish sandstone, similar to that of Bird island, the straits, and San Francisco; apparently here, as below, destitute of fossils. This is succceded by a series of finer grained, soft sandstones and shales, which contain great numbers of fossil shells. Above these fossiliferous beds ensues a great thickness of conglomerates and tufas, extending to the Straits of Carquines.

SECTION OF STRATA EXPOSED ON SOUTH SHORE OF SAN PABLO BAY.



a a a a, Stratified tufas. *b b*, Sandstones and shales. *c c c*, fossiliferous strata. *d d*, Sandstones. *e e*, Oyster shells.

Fossils.—The fossiliferous shales and sandstones to which I have referred, if they are, as seems probable, the equivalents of those associated with the sandstone of San Francisco, afford us the first satisfactory evidence which we have of the age of the group to which they belong; and they therefore become of special interest in the study of the geology of this region. The circumstances under which I visited the locality did not permit me to give as much time to the examination of these beds, nor to collect so full a suite of their fossils as I thought their importance demanded; it is, therefore, to be hoped that some one who shall hereafter have the time and opportunity may make these strata the subject of special study.

Pecten bed.—My attention was first called to the fossiliferous beds by noticing a stratum, which may, perhaps, be called a shell-limestone, about 4 feet in thickness, which was composed almost exclusively of Pectens. From its superior hardness it had resisted the action of the waves, which had cut deeply into the softer strata, and stood out like a wall, breast high, across the beach, and running, like a reef, far out into the shallow waters of the bay. The strike of these strata, as indicated by the direction of the projecting edge of this stratum, is northwesterly, and generally accordant with the trend of the adjacent axes of elevation.

The Pectens contained in this bed include at least two species: one, a small one, of which I was able to obtain numerous specimens, since described by Mr. Conrad under the name of *P. Pabloensis*, (Pl. III, fig. 14;) the other is very large; some individuals being more than six inches in diameter, but so involved in the rock that I was unable to bring away more than fragments, not enough from which to describe it. It considerably resembles a large species procured from the Miocene deposits of southern California, by Mr. Blake, and called by Mr.

Conrad *Pecten Nevadanus,* and is, perhaps, identical with it. It seemed to me, however, in the widely expanded alae, in the unusual curvature of both valves, and in the very angular and striated costae and intercostal spaces, to exhibit differences from any species known. Beside the *Pecten,* I found in this rock numbers of a large *Mactra,* of which I could obtain no entire specimens, but which closely resembles *M. densata,* from the Miocene at Santa Barbara, and described and figured (Pl. III, fig. 12) in this report.

Lying immediately upon the pecten bed, are several strata of a soft, yellowish-brown rock, composed of nearly equal parts of clay and sand, and containing large numbers of shells; the smaller species of *Pecten* mentioned, (*P. Pabloensis*) with *Mactra, Natica, Nucula,* and *Tellina.* These beds are each 5–10 feet in thickness, and compose, perhaps, 50 feet of strata. Upon them lies a thicker stratum of coarse, but soft, non-fossiliferous sandstone, which is succeeded by other fossiliferous strata resembling, in fossils and lithological characters, those below it. Specimens of all these beds containing fossil shells, when examined under the microscope, exhibited no traces of infusoria.

Tufas and marls.—These fossiliferous strata, which have an aggregate thickness not exceeding 100 feet, are followed by a succession of relatively thin and perfectly conformable beds of conglomerate, soft, harsh, coarse sandstones, containing masses of scoria and pumice, concretes, tufas and marls, white, cream, bluish, greenish, yellow, and brown in color, in which I was able to detect no fossils, and which have an aggregate thickness of 1,500 to 2,000 feet.

These strata are evidently of volcanic origin, consisting of ashes, sand, mud, pumice, and scoria, which have been apparently discharged into water, perhaps of considerable depth, and accurately stratified by sedimentary deposition.

To strata of similar character I shall have frequent occasion to refer, as they are found in a great number of widely separated localities, and sometimes stretch continuously over large areas, constituting one of the most remarkable features in the geology of not only those parts of California and Oregon which were visited by our party, but, as I learn from various sources, of a large part of the region lying west of the Rocky Mountains.

These beds uniformly overlie, and are more recent than the tertiary deposits, and bring the geological history of the western coast down to, and, as it seems to me, probably through the drift.

Oyster beds.—A very interesting feature in the section exposed on the south shore of San Pablo bay, is a bed of recent shells which lies horizontally upon the edges of the inclined strata which I have described, at an elevation of some 20 feet above the present level of the water in the bay. This bed is about four feet in thickness, and composed of shells of species now living on the neighboring Pacific coast. They consist principally of *Ostrea,* with great numbers of *Mytilus, Lithodomus, Pholas,* &c.

The *Lithodomi* are found in the holes which they excavated in the rocky bottom of the water in which they lived. The shells are generally very perfectly preserved; the *Mytili* and *Lithodomi* having lost the epidermis in all cases, and the shells being tender, and somewhat chalky; but the *Ostreæ,* in many instances, retain the colors which characterize the living specimens.

This bed of recent shells affords a striking proof of the disturbances which this volcanic, and earthquake-shaken coast has experienced.

The cause which produced the difference between the present and former relative levels of the surface of the water in the bay and its shores was not merely local in its action; for a similar bed of shells occurs at something like the same altitude around the north and western shores of the bay; and the shallows of the southern and eastern parts of San Francisco bay contain a similar bed of dead oyster shells.

It might be supposed that this change in the relative level of the land and water had followed the opening of the Golden Gate to a greater depth than before, and by this means depressing the water level without seriously disturbing the general level of the surrounding country. This theory is, however, untenable, for it would require that the bays of San Francisco and San Pablo should be bodies of fresh water, to which the waters of the Pacific would scarcely have access; while we know, from the fact that this extensive bed of shells is composed of marine species, that the water in which they lived was salt. We may go still further and say that these beds of *Ostrea*, *Mytilus*, *Pholas*, &c., could scarcely be formed in San Pablo bay at present, from the relatively large admixture of fresh water derived from the Sacramento and San Joaquin rivers. It seems scarcely possible that a sufficient amount of salt water could ever have been supplied to these oyster beds through the narrow channel of the Golden Gate, and it is probable that the oysters of San Francisco bay, which are still submerged, were destroyed rather by a want of salt water than a change of level.

The presence of these shells above the level of San Pablo bay is, therefore, due to an elevation of the land, and not to a subsidence of the water. Dr. Trask (*Report on Geol. Cal.*, 1854, *p.* 27) mentions this oyster bed as occurring on the north shore of San Pablo bay at the height of 30 feet above high tide. On the south shore it is not over 20 feet above high water mark. In San Francisco bay it is still submerged. Although oysters are not necessarily always found at a fixed distance below the surface, we may infer, with considerable certainty, that the center of action and the greatest elevation was north of San Pablo bay.

On the west side of San Pablo bay occurs an interval of shore, which is very low, and seems connected with a depression in the general surface, which extends far to the westward. It is said this depression is continuous to Bodega bay, and that no part of it rises 50 feet above the ocean level. If this is true, San Pablo bay doubtless communicated directly with the ocean through this channel—a channel subsequently closed by the elevation which has been described, but which, when open, would have afforded a more abundant supply of salt water than they now have to the marine molluscs of the bay.

STRAITS OF CARQUINES.

The Bay of San Pablo is, in fact, but a continuation of San Francisco bay, and occupies a portion of the same great trough lying between the most distant of the nearly parallel axes of elevation which have been mentioned as determining the outline of the valley of San Francisco bay, viz: the Mount Diablo axis, and that forming the immediate coast of the Pacific. A subordinate anticlinal, a kind of shoulder of the Contra Costa range, crowds itself down into this great basin, and narrows a portion of the bay into the strait which connects the wider expanses of water which have received, for convenience, distinct names. As we traverse the bay of San Pablo, and approach its eastern boundary, we reach another barrier, which has opposed the drainage of the great Californian valley, through which, as at the Golden Gate, the waters of the Sacramento and San Joaquin have forced or found a passage. This barrier is formed by a continuation north of Mount Diablo of the Mount Diablo range, which, though greatly reduced in elevation, and considerably interrupted and divided, is still plainly distinguishable, trending about northwest, till it loses its identity in the numerous parallel ranges of the coast mountains. I was not able to examine the geology of the Straits of Carquines so closely as to determine the nature and relative position of all the rocks which are exposed there; nor was I able to carry my observations uninterruptedly from the section exposed on San Pablo bay to that of the straits. The shores of the upper part of the straits I found to consist of a great number of alternations of thin-bedded argillaceous sandstones, very similar to some of those exposed on the south shore of San Pablo bay, and precisely like those of the western shore on Point San Pedro, above San Rafael, and those of Rincon point, south of San Francisco.

These sandstones are inclined at a very high angle, some of them being nearly vertical, but not having a uniform dip. One, and perhaps more than one anticlinal crosses the straits in the general trend of the range. I was not able to detect any fossils in the rocks there exposed, but have no doubt of their identity with the San Francisco group, having the same geological age with those of San Pablo bay, and therefore Miocene or more recent.

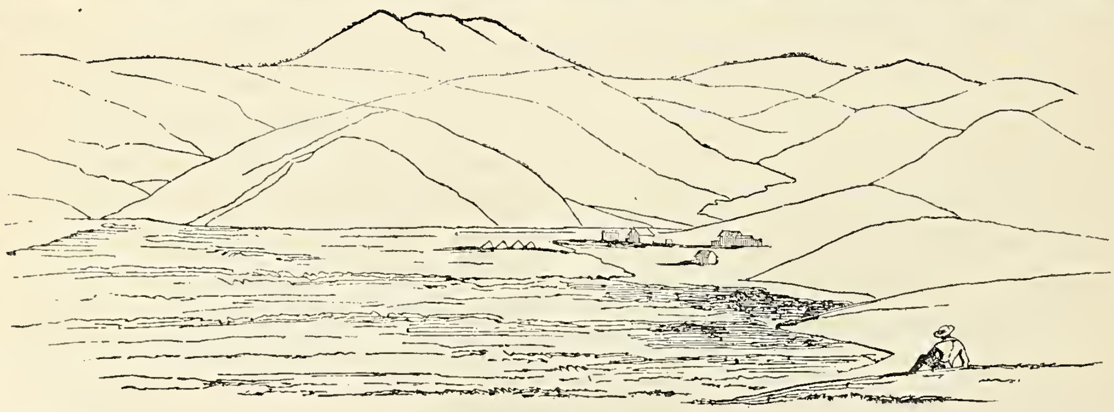
I saw no evidences here or below of the existence of the older slates which have been said to exist in this vicinity. Nor did I see here, or anywhere on the shores of San Francisco or San Pablo bays, with the exception of a single locality, the Golden Gate, any trap, trachyte, or other unmistakable plutonic rock.

The greenish argillaceous sandstones of the Straits of Carquines have threads and sheets of gypsum running through them in all directions, a feature shared by the similar strata in the localities which I have mentioned, Point San Pedro, &c.

BENICIA.

The geology of the vicinity of Benicia is apparently but a continuation of that of the Straits of Carquines. An anticlinal crosses from near Martinez to the vicinity of Navy Point, on either side of which are found sandstones, shales, &c., the apparent equivalents of the San Francisco group. There is, however, a conglomerate at Navy Point which presents somewhat different characters from those of San Pablo bay, the pebbles which it contains consisting in a great degree of fragments of the harder silicious rocks, jasper, hornstone, agate, carnelian, &c. Though I had little opportunity of examining it, my impression was that it did not present a new element in the geology of our route.

At Navy Point Mr. W. P. Blake, geologist of the Pacific Railroad Survey in southern California, under Lieut. Williamson, U. S. A., discovered teeth of sharks, which give to these strata a date certainly no older than the Miocene. I did not notice any fossils in any of the rocks about Benicia; but it is probable they would reward a more thorough search than I was able to make.



SANDSTONE HILLS NEAR BENICIA.

Sandstones.—The high hills which border the straits and occupy all of the area between

Vallejo and Benicia, and which, with their wavy and graceful outline and their unbroken mantle of wild oat, present a view so peculiar and so pleasing, are all composed of the San Francisco group of sandstones; at least such was the inference which I derived from my examination of them. Immediately back from the town of Benicia the sandstone is considerably massive and thick bedded, and has been extensively quarried as a building stone, for which it serves a very good purpose, but is open to the objections suggested when speaking of a similar stone at San Francisco. When exposed in ledges it has a most striking resemblance to trap. About Major Vaughn's rancho, two miles northwest of Benicia, where we were encamped for some days, the only rocks visible are a soft grayish sandstone, generally somewhat massive, and thin layers of greenish brown shales, some of which are soft, and where exposed are often covered with an efflorescence of sulph. alumina. These beds are dipping in different directions in the different localities where examined, and are evidently traversed by several lines of uplift.

Five miles northwest from Benicia, among the rounded sandstone hills, the most elevated summit in the vicinity is crowned by a crest of red jaspery rock, similar to that which occurs so abundantly at Point Diablo, near San Francisco. This crest is particularly rough and rugged, is nearly half a mile in length, and has the general trend of the ranges of hills which surround it, and of the Mount Diablo mountains. It is somewhat cellular and spongy in texture, and projects forty to sixty feet above the softer rocks which flank it. It exhibits no tendency to stratification, as far as I examined it, and has all the external characters of an injected dyke of plutonic rock which owes its relief to the erosion of the softer material which once formed its enclosing walls. The junction of the sandstones with the jasper is covered by debris and not visible; but where exposed in the vicinity, though much disturbed, they exhibit no marks of metamorphic action.

Warm spring.—At the north end of this ridge of jasper is a copious spring, which seems to issue from immediate contact with the rock. The water is strongly charged with sulph. hydrogen, and is slightly thermal, having a higher temperature at its source than in the basins which it fills, a few rods down the hill-side. I had no thermometer with which to test its temperature, but supposed it to be between 80° and 90°. No silicious or calcareous deposit is made by it. It has the common taste of sulphur water, and is habitually used by a family residing near.

In a ravine near by, lenticular nodules of argillaceous iron ore are interstratified with the thin layers of greenish, soft, fine-grained sandstone.

Soil.—The country about Benicia is generally productive, though its value as an agricultural district, in common with the whole of the interior valley, is greatly impaired by a want of water. The soil, which is formed by the decomposition of the argillaceous sandstones of the San Francisco group, is dark, deep, and rich. The surface is thrown into hills, often rising several hundred feet, but in gentle swells and slopes, with smooth and graceful curves, never presenting a broken outline. And this surface, as far as the eye can reach, is covered with the wild oat, (*Avena fatua.*) No peculiarity of the soil, but atmospheric influences have given to this region such a prevalence of annual vegetation, and limited its trees to the few scattered clumps of evergreen oak, (*Quercus agrifolia,*) which, so much resembling orchards, combine with the unbroken stretches of wild oat to give to it the appearance of being universally and thoroughly cultivated.

MOUNT DIABLO.

While encamped near Benicia, this mountain, which we had first seen when entering the Golden Gate, was in plain view from our camp. Its altitude is 3,760 feet, while its base is at the sea level. Of its geological structure no account has yet been given, and it was not ascended by our party. Its base, and perhaps its principal mass, is composed of the series of sandstones which have been so fully described in the preceding pages. Specimens brought from the higher positions of the mountain, which I had the pleasure of examining, show that with tertiary sandstones, trap, serpentine, and diallage occur, but on what relative positions and quantities I could not ascertain. Its structure, however, can scarcely be a matter of doubt. It marks a conspicuous focus of action in the elevation of the Mount Diablo or Contra Costa range, which we know has the same general structure as that of the range immediately bordering the coast; having probably the same date, and, like the coast mountains, having not constant but characteristic axes of serpentine, flanked by thick beds of tertiary sandstone and shale, frequently associated with which are jasper, diallage, and actinolite.

Some of the tertiary beds of Mount Diablo are highly fossiliferous, containing the same assemblage of genera, and probably of species, which are so characteristic of the coast mountains in southern California. Among the most striking of these fossils is an immense oyster, which is apparently the same with that figured and described p. 72, Plate IV, fig. 17 and 17*a*, of this report, and called by Mr. Conrad *Ostrea Titan*.

Gold has been found in small quantities in the streams flowing from Mount Diablo, and it was at one time supposed that the diallage brought from there contained this metal, and a quantity was transported to San Francisco, for the purpose of extracting the gold from it. Little or none was found, however, and the error of the first experiment is said to have resulted from employing mercury which had been before used in extracting gold, not all of which had been separated from it.

SUISUN BAY.

North of Mount Diablo the range of mountains which has received its name is somewhat divided and broken. This has offered a convenient avenue through which the drainage of the upper country could be carried; and through this the Straits of Carquines have been cut. The waters of the great Californian valley, somewhat impeded in their flow to the ocean, and falling to high tide level long before reaching the Golden Gate, accumulate above the straits, forming Suisun bay, and the *tulê* marshes at the junction of the Sacramento and San Joaquin.

From Benicia to Goodhues, four miles, the north shore of Suisun bay is formed of the sandstones which have been so fully described.

Calcareous tufa.—Near Goodhues occurs a deposit of calcareous tufa, which has been quarried out and burned for lime. It is very pure and white, and would undoubtedly make an excellent mortar.

From this point to Cordelia, the hills bordering the bay are all composed of some kind of volcanic rock. The most abundant forms are soft and tufaceous, reddish or bluish gray; other portions are harder, either scoriaceous, compact, or vesicular trap.

Above Cordelia, on Suisun creek, the rock which forms the hills, bordering the road, is a hard, tough, umber-colored trap, which seems to be the prevailing rock over a large area in this vicinity.

It would make a very good building stone, and, though wrought with more difficulty than the Benicia sandstones, would be far more strong and durable, and to many eyes more pleasing.

Soil.—The soil of the shores of Suisun bay is black, and evidently highly productive, but the area of level land below Cordelia is relatively small, and of that a considerable portion is marshy. The sandstone hills are covered with wild oats and cultivated to their summits, but the trap ranges are rough, rugged, and valueless.

SUISUN VALLEY.

This valley is enclosed between two ranges of hills, of which those on the west are high and rough, and formed of vesicular trap; while those on the east are low, rounded, and apparently composed of sandstone.

Near where we crossed the eastern hills to Vacaville, a deposit of calcareous tufa was noticed, similar to that at Goodhues.

At Lagoon lake, and in that vicinity, the sandstones are fully exposed. I was able to discover no fossils, but the rock is identical in appearance with that at Benicia, and is doubtless the same.

CHAPTER II.

GEOLOGY OF THE SACRAMENTO VALLEY.

General features.—Structure of the coast mountains.—Trap, serpentine, and granite.—Auriferous slates.—Structure of sierra nevada.—Older than coast mountains.—Metamorphic limestone.—Auriferous rocks.—Placer deposits.—Alluvial plain.—Local geology.—Vacaville to chico creek.—Gravelly plains.—Alluvial soil and terraces of putos and cache creeks.—Banks of the sacramento.—Red color of yuba river.—Want of stone at marysville.—Sacramento buttes.—Chico creek.—Fossiliferous sandstone.—Interesting mingling of fossils.—Strata probably cretaceous.—Trap hills.—Streams absorbed by the plain.—Volcanic phenomena.—Lava streams.—Crater.—Obsidian.—Fort reading.—Trap hills.—Tufaceous conglomerate.—Cretaceous rocks near shasta city.—Ammonites batesii.—Carboniferous limestone.—Fossils.

GENERAL FEATURES.

The area which has received this name constitutes the north half of what might properly be called the great Californian valley, forming a continuous trough, lying between the converging axes of the two great ranges of Californian mountains, and of which the northern and southern halves would be inseparable were it not that, draining to the centre, they are respectively traversed by the rivers Sacramento and San Joaquin; and hence, for convenience, have been distinguished from each other by the names of these streams. This great valley, which has a length of 350 miles, and a maximum breadth of 50 miles, may be regarded as affording in its structure and origin a typical example of the manner in which—formed by common causes—all the principal valleys of the far west have been produced. All may be said to occupy the elongated areas enclosed between the separated but inosculating ranges of mountains, having nearly the same common trend.

Of these valleys the Gulf of California is the most southern and the largest. Though its floor is now below the ocean level, and its mountain boundaries do not quite enclose it, it presents a marked similarity of general structure to the others to which I have alluded—the valleys of San Francisco and Sacramento—and, to carry the comparison still further, to the second double valley, that of the Cowlitz and Willamette.

The mountain chains which enclose the Sacramento valley are the coast mountains on the west, and the Sierra Nevada on the east. Between these it lies as a broad plain, of which the central portion is scarcely raised above the level of the sea, while the remote ends are scarcely more than twice as many feet above as they are miles distant from the centre. The greater part of the fall of the draining streams being confined to the vicinity of the ends of the valley, as a consequence, through most of the length, the current of these streams is slow, their course tortuous, and their borders, especially near their point of exit, are marshy and covered with wide expanses of *tulé*, (bullrush.)

Surface and soil.—The centre of the valley is occupied by a broad alluvial plain, with little diversity of level, of which the soil is generally fine and fertile, but sometimes coarse, gravelly, or stony, and barren. The more fertile surface is covered with a growth of wild oat, or grasses, interspersed with a great variety of flowering annuals, while the gravelly and more unproductive portions support a thinner growth of coarser plants, (*Eryngium*, *Hemizonia*, *Madária*, &c.) Of trees, there are none, except such as grow in narrow lines along the streams. These belts of timber are of varying breadth, from a mile or more, of wide-spreading magnificent oaks, (generally *Quercus Hindsii*,) to a meager border of willows, poplar, or sycamore, hung with festoons of grape along the water's edge.

Bordering the central plain on either side is a second "bench," or terrace, generally less than 100 feet above the lower, and which sometimes, by erosion, thrown into low rounded hills, oftener forms a distinct prairie plain. Crossing this upper terrace toward the mountains we soon rise into the foot hills, which are covered with groves and clumps of oak, with here and there scattered trees of the nut-pine. The scenery of the foot hills is frequently picturesque and beautiful, with its lawn-like slopes and clumps of spreading oaks, presenting views which might well serve as models for the landscape gardener.

The agricultural capabilities of the different parts of the Sacramento valley, though considerably influenced by the structure and constituents of the soil, are more directly dependent on the degree in which its greatest want—the want of water—is supplied. With an abundance of this indispensable element, it would be one of the most productive portions of the globe.

COAST MOUNTAINS.

The structure of the coast mountains, where they form the western border of the Sacramento valley, is apparently similar to that of the same ranges in the vicinity of San Francisco, which has already been described. They form a belt thirty to fifty miles wide, composed of several associated ranges, and having an altitude of from 3,000 to 5,000 feet. They are composed, for the most part, of volcanic rocks, trap, trachyte, pumice, with occasional protrusions of granite and serpentine. The flanks of these mountain ranges on either side are interruptedly occupied by tertiary sandstones, and by volcanic marls and tufas of still more recent date—the sandstones containing characteristic Miocene fossils; the finer marls containing infusoria, generally of fresh water origin.

Near Tomales bay a bed of whitish limestone occurs, highly metamorphosed, exhibiting no fossils, and as yet of unascertained age. Specimens of a limestone containing no fossils were also collected by Lieutenant Abbot near Yreka. There are in many localities on the coast mountains, particularly near the north end of the Sacramento valley, metamorphic slates, sometimes auriferous, which are probably of ancient date; but this is only conjecture, as they have, so far, yielded no fossils.

SIERRA NEVADA.

The structure of the eastern wall of the valley of the Sacramento has not yet been fully made out. It is, for the most part, composed of the same geological constituents as the coast mountains, having an origin due to the same general system of elevation, and probably nearly the same date, *i. e.*, subsequent to the deposition of some of the tertiary strata. I should, however, be disposed to regard the Sierra Nevada as having had an existence, and the greater part of the range as having been above the level of the ocean previous to the deposition of the San Francisco sandstone, which is so characteristic of the coast mountains, and which, if it can be identified in the Sierra Nevada, is probably confined to its flanks, at a low level.

A metamorphic limestone is found at intervals throughout all that part of the Sierra Nevada which skirt the California valley. Its age has not been determined, as it is generally highly crystalline and metamorphic, and contains no fossils. From its relations to the limestone discovered by Dr. Trask, near the base of Mount Shasta, and which is of carboniferous age, one may suspect it to belong to that era.

The great mass of the Sierra Nevada is composed of plutonic or volcanic rock, granite, gneiss, mica schists, and porphyrys, trap, trachyte, &c., with auriferous talcose slates, and veins of quartz. These strata, having been extensively broken up and eroded by aqueous or glacial action, have, in the re-arrangement of their constituent materials, given rise to the *placer* deposites which skirt the base of the range. The deposition of this comminuted material has apparently been effected by aqueous agency, and controlled in a degree by the law of gravitation, as the gold, the heaviest of the component materials, is found at or very near the bottom. The surface of the plain which lies between these ranges of mountains is underlaid by beds of transported material—gravel, clay, and tufaceous conglomerate—several hundred feet in thickness, which were once deposited as sediments on the bottom of the trough, but have been extensively re-arranged by the present water-courses, and in many places subjected to considerable disturbance from volcanic action.

LOCAL GEOLOGY.

VACAVILLE TO CHICO CREEK.

After leaving the foot hills of the coast mountains, we traversed the valley diagonally to the vicinity of its eastern margin. Making this transit, we were constantly upon the alluvial deposits which have been referred to, and nowhere found any rock in place on the immediate line of our march. Between the base of the hills, near Vacaville and Putos creek, the surface passed over formed low hills and table land composed of gravel, entirely destitute of trees, but covered with a thin coating of the grasses and other plants which have been mentioned as characteristic of the gravel surfaces of the valley. The soil has apparently but little fertility, and is nowhere grazed or cultivated. The pebbles which compose the gravel beds are generally of small size, well rounded, and consist of jasper, quartz, porphyry, trap, &c. As we approached Putos creek the soil became fine, loamy, and fertile, and on the banks of the stream supported a narrow belt of magnificent oaks.

The banks of the stream are distinctly terraced, the upper bench being some 25 feet above the lower, which is about the same distance above the bed of the creek. The material of which these lower terraces is composed is principally a fine alluvial earth, mingled with which are a few pebbles. The upper terrace consists in greater degree of pebbles, some of which are of considerable size, much rounded, and, like those found in the bed of the stream, composed of trap, jasper, and quartz.

Cache creek.—The interval lying between Putos and Cache creeks is similar in its features to that south of the former. The immediate vicinity of Cache creek, however, is a region of great fertility; the soil is dark and deep, and the belt of timber which borders the stream is wider, and the trees even finer than those of Putos creek. These differences are doubtless mainly due to a more abundant supply of water afforded by Cache creek.

Its banks are alluvial, the bed gravel, the current rapid, and the water clear and good. The terraces of Cache creek are not as perceptible as those of the Putos, the upper bench being further removed from its immediate banks. The region lying between the crossing of Cache creek and the Sacramento, at Knight's Landing, is very level and nearly all under cultivation. Unlike the country previously traversed, we found this not covered with wild oats or dried grass, but everywhere sustaining a growth of *green* vegetation, except where covered with the ripening wheat. A great breadth of surface was occupied by this crop, which the farmers told me generally produced from 35 to 40 bushels to the acre. The drought of the present season would reduce the yield to 25 to 30 bushels.

The banks of the Sacramento, at Knight's Landing and at Frémont, where we crossed it, are composed of fine alluvial earth, generally about 30 feet above the water-level at that time. A belt of timber lines either side; that near the water being willow, poplar, and sycamore, bound together by grape vines; further back the long-acorned oak, which, when the trees are crowded, assumes the form of the white oak of the forests of the eastern States.

No terraces are visible in the immediate vicinity of the Sacramento. Like those of Cache creek, its banks have been formed by the stream when at nearly its present level, and belong entirely to the present era.

The water of Feather river, at the junction with the Sacramento, is so highly charged with sediment, derived from the gold diggings on its tributaries, that it is rendered quite opaque, and has a color as decided as that of the rivulets in the streets of our towns during a thunder-shower.

The country bordering Feather river to Marysville presents no new geological features. No rock is seen in place, and the banks of the stream are like those of the Sacramento, composed of fine loamy earth, with very few pebbles as large as walnuts. The soil is excellent, and melons and various crops are growing with considerable luxuriance.

The red color of Feather river, so noticeable at its junction with the Sacramento, is for the most part, derived from the Yuba, which, at Marysville, where they unite, has deposited such quantities of sediment as to render its navigation impossible at a point considerably below where boats could formerly run.

The floods of the Yuba, which have occasioned so great destruction of property at Marysville, have left piles of drift-wood forty feet above its bed.

The want of building stone is severely felt in this vicinity. The houses in the town, since the fires have swept away relays of wooden structures, have been all built of brick, and the wharf at the steamboat landing is built of bags of sand.

From Marysville, up the feather river, to Hamilton, we found no rock in place, and no transported masses of any considerable size. The soil is generally a fine sandy loam near the river, evidently fertile, and supporting a dense growth of vegetation; while the plains back from the streams are frequently gravelly, and less productive, bearing a thin crop of coarse grasses, and scattering trees of the two species of oak which have been mentioned, with occasional clumps of *manzanita*.

The gravel and rolled stones in the beds of the streams are generally composed of some form of trappean rock, usually trap, porphyry, trachyte, &c., more rarely of quartz. These are, probably, principally derived from the Sierra Nevada, but in part also from Sutter's buttes, which are but about 10 miles distant from the road which we followed.

These mountains have been distinctly visible since leaving Cache creek; first as a single peak, subsequently showing two others. They form, however, but a single mountain mass, and should be denominated by a common name. From specimens brought from there, as well as from the description given of them by Professor Dana, (Geol. Expl. Exped.,) we learn that they are of volcanic origin, and not of recent date.

They now rise like islands in the plain on which they stand, the highest point having an altitude of about 1,800 feet above its general level. The alluvial deposits of the valley, which surround their bases, exhibit little traces of disturbance, and do not cover their sides; from which it is apparent that they were not covered by the waters by which these transported materials were deposited.

We have here arrived at nearly the eastern limits of the Sacramento valley. The foot hills of the Sierra Nevada are but few miles distant, and although immediately on Feather river, we are still on the lower alluvial plain which borders the Sacramento river, and occupies all the central portion of the valley within a mile to the north; the surface rises more than 200 feet, and a series of rounded hills commence, which are so characteristic of the borders of the valley.

Chico creek.—No rock was found in place from Hamilton, where we left Feather river, to this point. The surface is somewhat undulating; the higher grounds being destitute of trees, the soil gravelly and unproductive, while the lower grounds immediately adjacent to the streams which we crossed are fertile, and sustain groves of oak timber.

The beds of the streams contain gravel and rounded stones in larger quantities than those before passed, and the fragments are of larger size. They consist principally of trap, compact or vesicular, some of it being scoriaceous.

Fossils.—At Bidwell's on Chico creek we saw fragments of calcareous sandstone—brought from a locality not far distant on the same stream, in the foot hills of the Sierra Nevada—which contained great numbers of fossils very perfectly preserved. The rock in which they occur is light brown in color, and quite hard and compact. The fossils are exclusively marine shells, and present an interesting mingling of forms, to which attention was first called by Dr. Trask, in the Proc. Cal. Acad. Sciences. The genera represented are *Mactra, Tellina, Nucula, Fusus, Turritella, Natica,* &c., of which the species are as yet undetermined, with the exception of two—a *Mactra* and *Nucula*—considered by Mr. Conrad as probably identical with two species, *Nucula divaricata* and *Mactra albaria,* described by him in the Geology of the Exploring Expedition, and obtained by Professor Dana from the shales and sandstones near Astoria, on the Columbia river.

The Astoria shales contain large numbers of fossils, many of which have been described by Mr. Conrad, (op. cit.) and have been regarded by him as of Miocene age. These shales and sandstones are also probably identical with the San Francisco group, which, as we have seen, may for still other reasons be considered as recent as the Miocene epoch.

Baculites and *Ammonites* have never heretofore been found in any strata of more recent date than the cretaceous, and there these genera have been regarded as furnishing the most certain criteria by which to distinguish between cretaceous and tertiary deposits. There can be no doubt, however, of their occurrence in the sandstones of Chico creek, and, from their mode of fossilization, could not have been transported from older deposits, but must have lived in the sea with the other associated genera.

The *species* of the fossil shells found with the *Ammonites* and *Baculites* in this locality are probably all new, unless the *Nucula and Mactra* alluded to are, as has been supposed, identical with those of Astoria. They are, therefore, of little or no value in determining the age of the deposit within the limits in question.

The *genera* represented are, perhaps, equally common in cretaceous and tertiary rocks, and, so far as known, do not afford any forms which, though specifically new, might be regarded as by their general pattern to indicate a cretaceous rather than a tertiary age, or *vice versa.*

One of two conclusions is therefore inevitable: either the *Nucula* and *Mactra,* which are supposed to link these strata to others known to be Miocene tertiary, are distinct from those of the shales of Astoria, and the Chico creek strata are cretaceous; or they are identical, and *Baculites* and *Ammonites* cease to be criteria in distinguishing tertiary from cretaceous rocks.

In either case the facts are of great interest, as indicating the presence of cretaceous rocks in a region where they had never been suspected to exist, or proving a new and important truth in palæontology. While a careful study of the fossils of Chico creek will alone solve all the problems which they suggest, it may be said that the evidence is still wanting upon which we must discard one of the most authoritative axioms of palæontology, and believe that the cephalopoda of the chalk continued to inhabit the Californian coast throughout all of the Eocene, and part of the Miocene tertiary periods. There are certainly no *living* species among those yet found in the Chico creek strata, and although much stress is laid by Dr. Trask (*Proc. Cal. Acad. Nat. Sciences, vol. I,*) on the recurrence there of living *genera*, it is a well known fact that a large part of the genera of the chalk are still represented in our seas. It is probable, too, that Mr. Conrad would not insist on his identification of *Nucula divaricata* and *Mactra albaria*, as the specimens submitted to him were few and imperfect. It may also be ultimately proven that the argillaceous standstones of Astoria are *not* of Miocene age, for although having very much of a Miocene look, none of the species are found in the present seas, nor in other known Miocene strata. For the present, therefore, with unmistakable *Baculites* and *Ammonites*,* with no recent, and but two doubtfully *Miocene* species, the evidence is in favor of these strata being cretaceous rather than tertiary.

CHICO CREEK TO FORT READING.

Above Chico creek the Sacramento valley rapidly narrows ; that portion lying east of the river forming a nearly level plain, four to six miles wide, from which the foot hills of the Sierra rise abruptly. Between Antelope and Deer creeks I crossed over to the hills at a place where a stream coming down from the mountains, and at its point of entrance into the valley passes through a magnificent gate, of which the side walls are at least 500 feet in height. The rock in the vicinity is all a dark basaltic trap, which has been accumulated by successive overflows from some volcanic vent, probably not far distant. These lava floods, where exposed in sections, present a stratified appearance, some of the beds being imperfectly columnar. Though exhibiting very strikingly the phenomena of volcanic action, these trap hills are not of recent date, but were probably formed synchronously with the upheaval of that part of the Sierra Nevada with which they are connected.

The stream which flows through this opening in the hills in the rainy season is evidently of considerable size, and at the point of entrance into the valley was, at the time of my visit, (July 19,) still flowing, and contained large numbers of fish ; yet long before it reached the Sacramento its waters were absorbed by the arid plain traversed by its channel, and where we crossed its bed, near the river, it was perfectly dry, a gravelly trough containing not a drop of water.

Our route from Antelope creek to Fort Reading lay across the hills which sweep around from the Sierra Nevada and, uniting with the foot hills of the coast mountains, form the northern boundary of the Sacramento valley. These hills we found composed exclusively of volcanic rock, generally a dark vesicular trap, which forms rough and ragged crests, divided by deep and narrow ravines, of which the sides are precipitous, or covered with angular blocks and fragments, among which we made our way with difficulty. In several places we passed over sheets of lava, which looked as though it had been but a few years since in a fluid state, the surface

*Mr. F. B. Meek writes me that he also finds *Inoceramus* in the Chico creek rock, and is inclined to regard it as upper cretaceous.

still bare, and exhibiting all the waves and eddies of a flowing stream. Some of these trappean rocks were apparently older. Among them were porphyry, trachyte, and volcanic breccia, in which the imbedded fragments formed masses of several hundred pounds weight. No drift action has modified the surface of these rocks; but, with the exception of the marks of atmospheric weathering, which they exhibit in different degrees, they are as rough, and their surfaces as fresh, as though but recently formed. The thin soil which covers or surrounds them is derived only from their decomposition, and is often highly colored by oxide of iron. It seems to possess the inorganic elements of fertility, and sustains among the rocks a vigorous growth of wild oat.

On the north side of Bear creek valley is a more striking proof of the comparatively recent date of volcanic action in this vicinity than even the lava streams. This is furnished by a volcanic cone 500 or 600 feet in height, which has a crater on the summit, and of which the sides are covered with reddish scoria.

VOLCANIC CONE NEAR FORT READING.

On Bear creek black obsidian occurs in considerable quantities, and some of it was brought me, as "probably some kind of stone coal."

The trap ranges in this vicinity, of which I have spoken, form high and sometimes precipitous banks to the Sacramento river, with but little level land between them, and constitute the entrance to the almost continuous cañon through which it flows for nearly a hundred miles.

FORT READING.

The geology of the vicinity of Fort Reading is not unlike that of the region lying immediately south of it. The valley of Cow creek, in which it is situated, is bounded by ridges of trap, of the brown and cellular variety, which is stereotyped in all this region. The trough between these ridges is partially filled with a stratified deposit which is very soft, light gray in color, and contains scattered lumps, of small size, of fine white pumice.

There is little doubt that this deposit is tufaceous in character, and is composed of the lighter and finer products of volcanic eruptions, rearranged by aqueous agency. It is probably of recent date, and synchronous with somewhat similar beds which are found in various portions of California, and are more recent than the tertiary *cretaceous rocks*.

A few miles southwest of Fort Reading, at Arbuckle's diggings, a locality which I was not able to visit, strata occur which are undoubtedly of cretaceous age. *Ammonites,* in considerable numbers, have been obtained there by Dr. Bates, of Shasta city, and a very handsome species has been described by Dr. Trask, (*Proc. Cal. Acad., vol.* 1, *p.* —,) under the name of *Ammonites Batesii.*

To the occurrence of cretaceous rocks in this locality I shall have occasion to refer again in a subsequent part of this report.

Carboniferous limestone.—In sight from Fort Reading is a group of mountains, bearing east of north, which, as we learn from Dr. Trask, are in a considerable degree composed of limestone, which he has described in his Report on the Geology of the Coast Mountains, 1855, p. 50, and which he regards as the equivalents of the upper carboniferous rocks of Iowa, &c.

The limestones of these mountains, as described by Dr. Trask, have a great thickness and are highly fossiliferous. While in San Francisco I had the pleasure of seeing through glass the fossils procured by Dr. Trask from this locality, and although the number of species collected is small, and they are probably all new, and cannot, therefore, be regarded as perfectly conclusive criteria in deciding on the age of the containing rock, there seems to be little question that they belong to some portion of the carboniferous group. Whether they are synchronous with the upper coal strata or the sub-carboniferous limestone is a question which cannot be definitely settled until a greater amount of material has been collected.

These fossils consist of small spirifers, orthis, encrinal stems, and cyathophylloid corals.

The lithological characters of the rock are not unlike those of the sub-carboniferous limestone of the Allegheny and Mississippi coal fields, but no value whatever can be attached to the resemblance.

It is very desirable that this deposit of limestone should be fully examined, and its fossils carefully studied by some one who is sufficiently familiar with carboniferous palæontology to determine accurately the relations which it sustains to the carboniferous rocks of the valley of the Mississippi. With its great thickness it may very well be the representative of the entire carboniferous series of the east; the open sea in which the carboniferous limestone was deposited here continuing open sea, while the coal measures were being formed on the immediate shores of the continent of that period.

CHAPTER III.

GEOLOGY OF THE WESTERN RANGE OF SIERRA NEVADA.

Relations of western range of Sierra Nevada to Mount Shasta and the Sierra Nevada of California.—General geological relations of Mount Shasta.—Coast line once formed by the Sierra Nevada and Cascade mountains—Successive stages in the elevation of the continent—Continuity of the coast mountains—Transverse chains.—Lines of fracture divergent from Mount Pitt and Mount Shasta.—Carboniferous limestones of Mount Shasta, perhaps continuous with the metamorphic limestones of the Sierra Nevada—Local geology.—Trap plateaus about Fort Reading.—Coal near McCumber's flat.—Recent volcanic rock around the base of Lassen's butte—Lassen's butte a volcanic cone.—Lava plain on Canoe creek.—Chimneys.—Subterranean galleries—Trap plateaus at the mouth of Canoe creek. Infusorial marls on banks of Pit river.—Beds of rounded stones underlying marls.—Trap forming the walls of the lower cañon of Pit river.—Mountain of metamorphic slate.

From Fort Reading we passed southward of the limestone mountains mentioned in the last chapter, and following a course little north of east, crossed that portion of the Sierra Nevada which connects Lassen's butte with Mount Shasta; coming down on to Pit river, at the upper end of its long cañon or series of cañons, formed by its passage through this chain of mountains. Some differences of opinion have prevailed in reference to the relations which this range sustains to the Sierra Nevada on the one hand, and to Mount Shasta on the other; but it has been generally regarded as a spur of the Sierra Nevada running off at a considerable angle with the main trend of that chain to connect with Mount Shasta. It has also been supposed that eastward of Mount Shasta the main range of the Sierra Nevada would be found extending northward and connecting directly with the Cascade mountains of Oregon. Mount Shasta has even been claimed as a portion of the coast mountains, and is so represented by Dr. Trask, (*Geol. Report*, 1853, *p.* 48.)

Dr. Trask also suggests that the Sierra Nevada terminates at Lassen's butte, and that the coast mountains, when continued northward, form the Cascades of Oregon and Washington Territories.

Both these hypotheses seem to me untenable. So distinct a line of upheaval connects Mount Shasta with Lassen's butte, and Lassen's butte with the Sierra Nevada, that they all seem to form the inseparable parts of a single mountain system.

As has before been stated, the geological data are still wanting for determining with precision the relative ages of the Sierra Nevada and coast mountains; but the evidence, as far as it goes, is altogether in favor of the greater antiquity of the Sierra Nevada, and of the connection of Mount Shasta with the older system. The most characteristic fossiliferous strata of the coast mountains have not yet been found in the Sierra Nevada.

The physical structure of the country traversed by these mountains teaches the same lesson. The Sierra Nevada, including Lassen's butte and Mount Shasta, form the wall which bounds the elevated plateau. The eastern bases of these mountains are four thousand feet above the western, and it seems difficult to resist the conclusion that at one stage in the elevation of the continent the mountains I have mentioned, with the Cascades of Oregon, formed its western limit, and that anterior to the emergence of the Californian valley or the coast mountains, the ocean dashed its waves against a continuous iron-bound coast, formed by the great Californian range. Of this coast Mount Shasta was a high and prominent headland.

With the subsequent elevation of the coast mountains, the entire western portion of the continent was doubtless considerably raised, and, like the higher, the lower terrace was bordered by mountain ranges, which presented to the Pacific a second continuous wall, on which its waves, though borne on by all the accumulated momentum of their long and unobstructed course, are still impotently beating.

I think we have evidence, derived from various sources, that the elevation of the western coast continued long after it reached the present level, and that since its maximum height was attained it has suffered a depression of many hundred feet. I shall, however, have occasion to return to this subject when speaking of the Cascade mountains, and will, therefore, leave it till the facts there to be gained can be brought to bear upon it.

The continuity of the present coast mountains of California and Oregon can scarcely be doubted. The fossiliferous sandstones of Monterey, Santa Clara, San Francisco, Port Orford, Coose bay, Astoria, and the Cowlitz, are all apparently of the same age. Though presenting marked local peculiarities, they have a common character both in their lithological features and in their fossils, and are to be referred to a common period—certainly not older than the Miocene.

In going from the mouth of the Columbia to San Francisco by sea, the coast seems formed of a continuous mountain chain, which is constantly in sight, and which produces, throughout nearly the entire distance, a bold, rocky, "iron-bound" shore. To this general rule the limited areas of level land in the valleys of the Umpqua, Coquille, Rogue, and Klamath rivers, form scarcely an exception.

As far north of San Francisco as Cape Mendocino the coast mountains have the same general northwest trend; and a more plausible supposition than that the Cascades form the continuation of the coast mountains would be, that the latter ranges terminate at Cape Mendocino, and that the coast mountains of Oregon were a continuation of the Sierra Nevada. It is not necessary to suppose this, however, but it is sufficient to consider the coast mountains of Oregon as the coast mountains of California deflected from the trend which they preserve below Cape Mendocino, and that the ranges of the coast and of the interior inosculate on either side of the parallel of 42° in the Calapooya, Umpqua, and Siskiyou mountains.

The structure of these subordinate ranges has as yet received but little attention from geologists, though it presents some very interesting problems, which, aside from their bearing on the local geology of the far west, will perhaps throw some light on the question of the synchonism of parallel axes of elevation, and the constancy of trend in the same line of upheaval.

Nor is the question of the relations of Mount Shasta to the coast mountains or Sierra Nevada one of merely abstract interest, but of the highest practical value in determining the relative age of these two mountain systems, and especially in fixing the age of the metamorphic limestones and slates of the Sierra Nevada, which as yet have yielded no fossils. If, as seems probable, the fossiliferous limestones of the mountains connected with Mount Shasta shall prove to be continuous with the limestones of the Sierra Nevada, referred to above, they will, perhaps, serve as a key by which to unlock the whole structure and age of the great "Californian range."

LOCAL GEOLOGY.

Our journey over the base of Lassen's butte to the basin of Pit river was productive of little geological information, except of the monotonous prevalence of recent volcanic rocks over all that portion of this mountain chain which we traversed.

From Fort Reading to McCumber's, some twenty-five miles, plateaus and ridges of dark vesicular trap extend in unbroken and unvaried succession. Here we had an inkling of some facts of high geological interest, but were unable to remain long enough to settle the questions raised by the information received. Mr. McCumber has found coal, as he says, of good quality, in the hills a few miles distant from his rancho. Of this coal he had then no specimen, and could tell me nothing of the character of the associated rocks, but represented the bed to be thick and extensive.

This information, though vague and unsatisfactory, was, as it seemed to me, highly important, as proving the existence of beds of coal at this elevation and distance from the coast.

McCumber's flat is about 4,000 feet above the sea, and the deposits of coal represented to be several hundred feet higher, probably at least 4,500 feet above the sea level. It is, perhaps, possible that the tertiary lignites of the coast recur here, but no tertiary rocks are known to exist within many miles of this locality; and the lignites of Santa Clara on one side and Coose bay on the other, are the nearest deposits of what could, with any propriety, be termed coal. Taken in connexion with the fact of the occurrence of carboniferous limestone a few miles northwest from McCumber's, and this limestone having a rapid easterly dip, indicate at least a possibility that the coal of this vicinity may be carboniferous. A single hand specimen would have decided the question, but that could not be obtained; and since the promise of Mr. McCumber to send into Fort Reading specimens of the coal was not kept, the problem is yet unsolved, whether the tertiary lignites of California and Oregon are the only coals found on the Pacific coast.

If these carbonaceous beds should prove to be of the same age with those referred to, the fact would be scarcely less important, and would perhaps materially aid us in the solution of some of the problems which the geology of the far west still presents.

After leaving McCumber's, we found the dark vesicular trap, which prevails over so large an area around Fort Reading, mingled with, and in many places entirely superseded by, volcanic rock of different character. Immediately east of McCumber's we passed a surface, a mile or more in extent, over which the vegetable soil covered rolled and rounded fragments of pumice and a light-colored felspathic lava. These boulders had, apparently, formerly occupied the broad bed of a water-course, from which the supply of water had long since been cut off by some of the convulsions of this volcanic region. That this change of course in the stream was not of recent date, is proved by the accumulation of soil on the surface and the dense growth of large trees which it supported.

Lassen's butte is evidently a volcanic cone, and one whose fires have not been long extinguished. Its summit is distinctly crateriform, as will be seen from the accompanying cut, and is capped with perpetual snow, and has an altitude of about 9,000 feet. Below the snow line for 1,000 feet the mountain is bare of vegetation, and covered with piles of lava, or slopes of ashes.

The geology of all this region bears the record of intense and recent volcanic action. The surface crossed before reaching the summit of the pass was covered with blocks of scoriaceous trap, pumice, trachyte, or porphyry. The prevailing rock at the highest part of our route is a friable felspathic lava, which readily disintegrates, forming a white sand, which reflects the sun almost like snow. This rock is lying in rough and ragged masses, in many places bare of vegetation, and of recent origin.

LASSEN'S BUTTE, FROM THE NORTH.

The open space about the base of Lassen's butte is doubtless due to the fires which, from time to time, sweep through these pine forests, yet a large area in its vicinity is overspread with volcanic products, evidently of so recent date that it seems not improbable that it has been in a state of activity since many of the pines which are growing on its base began their existence.

This accumulation of modern volcanic matter completely conceals all underlying rocks, and gives an uninteresting monotony to the geology of the surrounding region.

On Canoe creek, a tributary of Pit river, we found the first of the "Sage plains," which form so constant a feature of the central desert. They here present arid surfaces of but limited extent, bounded by cliffs, or ledges of trap, and covered with a light volcanic soil, which rose in clouds of dust as we passed. Scattered bunches of grass, clumps of *Artemisia*, and a few trees of yellow pine, comprise all the vegetation which their sterility does not exclude.

As we descended Canoe creek we entered a region where volcanic phenomena are displayed on an extended scale.

This stream traverses a valley expanding towards the north, bounded by walls more than a thousand feet in height, composed of dark lava-like trap or red scoria, the interval between them forming a nearly level lava plain, a kind of congealed sea, of which the surface was everywhere roughened by waves cooled while flowing; their crest black and ragged; the troughs containing a little ash-like soil, which supported a tangled growth of "sage" and "manzanita."

At numerous points on this lava plain we passed miniature volcanic vents or chimneys, which had evidently been formed by the bursting out of steam or gases from below, and in more than one instance we noticed subterranean galleries, or caverns, having a diameter of fifteen to twenty feet, an irregularly circular section, and extending indefinitely in either direction.

In some places the roofs of these passages had fallen in, permitting a full examination of their internal structure. They seemed to be conduits through which streams of lava had continued to flow when surrounded by a congealed and solid crust. They may in some cases have been modified by currents of water running through them, but it seems impossible that their origin could be due to the action of any such agent.

Similar galleries have been described by Prof. Dana and Dr. Winslow as occurring on the lava plains of the Sandwich Islands, and they seem to be a constant feature in the phenomena of great overflows of lava.

The chimneys to which I have referred probably communicated with these passages.

An oasis in this barren waste was formed by a stream of pure cold water, which issued from the cavernous wall bounding this plain on the east, ran half a mile, in many winding, life-giving channels, then fell into a chasm and disappeared.

The geology of the region bordering Canoe creek throughout its course is exceedingly monotonous. Cliffs, ridges, or tables of dark scoriaceous trap border it on either side, from the crossing of the emigrant trail to its mouth. Near its junction with Pit river, the tables of trap occurring on its banks exhibit a remarkable symmetry. They form a series of nearly level plateaus gradually rising in successive grades and receding from the stream. They terminate towards Canoe creek in abrupt, frequently mural edges, and present the same arrangement on both sides of it, as represented in the figure.

TRAP PLATEAUS BORDERING CANOE CREEK.

Infusorial marls.—The banks of Pit river, both above and below the mouth of Canoe creek, are partially formed of regularly stratified sedimentary deposits; the first seen since leaving the valley of the Sacramento.

They appear on both sides of Pit river at intervals for several miles, being in many places interrupted or covered by beds of trap. They are, perhaps, best exposed in the cañon formed by the passage of the river through "Stoneman's ridge," the most conspicuous of the lines of upheaval, which form what is known as the lower cañon of Pit river.

They here exhibit a thickness of about fifty feet, but are considerably tilted up, and are covered by a thick bed of trap, which has been poured out over them.

They exhibit narrow and parallel lines of deposition, but are very homogeneous, and can hardly be said to form more than two distinct beds. Of these, the upper is white and fine as chalk, resembling very pure kaolin, derived from the decomposition of crystalline felspar. The lower bed is light brown, or dirty white in color, and has a slightly gritty feel between the fingers.

These strata rest upon a thick bed of rolled and rounded fragments of trap, porphyry, and basalt, of all sizes, from masses of two and even three feet in diameter to pebbles. They are generally as large as one's head, and great numbers are each a foot in diameter.

The surface of this bed of boulders is, perhaps, twenty feet above the present surface of the stream; but it bears indubitable evidence of having at one time been covered by it, or, at least, the stones composing it, so large and clean, have been rounded where they lie by a current or waves of water.

The appearance presented by this bed of boulders is different from that of any of the beds of volcanic conglomerate, which are so common in many parts of California and Oregon, or of the stratified conglomerates of the Sacramento valley, and it is undoubtedly of local origin. The trap which formed the greater part of the bank above is evidently of recent date; more recent than the infusorial marls, and the marls more recent than the conglomerate, and the conglomerate an accumulation of rolled stones and pebbles, which belongs to the present epoch. The trap which overlies the infusorial marls composes a large part of the walls of the cañon at this point, where it has been much cut away by the stream, and forms nearly perpendicular faces of several hundred feet in height. The soft nature of the underlying strata has, however, very much assisted in its removal.

On the south side of the cañon and overlooking it is a mountain, which forms the most prominent point of Stoneman's ridge in this vicinity. It is conical in form, and has the outline of a volcanic peak, but I found it to be composed, from base to summit, of metamorphic slate.

CHAPTER IV.

GEOLOGY OF PIT RIVER AND KLAMATH BASINS.

Pit river basins.—Lake-like character of the lower basin.—Proofs that it has once been a lake.—Infusorial sediments deposited by its waters.—Range forming the upper cañon of pit river.—Second basin of pit river.—Infusorial marls.—Hills of metamorphic slate, greenstone, porphyry, and trap bordering pit river.—Geology of the country about the head of pit river.—Hot springs and infusorial marls.—Klamath basins typical illustrations of the geological structure of a great area.—Common features of the region lying east of the sierra nevada and cascades.—Not one but many basins.—Klamath basins once lakes.—Local geology.—Pit river to wright lake.—Recent volcanic cone.—Cliffs bordering rhett lake of sandstone and trap.—Efflorescence on the shores of rhett lake.—The natural bridge a fault.—Infusorial marls of lost river and lower klamath lake.—Metamorphic form of these marls resembling jasper.—Geology of the shores of klamath lake.—Basaltic conglomerate on klamath river.—Infusorial marls.—Pumice.—Trap ranges south and east of klamath marsh.—Pumice plain between klamath marsh and the des chutes river.

LOWER BASIN OF PIT RIVER.

From the summit of the conical mountain, which I have mentioned as overlooking the entrance to the lower cañon of Pit river, we for the first time looked down into one of the series of areas which give character to the immense region which has been denominated the Great Basin. This conical mountain formed a portion of a subordinate axis of the range we had crossed, and of which Lassen's butte forms the most elevated point. This range constitutes the western wall of the first of the basins of Pit river, and runs off with a northwesterly trend in the direction of Mount Shasta, which was plainly visible from the point where we stood.

In the east rose from this plain another wall, similar to that which I have described, and having nearly the same trend. Toward the south, these two ranges coalesced, and were lost in the peaks composing the Sierra Nevada. On the north low ranges of mountains bounded the horizon, but the exact limits of this plain, in that direction, could not be determined. Its surface seemed as level as water, and, but that it was covered with grass, it had every appearance of a large lake, enclosed on every side by bold and rocky shores. The only exit from this wide area, as proved by its drainage, is through the deep chasm which Pit river has formed in its western wall.

It required no stretch of the imagination to see that, at a comparatively recent period, this basin had been what it now so much resembled, a lake, whose waters had gradually been withdrawn through the deepening channel of its present draining stream. As we descended to the plain, our conjectures of its history were confirmed by its geological structure. Its surface, which is nearly level, is everywhere underlaid by a series of fine infusorial marls, similar to that which occurs in the cañon of Pit river. These marls are apparently horizontally stratified, and as the channels of the streams which cross the plain have cut them to a depth of but a few feet, it was impossible to determine their thickness. Exposed at various points, they exhibited great uniformity of color and texture, being pure white or light brown, and all of them containing, in large quantities, the remains of fresh water *Diatomaceæ*. In the examination of the structure of this basin, many points of analogy with that of the Sacramento valley suggested themselves. It has the same elongated form, is bounded by similar parallel mountain ranges, having nearly the same trend. It is drained by streams which unite in the same way to force a passage through its eastern wall. The sediments deposited by its waters, which form the surface over which we passed, though for the most part undisturbed, and nowhere exhibiting the rearrangement which marks most of the sediments of the Sacramento valley, closely resembled the strata of fine infusorial marls which are found in various parts of that valley, and which seems at one time to have stretched over a large portion of its surface.

RANGE FORMING UPPER CAÑON OF PIT RIVER.

The geological structure of this range presents a striking similarity to that which connects Lassen's butte and Mount Shasta. The dark vesicular trap, which forms the lower cañon of Pit river, here reappears, and almost without exception or variation forms the mass of the range where we crossed it. Through this barrier Pit river has forced its way in a narrow and somewhat tortuous cañon, of which the perpendicular walls present sections frequently several hundred feet in height. The surface rock on the north side is everywhere the dark vesicular trap to which I have referred, and of which the exposed surface in many places retains the form and appearance which it had when in a melted state. It is often bare; at other times covered with a thin soil, which has been formed by its decomposition. It presents very few level surfaces; is covered with a thin growth of coarse grasses, with here and there a dwarfed tree of the western cedar. On the south side of the cañon the rock is generally similar in character, but near the middle of the range I noticed a mass of red and apparently recent scoria.

SECOND BASIN OF PIT RIVER.

Descending the eastern side of the range of which I have been speaking, we came down on to a second plain, similar in all respects to that which lies westward of it. It has nearly the same breadth, about twenty miles; its longest diameter being parallel to the mountain range which borders it, its limits north and south not being visible from any point of our route. Like the lower basin, it is very nearly level, and lies at an average altitude of a little over 4,000 feet, being 800 feet higher than the one we previously crossed. The drainage of this plain is, apparently, less perfect than that of the lower one; it is more moist; covered with a deeper soil, sustaining a more vigorous growth of green grasses; and, from the number of fluviatile shells strewed over its surface, is evidently at some seasons overflowed. We had little opportunity of examining the structure of this plain, but it is apparently generally underlaid by infusorial marls similar to those already described. In the vicinity of the hills which border it on the east these marls appear in various localities, considerably elevated above its level, and have, apparently, been subject to some disturbance since their deposition. The most common form which they here present is precisely like that which occurs in the lower cañon of Pit river, being as fine and white as chalk, and like that abounding in the remains of fresh water infusoria. Associated with this are strata of soft green sandstone, which occurs in thin beds interstratified with the last.

The hills of which I have spoken, as forming the eastern limit of this plain, scarcely deserve the name of mountains, and in the imperfect examination I was able to give them I was unable to detect the course of the lines of upheaval by which they had been formed. They exhibit considerable variety in the rocks which compose them, which are, however, all erupted or highly metamorphic. A dark compact basalt, greenstone, and porphyry are all present, and among the boulders found in the bed of Pit river, apparently derived from these hills at a higher point in its course, I found jasper, agates, quartz, granite, porphyry, and obsidian. The hills which we crossed immediately after leaving Pit river, on our route to Klamath lakes, are composed of a blue, hard, highly metamorphosed silicious slate. A few miles further north occurs a beautiful variety of porphyry, of which the ground work is chocolate color, the crystals of felspar, white, and of large size. In a greenstone dyke, near the same locality, I found small quantities of green carbonate of copper. The plutonic rocks exposed on Pit river, where we left it, are apparently older than the floods of lava-like trap which have covered so much of the country traversed before reaching that point. Here, rather than anywhere else on the line of our route to the Columbia, I should expect to find veins of quartz and talcose slates, which are so frequently the repositories of gold. From the rolled fragments brought down by Pit river, as well as from specimens brought in by our hunters, who followed the river to a higher point than where we left it, it is evident that there exists in this vicinity a protrusion of granite, and associated with it, the porphyries, quartz, greenstone, &c., of which I have spoken.

Beyond this range of hills Pit river traverses, and rises in, a region which, over a large area, exhibits precisely the same features as that through which we have followed it.

Lieutenant Williamson, while connected with an exploring party which visited this vicinity some years since, followed up Pit river to its source, and traversed the plain in which Goose lake is situated. from his detailed and clear description of the country I learn that the white, chalk-like marls, which form so marked a feature of the geology of the lower plains of Pit river, recur at various points near its source above, as below, in lake-like plains, which are separated by walls of volcanic rock. The plain about Goose lake is of the same general character with those we have passed over. Pit river takes its rise in a series of hot spring, which, in their character and surroundings, apparently resemble those of the Des Chutes Basin, to which I shall soon have occasion to refer.

From a gentleman whom I had the pleasure of meeting at Fort Reading, and who had recently passed over the country lying between Fort Hall and Goose lake, I obtained valuable information, and specimens illustrative of the geology of his route. From these it is evident that the geological structure of the region bordering lower Pit river affords a complete illustration of that of a large portion of country lying east of it.

KLAMATH BASINS.

Like the plains of Pit river the several areas, in which are set Wright, Rhett, and the Klamath lakes, exhibit the typical features of the structure of the entire region with which they are inseparably connected, and which, with very imperfect notions of its character, has been denominated the Great Basin. This immense area, cut in various directions by ranges of low mountains and hills, has, by this and other causes, been divided into many subordinate districts, each of which, possessing some characters peculiar to itself, has, also, many features which are common to all. They all form portions of the same great plateau to which allusion has already been made, and which exhibits everywhere a remarkable unity of geological structure, of climate, and in its flora and fauna.

Of the many secondary basins which go to make up this area, those which lie nearest the base of the mountain wall, on the west, receive a larger share of the rain precipitated upon it than those which are more remote. As a consequence, the supply of water received through the year is greater than the annual evaporation, and this excess flows off in the streams which lead from them. At a period not very remote in the history of our continent, the amount of water falling into the Klamath and Pit river basins was, probably, much greater than now, and coverd, to a considerable depth, surfaces which are now exposed. The streams which flowed from these areas had greater volume, and flowed from a higher level than at present. To this cause we may attribute the deep channels which they have cut through the resistant material of the mountain barriers which opposed their progress to the ocean.

In all their general features, the basins of the Klamath lakes closely copy those of upper Pit river. They form elongated troughs, lying between nearly parallel mountain ranges, of which that on the west is broken through by Klamath river, which reaches the ocean through a cañon as deeply cut as that of Pit river. The bottom of this trough is covered—to how great a depth we do not know—by a series of stratified deposits, altogether similar to those which I have described. The drainage of this basin has, however, been less complete than that of the Sacramento and upper Pit river, and large portions of its surface are still occupied by bodies of water.

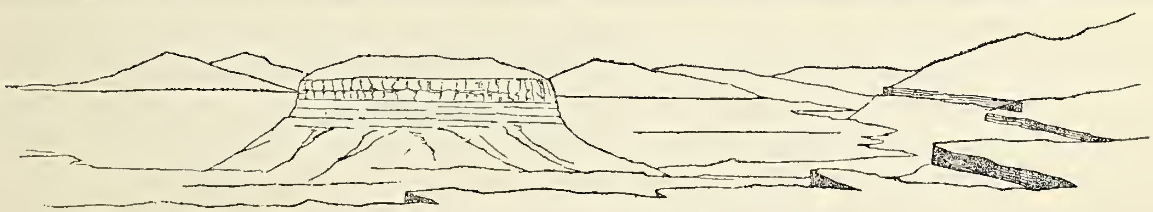
LOCAL GEOLOGY.

The geology of the interval between Pit river, at the point where we left it, and Wright lake, is exceedingly monotonous. Four or five miles north of Pit river we lost all traces of the older volcanic rocks, to which I have referred as occurring in that vicinity; and from that point, northward, for thirty miles we passed over a succession of plateaus of vesicular trap, precisely like that which occurs so abundantly about Fort Reading, this being apparently the form which the volcanic material always assumes when poured out in floods of considerable depth on to surfaces not covered by water.

Near Wright lake occurs a conical mountain of trap rock, which rises to a height of perhaps 1,500 feet from the plain on which it stands. The south shore of this lake is bordered by a mountain range of nearly equal altitude, which has here a course nearly east and west; curving round towards the north, its western extremity terminates in a bold headland on the shore of Rhett lake, and is connected by a low ridge, with similar hills, lying north of these lakes. This connecting ridge, forming the barrier between Rhett and Wright lakes, is composed exclusively of trap, and bears on it a conical hill of blood-red scoria, which has evidently at no distant day formed a volcanic vent.

Rhett lake is bordered on the east and north by cliffs of considerable height, of which the base is composed of light-colored sandstone, the upper portion of trap. This sandstone, which is very soft and friable, belongs to the series of infusorial marls of which I have so frequently spoken.

On the eastern shore of the lake is a conical hill, considerably removed from the cliffs referred to, but having apparently the same structure. It is composed at base of sandstone, regularly



HILL OF SANDSTONE, CAPPED WITH TRAP, RHETT LAKE.

stratified, and nearly horizontal, and is capped with trap. Both the trap and sandstone were doubtless once connected with the similar strata in the cliffs, now nearly half a mile removed. We have here evidence of an amount of erosion which can hardly be attributed to the action of any cause now operating, and it is quite certain that the surface of the surrounding country—like all that which we traversed west of the Cascade mountains—has never been swept by a drift current. I can only explain it by connecting it with the presence of a much larger quantity of water in this basin at a former period than is found here now.

In that portion of the Klamath basin through which Lost river flows, the same sandstone is found interstratified with infusorial marls, which are fine and white. At the "Natural Bridge" these strata have been thrown up by a fault, and form a dam across the stream, where it is forded. The sandstone here contains black scoria in rounded masses, frequently as large as an egg. In this respect, as well as in texture, it resembles a sandstone forming part of the series of tufaceous marls, described in Chapter I, as occurring on the south shore of the San Pablo bay. Here, as there, the greater part of the material being undoubtedly of volcanic origin, consisting of ashes, comminuted pumice, mingled with masses of scoria, all of which have been thrown into water and stratified by deposition.

I may say, in this connexion, that I obtained from Mt. Hood, in Oregon, volcanic ashes which had been recently thrown out, which would form precisely similar strata, if similarly treated. From Lost river, these infusorial marls underlying the surface of a nearly level plain, extend to and artially surround Lower Klamath lake, reaching as far north as the southern end of Upper Klamath lake. On the shores of Rhett lake, and several localities on the plain, which I have mentioned, the surface is covered with a white efflorescence resembling snow. It is doubtless derived, in a great degree, from the marl beds, which usually contain a notable quantity of soluble salts. Specimens of this efflorescence was remitted to Dr. J. D. Easter for analysis, upon which he has rendered the following report:

"*A white saline efflorescence from Rhett lake, Oregon.*—The salt, freed by solution from earthy and vegetable matter, consisted of sulphates of soda and magnesia, with a considerable proportion of chloride of sodium. A quantitative analysis was begun, but the vessel containing the solution was broken during my absence from the laboratory, and no more of the salts remained. The efflorescence is similar to a large number of specimens which I have analyzed from California and New Mexico."

Across the south end of Upper Klamath lake a low ridge of trap runs, by which its waters are considerably raised above the plain surrounding Lower Klamath lake. On the flanks of the hills which compose this barrier I found the infusorial marls, here highly metamorphosed, some of the specimens approaching jasper in appearance. The hills bordering the lake near its southern end are composed of soft pulverulent sandstone, similar to that found on the shore of Rhett lake, and, like that, composed of thick beds of trap.

The hills bordering Upper Klamath lake are high and bold on either side: on the west, rising in successive grades until they join the Cascades, here crowned by the lofty and symmetrical cone of Mount Pitt; on the east, a succession of trap ranges, having a trend nearly northwest and southeast, terminate in bold headlands which project into the lake and form its shore. These ranges rise to an altitude of twelve to fifteen hundred feet, with valleys of corresponding depth. They are composed of dark vesicular trap, in some places scoriaceous. The most northerly of these interrupted ranges, along the northern base of which Klamath river flows for several miles, is, in a great degree, composed of volcanic breccia, the enclosed fragments ranging in size from two to six or eight inches in diameter.

At the junction of the east branch of Klamath river with the main stream, for some distance along the base of the ridge of which I have spoken, a stratum of infusorial marls is exposed, which is white and chalk-like, in all respects resembling that from Pit river and the plains about Lower Klamath lake. A few miles north of this occurs another volcanic ridge, having nearly the same trend with those last mentioned, from which it is separated by the nearly level and, in many places, fertile valley through which Klamath river flows. This ridge is composed partly of dark, compact trap and partly of white and soft pumice, which, in many places, covers the surface, and, in its decomposition, gives rise to a peculiarly light and ash-like soil, upon which nothing seems to flourish but the yellow pine. Through this ridge Klamath river flows in a cañon, of which the walls are perpendicular and two hundred feet or more in height.

North of this ridge is another low and level plain, of which the surface is in many places covered with pumice. Crossing another but lower ridge of similar character, we descend to the shores of Klamath marsh. This lake occupies an area similar in all respects to those below, and like them is formed by the crossing of the general trough in which they all lie, of the transverse trap ranges to which I have alluded. Along the eastern shore these ranges are very conspicuous, several of them running far out into the lake, and throwing its eastern border into a series of long points, alternating with deep bays.

The pumice is here as marked a feature in the geology of the district as the trap; covering all the surfaces, and forming a soil into which the feet of our horses sank so deeply as to render any departure from the trail which followed the outline of the shore very disagreeable. At the north end of the lake, a point of metamorphosed slate projects a few feet above the surface, and forms the only exposure of rock of this character seen within many miles of that point.

The western shore of this lake is formed by a broad prairie scarcely raised above the water level, and doubtless at some seasons submerged. It seemed everywhere underlaid by fragments of pumice, which had apparently been so accurately levelled by the action of the water. This pumice, when pulverized, forms a substance having a striking resemblance to the marls to which I have so often referred, and, aside from the organic structures which they contain, they have doubtless been formed of similar materials.

The interval separating Klamath lake from the head-waters of the Des Chutes river forms a nearly level plain, covered everywhere with pulverized pumice, and supporting a meagre growth of yellow and spruce pine. Both east and west, ranges of hills are visible from the route which we followed, and at various points masses of black basalt project above the general surface. From the porous nature of the soil, the streams which come down from the mountains at the west are soon absorbed, and we were only enabled to obtain water by digging, at a single point on our journey. At this point, the water seems to have been brought to the surface by a dyke of trap rock which impedes its subterranean flow from the west.

A precisely similar surface borders the south fork of the Des Chutes to its junction with the main stream which comes down from the Cascade mountains. On the banks of this latter stream are exposed, in various localities, strata of white, chalk-like marls, and light brown, green, and friable sandstone, in all respects identical with those of Pit river and Klamath basins.

CHAPTER V

GEOLOGY OF THE CASCADE MOUNTAINS.

Panoramic view of the cascade mountains.—Sierra Nevada and cascade mountains.—A wall crowning the western margin of the great central plateau.—Structure and origin of the cascade range—Main crest near its eastern margin a line of volcanic peaks.—More westerly mountains, metamorphic slates.—Local geology.—Crater pass—Evidences of glacial action.—Glaciers once descended far below the present snow line.—Extent of glaciers in the cascades.—Conditions under which they must have been formed.—By elevation or change of climate?—Evidences of elevation.—Sub-aerial excavations of mouths of rivers.—Depression of temperature would produce greater precipitation of moisture—Streams flowing from the cascade mountains formerly larger than now.—Cañons of these streams not rifts but excavations.

After reaching the head-waters of the Des Chutes river, we ascended the main fork of that stream to its source, in the Cascade mountains, spending a month crossing and recrossing the main crest, latitude 44° north, in the vicinity of the Three Sisters. The mountains which have received this name form part of a group of five, of which only the three most westerly are visible from the Willamette valley, and have been known to the residents. The altitude of the loftiest of the group is about 10,000 or 11,000 feet above the level of the sea, the line of perpetual snow being 7,000 feet. This group of mountains marks an angle or joint, if I may use the expression, in the Cascade range. Standing on the summits of the passes between them, we saw the main crest of the range crowned by several peaks of considerable altitude, but particularly marked by the lofty and snow covered cones of Mount Jefferson and Mount Hood, trending away nearly due north. Looking southward, we saw the belt of the Cascade mountains, so broad above, narrowed in its limits, trending southwest by south, marked by no conspicuous peak, and yet continuous to the point where the sharp, snow covered cone and broad base of Mount Pitt bounds the horizon in that direction. There, another joint marks a deflexion of the chain to the south, a course which it holds till lost in the huge mass of Mount Shasta; there again deflected to the eastward, to be again turned south at Lassen's butte. This mountain system seems like some grand fortification, as though Nature, when the broad plateau, which reaches inland from its base, was redeemed from the sea, had built along its western margin a wall of such altitude as should forever bid defiance to the waves, and at all the salient or re-entering angles had planted towers which should strengthen and command the whole.

Looking north from the Three Sisters, and viewing the Cascade mountains in profile, we saw that the axis of the range was set nearest to its eastern border, and that the descent from this crest to the plateau which forms its base in that direction was made by few and steep declivities; while toward the west stretched a broad belt of mountains which gradually diminished in altitude, and, as we subsequently learned, more than fifty miles distant, were lost in the foot hills which border the Willamette valley.

This section seemed to afford us some clue to the manner in which this range had been formed. The series of principal peaks marks the line of fracture in the earth's crust, along which the greatest exhibition of volcanic forces would naturally be displayed. Toward the east, the great

WESTERN SLOPE OF MAIN RIDGE OF CASCADE MOUNTAINS FROM NEAR CAMP M plateau preserves its general horizontality, only broken by subordinate hills and mountains, which mark the cracks and fissures formed in the convulsions by which it has been shaken.

Toward the west the rocky strata, with many fractures, bent down toward the depression of the ocean's bed, by their broken and upturned edges, had formed the succession of mountain peaks which constitute the great breadth of the chain. The nature of the rock exposed at the various points which we visited seemed to lead to the same conclusion. The line of fracture is marked by a series of volcanic peaks—many of them of great altitude—of which the fires are not yet wholly extinguished; their sides being covered by an immense accumulation of volcanic material, of which the greater part seems as fresh as if thrown out but yesterday. The streams of lava which have poured down their sides now stand bare, black, and ragged, scarcely a lichen even as yet having found a foothold on them. Toward the west the mountain masses are composed of highly metamorphosed slates, set on their edges and inclined at every possible angle.

LOCAL GEOLOGY.

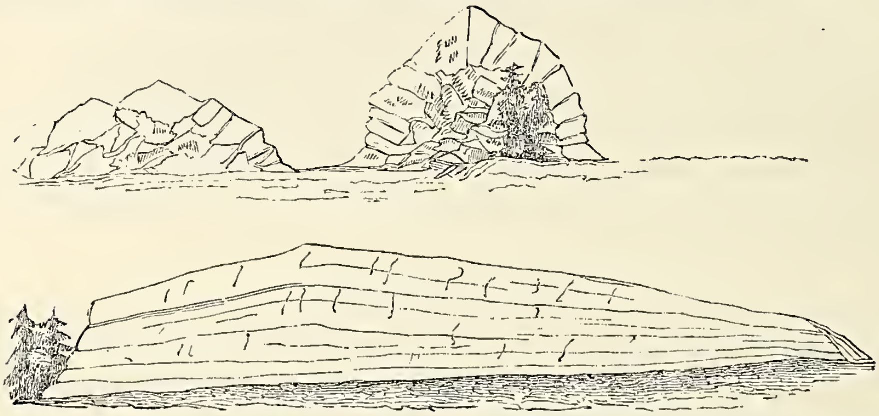
As we ascended the Des Chutes river we soon left behind us the pumice plains and the stratified marls which line its banks, and at an altitude of 4,500 feet entered a region south of the Three Sisters, abounding in lakes, mountain meadows green and fresh, and forests of fir and pine, of different species from those occupying the plain below. The soil in many places was fertile, the scenery as picturesque as can be found in any part of the world. The only rock exposed being a dark vesicular trap, or a nearly black compact basalt.

Ascending to a pass between the snow mountains in the group I have mentioned, we passed over a surface covered with comparatively recent volcanic material, heaped up in the greatest confusion. This we traced to its origin in a crater, half a mile in diameter, which lies between two of these snow mountains, which form portions of its once continuous enclosing walls. The southern rim of this crater has an altitude of 6,500 feet; the northern rim being two or three hundred feet higher. The eruption, of which we saw such evident traces, seems to have taken place from the southern side of the mountain, the crater being here opened by a deep fissure, through which a stream flows from the lakes occupying its centre. The walls of the mountain which border the crater are formed of black lava or blood red scoria, and immense piles of pumice and obsidian, fresh and bare, mark the recent date of its activity.

EVIDENCES OF GLACIAL ACTION.

The north wall of this crater is composed of black porphyry, which is very compact, and apparently older than most of the trap and lava which we saw in the vicinity. This rock, though intensely hard and very homogeneous, everywhere bore the marks of the action of some powerful agent. It was planed down to a smooth and even surface, or scored into deep grooves or furrows, which were sometimes continuous for rods. These grooves ran down the northeast slope of the mountain, were confined to the outside of the crater, and seemed to radiate from a point over its crater. On a subsequent occasion, descending the mountain toward the southwest, we traced these grooves for several miles to a point two thousand feet below the line of perpetual snow. On this slope the marks of glacial action were much more conspicuous than at Crater pass. All the projecting points and ridges of the older trap rock were worn down, smoothed off, and cut by deep furrows, which now pointed northeast toward the centre of the mountain mass formed by the Three Sisters.

Still later, having crossed the main ridge north of the Three Sisters, we noticed the same phenomena extending down to the altitude of 4,459 feet, where they terminated in a deep cañon, through which a stream flowed into the Willamette valley. This cañon led down from Mount Jefferson, and was joined by another, which came from the Three Sisters. At their point of junction they had a depth of more than a thousand feet. Here, as before, the furrows in the rock pointed to the Three Sisters, bearing from us a little south of east.



TRAP-LEDGES, EXHIBITING MARKS OF GLACIAL ACTION.

We had evidence in these scratched and furrowed rocks of the former existence in these mountains of glaciers, which extended down at least 2,500 feet below the present line of perpetual snow. I suspect, indeed, that they descended much lower, and that they filled the cañons of which I have spoken, which, in the regularity of their outline, and the accurate slopes of their sides seem to have been formed by some such cause. The area over which these marks of glacical action extend is probably very large, including the slopes of the Three Sisters, Mount Jefferson, and all the line of peaks which mark the crest of the chain. And there is little doubt that all this surface was once covered, not simply by lines of ice following the valleys, but by a continuous sheet which, on the west, reached down to the base of the next and lower line of mountains, and that the sides and summits of these subordinate peaks, rising high above the lowest point where I noticed the grooves and scratches, were also capped and covered by masses of ice. These glacial grooves do not seem to have attracted the attention of those who have crossed the Cascade Range further north; but we can hardly suppose that while here the evidences remain of glaciers, so wide, and extending to so low a level, that they could have been produced by the operation of local causes; or that upon more careful examination the traces of their former existence will not be found on the flanks of Mount Hood, the loftiest peak in the chain, of Mount Rainier, and Mount Adams north of the Columbia, and of the many other lower but still elevated summits.

Origin of cañons.—The indications of the existence, in former times, of glaciers extending over large surfaces in the Cascade mountains is closely connected with the formation of the deep cañons, through which the streams which drain these mountains and the plateau of the "Great Basin" beyond uniformly flow. I think we have evidence in the magnitude of the excavation—often in the most resistant material—as compared with their present volume, that the amount of precipitation which formerly supplied them was much greater than now.

The Golden Gate, the Straits of Carquines, the cañon of Pit river—which, following its tortuous course is, for nearly a hundred miles, cut through a succession of walls of volcanic rock—the many cañons of Klamath river, those of the Des Chutes and its tributaries—to which I shall soon have occasion to refer—and the gorge of the Columbia, the most stupendous of all, holding, as they do, such peculiar and constant relation to the areas which are drained through them, cannot possibly be regarded as rifts formed by volcanic action in the barriers which they traverse. The conclusion seems irresistible that they have been formed principally, if not entirely, by currents of water, of which the present streams are representatives.

Another of the deeply graven records from which we are attempting to deduce the ancient history of the western coast is found in the great depth of the channels by which these streams terminate in the Pacific. The deep and narrow fiords which mark the northern portion of the western coast, of which those opposite the island of Vancouver, on the coast of Washington Territory, are good examples, have been described by Professor Dana, in his Geology of the Exploring Expedition. The mouth of the Columbia exhibits similar features. For a hundred miles it forms an arm of the sea of great and uniform depth.

The channel of the Golden Gate has a maximum depth of nearly fifty fathoms, being greatest immediately in the line of the axis of the chain through which it is cut, while the bar without and the bay within are silted up to within less than ten fathoms of the surface.

The Straits of Carquines have a maximum depth of eighteen fathoms, and in the line of the range which bounds them an average depth of fourteen.

It is evident that glaciers could now be formed in the Cascade mountains only by a great depression of temperature, and it is perhaps doubtful whether glaciers would now form to the extent indicated by the traces of their former existence, which has been described, even with a depression of temperature so low as to precipitate and congeal all the vapor which floats above them. Without, however, raising that question, we may be at least certain that with the former existence of glaciers in the Cascades, the average temperature was much lower than at present. This must have been dependent upon one of two causes: either a great and radical difference in the climate of the coast without a change of elevation, or, the climate remaining the same, by the elevation of the coast to a general altitude several thousand feet higher than at present.

Of the condition required by the first of these hypotheses we have no other evidence than that of the glaciers themselves, while of the former elevation of the coast, in the sub-ærial excavation of the fiords at the north in the deep channel of the Columbia, and, as it seems to me, in that of the Golden Gate, we have cumulative and conclusive proof. The effect of such an elevation as would be required to cover the slopes and valleys of the Cascades with glaciers, would be exhibited in various ways. The amount of moisture precipitated upon the sides of these mountains would then be much greater than now. Instead of presenting isolated peaks rising above the line of congelation, they would form an unbroken wall, of which the summit, white with perpetual frost, would rob of all its moisture the wind, then as now, blowing over it from the Pacific. This precipitation, though greatest on the western slopes, and forming by its congelation sheets of ice which would reach far down its sides, crowding themselves into the angular valleys which now lead toward the Pacific, would also extend its influence to the eastern slope, fill many of its basins, now dry, with water, give greater volume and efficiency to the streams, and enable them to score so deeply the surfaces of the plateau, and force mountain barriers to reach the ocean, cutting deep channels in its shores where we now find them.

CHAPTER VI.

GEOLOGY OF THE DES CHUTES BASIN.

Compound nature of this basin.—Its subdivisions similar in structure to those of Pit and Klamath rivers.—Trap plateaus.—Volcanic tufas and infusorial marls.—Local geology.—Plateau east of Three Sisters.—Cañon of Mpto-ly-as river.—Mount Jefferson.—Congealed lava stream.—Castle rock.—Columns of basaltic conglomerate capped with blocks of trap.—Tufaceous strata of Mpto-ly-as river.—Cañon of Psuc-see-que creek.—Picturesque appearance of the colored tufas and concrete.—Trunks of coniferous trees imbedded in tufa.—Columnar trap covering the tufas.—Wam-chuck river.—Hot springs.—Gelatinous silica.—Metamorphosed tufas.—Onyx.—Opal.—agate.—Silicified wood.—Wam-chuck mountains.—Metamorphic slates.—Quartz and chalcedony.—Nee-nee spring.—Metamorphosed marls.—Ribband jasper.—Plateau of Tysch prairie.—Tysch mountains.—View of Mount Hood.—Cañon of Des Chutes river.—Mounds.—Hills of infusorial marl south of the Columbia.

Although for convenience it may be desirable to group, under the name of the Des Chutes basin, the several distinct areas which are drained by the waters of the Des Chutes river, it should be stated that no such surface exists as would be indicated by its unqualified use. The several divisions which it must include have only in common their geological structure which, in all its essential particulars, they also share with the Klamath and Pit river basins. But while differing little in kind from that of the areas I have mentioned, the geology of the Des Chutes basin exhibits some striking features in the scale on which it is developed. Lying near the base of the chain of great volcanic cones which forms the axis of the Cascade range, immense quantities of erupted material have been thrown over it, which contrast strongly with the modest trap ridges, pumice plains, and fine chalk-like marls of the Klamath basin.

The Des Chutes basin consists of a series of plateaus, having varying elevations from 4,000 to 2,200 feet above the level of the sea, and being separated by subordinate ranges of volcanic mountains, of so low an elevation as scarcely to be noticed when overlooking the general surface from the Cascade mountains. These plateaus are usually covered by a floor of trap, which extends in a smooth sheet from fifty to a hundred and fifty feet in thickness, unbroken, except where crowning the slopes of the profound cañons of the streams which traverse them. These layers of trap are frequently columnar, the columns being perpendicular. Below this stratum we find a series of volcanic marls, tufas, and conglomerates, locally intercalated with which are thin beds of trap.

These tufaceous strata are, in many places, cut by the Des Chutes and its tributaries to the depth of more than a thousand feet without exposing the basis on which they rest. They are usually quite horizontal, from a few lines to twenty feet in thickness, and very accurately stratified. They exhibit great variety of color and texture, some being very fine and chalk-like, in all respects similar to those of Klamath and Pit river basins, while others are composed of fragments of pumice, volcanic sand, and a firmly cemented conglomerate of trap, pumice, scoria, and other erupted rocks. Some are pure white, others pink, orange, blue, brown, or green. The sections made by their exposures have a picturesque and peculiar appearance, of which some idea may be formed from the geological diagrams used in the lecture room.

The subordinate mountain ranges which divide the Des Chutes basin are usually low, having an altitude rarely greater than 1,000 feet above the level of the plateaus which border them. They are composed of trap or metamorphic slate, sometimes forming groups or clusters of conical hills ; at other times continuous chains, of which the trends do not harmonize with each other, nor with those of the mountain systems which border either side of the great area in which they are situated.

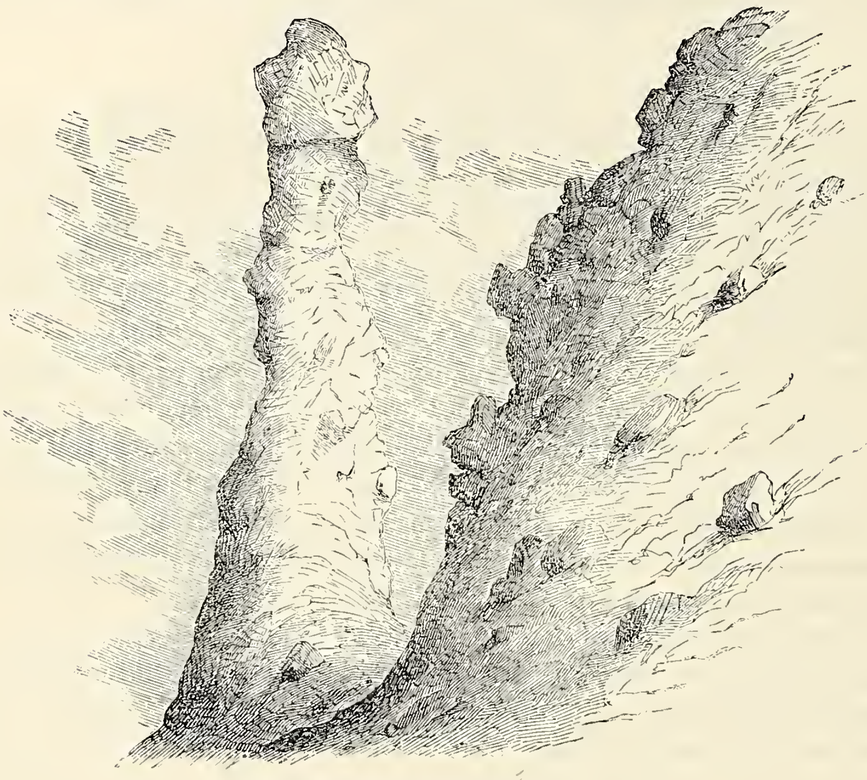
LOCAL GEOLOGY.

The plateau forming the eastern base of the group of mountains, of which the Three Sisters are the most prominent peaks, has a nearly uniform altitude of about 4,000 feet, and extends from the base of the Cascades thirty miles eastward, with no considerable interruption. It is here everywhere covered by a thick layer of trap, which is cut through only by the cañon of the Des Chutes, which we did not visit, but of which the dark and perpendicular walls were visible from the summit of the Cascades. Near our depot camp, on Why-chus creek, a rounded hill rises some three hundred feet above this plain, composed of trap, or red and frothy scoria. This hill has the appearance of having been formed by an eruption from below, subsequent to the consolidation of the plain on which it stands. A few miles northwest from this point a detached mountain rises from the plain, more accurately conical in outline than any other I have seen. It is wooded to the summit, though exhibiting many bare surfaces composed of scoria. There can hardly be a question that this is one of the lateral vents of the great volcanic chain which passes but few miles to the westward of it.

East of this conical mountain we crossed a succession of ridges of trap, evidently formed by streams of lava poured down from the Cascade range. Approaching Mount Jefferson, we one morning found our progress suddenly arrested by a cañon 1,950 feet in depth. The southern wall on which we stood was composed of metamorphic slate, dark gray in color, silicious and somewhat crystalline in structure. The opposite side of the cañon was formed by the slope of Mount Jefferson, which rose, almost unbroken, to its summit, far above the line of perpetual snow. On the side of Mount Jefferson was plainly discernible a stream of black and ragged lava, which, issuing from a point near the snow line and following the course of a mountain torrent, had descended nearly to the Mpto-ly-as river. Picking our way down the wall of the cañon which I have described, we found all parts above the talus which covered its base, composed of the same metamorphic slate, very homogeneous in texture, and nowhere exhibiting any intruded minerals. This slate was inclined at a high angle, dipping toward the southeast.

From this point we followed down the Mpto-ly-as river, for nearly twenty miles, along the immediate banks of the stream. The walls of the cañon on either side continued as high as where we struck it till we emerged from the hills which form the eastern base of Mount Jefferson, and came upon the plateau of the Des Chutes. This cañon, where cut through the hills, exposes nothing but volcanic rock, generally dark, vesicular trap, with sometimes volcanic conglomerate. In some places where this last formed the north wall of the cañon, the fragments which it included were of large size, cemented by a tufaceous base which was readily eroded by the action of the weather. The portions of this material which here underlie these larger masses of inclosed trap were protected by them from the erosion which wore away the surrounding rock, and they were left perched on pinnacles sometimes twenty or thirty feet in height, and having a less diameter at the summit than the rock which they sustain.

The cañon, as far as we followed it, seemed to be of uniform character, precipitous walls rising on either side from the immediate vicinity of the stream which flowed at the bottom. It had every appearance of having been excavated from the solid rock which forms its sides. The stream which flows through it is thirty yards in width, three or four feet deep, and very rapid. It is formed by the drainage of Mount Jefferson and the Three Sisters.

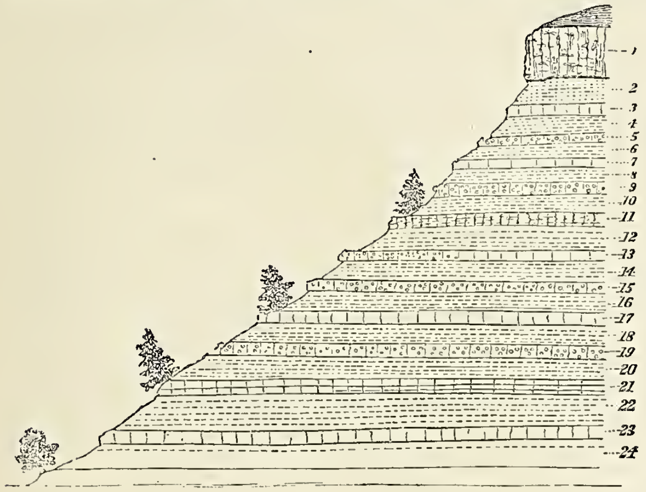


CONGLOMERATE COLUMN, MPTO-LY-AS RIVER.

At the point where we left the cañon of Mpto-ly-as river a marked change occurred in the character of the material composing its walls. The precipices, composed of trap and volcanic conglomerate, which with a height of nearly 2,000 feet had enclosed it for twenty miles, were here succeeded by strata of tufas, which formed walls of perhaps 1,200 feet in height, capped by a thick layer of columnar trap. These tufas were nearly horizontally stratified; exhibiting all the varieties which I have described; the different strata varying in thickness from a few inches to twenty feet.

Some of the finer varieties are highly infusorial. The forms which they contain have since been examined by Professor Bailey, who pronounces them indicative of a fresh water origin. We here ascended to the north wall of the cañon, travelling over the plateau to the banks of Psuc-see-que creek, another tributary of the Des Chutes, flowing down from Mount Jefferson. Here we found a similar series of tufas apparently quite undisturbed, their strata horizontal and continuous.

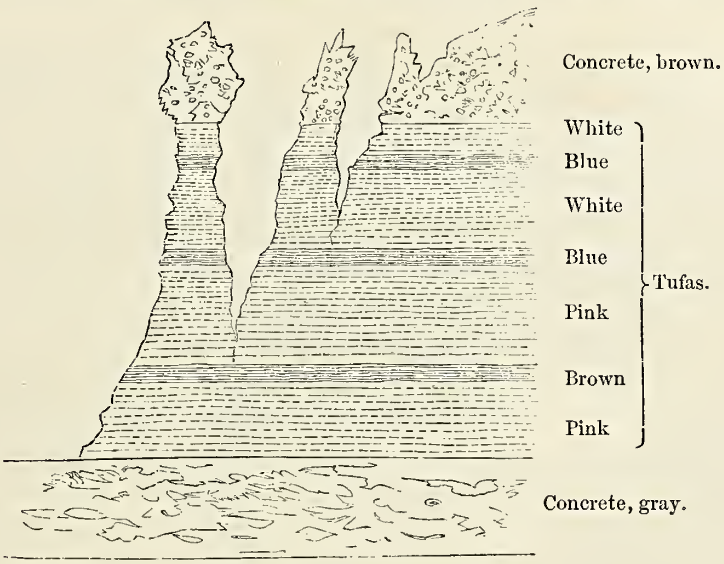
Mingled with these tufas, at this point, are many strata of conglomerate, of which the base resembles closely Roman cement; the inclosed pebbles, usually of small size, and of all varieties of volcanic rock. These beds of concrete being harder than the associated strata, have, in the erosion of the cañon, formed successive steps, frequently thirty or forty feet in width. The detached fragments of these layers of concrete cover and protect pinnacles of the softer stratum below; a single column often being formed of several successive differently colored layers; the prevailing colors being pink, white, orange, blue, gray, and lilac, and these colors frequently strongly contrasted, producing a very peculiar and pleasing effect.



No. 1, columnar trap.
Nos. 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, soft tufas, and infusorial marls.
Nos. 3, 7, 13, 17, 21, 23, harder tufas.
Nos. 5, 8, 15, 19, concrete.
No. 11, trap.

SECTION OF BANK OF PSUC-SEE-QUE CREEK.

Near the base of the series was a stratum of three feet in thickness, composed for the most part of brilliant white felspathic pumice, so soft as to be easily crumbled in the fingers. This pumice was in somewhat rounded masses, averaging less than an inch in diameter, and

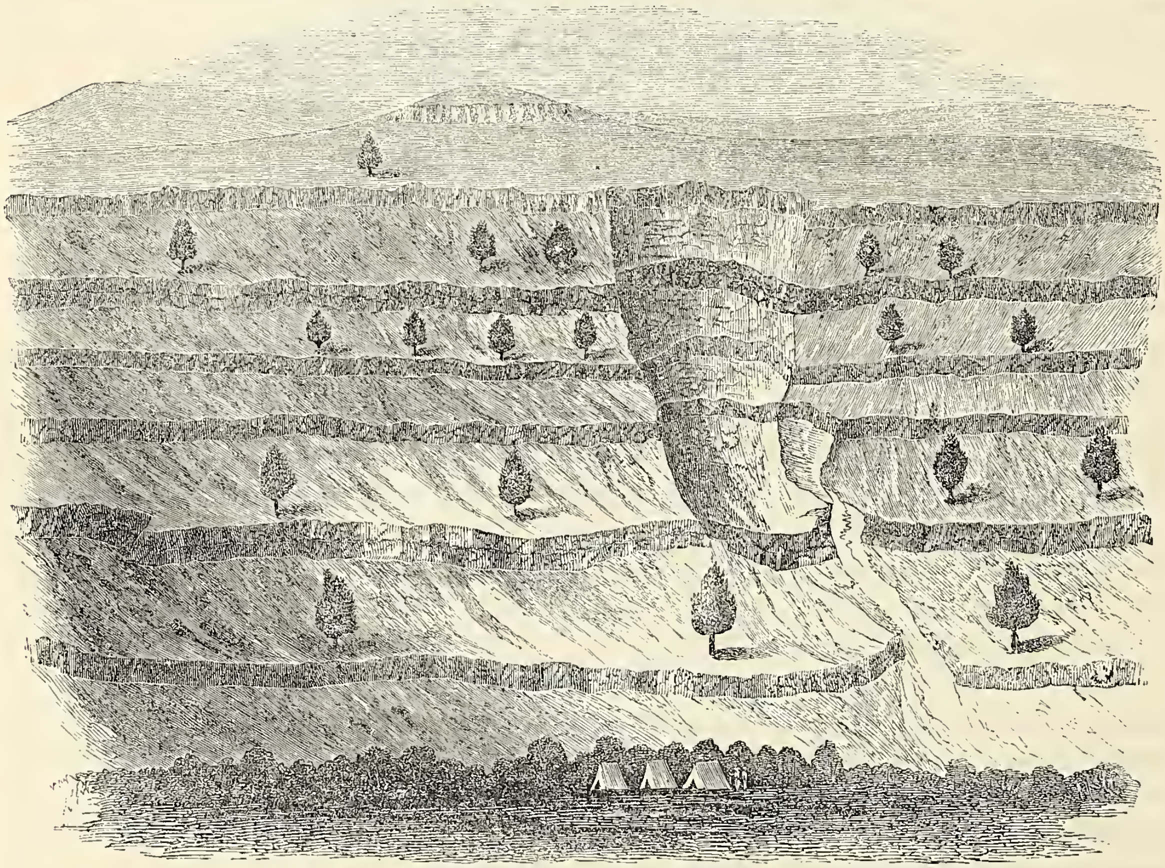


COLORED TUFAS, PSUC-SEE-QUE CREEK.

cemented by a fine lilac colored clay. The general aspect of this layer was that of marbled paper, the spots being pure white and the interstices lilac. A line of dark carbonaceous matter, less than a quarter of an inch in thickness, marked the line of separation between this stratum and another of nearly the same thickness, which was blue in color, having the texture of soft pulverulent coarsish sandstone. The under surface of this layer was pierced in every direction by holes as large as straws, left by the decaying branches of some small plant which had apparently grown from the carbonaceous surface below. The appearance presented by these impressions of plants led me to suppose that during the interval between the deposition of the lower and upper of these layers a growth of vegetation had covered the lower stratum, which became enveloped in the sediment which formed the upper. The specimens which I obtained of these vegetable impressions did not permit me to determine the class to which they belonged. The branches are opposite and alternate, and the plant must have somewhat resembled the *salicornia* which now grows on our salt marshes. It is possible, too, that these stems of plants may have been transported and deposited at the bottom of the water; but the regularity of their arrangement, and the carbonaceous matter below, indicated to my mind that they had grown where they were found.

Two or three hundred feet higher up in this series I found the trunks of large coniferous trees, and stems and roots of small plants imbedded in strata somewhat similar to those which I have described; but in these cases the vegetable matter had not been fossilized, and resembled decayed wood; the appearance of the trunk set with branches, of which the extremities were broken off, the roots still attached, gave the impression that they had not been transported to any great distance from where they grew. In general form and mode of branching they closely resembled the trees of cedar now growing scattered over the declivities of the cañon.

The succession from the bottom of the cañon to the general level of the plateau, together with these, includes a layer of trap, which forms a horizontal stratum twenty or thirty feet in thickness, occupying a place nearer the top than the bottom of the section.



NORTH BANK OF PSUC-SEE-QUE CREEK.

On the banks of Mpto-ly-as river, in one locality, was a succession of seven of these layers of trap, as perfectly as the materials with which they were associated, and on the slope of the cañon exhibiting the typical form of trap stairs. Crossing to Chit-tike creek, the same formation reappears, apparently undisturbed; the cañons of several confluent streams flowing from Mount Jefferson having here cut the plateau into a series of narrow ridges, perhaps a thousand feet in height, crowned with a layer of trap, which closely resembles a wall of artificial masonry, built on an immense artificial embankment.

The east wall of the cañon of the Des Chutes river at this point consists of a layer of trap a hundred feet in thickness, composed of perpendicular columns, from the base of which it slopes away to the water's edge. The course of the stream, marked with geometrical precision by the lines and angles of the stratum of trap stretching off for many miles in perspective, vividly recalled the cyclopean architecture which gives so impressive a character to Martin's paintings.

On going over to the valley of Wam Chuck river, still another tributary of the Des Chutes from the Cascades, we found a marked change had taken place in the stratified tufas, which are so characteristic of the geology of all this region.

Hot Springs.—At different points along the valley of Wam Chuck river, hot springs issue from the base of the cliffs which bound it. The number of these springs is large, and two or three of them are quite copious. They issue from fissures in the rock, the water flowing from them collecting in basins of several feet in diameter, thence flowing into the Wam Chuck river, and giving it its name. The temperature of two of these springs was respectively 143° and 145°. The water holds large quantities of silica in solution, but has a bland and pleasant taste, and, when cooled and drank, has, apparently, no medicinal effect. The quantity of silica is, however, very large; the basins in which the water collects containing floating masses of gelatinous silica, of which the surfaces are tinged with a green color, which I have supposed was derived from silicate of iron. The sides of these basins, and of the streams flowing from them, are encrusted with a white frothy silicious deposit, which also invests whatever stones, sticks, or other foreign substances project from the surface of the water.

Metamorphosed Tufas.—The cliffs which border Wam Chuck river, in the vicinity of the warm springs, are apparently composed of the same or a similar series of volcanic tufas and marls with those described as forming the banks of Mpto-ly-as river, Psuc-see-que and Chit-tike creeks, but here so changed as hardly to be recognized at first sight. They are traversed by a thousand cracks and fissures, from which the steam or water of the hot springs emanate, by which the aspect of the rock has been made to resemble that of serpentine or some light colored volcanic or metamorphic rock which has suffered complete fusion. Upon closer examination, however, many of the varieties of tufaceous rock exposed in the localities referred to above may be here recognized, but presenting such changes of physical character and composition as would deceive the most practised observer, until he had obtained a series which exhibited all the successive grades of metamorphosis. The white, chalk-like, infusorial marls are, by the action of these hot silicious springs, first rendered harder and more dense without marked change of color, subsequently becoming still more consolidated; the extreme form of metamorphism of this variety being a jasper, colored red or green by the silicate or oxide of iron, closely resembling the porcelain jaspers of Germany.

The coarser tufas, such as that described as occuring on Psuc-see-que creek, composed of lumps of fine felspathic pumice, resembling kaolin, cemented by a fine sediment, exhibit more distinct and interesting grades of change. The cement is first consolidated—sometimes remaining bluish-white, sometimes tinged with green—the balls of cotton-like pumice being scarcely changed; second, the cement has become hard and almost crystaline, somewhat resembling burrstone; the spaces occupied by the pumice being empty, or containing a small flock of light-reddish matter, the remainder having been dissolved and carried off, or chemically combined. The cavities which the mineral in this state exhibit are angular, their walls having a radiated and crystaline structure, apparently produced by an effort of the particles composing them to assume a spherical form with a radiated arrangement. Not unfrequently a small, hollow, or solid sphere is formed on all or several of the walls of the cavity. The third stage of metamorphosis exhibits these cavities filled with onyx or opal—more rarely with agate—the rock having assumed a peculiar concretionary structure. The onyx consists of bands of red, white, green, or translucent silica, forming specimens of great beauty.

These layers would seem to have been deposited parallel with the horizon, as the bands of color in the onyx, filling different cavities of the same mass, are accurately parallel. In some cases the cavities are but partially filled, several bands stretching across from side to side, with open spaces between them.

The opalescent silica exhibited considerable variety, some being milk white and opaque, apparently retaining a considerable portion of felspathic material which originally filled the cavity. Other specimens were more transparent, sometimes exhibiting the beautiful reflections of precious opal. I was able to satisfy myself on the spot, as well as obtain a series of specimens, which show that all these changes, and those of other varieties, which it is not necessary to enumerate, followed the action of hot water containing large quantities of silica in solution upon the porous and permeable structure of tufas and marls.

Metamorphosis so complete, and due to such a cause, would not be without interest, though limited to small quantities of material. We had here evidences, however, that the metamorphosis of these tufas extended over a large area, for we found the same or similar changes indicated in the stratified deposits at points on our route more than ten miles distant. Where trap rock had been exposed to the action of these springs, it had, to a great degree, been converted into a blood-red pulverulent earth.

Silicified wood is very abundant in the Hot Spring valley, and has doubtless been mineralized by the action of the hot silicious water. I suspect it will be found that the profusion of silicified wood, which has been so frequently noticed in different parts of the area lying between the Cascade range and the Rocky mountains, is traceable to the same cause.

Fossil wood was also given me, collected near the hot springs at the head of Pit river, by a gentleman whom we saw at Fort Reading, and it is known to abound in those portions of the area called the Great Basin, in New Mexico and northward, which are most marked by volcanic phenomena, and by the occurrence of hot springs.

At the Cascades of the Columbia, fossil wood has attracted the attention of every traveller who has passed. There, too, I think we can connect its occurrence with recent volcanic eruptions.

The thermal springs of the Wam Chuck valley are probably of ancient date, and in their origin are doubtless connected with the Wam Chuck mountains, about the base of which they rise.

WAM CHUCK MOUNTAINS.

These mountains form a group of rounded summits, rising abruptly from the plain which encircles them on the east, west, and south sides. They are composed of metamorphic slates and trap, exhibiting but little variety of structure or material. They have the appearance of greater age than many of the volcanic hills and ridges which we have passed—an appearance due to the regularity of their outlines, as well as to the entire absence of recent volcanic rock. The slates which for the most part compose them are alumino-silicious, very hard and highly metamorphosed, exhibiting the same general characters with those which form so prominent a feature in the geology of the Cascade mountains west of its principal axis. They are divided by deep, narrow ravines, and their slopes are long and steep, generally unbroken by any projecting crag or perpendicular wall. The surface of these mountains is in many places strewed with geodes and crystals of quartz, or masses of chalcedony, which have apparently filled cavities in the rocks composing them.

At Nee-nee Springs, several miles north of the Wam Chuck valley, stratified tufas—here somewhat disturbed and broken—exhibit varieties of metamorphism not before noticed. What was formerly one of the finer marls is here converted into a kind of fine-grained sandstone, marked with ribbon-like lines of red and white. These seem to be the lines of deposition, and indicate a periodical recurrence of the effects produced by two sets of causes. The red lines, which are perfectly distinct—sometimes not thicker than a sheet of paper; more frequently combining to form bands a quarter of an inch in width—alternate with lines of white of about the same width and of somewhat coarser texture. Small masses of scoria are disseminated through the rock, and over these the lines of deposition are flexed, showing that the different bands were formed by alternating layers of sediment—the flexures of the lines of deposition over a foreign body indicating, even in a hand specimen, which was the superior and which the inferior surface. The general parallelism, and the continuity of the most delicate lines of color, show that these sediments were deposited in tranquil water—the bands of red indicating the periods of most perfect quiet, when the finer materials, including a larger quantity of iron, sank to the bottom. I have supposed it possible that the presence of iron in the red bands was due to infusoria. If this material were carried through the same stages of metamorphosis as much we have seen, it would form beautiful ribbon jasper. More perfect imitations of the ribbon jasper of Germany and Egypt were, however, found at the Hot Springs, where a jaspery rock was marked by bands of red and green.

TYSCH PRAIRIE.

North of the Wam Chuck mountains we came down on to Tysch prairie, which forms a plateau precisely similar, in all its general features, to those we had previously traversed, but lying at a lower level, having an altitude of but 2,200 feet above the sea. Mount Hood rises from its western border, presenting an appearance remarkably imposing and beautiful, well represented in plate No. IX, illustrating the general report of Lieutenant Abbot. From the base of the Cascades it stretches eastward for thirty miles or more, forming a nearly level plain, cut by the deep cañons of Tysch creek and the Des Chutes. This plain is everywhere underlaid by a stratum of trap, beneath which is a series of stratified tufas.

TYSCH MOUNTAINS.

The mountains which bound Tysch prairie on the north rise to an altitude of about 2,500 feet above it. Their outlines are all rounded, and they are composed principally of compact trap, not of recent date; and of which all the rough and ragged surfaces have been worn away by the action of the elements.

Like Wam Chuck mountains, rising abruptly from the plateau which surrounds them, they have a peculiar insular appearance. Like the Wam Chuck mountains, too, their slopes toward the north are long and gentle—toward the south, short and steep. The view from their summits is exceedingly picturesque and peculiar. Except on the slopes of the Cascades, no forests are visible. Lines of trees follow the streams which come down from the mountains far out into the prairies, and a few pines and cedars crown the summits of the hills lying southward. With these exceptions, the whole country is covered by a sparse growth of grass, now everywhere dry, tinging the landscape with a universal monotonous brown.

The Cascades, from this point, exhibit a scene of unusual grandeur. Mount Hood, directly west, rises to a height, variously estimated, at from 15,000 to 18,000 feet; its summit not unfrequently enveloped in clouds, and, in a clear atmosphere, giving off steam or smoke. Mount Jefferson distinctly visible in the west, and Mount Rainier and Mount Adams, snow peaks north of the Columbia, in the northwest. The cañon of the Des Chutes appears like a deep, dark gorge, traversing the plateau of which I have spoken.

The region lying between the Tysch mountains and the Columbia is occupied by a series of rounded grass-covered hills, having an altitude above the valleys which divide them of several hundred feet; precisely resembling, in appearance, the sandstone hills about Benicia, in California. They are composed of white, frequently infusorial, marls, belonging to the same series with those which cover so large a surface in other parts of the Des Chutes basin. Here, as elsewhere, the infusorial forms which they contain are of fresh water origin.

Mounds.—Every day while traversing the Des Chutes basin we noticed upon surfaces unoccupied by trees numbers of low and rounded mounds, apparently formed by causes not now in operation. As we progressed toward the north, they became more numerous and of larger size. In the vicinity of the Dalles they form a very marked feature in the scenery; in many places covering the prairies and hillsides so completely that their margins are almost in contact. They have here an altitude of from three to five feet, and a diameter of from twenty to fifty. Although I have examined them with great care, I have been unable to arrive at any satisfactory conclusion in respect to their origin. They occupy equally the hillsides and the levels, and exhibit no traces of stratification, nor is there anything in their structure which afforded me any clue to the cause or manner of their formation. I have seen in California mounds not very unlike, but of less magnitude, formed by burrowing squirrels, but it seems impossible that this cause could have here produced them.

CHAPTER VII.

GEOLOGY OF THE COUNTRY BORDERING THE COLUMBIA RIVER.

Region east of the cascade mountains.—General features apparently similar to those of des chutes basin.—Local geology.—Dalles of the columbia.—Sedimentary infusorial deposits.—Their fresh water origin.—Their age.—The cañon of the columbia.—General features.—How formed.—Local geology.—Horizontal strata of trap.—Submerged forest.—Cascades formed by slide from mountains.—Conglomerate.—Silicified wood.—Tertiary strata below cascades.—Country bordering the lower columbia.—General features.—Willamette valley.—Its resemblance to the californian valley.—Local geology.—Western slope of the cascade range.—Cañon of mckenzie's fork.—Marks of glacial action on mount hood.—Trap, scoria, ashes, etc., from mount hood.—Trap and sandstones of willamette valley.—Erosion of sandstones.—Lignites near st. helens.—Terraces.—Coast mountains.—Sandstones and shales of astoria.—Fossils.—Age of the deposit.—Port Orford.—Tertiary sandstones, trap.—Gold.

GENERAL FEATURES.

The entire region drained by the tributaries of the upper Columbia has apparently so many features common to all its parts, in its geological structure, its climate, its indigenous plants and animals, that it can only be properly studied as a whole. So viewed, it would furnish an interesting subject of investigation in tracing the connexion and community of character of its parts, and deducing from the common phenomena which they exhibit the common causes which have produced them.

The Des Chutes basin and the banks of the Columbia in the immediate vicinity of the Dalles are the only portions of this area which I visited, and I should not be warranted in deducing the structure of the whole from so small a part. From published and oral descriptions, however, of the country traversed by the upper Columbia, as well as from specimens received from different localities, I am led to believe that the Des Chutes basin may be considered as a type of the greater part of it; and that what has been said of the origin of the geological structure exhibited by that portion of the basin of the Columbia which I saw, is equally applicable to at least that part of it which lies north of the Columbia, and immediately east of the Cascade range.

These mountains have, as we learn from the graphic descriptions of Mr. George Gibbs, (U. S. P. R. R. Explor. & Surveys, vol. II,) much the same character north of the Columbia as in Oregon. Volcanic peaks crown the crest of the chain, which have deluged the country with floods of lava, and thrown out showers of ashes, from which beds of tufa have been formed similar to those of the Des Chutes basin. Specimens from the banks of the Yakima and upper Columbia, which I have received, are undistinguishable from those collected on Psuc-see-que creek. Basin-like areas, enclosed by walls, now cut through by the draining streams, have been described in varying language by all who have visited this region.

The Columbia drains many basins and traverses many cañons before it reaches the great gorge in which it flows through the mountains; and it came to the herculean task of excavating that channel, no novice in the art of stone-cutting, but skilled by a training begun with its birth, in the thousand mountain streamlets which combine to form it.

LOCAL GEOLOGY.

The trough of the Columbia at the Dalles is similar, in all its general features, to the cañons of the streams which traverse the Des Chutes basin. The banks which bound it are less abrupt and further removed from the channel; but this difference is, doubtless, due to the absence of the thick bed of overlying trap which protects the softer marls from erosion, and forms the precipitous walls which enclose the Des Chutes. Layers of trap occur, however, at several points in the slopes of its banks, which are very noticeable to any one descending to the stream, but they are of less thickness and less continuous than those of which I have spoken.

The Dalles of the Columbia are formed by one of these beds of trap, through which the stream cuts in deep and narrow channels, which have received the name of Dalles. Directly opposite the village, the north bank of the river presents the mural edge of a layer of trap which is partially columnar, and continuous for some miles. Although so much modified by the erosion to which I have referred, the banks of the Columbia, at the entrance to the great cañon which traverses the Cascades, are formed of sedimentary deposits, which were once continuous over all the area now occupied by the valley through which it flows; and, although these strata have been somewhat disturbed, I think we have conclusive evidence that they have been eroded, by the deepening of the bed of the stream, to a point two thousand feet below their upper surface. The area about the entrance of the cañon of the Columbia corresponds in every essential particular to those which are drained through the several cañons of Pit river, the Klamath, and the Des Chutes. Whatever has been said, therefore, in reference to those areas, the sedimentary deposits which occupy them, and the cañons formed by their draining streams, is equally applicable to the basin of the Columbia; and if its structure has not at once suggested its history to those who have examined it, it is doubtless because, from its magnitude, it could hardly be viewed as a whole, and it was necessary to come to its study through similar but smaller basins, which could, with all their relations, be taken in at one view.

In all these basins the sedimentary deposits, so accurately stratified over such large areas, prove the presence and agency of water of considerable depth. The deeply cut cañons through which they are drained must have been worn by streams which commenced their work of erosion many hundred, sometimes two or three thousand, feet above their present beds. The nature of the sediments deposited by this water proves that it was fresh. Among the great number of specimens of deposits known or suspected to be infusorial, collected in Oregon or California, and sent to Prof. J. W. Bailey for examination, were some from Monterey, from Shoalwater bay in Washington Territory, and several other points on the coast. With these were representatives of the infusorial marls of the different basins of Pit river, the Klamath, the Des Chutes, and the Columbia.

A short time previous to the death of this eminent microscopist, he indicated to me the results of his first examination of these specimens; and, although the localities were but imperfectly known to him, I was much interested to observe that, while the infusorial deposits of Monterey were marked as containing marine forms, and others on or near the coast as containing mingled marine and fluviatile forms, every specimen collected east of the Cascades, or Sierra Nevada, was said to contain only "fresh water *Diatomaceæ*." It is a little remarkable that, in these great accumulations of stratified sediments, many of them fine, and indicating the tranquillity of the water in which they were deposited, I was able to discover no other fossils than the infusoria referred to; nor did I find any other organisms but the imperfectly preserved plants of Psuc-see-que creek; the only intelligible vegetable remains being trunks of coniferous trees. From these facts we must infer that the fauna and flora of that period were exceedingly meagre ; a state of things which we might expect with the arctic temperature which should form glaciers in the Cascades ; the drainage from which supplied these basins.

The question of the age of the tufas of the basins east of the Cascade mountains is not without its interest in this connexion, for, if they are of ancient date, it would be impossible to associate them with the modern and superficial phenomena of glaciers. We have every evidence however, that, geologically speaking, they are very recent ; the unmineralized vegetable matter which they contain proving this conclusively. They have evidently been formed of materials thrown out and washed down from the volcanic peaks which crown the summit of the Cascade mountains, and which have been in vigorous action within a few hundred years. Similar deposits in the valleys west of the Sierra Nevada belong to a period subsequent to the tertiary, as they contain the remains of the mammoth and mastodon, and are not older than the drift.

On the plateaus of the Des Chutes and Klamath basins I was never able to detect the least evidence of the action of drift currents. On the contrary, it was perfectly apparent that the trap plateaus, the volcanic ridges, and the rough and ragged lava plains, had never been submerged, but presented surfaces in all respects similar to those first formed, except where covered by a soil derived from the disintegration of the rock, through the agency of the atmosphere or vegetation. I may say, in conclusion, that the glaciers of the Cascade mountains, stratified deposits of great thickness, exhibiting nearly an entire absence of fossils, and not older than the drift, large lakes once existing where now are only arid plains, and cañons cut through mountain walls, offer an interesting parallel with the stupendous phenomena, and evidences of change elsewhere furnished by the drift, and afford, at least, presumptive evidence of synchronism.

THE CAÑON OF THE COLUMBIA.

GENERAL FEATURES.

On any other supposition than that the gorge of the Columbia has been cut by the stream now flowing through it, it becomes a matter of no little difficulty to account for its existence. To the theory more commonly adopted, that it is a rift formed by volcanic forces, many objections at once suggest themselves.

Fissures caused by earthquakes or volcanic action have never been known to assume such a form or direction. We should expect to find them, if at all in that region, radiating from some one of the great foci of volcanic forces ; Mount Hood, Mount Jefferson, Mount Adams, or Mount Baker ; while, on the contrary, we find this gorge traversing the entire, though compound chain, and afterward the Coast mountains, with a line of bearing which shows that the forces which formed it did not centre in the peaks I have mentioned, nor any other of the range.

We should also expect, if such was its origin, that other and similar fissures would be not uncommon, or at least unknown in the mountain chain which it traverses ; but it is a singular fact that, throughout the entire breadth of Washington and Oregon Territories, from the British line to the boundaries of California, the Cascade mountains extend in a wall whose continuity is broken only by this single gorge.

The lowest of its passes (Abbot's new pass) has an altitude of not less than 4,400 feet. In winter, the chain cannot be crossed, and in summer the obstacles which it presents are such that loaded mules are taken over with difficulty ; and yet through this barrier the Columbia flows nearly at the sea level.

The structure of the cañon of Pit river, the relations which all the cañons I have described sustain to the basins drained through them, the sediments accumulated to such a depth above the beds of the present draining streams, &c., aside from the want of another adequate cause, has led me to consider the gorge of the Columbia as formed, entirely or in part, by water. We may obtain further evidence in the case by studying its

LOCAL GEOLOGY.

Within a few miles of the Dalles the river enters the "gorge of the Columbia," and from that time to its exit, fifty miles below, the view of the traveller is bounded on either side by high mountains, which rise with precipitous walls immediately from the water's edge. Except in a few rare instances, where streams come down from the mountains, on either side, there is no level land between the base of the cliffs and the river. This gorge has everywhere the appearance of having been cut through by the stream which now traverses it. In many places there are perpendicular walls of trap rock many hundred feet in height, composed of different strata, formed by distinct overflows, of which the cut edges are now exposed. These layers of trap are often horizontal, and apparently continuous for miles. They frequently, too, exhibit a columnar structure, the columns being perpendicular, and evidently have been subject to no disturbance since their formation. Near the Cascades, however, there are evidences of very recent volcanic action. The layers of trap are more or less disturbed, and the mountains, particularly on the north side, exhibit large surfaces covered with blood-red scoria.

Submerged forest.—The river, from the Dalles to the Cascades, is very deep, has an imperceptible current, and has rather the appearance of an elongated lake than of a flowing stream. At intervals, over the entire distance from the point where we entered the mountains to the Cascades, the river is bordered on either side by the erect, but partially decayed, stumps of trees, which project in considerable numbers above the surface of the water. This has been termed the sunken forest, and has been generally attributed to slides from the sides of the mountains, which have carried down into the bed of the stream the standing trees. This phenomenon is, however, dependent on a different cause. As I have mentioned, the vicinity of the falls has been the scene of recent volcanic action. A consequence of this action has been the precipitation of a portion of the wall bordering the stream into its bed. This impediment acting as a dam, has raised the level of the water above the Cascades, giving to the stream its lake-like appearance, and submerging a portion of the trees which lined its banks. Of these trees, killed by the water, the stumps of many are still standing, and by their degree of preservation attest the modern date of the catastrophe. On examination, I found these stumps to be the remains of trees of the Douglass spruce, which still forms the forests covering the slopes of these mountains.

Cascades.—At the Cascades the river is deflected against the southern wall of its cañon, and, in a succession of rapids, falls sixty feet in three miles.

The material which composes the dam in the river at the Cascades is a kind of conglomerate, made up of fragments of trap rock, mingled with earth and sand. This is, in many places, penetrated by threads of silica, which has often filled cavities and formed masses of agate and chalcedony. In this conglomerate are imbedded many trunks of trees, which are sometimes silicified, in other cases merely carbonized, and occasionally the same trunk exhibits both forms of preservation. Of these silicified trunks there are some of large size, which so much resemble recent wood as completely to deceive the eye. In many of them the structure of the wood is very well preserved, and, upon microscopic examination, seems identical with that of the Douglass spruce now growing on the same surface.

Below the Cascades, and on the western skirts of the Cascade mountains, the river is in some places bordered by tertiary strata, which I had no opportunity of examining. The hills and mountains adjacent to the stream below seem to be still, as above, composed of trap and metamorphic slates.

THE COUNTRY BORDERING THE LOWER COLUMBIA.

GENERAL FEATURES.

The parallelism between the valleys traversed by the Sacramento and the San Joaquin and that traversed by the Willamette and Cowlitz has been before alluded to. This parallelism is much more complete than might be inferred simply from the general similarity of figure. If, as seems inevitable from the facts that have been stated, the Sierra Nevada and Cascade range form portions of the same mountain chain, the two great valleys—those of Oregon and California—are bounded on the east by the same wall. The Coast mountains of Oregon, as has also been stated, exhibit a remarkable similarity in their physical features and in geological structure with those of California, and we have every reason to believe that they form a continuation f the same chain. The sandstones and shales, which, with trap, are the only rocks exposed on the lower Columbia, and that portion of the Willamette valley which I examined, contain but few fossils, resembling in that respect, as well as in their lithological features, the sandstones and shales so characteristic of the coast ranges in the vicinity of San Francisco. Near the mouth of the Cowlitz they contain beds of lignite of greater thickness than in any part of California which I visited ; and the sandstones near Astoria have yielded a large number of fossils, which have been described by Mr. Conrad in the geology of the exploring expedition, and pronounced by him to be of Miocene age.

LOCAL GEOLOGY.

WESTERN SLOPE OF CASCADE MOUNTAINS.

While I descended the Columbia, two detachments of our party crossed the Cascades to the Willamette valley. Of these one, under the command of Lieutenant Williamson, passed south of the Three Sisters, crossing the summit something more than 150 miles south of the Columbia, following down the middle fork of the Willamette to its junction with the main stream. The other, under command of Lieutenant Abbot, crossed by a pass discovered by him just south of Mount Hood. From the gentlemen connected with these parties I received much valuable information, and specimens illustrative of the geology of that portion of the range which they traversed. From Lieutenant Williamson I learned that the entire mass of the chain at the point where he crossed it is composed of the same trappean and metamorphic rocks that have been noticed as constituting the geology of the region about the Three Sisters. No stratified rocks were met with before reaching the lower portions of Willamette valley, where the tertiary sandstones are largely developed, and by erosion have formed hills several hundred feet in altitude. These sandstones, with masses of vesicular trap, were the only rocks which he noticed in traversing the valley.

It will be remembered that, when speaking of the glacical grooves on the western declivity of the Three Sisters, reference was made to two deep cañons, one leading down from Mount Jefferson, the other from the Three Sisters, which combined to form a profound gorge leading westward, through which a stream flowed, supposed to be a tributary of the Willamette. This stream proved to be McKenzie's fork, and, when crossing it, near its junction with the Willamette, Lieut. W. learned that upon one occasion, and only one, its course had been followed from its source.

Three hunters, having descended to the Willamette in its bed, reported that, throughout its entire length, the cañon of which I have spoken preserves the character which it exhibits at its eastern termination—a deep and narrow gorge, bounded by nearly precipitous walls, from which there was no exit but at the extremities. Its inhospitable nature may be inferred from the fact that one of these hunters died from the hardships he encountered in traversing it, and the others suffered so severely that they never cared to repeat the experiment.

This would seem to have been the channel through which the drainage from the glaciers had found a passage to the ocean; and it is not improbable even, from its peculiar angular character, that ice occupied some portion of its length. From Mr. Anderson, who accompanied Lieut. Abbot, I learned that the draining valleys leading from Mount Hood have the same angular character, and there, as on the slopes of the Three Sisters and Mount Jefferson, the exposed surfaces of the rocks, in many places, exhibit marks of glacial action.

The minerals brought from Mount Hood are all volcanic, trap, volcanic conglomerate, scoria, and ashes. The ashes are white and fine, and closely resemble the marls and tufas of the Des Chutes and Klamath basins. They had probably been quite recently thrown out from Mount Hood; showers of ashes having been discharged from this mountain several times since Oregon has been occupied by the whites. From Mr. Dryer, of Portland, who attempted to ascend Mount Hood in 1854, I learned that steam and heated gases were escaping from its summit, in many places, at the time of his visit.

WILLAMETTE VALLEY.

I was able to examine but a small portion of the Willamette valley in person, as I ascended the river only twenty miles from its mouth. The only rock which I saw was the tertiary sandstone to which I have alluded, and dark vesicular trap. The sandstone appears in the bed and banks of the Willamette at several points below Oregon City. The rock over which the river pours at the falls is trap, as are the hills in the vicinity. From the detailed account of the geological structure of the valley above this point, given by Prof. Dana in his geology of the exploring expedition, it appears that the hills bordering the alluvial plain, as far south as the Calapooya mountains, are composed of one or the other of the two rocks I have mentioned. He represents the sandstones as being not only disturbed, but greatly eroded, as at the points examined by Lieut. Williamson. This is not an uninteresting fact, when taken in connexion with the evidences of great erosive action which I have cited, and which seem to be connected with the existence of glaciers, and may be, in a degree, dependant on the same cause. The sandstones of the Willamette valley contain no fossils at the localities where I examined them, but they exhibit all the lithological characters of the San Francisco group. In some places they are highly argillaceous, and better deserve the name of shales than sandstones, and not unfrequently contain laminæ of gypsum. Near St. Helens, a bed of lignite has been discovered, which at one time was supposed to have a high commercial value, but which ha proved to be nearly worthless as fuel. It occurs in argillaceous sandstone, apparently forming a portion of this series.

Terraces.—At Vancouver the banks of the Columbia are distinctly terraced. The alluvial bottom lands had an elevation of twenty feet above the surface of the water during the month which I spent there; but at certain seasons, as evinced by the collected drift wood, are liable to overflow. Above this level the terrace upon which the fort stands rises to a height which I estimated at forty feet. This terrace is found bordering not only the Columbia, but also the Willamette, and is the one upon which the town of Portland is built. From any elevated point where a view can be obtained over the dense forest which covers the country bordering the Willamette river near its mouth this terrace is seen to be distinctly marked by the summits of the trees, and may thus be traced for miles. The soil of the alluvial lands bordering the streams is fine, dark, and very fertile; that of the upper terrace is frequently gravelly and less productive.

COAST MOUNTAINS.

The Columbia, from the mouth of the Willamette to the ocean, forms rather an arm of the sea than a river channel. It is broad, in many places deep, and on either side bordered by marshes and swamps, which have the appearance of having been depressed below the level which they once occupied. Its bed is nowhere formed of rock, but seems like a trough, broadly and deeply excavated, and subsequently silted up by the sediment, which an arrested current no longer held in suspension.

The mountains which rise on either side form a broad belt, marked by no summit of great elevation, and everywhere covered with a dense evergreen forest. I had little opportunity of examining their geological structure, but noticed at various points masses of trap, and along the river, near its mouth, at a lower elevation, beds of tertiary sandstones and shales. Near Astoria these strata are fully exposed, but, in the brief time that I remained there, I was able to do little more than note the remarkable similarity, in lithological character, which they exhibit to those of San Francisco and San Pablo bay. Many species of fossils were, however, collected from the same series in this vicinity by Professor Dana, and have been described by Mr. Conrad in the geology of the exploring expedition. They have been regarded by him as of Miocene age, though containing no recent species, nor any previously described, from tertiary rocks in other localities. These fossils are chiefly molluscous, with bones of cetaceans and fishes. They are usually found forming the nuclei of calcareous concretions.

PORT ORFORD.

From the mouth of the Columbia to this point the coast presents a bold, irregular outline, with scarcely any level land along the shore. It is everywhere covered with a dense forest, and that portion north of the Umpqua river has been but rarely traversed by explorers. Of its geological structure almost nothing is known, except of the small portion visited by Professor Dana, in his excursion to the Saddle mountain, near Astoria. This mountain, as might be inferred from its outline, is volcanic, and has been in action at a comparatively late period.

The geology of the vicinity of Port Orford is similar, in all its general features, to that of Astoria. The high lands in the vicinity, as well as the bold and rocky points on the shore, are composed of trap rock. Beds of sandstone line the coast north of Port Orford, closely resembling the sandstones and shales of Astoria, and probably belonging to the same series.

They abound in lignite and fossil wood, and are doubtless of the same age. They are also, probably, continuous with the sandstones of Coose bay, which contain the beds of lignite now worked as coal.

The geology of the vicinity of Port Orford is interesting, from the fact that gold is obtained there by washing the beach sand. The source from which it is derived is not very apparent, but it has, probably, come from the decomposition of the auriferous slates which compose a portion of the mountains lying back from the coast, and extending from the Coquille river southwesterly to Mount Shasta and the head of the Sacramento valley, forming a wide and irregular belt, in which are many rich placers; those in the vicinity of Yreka yielding a large amount of gold. The gold obtained at Port Orford is mingled with a heavy black sand, from which it is separated with considerable difficulty. It is also associated with platinum, iridium, and osmium, which, for the same reason, serve to impair its value.

CHAPTER VIII.

ECONOMICAL GEOLOGY.

Building materials in the vicinity of San Francisco.—San Francisco sandstone.—Granite from Hong Kong.—Of Tomales bay.—Limestone of Tomales bay.—Sandstones of Benicia.—Sandstone and trap of Vacaville.—Want of building stone on the Sacramento and Feather rivers.—Trap near upper end of the valley.—From Fort Reading to the Columbia, trap everywhere on our route.—Gold.—No new deposits discovered.—Country covered by recent volcanic matter.—Gold of Port Orford.—Coal.—Efforts to find true coal on the western coast.—Coose bay coal; geological position; physical and chemical characters; economical value.—Coal of Bellingham bay; geological position; extent and thickness of the beds; associated fossils.—Miocene flora.—Lignite beds of the upper Missouri.—Chemical and physical character of Bellingham bay coal.—Its economical value.—Coal of Vancouver's island; geological position.—Cretaceous rocks.—Parallelism of the chalk and tertiary of the upper Missouri with similar strata on the Pacific coast.—Physical character of the coal and its chemical composition.—Coal of Cape Flattery, probably the equivalent of the lignites of the Cowlitz and Coose bay.—Coal of Santa Clara, California.—Coal market of San Francisco.—Coal of the Lota mine, Chili.—Coal of Australia.—Coal from the eastern states.

BUILDING MATERIALS.

VICINITY OF SAN FRANCISCO.

The only desirable building stone in the vicinity of San Francisco is the sandstone which is fully described in the first chapter of the report, where its fitness for architectural purposes is alluded to. It is very accessible, readily quarried and wrought, and will supply a cheap building material in exhaustless quantities. Some varieties of this stone, especially that quarried on Yerba Buena island, will even answer the demands of ornamental architecture, being to a considerable degree handsome and durable. For more elaborate and expensive structures, however, a more resistant as well as beautiful material will be sought; something which should fill the place of the granites, marbles, and finer freestones used in the eastern cities. Granite is already used to some extent in San Francisco, and it is now, for the most part, imported from Hong Kong, in China. In that part of California which we visited it was observed in but one or two localities. From Tomales bay I obtained specimens of granite which seems well adapted to architectural purposes. It is composed of small crystals of white felspar and quartz, with minute scales of black mica, and forms a very compact and durable as well as handsome stone. There is also, on Tomales bay, a light-colored crystalline limestone, which, when obtained in blocks of sufficient size, will make an excellent building stone. It is quite extensively used for making quicklime. I have also seen specimens of metamorphic limestone, obtained in various parts of the Sierra Nevada, which, for beauty and durability, will almost rival the white marble of Vermont or the Potomac. The sandstones which are quarried in the vicinity of Benicia are similar in character to those of San Francisco, but are softer and less desirable for architectural purposes than some found in the immediate vicinity of the city. From Benicia to Vacaville, the San Francisco sandstone is accessible at many points, and the hills which border the upper end of Suisun bay and Suisun valley on the west are composed of compact trap, which will afford a resistant and durable building material, but one wrought with some difficulty. The central portions of the Sacramento valley are entirely destitute of building stone, but the foot hills of the mountains which border it on either side will furnish trap, granite, or sandstone, in abundance, and within a distance which will render them available for all the wants of railroad construction. Near the upper end of the Sacramento valley the hills which border it are composed of trap, much of which would form an excellent building material, and would be everywhere accessible. From this point to the Columbia river, over all parts of our route, trap rock exists in abundance, and varieties would be everywhere attainable which would meet any want of building stone that might arise.

GOLD.

From the fact that other portions of California and Oregon had proved to be so rich in gold, especial interest was excited in our exploration of so much new territory by the anticipation that we might discover other localities in which this precious metal might be obtained. In no part of the region which we traversed, however, after leaving the Sacramento valley, was I able to detect any good evidence of its existence. Nearly all portions of our route are covered by accumulations of recent volcanic matter, by which the underlying rocks are as completely concealed as though the whole country was buried under a heavy bed of snow.

In many localities which we visited there are exposures of metamorphic slates, but they are nowhere talcose in character, nor contain veins of quartz, which would be the repositories of gold. In almost every stream which we crossed an effort was made by "panning" to obtain "the color," but uniformly without success. At the point where we left Pit river the boulders of quartz and other rock found in the bed of the stream led me to suppose that, at some point higher up in its course, the rocks might be found which usually contain it. The metamorphic slates there exposed have a more promising appearance than elsewhere, and in that vicinity I obtained the only traces which I saw of copper. From these circumstances I was led to believe that here, if anywhere on our route, valuable deposits of metal might be discovered. In the Klamath and Des Chutes basins the surface is either occupied with plateaus, or hills of trap, or by stratified tufas, or infusorial marls. The gold of Port Orford has already been alluded to, but I was not able to examine the geology of the vicinity sufficiently to trace it to its source. Gold mining is there carried on empirically, as in most parts of California, and it is worth an effort, on the part of those who may have the opportunity, to determine the law upon which the accumulations of gold in that vicinity depend.

COAL.

The want of this mainspring of modern progress; which has been felt by the inhabitants of California, has been supplied, only imperfectly, from the eastern States, or from other countries; and the price paid for coal transported from great distances has been so high that they have naturally felt a deep interest in the discovery of deposits of it within their own borders. Their efforts, with this end in view, have, however, been attended with but partial success. Beds of lignite have been found in various locations, which have served for a time to excite, and, subsequently, to disappoint the hopes of their discoverers. Although the fact has frequently been announced in the journals, no true coal had been found in California or Oregon at the date of our arrival in San Francisco. About the time of our arrival in San Francisco, however, the carbonaceous deposits on the shores of Coose bay began to attract the attention of the public, and it was confidently believed that there had at last been found beds of bituminous coal equal in quality to that imported from the eastern States.

I had an opportunity of examining several cargoes of Coose bay coal at Portland, Oregon, and San Francisco; and from Mr. Northrup, of Portland, Messrs. Flint, Peabody & Co., of San Francisco, and from others, I have received full descriptions of the mines, and much interesting information in reference to the character and extent of the coal deposits. Subsequently, through the kindness of Lieutenant W. P. Trowbridge, U. S. A., I received a map of the bay and of the locality where the mines are situated, and a section across from Point Arago to the bay, including the strata of coal which are worked; also drawings of a large number of the fossils taken from the associated strata, very beautifully executed by Mr. Bridgens, of San Francisco. I was able to bring home a suite of specimens of the coal, of which I have since made chemical analyses. From this material I am able to make the following report:

COOSE BAY COAL.

Geological position.—This coal is interstratified with sandstones and shales, which form a series several hundred feet in thickness, the strata being very much disturbed by intrusion of trap rock, some of them being inclined at an angle of 45°. The beds of coal are found in the upper part of the series, being most fully developed on the shores of the bay, where the strata are much less disturbed than nearer Cape Arago. From the description and section given by Mr. Higgins, I infer that a line of upheaval, with a northwesterly trend, passes between Coose bay and the ocean, giving character to the headland of which Cape Arago is the extremity, and tilting up the stratified rocks on either side. Several of the strata associated with the coal are highly fossiliferous, most of the fossils being marine mollusca. Impressions of plants are also found, but none are represented in the drawings of Mr. Bridgens. Among the fossil shells which he has figured, I recognize *Nautilus, Arca, Cardium, Tellina, Nucula, Natica, Fusus, Cerithium, &c.*, with bones of fishes. It is impossible to be certain with reference to the species of these fossils, but they have all a general resemblance to those obtained from the sandstones and shales of the Columbia, and some of the species are probably the same. Those portions of the series from which the fossils come are evidently tertiary, and there is little doubt that the series, as a whole, is identical with that of the Columbia, which has been pronounced by Mr. Conrad to be Miocene.

The coal occurs in several distinct strata, three of which are represented in Mr. Higgins' section. They are apparently confined to the upper portions of the series which I have mentioned. The most important stratum varies considerably in thickness in different localities, its maximum being about 9 feet. These beds of coal are said to extend over a large area in the vicinity, and have been traced many miles inland.

Physical and chemical character.—The coal is bright, black, and handsome, and when first mined has much the appearance of some of the bituminous coals of the Mississippi valley; most resembling those from the coal fields of Illinois and Iowa. Upon a closer examination, however, it is readily seen to be a tertiary lignite, most of it exhibiting very distinctly the structure of the wood from which it has been formed. I have seen masses of several hundred pounds weight, which were evidently portions of the carbonized trunks of trees of large size. In these, the rings of annual growth, knots, and branches, were almost as plainly perceptible as in recent wood. Like most of the lignites of the west, though firm when first mined, having a conchoidal fracture, somewhat resembling Wigan cannel, upon exposure to the air for any length of time it cracks up into a thousand cubical fragments. It burns freely, producing a bright cheerful blaze and considerable heat, but is more flashy, and has far less heating power than the best bituminous coals.

A proximate analysis gives me for its composition the following formulæ:

Fixed carbon	46.54
Volatile matter	50.27
Ashes	3.19

Coke, 49.73, dark, friable, and of but little value. The amount of gas is large, but of low illuminating power. This coal apparently contains very little bi. sulph., iron, or other injurious impurities, and is extensively used in San Francisco, and was selling, at the time of our visit, at $22 per ton, in small quantities, but could be bought, by the cargo, at $16 to $18 per ton.

COAL OF BELLINGHAM BAY, W. T.

Geological position.—This coal is found interstratified with sandstones and shales on the shores of Bellingham bay. Lieut. W. P. Trowbridge, U. S. A., while superintending the construction of light-houses on that part of the coast, made a careful measurement of the strata of the section in which the beds of coal are exposed, of which the results have been published in the geological report of Mr. W. P. Blake, contained in vol. V, U. S. P. R. R. Reports.

The section exposed, when measured by Lieut. Trowbridge, consisted of about 2,000 feet of shales, sandstones, and coal, of which the coal presented the enormous aggregate of 110 feet. It is possible, however, that the series is, in part, composed of repetitions of the same members, as the strata are inclined at a high angle, and are much convoluted and disturbed in all that region.

Many of the shales are fossiliferous, and vegetable impressions are particularly abundant. These consist, for the most part, of the impressions of dicotyledonous leaves, and are similar in general character; and some of them specifically identical with those collected on Frazer's river by the United States Exploring Expedition, under Capt. Charles Wilkes. Among them are species of *Platanus*, *Acer*, *Alnus*, *&c.*, as yet undescribed. There is also a *Taxus*, or *Taxodium*, and a *Juniperus*. It is probable that all the dicotyledonous species there represented are extinct. The *coniferae* may not be so. A sufficient number of well marked specimens has, however, not yet been collected to determine this question.

The flora of the coal deposits of Bellingham bay is remarkably like that of the lignite beds of the upper Missouri, the genera being nearly all represented on the Missouri, and some of the species are identical.

The lignite beds of the Missouri are undoubtedly Miocene, and it is very difficult to distinguish some of the species found in them from those of the Miocenes of Austria and of the Island of Mull.

The strata exposed on Bellingham bay, both in their lithological character and their fossils, are closely related to the sandstones and shales of the Columbia and Coosė bay, and are, probably, portions of the great San Francisco group, which forms the most striking feature of the geology of the coast mountains.

The mines at Bellingham bay were among the first opened on the western coast, and have already furnished a large quantity of coal for the San Francisco market.

Physical and chemical characters.—While having much the appearance and character of that from Coose bay, this coal is harder and better, and more resembles the carboniferous coals of the Mississippi valley. Several analyses give me for its composition—

Fixed carbon	47.63
Bitumen	50.22
Ashes	2.15

Its economical value and adaptation to the different purposes for which coal is used are very similar to those of the Coose bay coal, but commands a somewhat higher price in market. When I was in San Francisco, coal from Bellingham bay was selling for $22 per ton.

VANCOUVER'S ISLAND COAL.

Geological position.—Very little has heretofore been known of the geology of Vancouver's island except that extensive deposits of coal existed there. The island is inhabited by Indians of a peculiarly warlike character who have always been hostile to the whites, and have rendered it dangerous to attempt to explore its geology.

It is also said to be, for the most part, covered with a dense forest and tangled thickets of vine-maple, which present almost insurmountable obstacles to any one who should attempt to penetrate the interior. At Nanimo, however, a small English colony has been established, and the deposits of coal which are found there have been, to some extent, worked for the San Francisco market, and to supply the English steamers which sometimes touch there.

I have been able to obtain but little information in reference to the geological associations of the coal of Vancouver's island; the only persons who have visited the island, to my knowledge, having examined only that portion immediately adjacent to the coal mines of Nanimo. They have also contented themselves with a hasty inspection of the mines, and with collecting the fossils, which seemed to be abundant, without taking much note of the relative positions of the strata which contain them. I have received from them, however, a full suite of specimens of the coal, and a series of fossils of great beauty and of special geological interest.

The fossils consist, for the most part, of marine shells, of which the most conspicuous are *Ammonites, Baculites,* &c., of large size, and evidently derived from cretaceous rocks. These fossils occur in calcareous concretions and so much resemble, in their mode of fossilization, those brought from the upper Missouri by Mr. Meek and Dr. Hayden, that they would be supposed to have come from the same locality. Of the species obtained from Vancouver's island many are new, but some are identical with those from the upper Missouri and fully establish the parallelism of the cretaceous strata which occur on different sides of the Rocky mountains. The discovery of cretaceous fossils, as far west as the Island of Vancouver, seemed to me a fact of peculiar geological interest; not only as extending over an area far greater than has been suspected the cretaceous rocks of the upper Missouri, but as furnishing a basis upon which we shall probably find the Miocene tertiaries to rest, as on the eastern slope of the Rocky mountains. It is not uninteresting to note, also, that the Miocene strata of the upper Missouri are peculiarly characterized by beds of lignite, which have attracted the attention of every traveller who has passed up or down that river; and that, on descending the Columbia, below the region covered with recent volcanic material, we find a series of Miocene deposits, which are also associated with great accumulations of carbonaceous matter.

It is true that much of the lignite of the Pacific coast is more compact, approaches nearer to true coal, and furnishes a better fuel than that of the upper Missouri, but this is doubtless, in a great degree, due to the metamorphic action of erupted rocks which, as we have seen, have in so many places disturbed the tertiary strata. The close affinity, and probable synchronism, of the lignites of the upper Missouri and those of the Pacific coast is proved from the flora of these deposits, and has already been referred to. Until further information shall be obtained in reference to the relationship existing between the cretaceous rocks of Vancouver's island and the coal found there, the age of that coal can only be conjectured. The character of this coal, its resemblance to that of Bellingham bay, and the proximity of the two localities, give us reason to suspect that they belong to the same age and are equivalents of each other.

And it is at least presumable that the strata which enclose the coal overlie the cretaceous rocks occupying the same relative positions as the chalk and lignite beds of the Missouri. In a preceding chapter of this report I had occasion to notice the existence of cretaceous rocks near the upper end of the Sacramento valley, and, in the same connexion, referred to exposures of carboniferous limestone in localities not far distant. When the connexion shall be traced between these deposits, and the relations which they hold to the widely spread tertiary strata of the Pacific coast ascertained, it seems not improbable that, having there at different points all the principal elements which compose the geological structure of the eastern slope of the Rocky mountains, we shall be able to combine them in such a way as to establish a much more complete parallelism between the eastern and western sides of the continent than has been hitherto suspected. Among the fossils brought from Vancouver's island there is a large number, including many species, which are apparently not cretaceous, and which are very unlike any of the many tertiary fossils which have been collected at various points on the western coast. They are contained in a soft, greenish sandstone, and have been regarded by Mr. Meek, to whom they have been submitted, as probably indicative of strata of Jurassic age. The genera represented are, perhaps, not peculiar to that period, and the species are, without exception, new; but he regards them as presenting forms which are rather Oolitic or Jurassic, than cretaceous or tertiary. If the strata from which they are derived should be found to occupy a lower position than those yielding the cretaceous fossils, we should, perhaps, have then a representative of the Jurassic strata which underlie the chalk on the Atlantic coast, and probably throughout a large area in the interior of the continent.

PHYSICAL AND CHEMICAL CHARACTERS.

The coal from the Island of Vancouver resembles in many respects, as has been stated, that from Bellingham bay, and is more compact and crystalline than any of the tertiary lignites I have seen. It is as hard and handsome as many of the coals derived from the basins of the Mississippi valley, and, like many of the coals of the carboniferous period, exhibites scales of carbonate of lime in its joints. Its chemical composition, however, shows that, although a very well finished article, it is comparatively of recent date.

It is composed of—

Fixed carbon	51.81
Volatile matter	44.30
Ashes	3.89
Total	100.00

I saw several cargoes of this coal in San Francisco, where it has been used for several years.

It is regarded as very similar in its character to that of Bellingham bay, and commands about the same price.

COAL FROM CAPE FLATTERY.

This coal I have marked as coming from Cape Flattery, that being the nearest point to the locality from which it is derived, whose position is generally known. It is, in fact, obtained some 25 miles lower down on the coast. I owe to the kindness of Lieut. Trowbridge, U. S. A., the specimens which I have of this coal, and also whatever information I possess in reference to its geological position. It occurs associated with similar shales and sandstones to those which enclose the coal of Bellingham bay, and is doubtless of the same age. From what I have been able to learn of the geology of this part of the coast, it seems probable that the tertiary strata of Bellingham bay extend continuously, or with but local interruptions, to the Columbia.

The character of the Cape Flattery coal is similar in all respects to that of Coose bay, and hand specimens from the two localities are undistinguishable. Its chemical composition is also nearly identical, and whatever has been said of the character or value of the former is equally applicable to the latter. Its chemical composition is as follows:

Fixed carbon	46.40
Volatile matter	50.97
Ashes	2.63
	100.00

COAL FROM SANTA CLARA, CALIFORNIA.

This coal, or lignite, occurs 12 miles back from Santa Clara, and is said to form a stratum 3 feet in thickness, and is overlaid by a sandstone containing marine shells. In the small specimens of this rock which were given me by Lieut. Trowbridge, but a single species of fossil shell is distinguishable, though this is represented by considerable numbers. This shell is that of a gasteropodous mollusc, and a type of a new genus, described by Mr. Conrad under the name of *Schizopyga*, and figured in this report, plate 1, fig. 1. The coal, or rather lignite, from this locality exhibits some variety in appearance and purity; some of it showing very plainly the structure of the wood from which it has been formed, while other portions resemble a consolidated carbonaceous mud, and contain a large proportion of earthy matter. No analysis has been made of it; but while the better portions closely resemble the coal of Coose bay, it is evident that, as a whole, it is decidedly inferior as a fuel to the coal from that locality.

Aside from the coals I have mentioned, there are annually sold in the San Francisco market many cargoes from Chile, Australia, and the eastern United States. Of these, the anthracite and semi-bituminous coals from the eastern States are much preferred, and always command a higher price. The price of anthracite coal during my stay in the city varied from $37 to $40 per ton, while that from Chile and Australia ranged from $25 to $27.

The Chilean coal, of which I saw large quantities, was all derived from the Lota mine; of which the coal has been carefully examined, and an analysis published (in the report of the Naval Astronomical Expedition, vol. II, page 105,) by Professor J. L. Smith. I was much interested in noting the very evident similarity which exists between the Chilean coal and that of the northwestern coast. It apparently belongs to the same geological epoch, and indicates the extent of the area over which the tertiary deposits are spread along the North and South American Pacific coasts.

The coal of Australia has been fully described by Professor Dana in the geology of the exploring expedition, and is only interesting in this connexion on account of the amount annually sold in the San Francisco market, and for comparison with those which have been already described. This coal has more of the laminated structure, the rhombohedral fracture and general appearance of the older coals, but, from its softness and the evidently large quantity of sulphuret of iron which it contains, it cannot claim the first rank as a fossil fuel.

No. 2.

DESCRIPTION OF THE TERTIARY FOSSILS COLLECTED ON THE SURVEY.

BY T. A. CONRAD.

The California fossils, described from the collection of Dr. Newberry, consist of shells, which appear to me to represent the Miocene period, or to have existed contemporaneously with the fossil fauna of Virginia referred to that epoch. The few shells from Gatun, Isthmus of Darien, are not sufficient to indicate precisely the geological age of that vicinity. The well known univalve, *Malea ringens*, is one of the number, a shell which now exists only in the Pacific, and I believe the genus is unknown in the Atlantic. The probability is, therefore, that posterior to the Eocene period the Pacific was separated from the Caribbean sea by a narrower strip of land than at present, and that while the land was rising towards the Pacific it was probably sinking on the eastern coast.

CALIFORNIA FOSSILS.

UNIVALVE.

SCHIZOPYGA, *Conrad.*

Bucciniform ; columella concave, plicate ; lower part of body volution deeply channelled, the channel emarginating the columella.

Schizopyga Californiana, Plate II, fig. 1. Volutions rounded, having revolving ribs and longitudinal furrows, giving the ribs a nodulous character ; basal excavation profound.—Proceedings of Acad. Nat. Sc., Dec., 1856, p. 315.

Locality.—Santa Clara, Cal.—Dr. Newberry.

The above genus is probably related to Cancellaria.

BIVALVES.

CRYPTOMYA, *Conrad.*

Cryptomya ovalis, Pl. II, fig. 2. Oval, compressed, posterior end truncated ; umbonal slope angulated on the umbo ; beaks medial ; basal margin medially truncated ; disk medially flattened.—Proceedings Acad. Nat. Sc. for Dec., 1856, p. 314.

Locality.—Monterey county, Cal.—Dr. Newberry.

Rather smaller than the recent *C. californica*, less regularly oval, inequilateral, &c.

THRACIA, *Leach.*

Thracia mactropsis, Pl. II, fig. 3. Subtriangular, subequilateral, ventricose ; anterior side cuneiform or subrostrated, posterior end regularly rounded ; ligament margin very oblique ; base regularly and profoundly rounded; umbonal slope abruptly rounded; summit prominent, posterior to the middle of the valve; anterior extremity angular. Length 1 inch.—Proceedings Acad. Nat. Sciences, Dec., 1856, p. 313.

Locality.—Monterey county, California.—Dr. Newberry.

MYA, *Lin.*

Mya Montereyana, Pl. II, fig. 4. Suboval, slightly ventricose, thin, inequilateral; summit hardly prominent; anterior end subtruncated? posterior end acutely rounded, the extremity situated more nearly on a line with the beak than the base; disk concentrically rugoso-striate. Length $1\frac{1}{4}$ inches.—Proceedings Acad. Nat. Sciences, Dec., 1856, p. 313.

Locality.—Monterey, Cal.—Dr. Newberry.

This and the preceding fossil belong to the same rock in which the Schizopyga occurs, the group having no resemblance to that of Estrella, or other localities referred to in this paper.

Mya ? subsinuata, Pl. II, fig. 5. Somewhat sinuous, ovate, slightly reflected at both ends; contracted medially or from beak to base.

Locality.—Monterey county.

ARCOPAGIA, *Leach.*

Arcopagia medialis, Pl. II, fig. 6. Oval, both valves slightly ventricose anteriorly; upper valve much contracted or concave towards the umbonal slope, which is angulated; post umbonal slope slightly contracted in the middle, emarginate at base; the corresponding slope of the lower valve deeply folded, reflected towards the extremity; disks rugoso-striate concentrically.—Proceedings Acad. Nat. Sciences, Dec., 1856, p. 314.

Locality.—Monterey county, Cal.—A. S. Taylor.

This shell is proportionally longer than *A. biplicata*, Conrad, of the Maryland Miocene, but the general resemblance is noticeable and adds to the probability that the very remote strata in which they occur are parallel.

TAPES, *Sowerby.*

Tapes linteatum, Pl. II, fig. 7. Oblong-oval, ventricose; buccal side short, extremity obtusely rounded; anal side elongated, end regularly rounded; ligament margin long, oblique, straight; disks radiated with fine, unequal lines, except on the post-umbonal slope, which is entire.—Proceedings Acad. Nat. Sciences, Dec., 1856, p. 314.

Locality.—California.—Dr. Newberry.

ARCA, *Lin.*

1. *Arca canalis*, Pl. II, fig. 8. Subtrapezoidal, ventricose; ribs 24 to 26, flattened, scarcely prominent, divided by a longitudinal furrow; disk concentrically wrinkled; umbo ventricose; summits prominent, remote from the centre.—Proceedings Acad. Nat. Sciences, Dec., 1856, p. 314.

Locality.—Santa Barbara, Cal.—Dr. Newberry.

2. *Arca trilineata*, Pl. II, fig. 9. Trapezoidal, somewhat produced, inequilateral, ventricose; ribs 22–24, scarcely prominent, square, wider than the intervening spaces, ornamented with three impressed or four raised lines; disks concentrically wrinkled; summits prominent; beaks approximate. Length 3 inches.—Proceedings Acad. Nat. Sciences, Dec. 1856, p. 314.

Locality.—Occurs with the preceding.

3. *Arca congesta*, Pl. II, fig. 10. Rhomboidal, ventricose, inequilateral; ribs about 27, con-

vex on the back, wider than the intervals, which are transversely striate; anterior ribs crenate; ligament margin elevated; posterior end obtusely rounded; summits prominent. Length, $\frac{5}{8}$ inch.—Proceedings Acad. Nat. Sciences, Dec., 1856, p. 314.

Locality.—California.—Dr. Newberry.

AXINÆA, *Poli.* PECTUNCULUS, *Lam.*

Axinæa barbarensis, Pl. III, fig. 11. Lentiform, subequilateral, concentrically wrinkled; ribs about 37, scarcely prominent, flat, defined by an impressed line, wanting on the submargins and obsolete towards the base; summits slightly prominent.

MULINIA, *Gray.*

M. densata, Pl. III, fig. 12. Subovate, ventricose, thick, very inequilateral; posterior side very short comparatively, contracted; extremity subtruncated, much above the line of the base; posterior basal margin very oblique and contracted; anterior end obliquely truncated; anterior basal margin rounded; summits prominent, distant; lateral teeth very robust and prominent; inner margin entire.—Proceedings Acad. Nat. Sciences, Dec., 1856, p. 313.

Locality.—Santa Barbara and shores of San Pablo bay? California.—Dr. Newberry.

DOSINIA, *Scopoli.*

1. *Dosinia longula.* Regularly ventricose, inequilateral, longitudinally oval; margins and base regularly rounded; summit prominent; buccal margin more obtusely rounded than the anal.—Proceedings Acad. Nat. Sciences, Dec., 1856, p. 315.

Locality.—Monterey, Cal.—Dr. Newberry.

2. *Dosinia alta*, Pl. III, figs. 13*a* and 13*b*. Obtusely subovate or suboval from beak to base; posterior margin curved, profoundly oblique; base regularly and rather acutely rounded; summits prominent, oblique; surface marked with numerous fine, concentric, impressed lines; beaks medial. Height, 4 inches.—Proceedings Acad. Nat. Sciences, Dec., 1856, p. 315.

Locality.—Monterey, Cal.—Dr. Newberry.

PECTEN, *Lin.*

Pecten Pabloensis, Pl. III, fig. 14. Orbicular, compressed, thin, concentrically wrinkled; ribs 18–20, slender; little prominent, with an intermediate radiating line.

Locality.—San Pablo bay, Cal.—Dr. Newberry.

PALLIUM, *Klein.*

P. estrellanum, Pl. III, fig. 15. Suborbicular; lower valve ventricose, slightly undulated; ribs 17, broad, little prominent, convex, with an intermediate linear rib, from which the larger ribs are separated by an impressed line; upper valve convex, somewhat undulated, ribs flattened, and the intermediate small ribs with a longitudinal impressed line on the lower part of the valve.—Proceedings Acad. Nat. Sciences, Dec., 1856, p. 313.

Locality.—Estrella valley, Cal.—Dr. Newberry.

JANIRA, *Shum.*

Janira bella, Pl. III, fig. 16. Subtriangular; inferior valve convex, ribs 14 or 15, square, about as wide as the intervening spaces, very prominent, some of them with one or two longitudinal obsolete lines; disk finely wrinkled concentrically; upper valve flattened, deeply depressed towards the apex; ribs rather narrower than those of the opposite valve, obscurely bicarinated above, disk ornamented with close, fine, squamose, concentric wrinkles. Length, 4 inches; height, 3¾ inches.—Proceedings Acad. Nat. Sciences, Dec., 1856, p. 312.

Locality.—Santa Barbara, Cal.—Dr. Newberry.

OSTREA, *Linn.*

Ostrea Titan, Pl. IV, fig. 17, Pl. V, fig. 17*a*, profile. Produced from beak to base, straight or slightly curved, substance very thick, coarsely laminated; upper valve flat, very thick, somewhat gibbous; lower valve profoundly ventricose, umbonated, the summit rising above the beak of the opposite valve. Length, .—Proceedings Acad. Nat. Sciences, 1855.

Locality.—San Luis Obispo, California.

FOSSILS OF GATUN, ISTHMUS OF DARIEN.

MALEA, *Valenc.*

Malea ringens, Pl. V, fig. 22.

Dolium ringens, (Cassis,) Swainson.

Locality.—Gatun. This shell inhabits the Pacific coast of South America, and the genus is unknown in the Atlantic.

TURRITELLA, *Lam.*

1. *Turritella altilira,* Pl. V, fig. 19. Subulate, carinated; volutions with 2 distant, elevated, revolving, crenulated ribs, interstices with revolving lines; body volution bicarinated at the angle.

Locality.—Gatun.—Dr. Newberry.

2. *Turritella Gatunensis,* Pl. V, fig. 20. Subulate; volutions each with 2 slightly concave spaces; body volution ventricose, much larger than the penultimate, having about 20 revolving lines, 7 or 8 of which are on the base, which is flattened; 3 lines on the body volution larger than the others, the 2 lower ones remote.

Locality.—Occurs with the preceding.

TRITON, *Lam.*

An imperfect cast of an unknown species occurs with the preceding.

I have compared the above three univalves with what recent species and figures I have access to, and cannot identify them; but if they should be representatives of existing shells, they will doubtless prove to be inhabitants of the Pacific coast, of the Isthmus, or of South America.

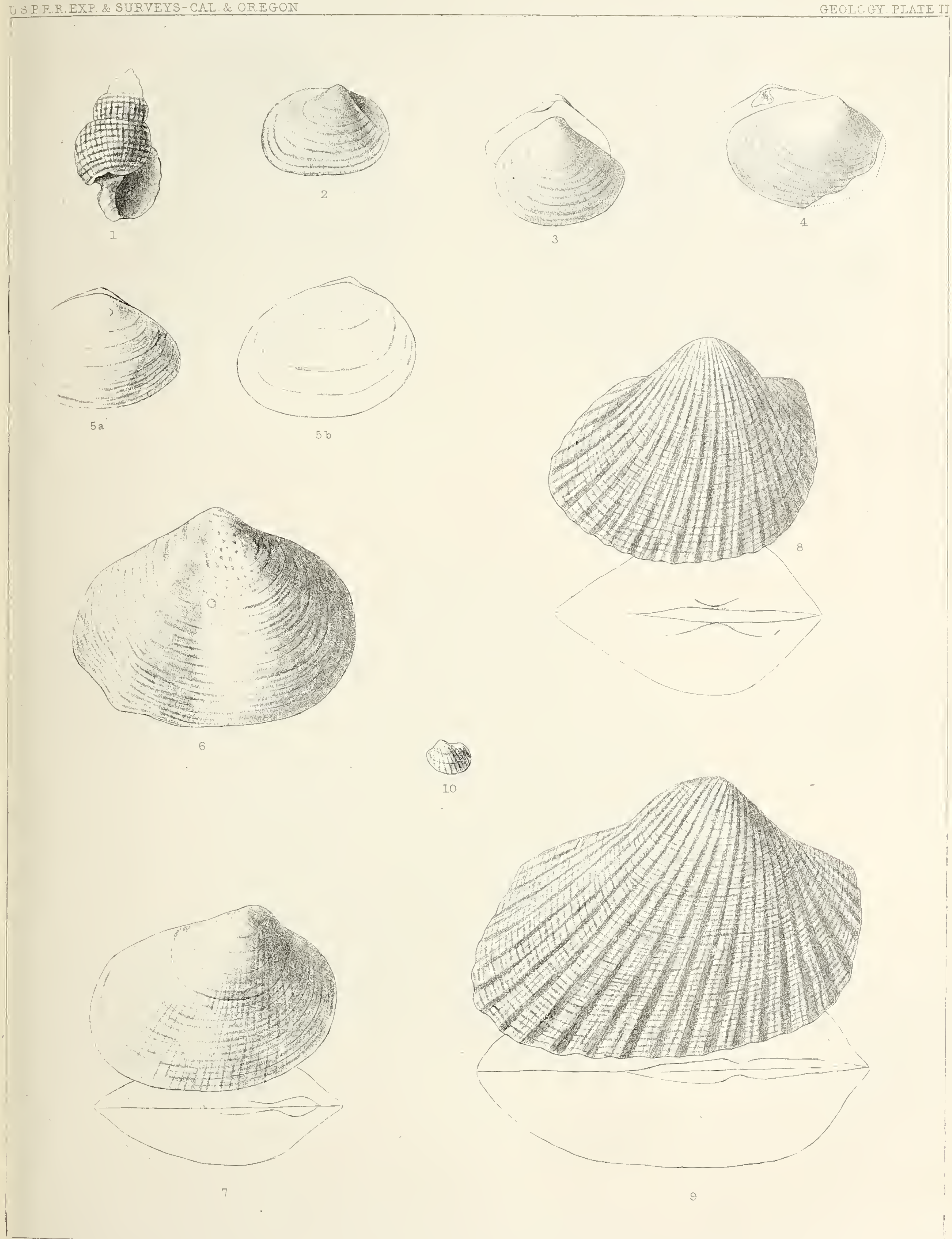
CYTHEREA? *Lam.*

Cytherea? (Meretrix) Dariena? Pl. V, fig. 21. Meretrix Dariena, *Con.* Desc. of Foss. and Shells collected in Cal., by Wm. P. Blake, p. 18. I have referred this shell to Cytherea, as it is probable that Venus meretrix may prove the type of a genus distinct from Cytherea.

TAMIOSOMA, *Conrad.*

An elongated tube, apparently entire, porous and cellular throughout its substance; interior filled with numerous irregularly-disposed vaulted cells connected by longitudinal slender tubes, funnel-shaped beneath; aperture resembling that of Balanus.

Tamiosoma gregaria, Pl. IV, fig. 18. Subquadrangular, elongated, longitudinally furrowed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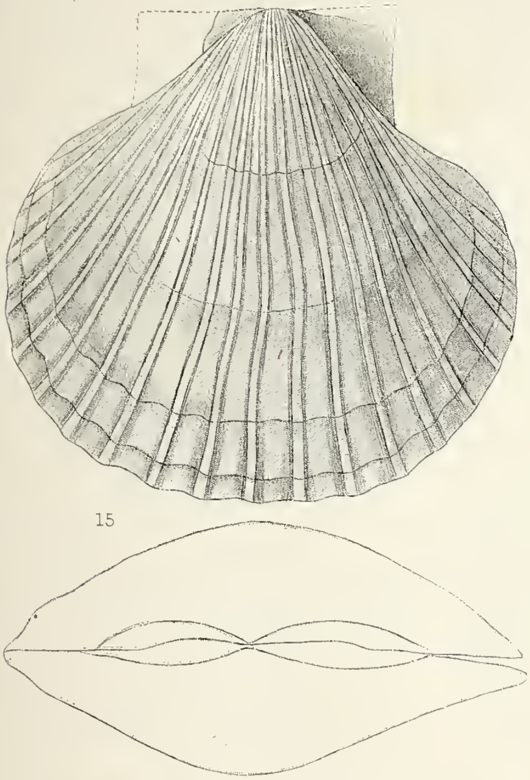

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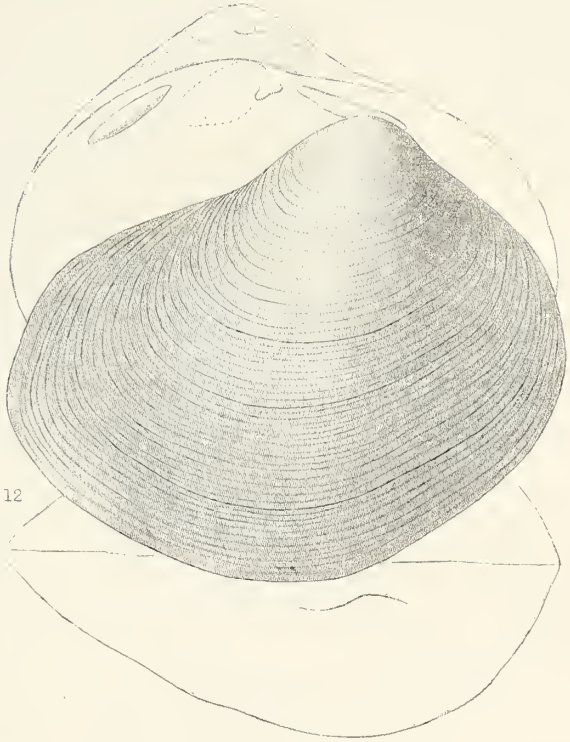

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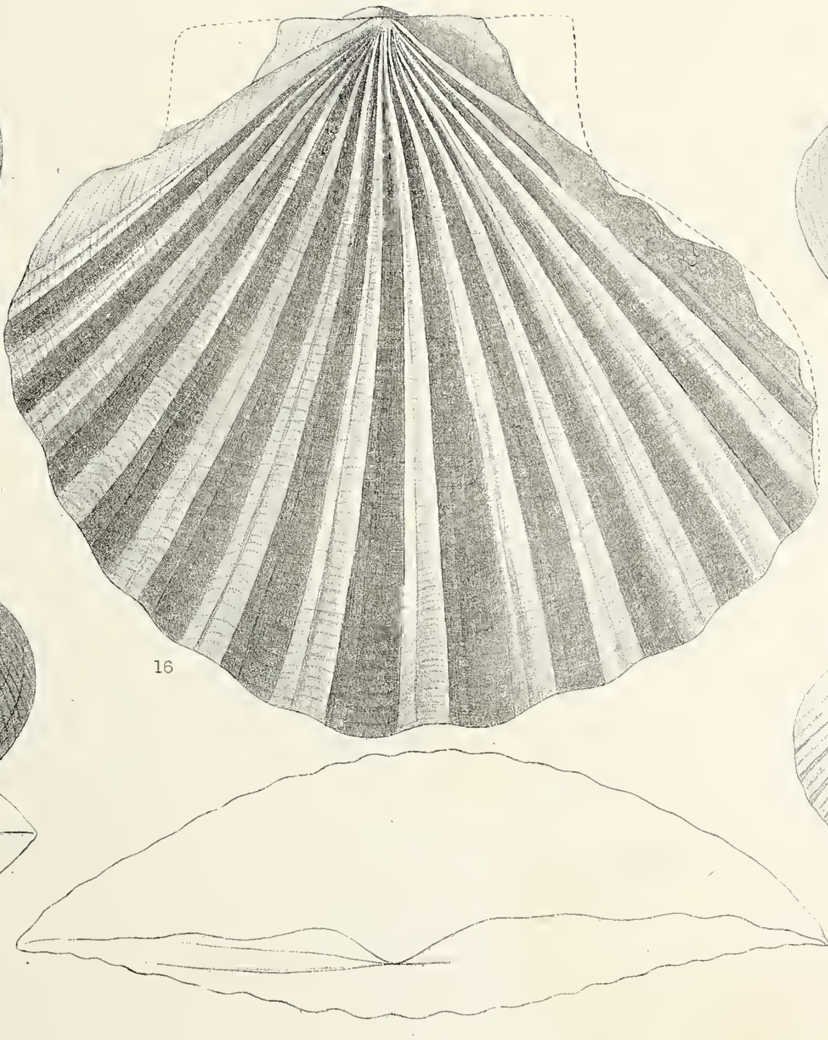
13 *a*



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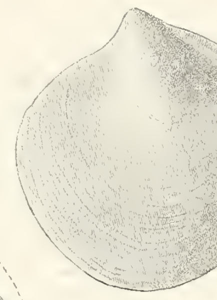

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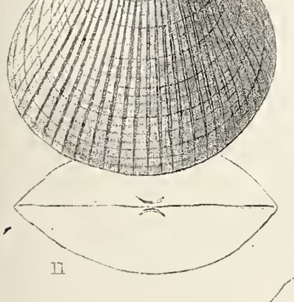

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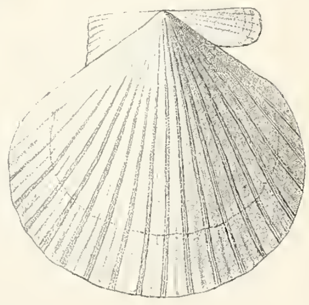

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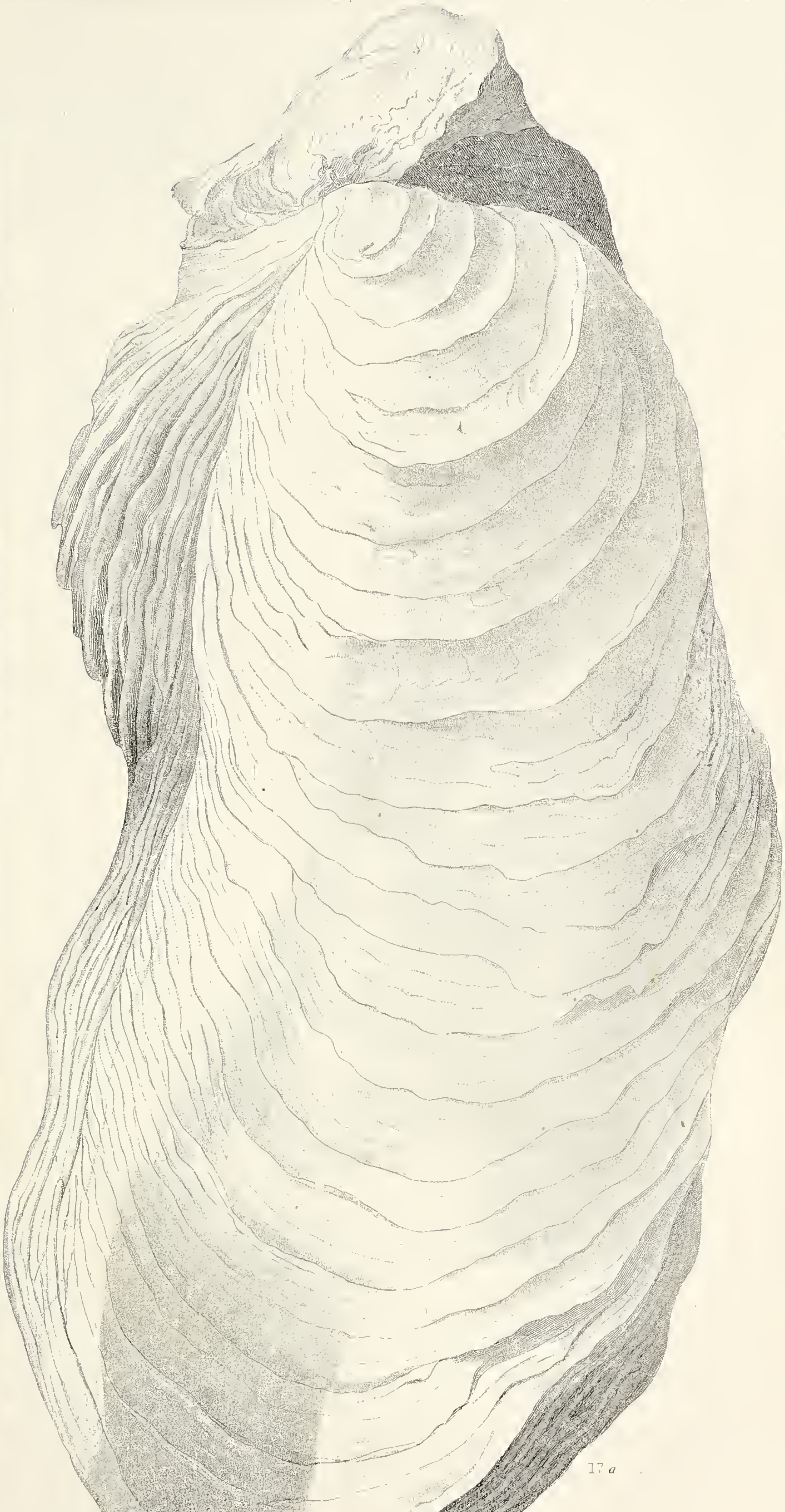

17 a

21 22 19 4 23 20 24 25

and striate, and having fine, undulated, transverse lines; mouth small, oblique; upper part of the tube oblique, deeply indented or Balaniform, and coarsely striated longitudinally. Length 8 inches,

Locality.—Monterey county, California.—A. S. Taylor. Growing in clusters like Balani. No sutures, indicating separate valves; cells very thin plates, convex surface downwards.

PANDORA, *Lam.*

Pandora bilirata, Pl. V., fig. 25, Conrad.—Proceed. Acad. Nat. Sciences for 1855, vol. vii, p. 267.

Locality.—Santa Barbara, Cal.

CARDITA, *Brug.*

Cardita occidentalis, Pl. V., fig. 24, Ib.

Locality.—Santa Barbara.

DIADORA, *Gray.*

Diadora crucibuliformis, Pl. V., fig. 23, Ib.

Locality.—Santa Barbara, Cal.

No. 3.

REPORT UPON AN ANALYTICAL EXAMINATION OF WATER AND MINERALS FROM THE HOT SPRINGS IN DES CHUTES VALLEY.

CONDUCTED UNDER THE DIRECTION OF PROF. E. N. HORSFORD.*

LETTER FROM PROF. E. N. HORSFORD.

HARVARD UNIVERSITY, CAMBRIDGE, *May* 25, 1857.

SIR : I enclose to you the report of my assistant, Mr. L. M. Dornbach, upon the minerals and water of the hot siliceous springs of the Des Chutes valley, Oregon, which you placed in my hands.

I am, very respectfully, yours,

E. N. HORSFORD.

Lieut. H. L. ABBOT, *U. S. Top. Engs.*

REPORT BY MR. L. M. DORNBACH.

The notes accompanying the specimens are as follows :

" The sample of water is taken from one of a number of thermal springs which give a peculiar character to a region some miles in extent. The temperature of the water is about 145° Fahr., and the basins into which it flows are filled with floating jelly-like masses of silica. A white incrustation is formed upon all objects lying in the water. The volcanic tufas in the vicinity of the springs are accurately stratified, horizontal, and nowhere disturbed. The stream and hot water from the springs have penetrated the strata in all directions, producing complete metamorphosis of the different materials of which they are composed, converting the porous pulverulent tufas, by a succession of changes, into a kind of jasper."

The method adopted in the qualitative analysis for the detection of the alkalies was to fuse one part of the finely pulverized mineral with four parts of a mixture of three parts of carbonate of baryta and one part chloride of barium. The fused mass was next digested with hydrochloric acid to decompose the silicate of baryta ; then evaporated to dryness to expel most of the free acid, treated with water and the silica filtered off. The baryta, with the iron, lime and alumina was precipitated by adding carbonate of ammonia, the filtrate was then evaporated to dryness, the ammoniacal salts expelled, and the chloride of magnesium converted into insoluble mag-

* *Note by Lieut. Abbot.*—It is proper to state that Prof. Horsford conducted these analyses in his laboratory, without expense to the government. The specimens were collected at the most interesting locality upon our route, in a geological point of view, and the results of the analysis are of great value in illustrating the action of thermal springs.

nesia by ignition. The residue, if any, was treated with hot water, which dissolved the alkaline chlorides; these were then tested for by the usual methods. Magnesia being absent when alkalies were found, their quantitative estimation was conducted in the same manner, with the exception that the baryta was precipitated by adding sulphuric acid in slight excess. From the filtrate the iron and alumina were precipitated by ammonia and separated, after igniting, weighing, and redissolving in hydrochloric acid, by caustic potassa. The lime by oxalate of ammonia, the filtrate evaporated and ignited left the alkalies in the state of sulphates. If the alkalies were absent the mineral was easily decomposed by digesting for several hours with concentrated hydrochloric acid, and the different substances separated by the method stated. The water was estimated by igniting the substance after drying, at 212° Fahr., for forty-eight hours. In determining the specific gravity, coarse fragments of the specimens were put in a specific gravity flask, partially filled with water, and placed under an exhausted receiver, thus expelling the air from the porous mass. The temperature at which this determination was made was 15° C, or 59° Fahr.

In the following arrangement of the results of analysis, all from A to G are friable tufas, unchanged by action of water; H is a specimen of incrustation, while all the remainder have been changed more or less by the action of the thermal springs; and, in consequence, have acquired greater hardness. Both the changed and unchanged have no cleavage, but break into irregular fragments, having an uneven and hackly fracture.

A has a specific gravity of 2.2505; of fine granular structure; color, yellowish, ochreous, from sesquioxide of iron; with numerous irregular nodules of clear quartz crystals, and quartz colored by iron and manganese interspersed through the entire mass. No cleavage, breaks into irregular fragments; fracture uneven, opaque, very soft and friable.

COMPOSITION.

$$\dddot{\mathrm{Si}}.\ 54.386,\ \dddot{\mathrm{Al}}.\ 20.665,\ \dddot{\mathrm{Fe}}.\ 9.945.$$
$$\dot{\mathrm{Ca}}.\ 1.894,\ \dot{\mathrm{H}}.\ 12.919 = 99.507.$$

B. Specific gravity, 2.1947; coarsely granular; fracture uneven; color, whitish gray, resembling gray sandstone in appearance very much; easily crushed.

COMPOSITION.

$$\dddot{\mathrm{Si}}.\ 80.837,\ \dddot{\mathrm{Al}}.\ 6.401,\ \dddot{\mathrm{Fe}}.\ 4.680.$$
$$\dot{\mathrm{Ca}}.\ .384,\ \dot{\mathrm{H}}.\ 6.932 = 99.234.$$

C. Specific gravity, 1.950; finely granular; color, white; resembles chalk not only in color, but in fracture and softness.

COMPOSITION.

$$\dddot{\mathrm{Si}}.\ 84.721,\ \dddot{\mathrm{Al}}.\ 1.704,\ \dddot{\mathrm{Fe}}.\ 4.589.$$
$$\dot{\mathrm{Ca}}.\ 1.009,\ \dot{\mathrm{H}}.\ 7.977 = 100.$$

D. Specific gravity, 2.2466; coarsely granular; irregular fracture; color, reddish; resembling specimen B very much in texture and friability, but owing to a larger per cent. of sesquioxide of iron, it is more nearly a red sandstone.

COMPOSITION.

$$\dddot{\mathrm{Si}}.\ 74.758,\ \dddot{\mathrm{Al}}.\ 4.517,\ \dddot{\mathrm{Fe}}.\ 9.152.$$
$$\dot{\mathrm{C}}\mathrm{a}.\ 1.469,\ \dot{\mathrm{H}}.\ 10.146 = 100.042.$$

E. Specific gravity, 2.2431; structure, granular; color, gray; differs from B only in possessing a somewhat finer granular structure, and is slightly tinged red by a larger quantity of sesquioxide of iron.

COMPOSITION.

$$\dddot{\mathrm{Si}}.\ 81.554,\ \dddot{\mathrm{Al}}.\ 3.331,\ \dddot{\mathrm{Fe}}.\ 8.076.$$
$$\dot{\mathrm{C}}\mathrm{a}.\ 1.443,\ \dot{\mathrm{H}}.\ 6.137 = 100.541.$$

F. Specific gravity, 1.970; structure, finely granular; very soft and friable; full of irregular seams or cracks, along which it breaks readily; color, grayish, with yellowish streaks.

COMPOSITION.

$$\dddot{\mathrm{Si}}.\ 61.020,\ \dddot{\mathrm{Al}}.\ 13.017,\ \dddot{\mathrm{Fe}}.\ 8.639.$$
$$\dot{\mathrm{C}}\mathrm{a}.\ 1.257,\ \dot{\mathrm{H}}.\ 15.292 = 99.215.$$

G. Specific gravity, 2.000; resembles F in many particulars, and differs from it only in having some small elliptical or spherical portions of half an inch in diameter, perfectly white, while layers surrounding these have a darker shade of gray, thus presenting a motley appearance; and in containing no yellowish streaks, which exist in F, in consequence of containing a larger proportion of sesquioxide of iron.

COMPOSITION.

$$\dddot{\mathrm{Si}}.\ 75.746,\ \dddot{\mathrm{Al}}.\ 10.326,\ \dddot{\mathrm{Fe}}.\ 6.016.$$
$$\dot{\mathrm{C}}\mathrm{a}.\ 1.773,\ \dot{\mathrm{H}}.\ 7.339 = 101.2.$$

H. Specific gravity, 2.2705; granular structure; color, grayish; soft and friable; is a deposit from the hot springs, which forms incrustations upon objects in the water.

COMPOSITION.

$$\ddot{\mathrm{Si}}.\ 1.615,\ \dot{\mathrm{C}}\mathrm{a},\ddot{\mathrm{C}}.\ 40.623,\ \dot{\mathrm{N}}\mathrm{a},\ddot{\mathrm{C}}.\ 45.567.$$
$$\dot{\mathrm{H}}.\ \text{and organic matter},\ 10.623 = 98.398.$$

The next four, marked *b*, *c*, *d*, and *e*, have been changed by agency of water; differ from the unchanged in possessing superior hardness and specific gravity without differing very much in chemical composition.

b. Specific gravity, 2.2774; coarsely granular structure; compact; color, gray, with a reddish tint; a complete sandstone.

COMPOSITION.

$$\dddot{\mathrm{Si}}.\ 81.592,\ \dddot{\mathrm{Al}}.\ 4.144,\ \dddot{\mathrm{Fe}}.\ 5.096.$$
$$\dot{\mathrm{C}}\mathrm{a}.\ 1.627,\ \dot{\mathrm{H}}.\ 6.578 = 99.037.$$

c. Special gravity, 2.3242; finely granular; hard; is composed of alternate layers, one of gray color, the other of pinkish hue; does not cleave along the apparent strata, but has an irregular fracture.

COMPOSITION.

$\dddot{\mathrm{Si}}$. 80.401, $\dddot{\mathrm{Al}}$. 3.145, $\dddot{\mathrm{Fe}}$. 4.061.

$\dot{\mathrm{Ca}}$. 1.365, $\dot{\mathrm{H}}$. 10.750 = 99.722.

d. Specific gravity, 2.490; extreme change of form; structure compact, even; fracture conchoidal, smooth; color, reddish purple; resembles jasper.

COMPOSITION.

$\dddot{\mathrm{Si}}$. 96.507, $\dddot{\mathrm{Al}}$. and $\dddot{\mathrm{Fe}}$. 1.181, $\dot{\mathrm{Ca}}$. .987.

$\dot{\mathrm{Na}}$, trace, $\dot{\mathrm{H}}$. .546 = 99.507.

e. Specific gravity, 2.2542. Granular, compact; can be broken with the nail. Color, grayish white.

COMPOSITION.

$\dddot{\mathrm{Si}}$. 80.891, $\dddot{\mathrm{Al}}$. 12.211, $\dddot{\mathrm{Fe}}$. 1.771.

$\dot{\mathrm{Ca}}$. 1.181, $\dot{\mathrm{H}}$. 3.211 = 99.265.

The next two, M and N, contain silicate of soda, and some iron as protoxide, as is shown by digesting the mineral in fine powder with some hydrochloric acid, and testing with permanganate of potassa.

M. Specific gravity, 2.371. Fracture hackly, coarse. Full of small cavities of a light yellow color. Color of the mass, greenish gray.

COMPOSITION.

$\dddot{\mathrm{Si}}$. 69.697, $\dddot{\mathrm{Al}}$. 15.685, $\dddot{\mathrm{Fe}}$. 2.200.

$\dot{\mathrm{Ca}}$. .332, $\dot{\mathrm{Na}}$. 10.00, $\dot{\mathrm{H}}$. 1.186 = 99.100.

N. Specific gravity, 2.346. In appearance differs from the last only in having the cavities in the mass larger and colored darker yellow or red by the sesquioxide of iron.

COMPOSITION.

$\dddot{\mathrm{Si}}$. 81.540, $\dddot{\mathrm{Al}}$. 8.454, $\dddot{\mathrm{Fe}}$. 4.227.

$\dot{\mathrm{Ca}}$. .684, $\dot{\mathrm{Na}}$. 4.650, $\dot{\mathrm{H}}$. 1.184 = 100.739.

The last specimen had a variable composition and appearance. Vitreous opal of a specific gravity 2.105, slightly streaked yellow, by iron constituting central and principal portions of the mass. Surrounding the opal was a brownish substance, P, and outside this a greenish mineral, O.

O. Specific gravity, 2.392. Coarse, brittle structure; hard. Fracture irregular. Color greenish. Resembles M in all its properties, physical as well as chemical.

COMPOSITION.

$\dddot{\mathrm{Si}}$. 69.455, $\dddot{\mathrm{Al}}$. 12.313, $\dddot{\mathrm{Fe}}$. 2.205.

$\dot{\mathrm{Ca}}$. 1.908, $\dot{\mathrm{Na}}$. 4.667, $\dot{\mathrm{H}}$. 9.416 = 99.959.

P. Specific gravity, 2.4819. Hard and brittle. Color brownish.

COMPOSITION.

$$\dddot{\mathrm{Si}}.\ 70.430,\ \dddot{\mathrm{Al}}.\ 14.680,\ \dddot{\mathrm{Fe}}.\ 3.047.$$
$$\dot{\mathrm{Ca}}.\ .322,\ \dot{\mathrm{Na}}.\ 9.623,\ \dot{\mathrm{H}}.\ 1.255 = 99.357.$$

The silica found in the water exists in combination with an alkaline base; since upon evaporation the whole of the residuum is again redissolved in water. But if treated with some strong acid previous to evaporation, one part of silica is obtained in 11,976 parts of water. From the quantity of alkali found, the silica, which separated very soon upon exposure to the air, and which floats in the basins, must, at least in part, be in combination with an alkali, as an alkaline silicate, which the carbonic acid of the atmosphere decomposes, forming an alkaline carbonate. The result of analysis is as follows:

Specific gravity of water, 1.00085. In 10,000 parts there are 13.82 parts of solid matter, not considering the excess of carbonic acid which is expelled during evaporation.

COMPOSITION OF SOLID MATTER.

$$\dot{\mathrm{K}}.\ .218,\ \dot{\mathrm{Na}}.\ 6.574,\ \dot{\mathrm{Ca}}.\ .129,\ \mathrm{Mg}.\ .088.$$
$$\dddot{\mathrm{Si}}.\ .835,\ \mathrm{Fe.\ trace},\ \mathrm{Cl}.\ 2.442,\ \ddot{\mathrm{C}}.\ 4.266.$$
$$\dddot{\mathrm{S}}.\ 1.099 = 15.651.$$

The following arrangement may represent the presumed combinations as they exist in solution:

Water	9984.856
Chloride of potassium	.343
Chloride of sodium	3.501
Chloride of magnesium	.209
Sulphate of lime	.313
Sulphate of soda	1.624
Silicate of soda	1.407
Carbonate of soda	5.916
Free carbonic acid	1.831
	10000.000

The carbonic acid which I have represented as free evidently exists in combination with bases forming bicarbonates.

No. 4.

CATALOGUE OF THE MINERALS AND FOSSILS COLLECTED ON THE SURVEY.

No	Name.	Locality.
1	Red jasper	Benicia, California
2	Sandstone	do do
3	do	San Francisco, California
4	do	Santa Barbara, California
5	do	San Pablo bay, California
6	Volcanic tufa	do do
7	Volcanic conglomerate	do do
8	do do	do do
9	do do	do do
10	Scoria in conglomerate	do do
11	Blue limestone	do do
12	Calcareous tufa	Near Benicia
13	Tufaceous trap	Hills west of Suisun bay
14	do	do do
15	Granite	Near Sonoma, California
16	Cellular trap	Near Fort Reading
17	do	Pit river, lower cañon
18	do	Pit river, upper cañon
19	Alumina—silicious marl, pure white	Pit river, lower cañon
20	do do brown	do do
21	do do pure white	Pit river, above upper cañon
22	Green sandstone	20 miles above upper cañon, Pit river.
23	Trachyte, containing crystals of hornblende and glassy felspar	Lassen's butte, California
24	do decomposing into felspathic sand, reflecting the sun like snow	
25	Sandstone, cream colored and friable, forming bluffs capped with trap	Shores of Rhett lake
26	Alumina—silicious marl, pure white	Plain about Lower Klamath lake
27	Scoria in sandstone (25)	Natural Bridge, Lost river, O. T.
28	Pumice, coarse	Lassen's butte, California
29	Epidote, with crystals of hornblende	Upper Pit river, California
30	Gray syenite	Upper Pit river
31	Gray porphyry	do
32	Greenstone	do
33	Massive quartz, with epidote	do
34	Black obsidian, in balls	do
35	Pumice, from Pumice plain	North of Upper Klamath lake

CATALOGUE—Continued.

No.	Name.	Locality.
36	Obsidian and pumice, in same mass	Crater pass, Cascade mountains, O. T.
37	----do--------do	----do--------do--------do
38	Obsidian, columnar	--- do--------do--------do
39	Black basalt, with zeolites	----do--------do--------do
40	Amygdaloid, with zeolites	Upper Pit river
41	----do---- -do	Crater pass
42	Black basalt, with olivine and mesotype	----do
43	Scoria, blood-red	----do
44	----do	Hill in Des Chutes basin
45	Metamorphic slate	Cascade mountains, latitude 44°
46	Scoria, from melting of last	----do--------do--------do
47	Dark green basalt	Crater pass, O. T.
48	Pitch stone	Upper Pit river
49	Scoria, red	Mount Hood, O. T.
50	Scoria, black	----do
51	Vesicular trap	----do
52	--- do	Upper Pit river
53	Quartz	Mount Hood, O. T.
54	Pitch stone	Upper Des Chutes river, O. T.
55	Infusorial deposit	Pit river, above upper cañon
56	----do	Monterey, California
57	----do	----do--------do
58	----do	San Francisco, California
59	----do	Sonoma
60	----do	Monterey
61	----do	Pit river, lower cañon
62	----do	----do--------do
63	----do	Pit river, above lower cañon
64	----do	20 miles above upper cañon
65	Alkaline efflorescence	Shores of Rhett lake
66	Red earth	Nee-nee Springs, Des Chutes basin.
67	Infusorial earth	Lost river, O. T.
68	----do	Lower Klamath lake
69	Deposit from waters of Klamath lake	
70	Infusorial deposit	Mpto-ly-as river, O. T.
71	----do	----do--------do
72	----do	----do--------do
73	----do	Banks of Psuc-see-que creek, O. T.
74	----do	----do--------do--------do
75	----do	----do--------do--------do
76	----do	----do--------do--------do
77	----do	----do--------do--------do
78	----do	Hills near Dalles, O. T.
79	Infusorial mud, later	Cascade mountains, O. T.
80	Volcanic ashes	Mount Hood, O. T.
81	Silicified wood	Petaluma, California
82	----do	Upper Pit river, California

CATALOGUE—Continued.

No.	Name.	Locality.
83	Silicified wood	Upper Pit river, California
84	do	do do
85	Silicified wood, decayed before fossilization	do do
86	do	Cascades of Columbia
87	do	do do
88	do	do do
89	do	do do
90	Silicified wood (partially fossilized)	do do
91	do do do	do do
92	do do do	do do
93	do do do	do do
94	Silicified wood (wholly silicified)	do do
95	do do do	do do
96	do do do	do do
97	do do do	do do
98	do do do	do do
99	do do do	do do
100	do do do	do do
101	do do do	do do
102	do do do	do do
103	do	do do
104	do	Shoal Water bay, W. T.
105	do	do do
106	do	do do
107	do	do do
108	do	do do
109	do	do do
110	do	do do
111	Lignite	do do
112	do	do do
113	Wood unchanged, lignite beds	do do
114	Cone, (Abies Menziesii ?)	do do
115	Wood of sunken forest	Columbia river
116	Wood of Abies Douglassii (recent)	
117	Wood of Abies Douglassii (fossil)	
118	Fossil plants	
119	do	
120	Coal	Santa Clara, California
121	do	do do
122	Fossil limestone overlying last	
123	Coal	Coose bay, O. T.
124	do	do do
125	do	do do
126	do	Clalam bay, W. T.
127	do	do do
128	do	Cape Flattery, W. T.
129	do	do do

CATALOGUE—Continued.

No.	Name.	Locality.
130	Coal	Bellingham bay, W. T.
131	do	do do
132	do	Vancouver's island
133	do	do do
134	do	Lota mine, Chile
135	do	Sydney, Australia
136	Fossil plants	
137	do	
138	Obsidian, black	Upper Pit river
139	do	do
140	Obsidian, brown	do
141	do	do
142	do	do
143	Obsidian, striped	do
144	do	do
145	Obsidian, translucent	do
146	do	do
147	Obsidian, gray	do
148	Agate	do
149	do	do
150	Chalcedony	do
151	Volcanic tufa	Mpto-ly-as river, O. T.
152	do do pink	Psuc-see-que creek, O. T.
153	do do blue	do do
154	do do brown	do do
155	do do yellow	do do
156	do	do do
157	Tufaceous conglomerate	do do
158	Volcanic tufa	do do
159	do	do do
160	do	do do
161	do	do do
162	do	do do
163	do	do do
164	do	do do
165	do	do do
166	do	do do
167	do	do do
168	do	do do
169	do	do do
170	do	do do
171	do	do do
172	do	do do
173	do	do do
174	do	do do
175	Metamorphosed tufa	Hot Spring valley, O. T.
176	do do	do do
177	do do	do do

CATALOGUE—Continued.

No.	Name.	Locality.
178	Metamorphosed tufa	Hot Spring valley, O. T.
179	do do	do do
180	do do	do do
181	do do	do do
182	do do	do do
183	do do	do do
184	do do	do do
185	do do	do do
186	do do	do do
187	do do	do do
188	Pitch stone	do do
189	do	do do
190	Quartz, geode	do do
191	do	do do
192	do	do do
193	Metamorphosed tufa	Willow Springs, O. T.
194	Chalcedony	Hot Spring valley
195	do	do do
196	do	do do
197	do	do do
198	do	do do
199	do	do do
200	do	do do
201	do	do do
202	do	do do
203	Quartz, geode	do do
204	do	do do
205	Chalcedony	do do
206	do	do do
207	Chalcedony, coated with green silicate of iron	do do
208	Green jasper	Hot Springs, Des Chutes basin
209	Onyx	do do
210	do	do do
211	do	do do
212	Pitch stone	do do
213	Black basalt	do do
214	Onyx	do do
215	do	do do
216	do	do do
217	Opal	do do
218	do	do do
219	do	Hot Spring valley, O. T.
220	Agate	do do
221	do	do do
222	do	do do
223	Agate	Cascades of Columbia
224	do	do do
225	do	do do

CATALOGUE—Continued.

No.	Name.	Locality.
226	Silicious concretions	Hot Springs
227	Silicified wood	---do
228	Pitch stone	---do
229	---do	---do
230	---do	---do
231	Chalcedony	---do
232	Silicate iron	---do
233	Horn stone	---do
234	Radiated quartz	---do
235	Silicious conglomerate	Mount Hood, O. T.
236	Silicious sinter	Hot Springs
237	---do	---do
238	---do	---do
239	---do	---do
240	Granite boulder	Upper Pit river
241	---do	---do
242	Porphyry	---do
241	Trap	---do
242	---do	---do
243	---do	---do
244	Jasper	---do
245	Obsidian	---do
246	---do	---do
247	---do	---do
248	---do	---do
249	---do	---do
250	---do	---do
251	Saline efflorescence	Des Chutes basin, O. T.
252	Red jasper	Shoalwater bay, W. T.
253	---do	---do ---do
254	Carnelian	---do ---do
255	---do	---do ---do
256	Agates	---do ---do
257	---do	---do ---do
258	Silicious stalactite	---do ---do
259	Silicious casts of shells	---do ---do
260	---do ---do	---do ---do
261	---do ---do	---do ---do
262	Ochery sandstone	---do ---do
263	---do	---do ---do
264	Auriferous sand	---do ---do
265	Tooth of fossil horse	---do ---do
266	Fossil plant	Bellingham bay, W. T.
267	---do	---do ---do
268	---do	---do ---do
269	---do	---do ---do
270	---do	---do ---do
272	---do	---do ---do
273	Malea ringens, (figured)	Isthmus of Darien
274	Turritella altilira. Con	---do ---do
275	---do--- Gatunensis. Con	---do ---do
276	Triton	---do ---do
277	Cytherea, (Meretrix Dariena.) Con	---do ---do

CATALOGUE—Continued.

No.	Name.	Locality.
278	Pandora bilirata. Con	Santa Barbara, California
279	Cardita occidentalis. Con	do do
280	Diadŏra crucibuliformis. Con	do do
281	Dosinia alta. Con	Monterey, California
282	Pallium estrellanum. Con	Estrella valley, California
283	Janira bella. Con	Santa Barbara, California
284	Arca trilineata. Con	do do
285	Arca congesta. Con	do do
286	Axinea Barbarensis. Con	do do
287	Mulina densata. Con	do do
289	Dosinia longula. Con	Monterey, California
290	Schizopyga Californiana. Con	Santa Clara, California
291	Cryptomya ovalis. Con	Monterey, California
292	Thracia mactropsis. Con	do do
293	Mya Montereyana. Con	do do
294	Mya subsinuata. Con	do do
295	Arcopagia medialis. Con	do do
296	Tapes linteatum. Con	do do
296	Arca canalis. Con	do do
297	Pecten Pabloensis. Con	San Pablo bay
298	Nucula	do
299	Mactra	do
300	Tellina	do

PART III.

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

ROUTES IN CALIFORNIA AND OREGON EXPLORED BY LIEUT. R. S WILLIAMSON, CORPS OF TOPOGRAPHICAL ENGINEERS, AND LIEUT. HENRY L. ABBOT, CORPS OF TOPOGRAPHICAL ENGINEERS, IN 1855.

BOTANICAL REPORT.

WASHINGTON, D. C.
1857.

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BY J. S. NEWBERRY, M. D.,
GEOLOGIST AND BOTANIST OF THE EXPEDITION.

LIST OF ILLUSTRATIONS.

LITHOGRAPHS.

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No. 1.

REPORT UPON THE BOTANY OF THE ROUTE.

BY JOHN S. NEWBERRY, M.D.,

BOTANIST OF THE EXPEDITION.

CHAPTER I.

GEOGRAPHICAL BOTANY.

Influences affecting the botanical character of the region between San Francisco and the Columbia.—Laws controlling the distribution of species at present not understood.—Novelty of botanical character of this region.—Variety of annual plants.—Small number of trees.—Preponderance of Coniferæ.—Climate.—Geological structure.—Local botany.—Coast mountains.—Climate.—Causes affecting it.—Vegetation.—Forests.—Shrubs.—Ferns and mosses.—Sacramento valley.—Climate, character of seasons.—Vegetation.—Its annual character.—Timber belts.—Local botany.—Wild oat.—Oak groves.—Shrubs.—Tule.—Character of soil.—Timber belts and thickets along the river banks.—Botany of Sierra Nevada.—Its unity of character.—Forests.—Local botany.—Zones of vegetation.—Annual plants.—Botany of the district east of Sierra Nevada and the Cascades.—Uniformity of vegetation.—Sage plains.—Yellow pine forests.—Local botany.—Bunch grass.—Annual plants.—Botany of Klamath lake.—Botany of the Des Chûtes basin.—Botany of the Cascade mountains.—Belts of vegetation.—Forests of Willamette valley.

The influences which have given character to the flora of the region lying between San Francisco and the Columbia, both as regards its botanical relations and the distribution of the plants which compose it, as in other countries, have been connected with its geological structure, its topographical features, and its climate.

To these causes, which are very appreciable in their action, and which have produced by far the most striking phenomena presented by the vegetation of the west, another should be added, that which has controlled the radiation of species from their original centers of creation.

The operation of this latter cause, though perhaps not less real, is far more obscure, requiring for its analysis an array of facts much greater than has yet been collected. This has, therefore, been entirely neglected, except in the few instances where plants are common to both sides of the continent, and an effort has been made to connect their eastern and western habitats. When the botany of the west shall come to be known far better than at present, we may expect that the physiological laws which have controlled the distribution of plants may be studied with equal profit with the more material influences of which I have spoken.

At present any hypotheses in reference to them, however plausible they may appear, must necessarily involve so much uncertainty, that they should be regarded as speculations rather than generalizations of fact. And in the future, by whomsoever theories on this subject may be suggested, and whatever weight or personal influence may be thrown into the scale, that personal influence must be carefully eliminated, and the facts permitted to stand isolated and independent, until, without compulsion, they shall crystallize into truths.

The botanist going from the valley of the Mississippi to the Pacific coast, will be immediately struck by certain general differences which he will perceive to exist between the vegetation of the region he has left and that to which he has come. The first feature in the aspect of the botany of the west, which he will be likely to notice, is the paucity of arborescent and the variety of annual plants.

The forests he finds restricted, for the most part, to the sea coast and the mountain sides, and exhibiting a great preponderance of coniferous over dicotyledonous trees. The forms of vegetation by which he is surrounded in these forests are among the most magnificent which the world affords, and nearly all are new to him. He may traverse the country for weeks, perhaps months, before he meets with a tree with which he has been familiar on the eastern side of the continent, and when he finds such an one, it exhibits a growth and appearance so different from that of the same tree at the east as to be not immediately recognized. The number of forest trees, exclusive of shrubs, found growing north of San Francisco and south of the Columbia, does not, probably, exceed fifty. These are distributed among the following genera: *Pinus*, 8; *Abies*, 5; *Picea*, 3; *Sequoia*, 2; *Cupressus*, 2; *Thuja*, 1; *Libocedrus*, 1; *Larix*, 1; *Taxus*, 1; *Torreya*, 1; *Quercus*, 5; *Populus*, 3; *Salix*, 5; *Fraxinus*, 2; *Acer*, 2; *Alnus*, 1; *Cornus*, 1; *Platanus*, 1; *Castanea*, 1; *Æsculus*, 1; *Arbutus*, 1; *Oreodaphne*, 1. Both in numbers of individuals and in size, the *coniferæ*, as has been mentioned, greatly preponderating. The annual vegetation which covers the prairie country of the valleys also presents an assemblage of forms quite new to the eastern botanist, and among them he will not fail to notice a greater relative number of liliaceous plants than in any part of the eastern States. The different mountain ranges he finds covered with vegetation which exhibits marked differences, and the areas which lie between and eastward of the coast ranges and Sierra Nevada, have each a flora so far peculiar to itself as to permit of its study in a degree apart from the others.

In order to trace the connection which exists between the physical geography of the region under consideration and the character and distribution of the plants which cover its surface, a general idea of the topography,* the climate, and geological structure of the different districts which it includes, is necessary.

Climate.—As is generally known, the climate of the Pacific coast, as compared with that of the Atlantic and the valley of the Mississippi, is much more equable, presenting no such extremes of heat or cold as that of the east, while the isothermal lines, when traced westward, are deflected to the north, striking the Pacific coast several degrees higher than the points where they pass that of the Atlantic. This seems to be due, in a great degree, to the influence of the prevalent westerly winds, which, constantly blowing in from the Pacific, assume the uniformity of temperature of the surface over which they pass. In the valleys of California the seasons are divided into wet and dry, rather than into cold and hot, while on the mountains snow falls to a considerable depth, and the severity of winter is proportioned to the altitude of the locality and its distance from the ocean. The summer temperature varies greatly in different localities, being extreme in the valleys of the interior, while in the mountains and on the coast a degree of heat is never suffered which is at all oppressive.

The annual precipitation of moisture exhibits even greater local variation than the tem-

* *Note by Lieut. Abbot.*—This subject is fully treated in Chapter I of the General Report.

perature, being greatest toward the coast and northward, less on the southern than northern coast, and least in the interior.

Geological structure.—The geology of that portion of California and Oregon under consideration has been given somewhat in detail in the accompanying geological report. It will, therefore, not be necessary to repeat what has already been said upon the subject. The general characteristics of the geology of this region may, however, be said to consist in the great prevalence of comparatively recent volcanic rocks, and of a soil derived from their decomposition, in all the mountain ranges. In the valleys, and on the flanks of the coast mountains, tertiary strata, generally of sandstones, constitute the sub-structure, and give character to the soil. As compared with the valley of the Mississippi, and the more northern of the eastern States, the Pacific coast is much more recent, the greater part of it having emerged from the ocean since the middle of the tertiary period.

LOCAL BOTANY.

COAST MOUNTAINS.

Climate.—The climate of the immediate shore of the Pacific is quite unlike that of the interior, a difference dependent upon its proximity to the evaporating surface of the ocean, the ocean currents, and the prevalent winds. It is much more uniform, cooler, and more moist. The uniformity of temperature which it exhibits is due, unquestionably, to the equalizing influence of the nearly constant temperature of the wide expanse of open sea which lies adjacent to it, and over which the winds blow inland, almost without intermission, throughout the year. These winds, which are loaded with moisture, in summer usually blow from the northwest or west; in winter, from the southwest or west. The temperature upon the coast scarcely ever rises to what is called summer heat, and is never so high as to render other than woollen clothing comfortable. From observations* made at San Francisco, Fort Humboldt, and Fort Orford—localities which may be supposed to present fair samples of the climate of the coast—we find that the average temperature for the year, taking the mean of the observations of several years, is, for San Francisco, 54°.88; for Fort Humboldt, 52°.80, and, for Fort Orford, 53°.62. At San Francisco, the mean temperature for January being 49°.60; for July, 57°.90. At Fort Humboldt, for January, in 1854, 40°.83; for July, 56°.71. At Fort Orford, for January, 48°.38; for July, 59°.73. The low summer temperature of the Pacific coast of the North American continent, like that of the Atlantic, seems to be due to the Arctic ocean current, which constantly sweeps it. The amount of rain falling at the same points, as indicated by the same tables, is, at San Francisco, 23.59 inches; at Fort Orford, 68.52.

Vegetation.—The coast mountains, throughout nearly the entire distance from San Francisco to the mouth of the Columbia, are covered by a continuous forest, which is more dense towards the north. Immediately north of San Francisco the forest is composed almost exclusively of the red-wood, (*Sequoia sempervirens,*) and is limited to the valleys, especially such as open towards the coast. Going northward the trees become more numerous, and with the red-wood are found the sugar and yellow pine, (*P. Lambertiana and P. ponderosa.*) In the vicinity of Crescent City these trees combine to form one of the most magnificent forests in the world—the red-wood and the sugar pine attaining nearly equal gigantic dimensions; trees of both species being not uncommon 12 to 15 feet in diameter, and 300 in height. Near the line of 42° a marked change is noticed in the trees which constitute the forest, which is even, perhaps, more dense than

* Medical Statistics U. S. A.

below. This is the northern limit of the red-wood. Thence northward, it is succeeded by the western white cedar, *Thuja gigantea*—Douglas' & Menzies' spruces; and these form the dense and almost impenetrable coating of vegetation which covers the coast mountains from Port Orford to the Columbia—Douglas' spruce here attaining its greatest dimensions, fully equalling those of the red-wood and sugar pine.

In the valleys of the Umpqua and other rivers, which discharge themselves into the ocean, *Quercus garryana* grows in groups and as solitary trees, in the open grounds. It attains a diameter of from 2 to 3 feet, and assumes the low and spreading form common to the oaks of the valleys of California and Oregon.

The undergrowth of the coast mountains is composed of so large a number of plants as to forbid their enumeration. Near San Francisco the shrubby undergrowth is made up, in a great degree, of the "wild lilac," (*Ceanothus thyrsiflorus,*) *Ceanothus rigidus*, and the bush lupine, (*Lupinus macrocarpus.*) About Port Orford, and thence northward, the "salmon berry" (*Rubus spectabilis*) is a conspicuous feature in the vegetation. It here grows to the height, sometimes, of six or eight feet, and bears a profusion of fruit, which is very attractive in appearance, and sometimes of excellent flavor. Thickets of *Rhododendron maximum* are of common occurrence, and by their stiff and tangled branches frequently form a serious obstacle to the progress of the traveller. Towards the Columbia, thickets, similar in appearance and character, are formed by *Ceanothus velutinus.* In the spruce forest, where not so dense as to exclude all undergrowth, the ground is covered with a carpet of the "salal" (*Gaultheria shallon*) and the Oregon grape, (*Berberis pinnata.*) Ferns and mosses grow in great abundance in some localities, furnishing very good indices of the moisture of the climate. Among the ferns, *Aspidium munitum* is the handsomest, *Pteris aquilina* the most abundant. Where the forest has been burned off, this last mentioned fern takes exclusive possession of the surface, and grows so dense and tall as to make the passage through it painful, even for one on horseback. In the transverse chains of mountains which run back from the coast to Mount Pitt and Mount Shasta, *Pinus Lambertiana*, *Pinus ponderosa* and *contorta*, *Picea grandis*, and, perhaps *Picea amabilis*, reach down nearly to the seashore.

SACRAMENTO VALLEY.

The geological structure of the Sacramento valley, with the characteristics of its soil, are given at some length in the second chapter of the accompanying geological report.

Climate.—The climate of the Sacramento valley affords a marked contrast to that of the coast. While the temperature in winter is never so low but that the grass is constantly green, and flowers, in the southern portions, perpetually in bloom, in summer the heat is intense to a degree never experienced in any portion of the eastern States.

The rain-bearing winds from the ocean during this season are either entirely excluded by the wall which bounds the valley on the west, or pass over to the Sierra Nevada, depositing none of their moisture. From May to November rain almost never falls, and neither clouds nor mist are seen during the greater part of that time. The effect of the sun's rays, beating down without obstruction into this enclosed area, is to elevate the temperature of the air frequently to 112°—115° Fah. in the shade, and to dry up and parch the surface to such an extent that the growth of annual plants is arrested as completely as by the snows and frosts of the winter of the northern Atlantic States. With the return of the autumnal rainy season vegetative life is again called into vigorous action, and the country, which a few weeks before was a desert, is now transformed into a flower garden.

Vegetation.—The peculiar climate which I have described has given to the Sacramento a vegetation very different from the district last considered. During the winter and spring the ground is saturated with moisture, and is everywhere covered with a dense growth of herbaceous plants.

After the month of May, however, the process of evaporation succeeds that of deposition, and by July the soil is dry and deeply cracked by the sun. The causes above enumerated have doubtless been most efficient in giving the Sacramento valley its broad expanses of prairie, and limiting the trees to a narrow belt bordering the streams; these timber belts being also governed as to their width and density by the magnitude of the streams which they follow, and the quantity of moisture derived from them, absorbed by their roots from the earth, or by their leaves from the air. Another feature of the climate of the Sacramento valley, common, also, to all the interior of California and Oregon, has had its effect in determining the character of the vegetation. From the fact, already mentioned, of the entire absence, during summer, of clouds or mist, the sun's rays are not only permitted to fall with extreme power upon the surface during the day, but the moment the heat ceases to be received from the sun it is radiated into space with equal facility, and, as a consequence, the nights are always cool—the mercury falling from above 100° to 75°–70° Fahr. during the night. The result of all these influences is, that the vegetation covering the greater part of the surface of the valley is not only annual in character, but runs through all its changes during the winter and spring; most of the plants having formed, and many of them cast, their seed before the 1st of July. Hence many of the wild and cultivated plants which occupy in their growth the whole of the tropical summer of the eastern States would not flourish here. Of this class, the Indian corn may be regarded as a typical example. We may here find the reason why its cultivation in California has been but partially successful.

LOCAL BOTANY.

The immense area in central and southern California, including the greater part of the Sacramento and San Joaquin valleys, as well as those portions of the coast mountains not occupied by forests, is covered with an almost uninterrupted growth of wild oat, (*Avena fatua.*) This plant is regarded by our best botanists as an importation from the Old World, and yet very few of those who see it as it grows in California can be made to believe that it was introduced by the early Spanish settlers, and is only naturalized, not indigenous. It now covers surfaces of many hundreds of miles in extent, both hill and plain, as completely as the grasses cover the prairies of Illinois. In early summer the districts where this plant prevails have all the appearance of being under high cultivation. The oat resembles very closely that cultivated at home, and frequently stands as thick on the ground as the grain in our fields. The hills and mountain sides bordering the bays of San Francisco and San Pablo are generally covered with the wild oat, and are destitute of trees, except that here and there, in the ravines and on the more broken surfaces, are a few grouped or scattered evergreen oaks, laurels, and buckeyes. Of these, the oaks (*Quercus agrifolia*) are low and spreading, having much the appearance of the apple trees in our orchards, and, combined with the wild oat, give to the country a civilized and cultivated aspect. On the low lands, bordering the bays I have mentioned, a great variety of flowering annuals find a place, and on the richer slopes of the hills dispute possession with the wild oat. These plants give the gay and varied appearance to the botany of the region, which has been remarked by all who have visited it at the proper season.

In the valleys of Napa and Sonoma the climate is intermediate in character between that of the coast and the interior, the extremes of each being tempered to produce a mean in the highest degree healthful, agreeable, and favorable to the development of vegetation. Here we find, besides a great profusion of annual plants, the California white oak, (*Q. Hindsii,*) which grows solitary or grouped in the manner of the evergreen oak, but attaining a much greater size. Here also, for the first time, we met with the nut pine, (*P. sabiniana,*) a tree highly characteristic of the flora of the interior, and generally distributed through the coast mountains back from the ocean. The *Manzanita* and several species of *Ceanothus* form shrubby clumps and thickets. Here, as elsewhere in this region, the lupins, one of which (*L. macrocarpus*) is shrubby, form a marked feature in the vegetation. About Benicia, the rounded hills are everywhere covered with wild oats, and no trees are visible except the evergreen oak, which forms low and limited groves in the ravines among the hills and on the slopes of Mount Diablo. The shores of Suisun bay, as well as the borders of the lower Sacramento and San Joaquin rivers, exhibit wide expanses of tule, (*Scirpus lacustris,*) which forms in its abundance a striking peculiarity of the botany of all portions which we visited of California and Oregon. The reasons for the prevalence of this plant are, however, probably to be found in the imperfect drainage of much of the surface, rather than in any peculiarities of soil or climate. The low lands bordering the belt of tule which encircles Suisun bay, are in many places covered and reddened by the *Canchalagua* (*Erythrea Muhlenbergii.*) The botany of Suisun valley exhibits many of the characteristics of that of the valleys of Napa and Sonoma. The soil, which is, for the most part, derived from the decomposition of sandstone rock, was originally covered with the wild oat, which here grows in great luxuriance, and with beautiful trees of the Californian white oak, (*Quercus Hindsii.*) A large part of the surface is now under cultivation, and at the time we traversed it was covered with wheat just ready for the reaper. It exhibited a vigorous growth, and, as I was informed by the farmers, produced from 25 to 50 bushels to the acre; the yield being greatly affected by the degree in which the great want of the region, that of water, was supplied.

At Vacaville we left the foot hills of the coast mountains, traversing the valley of the Sacramento diagonally to the foot hills of the Sierra Nevada, near the upper end of the valley. The rolling surface of the foot hills, on either side of the Sacramento, is covered with wild oat, scattered trees of the oaks I have mentioned, and, in the more rocky places, the nut pine. The plain bordering the river exhibits surfaces of different characters, and covered with differing vegetation. The upper terrace is frequently gravelly, and sustains a sparse growth of coarse grasses, of *Eryngium*, *Hemizonia*, *Madaria*, and other rough or viscous plants; such surfaces being comparatively sterile and of little value for cultivation. The alluvial plain immediately bordering the river possesses a fine and fertile soil, and is covered with a dense growth of wild oat, *Artemisia*, and other plants. The banks of the streams are lined with belts, of greater or less width, of timber, which are composed chiefly of the long-acorned oak, (*Q. Hindsii,*) here exhibiting a size and beauty of form not surpassed, if equalled, by the oaks of any other part of the world. Along the water's edge, the sycamore, (*P. Racemosa,*) *Fraxinus Oregona*, the cotton-wood, (*P. Monilifera,*) and two species of salix, (*S. Hindsiana* and *S. lasiandra ?,*) are overgrown by grape vines, (*Vitis Californica,*) and form a screen, by which the view of the river is frequently shut out from the traveller upon its banks. At the north end of the valley, along the river, and on the hills which border it, are found many plants not met with below. Of the trees, *Q. Hindsii*, *Q. Garryana*, and *Q. Agrifolia*, the "nut pine," and cotton-wood, were the most common. Among shrubs, on the higher lands, were the *Manzanita*, *Fremontia*, and *Ceanothus cuneatus*, here forming thickets; near the river bank, *Cephalanthus occidentalis*, *Cercis occidentalis*, *Calycanthus occidentalis*, *Eriodictyon glutinosum*, *Rhus diversiloba*, *Alnus viridis*, and *Alnus Oregana*, the latter forming a tree fifty feet in height.

BOTANY OF SIERRA NEVADA.

The Sierra Nevada, with its continuation, the Cascade range of Oregon, forms a distinct botanical district, characterized not only by the presence of many plants not found on the Coast Range or in the valleys, but by the prevalence of certain species throughout this entire mountain system. Its general altitude and the peaks, which, at many points, rise high above the line of perpetual snow, give an Alpine character to much of its vegetation, even in a low latitude. From the observations of many botanists who have crossed the Sierra Nevada in southern California, we learn that the different zones of vegetation which mark the different grades of altitude include many plants which, on the less elevated surfaces, are separated by several degrees of latitude. Of these, the Douglas spruce, the western balsam fir, and several other trees which compose a large part of the forests covering the banks of the Columbia, extend at a higher elevation quite to the northern line of Mexico. The number of these widely distributed species, among which should also be included very many annual plants, gives a unity of character to the botany of this mountain range which requires it to be regarded as a distinct botanical district. The influences which have most contributed to form or modify this flora are probably to be found in the continuity and the uniformity of geological structure and altitude of this mountain system, the similar relations which its different parts hold to the ocean from which they derive the marked similarity of their climate.

The western slope of these mountains receives a copious precipitation from the winds coming in from the Pacific over the coast ranges and the valleys. As a consequence, it is generally clothed with a dense forest. This forest is composed almost exclusively of coniferous trees, and, with the exception of the red-wood, includes all those gigantic forms of vegetation so characteristic of the botany of western America. On the western slope of the Sierra Nevada, in California, is found the famous group of Sequoias, which, from their unequalled magnitude, have very properly received the name of *gigantea*, in common language only known as the "mammoth trees." The yellow pine, (*P. Ponderosa*,) the sugar pine, (*P. Lambertiana*,) the western balsam fir, (*Picea grandis*,) and (*Libocedrus decurrens*,) comprise the greater part of the forests which cover this slope as far down as the latitude of San Francisco; the yew, (*Taxus brevifolia*,) and two species of cypress, (*C. nutkatensis and C. Lawsoniana*,) being also occasionally met with. Among the foot hills, at a lower level, the nut pine mingles with the oaks, reaching up to the pine forests above, but scarcely forming a part of them. In the same zone are *Quercus fulvescens*, *Quercus densiflora*, and *Quercus Kelloggi*, which do not, however, occur in any considerable numbers.

LOCAL BOTANY.

In crossing the Sierra Nevada, over the base of Lassen's butte, for twenty miles our route, gradually ascending, led among grooves of the three species of oak which I have mentioned as prevailing about Fort Reading, with scattered trees of the nut pine, the greater part of the surface being, however, covered with thickets of *Ceanothus, Purshia, Spiræa, Amelanchier, Cercis, Fremontia, Manzanita,* a low scrub oak, (undescribed,) and a wild plum, (*P. subcordata.*) At an altitude of about 3,000 feet we entered a dense forest composed—with the exception of a single oak, (*Q. Kelloggi,*)—of coniferous trees, the sugar and yellow pine, *Libocedrus,* and balsam fir, all attaining a very large size. At McCumber's, at an elevation of 4,000 feet, the forest was composed exclusively of coniferous trees, and was, in many places, very dense. The natural meadows, of which McCumber's flat is one, are covered with a luxuriant growth of annual plants, of which I collected nearly a hundred species in a few hours. As a whole, however, the catalogue does not differ greatly from one which might be made at Fort Reading, or in Sacramento valley, earlier in the season; but while, at this time, (July 29,) the plains of the Sacramento were completely dry, and the flowers of spring had long since passed, here everything was fresh and green, and the meadows were decked with flowers at the period of their greatest beauty. In the pine forest, the snow berry, (*Symphoricarpus,*) *Rubus nutkanus, (a variety of R. odoratus?) and Epilobium angustifolium,* grow everywhere, and the ground is in many places covered with mats of *Ceanothus prostratus.* Lillies and fritillarias also form a marked feature of the pine woods here as elsewhere. As we ascended to the summit of the pass, at an altitude of about 5,000 feet, we left behind us most of the trees which I have mentioned, and found the forest of the higher portion of our route composed exclusively of the yellow pine. About the base of Lassen's butte, where, over a large area, the forest had been burned off, it has been succeeded by dense thickets of *Ceanothus* and *Manzanita,* and along the banks of a stream coming down from the snow I noticed a *Cornus,* having much the general aspect of *C. Florida,* of the eastern States, but evidently quite distinct, (*C. pubescens.*) On the eastern slope of Sierra Nevada we found the forests much less dense, and composed of a smaller number of elements. The yellow pine here formed nine-tenths of all the arborescent vegetation, and grows to a larger size than on the western side of the mountains. This slope is evidently not so well watered as the other, and even among the mountains, in various localities, we found level surfaces, of which the light volcanic soil supported only bunches of *Artemisia* and *Purshia,* with scattered yellow pine trees, outliers of the sage plains, so characteristic a feature of the region lying east of the mountains.

BOTANY OF THE DISTRICT LYING EAST OF THE SIERRA NEVADA AND CASCADE MOUNTAINS.

Descending to the eastward from the summit of the western range of the Sierra Nevada, we came into a region of which the geological structure and physical features are fully described in the geological report. The general monotony of the geological structure of this area finds a perfect parallel in the simplicity and uniformity of its vegetation. Throughout all the interval lying between the Cascades and Sierra Nevada and the Rocky mountains, the causes which have given character to the vegetation have been exceedingly general in their action. The climate is everywhere characterized by the absence of moisture, which, with the exception of the mountain summits, which project above the general level, gives to the surface a character to which the name of desert has not been inappropriately applied. The general aspect of the botany of this region is made up of three distinct elements. Of these the first is presented by the grassy plains which border the streams flowing down from the mountains. On these surfaces grows a considerable variety of annual vegetation, in its general character not unlike that of the Sacramento valley. The second of these botanical phases is that of the sage plains; surfaces upon which little or nothing else than clumps of Artemisia will grow. The third is formed by forests of yellow pine, (*P. ponderosa*,) which apparently finds on these arid surfaces its most congenial habitat. It sometimes happened to us that, during a whole day's ride, we were passing through a continuous forest of these yellow pine trees, in which scarcely a dozen distinct species of plants could be found.

LOCAL BOTANY.

BANKS OF PIT RIVER.

After leaving the Sierra Nevada, the botany of no part of our route, before we reached the Klamath lakes, requires especial notice. Most of the plants collected on the banks of Pit river are identical with those before collected in the Sacramento valley. On the mountain range which forms the upper cañon of Pit river we first found a cedar, (*J. occidentalis*,) which fills precisely the same place in the botany of the west that the red cedar of Virginia does in that of the east. We here, too, for the first time, met with the "bunch grass," (*Festuca scabrella*,) which is found in all parts of the region under consideration, and now constitutes by far its most important vegetable production. This is an exceedingly nutritious grass, and was our main dependance for the subsistance of our mules in all parts of our route, between the lower cañon of Pit river and the Columbia. It grows in bunches, as its name implies, and in that dry climate, "curing" as it stands, forms a valuable fodder, and one highly relished by cattle and horses, even when it has the appearance of being perfectly worthless.

SHORES OF THE KLAMATH LAKES.

About the Klamath lakes, and along the banks of Klamath river, a better supply of moisture has produced a more vigorous and varied vegetation than in most parts of the surrounding country. A large number of annual plants was there obtained, many of which are unknown in the valleys of California and Oregon, as will be seen by reference to the catalogue of the plants collected. The immediate borders of the lakes are covered with a growth of tule, (Bull-rush and Cat-tail flag,) similar to that which borders the Sacramento. On drier ground, but still in the vicinity of the water, are thickets composed of *Pyrus rivularis*, *Prunus subcordata*, *Rhamnus Purshianus*, and wild cherry, (*Cerasus emarginata*,) all of which, at the time of our visit, were loaded with fruit. On the hill sides are several species of *Ribes*, which, with the wild plum and *Amelanchier*, form another series of thickets equally fruitful with those below, and with them constitute the favorite feeding grounds of the bears.

The number of trees in this vicinity is small. A few cotton-woods and willows are found in the neighborhood of the water, while the hills are covered with yellow pine and the western cedar. On the banks of Klamath river we found *Pinus contorta*, generally forming a dense forest of trees of small size. The botany of Klamath marsh and the country about it is similar in all respects to that just described, except that nearly half the surface of the marsh is covered with the broad leaves of the yellow pond lilly, *N. advena?* here exhibiting a vigor of growth that I have never seen equalled in the eastern States. The capsules which contain the seeds have somewhat the form, and are fully as large as hen's eggs, and are filled with seeds, which form an important part of the subsistence of the Indians who reside in the vicinity.

BOTANY OF THE DES CHUTES BASIN.

The botany of this area has the general characters of that of Klamath basin, except that, as we descend towards the Columbia, the forest of yellow pine gives place to scattered trees of the western cedar, which are, in time, succeeded by a growth of bunch grass, covering the country as exclusively as does the wild oat the valleys of California. Near the Columbia, the streams are bordered by *Quercus garryana*, which does not, however, here attain the size of the same species in the valleys of the Willamette and Umpqua.

BOTANY OF THE CASCADE MOUNTAINS.

As has been mentioned, the general features of the botany of the Cascade mountains is similar to that of the Sierra Nevada of California, the greater portion of the species which compose it extending southward as far as San Francisco. There are, however, many species, both of trees and minor plants, which, quite local in their range, yet in certain districts represented by great numbers of individuals, give a peculiar character to the prevalent vegetation. There are other plants, which, common in the vicinity of the Columbia, do not extend southward below the California line. Of these the western larch, (*Larix occidentalis*,) and *Abies Williamsonii* may be taken as examples.

LOCAL BOTANY.

In the vicinity of the Three Sisters we several times crossed and recrossed the main crest of the Cascade mountains, and were able to study, very carefully, the different belts of vegetation visible on the mountain sides, from the snow line down to the Des Chutes basin, on the east, and to the Willamette valley on the west. At this point, the plain bordering the Des Chutes, having an altitude of about 4,000 feet, is covered with a continuous forest of yellow pine.

Along the streams coming down from the mountains are a few trees of the western larch, nowhere in this vicinity found at a much greater elevation than the plateau I have mentioned. With the larch are occasionally mingled *Populus tremuloides*, *P. monilifera*, and *P. angustifolia*. A few hundred feet up the mountain side the yellow pine is joined by the sugar pine and *Pinus contorta*, the western balsam fir, and Douglas' spruce, all of which combine to form a thick forest. With these also are occasionally seen few and small trees of the western *Arbor vitæ*, (*T. gigantea*,) and the large-leaved maple, (*Acer macrophyllum*.) A little higher we found *Pinus monticola* of Douglas, to me scarcely distinguishable from the white pine of the eastern States, and the silver fir, (*Picea amabilis*.) At the height of 6,000 feet the trees which I have mentioned had all given place to *Abies Williamsonii* and *Pinus cembroides*, which rise to the line of perpetual snow. As we descended toward the west these two species were again succeeded by those I have mentioned as occurring on the eastern slope, but mingled in different numerical proportions, the most abundant species, and those constituting the great mass of the forest, being the Douglas spruce, the balsam fir, and the western *Arbor vitæ*. Here we found, for the first time, the *Nootka cypress*, which was confined to the western slope of the mountains. The under shrubs of the forest, on the western slope, consisted of the chinquapin (*Castanea chrysophylla*,) *Rhododendron*, two species, *Arctostaphylos tomentosa*, and *Spiræa ariæfolia*, the ground being covered with *Berberis*, "Salal," and ferns, as in the forests of the coast mountains, to which that of the western slope is like in all essential particulars. On the alpine summits of the Cascades, at this point, were collected about fifty minor flowering plants, some of peculiar interest. Of these, *Menziesia empetriformis, Saxifraga Tolmœi*, and *Pentstemon Menziesii*, covered large surfaces with their flowers, and, with the gentians, recalled the heaths and other alpine plants of the Old World.

The Cascade mountains, in the vicinity of the Columbia, are covered with a forest similar in character to that which I have described, but in which by far the largest number of trees are Douglas' spruce and the western balsam fir. Here, as on the coast mountains, where the forests have been burned off, the ground is covered with a rank growth of *Pteris aquilina*. The banks of the Columbia, along the water's edge, are lined with cotton-woods, and in some places with Garry's oak.

The lower part of the Willamette valley is occupied by the densest forest which I saw at the west, composed principally of Douglas' spruce, here known as the red fir, the western balsam fir, called by the inhabitants the white fir, the hemlock spruce, and arbor vitæ. Of dicotyledonous trees almost the only ones are the large leafed maple, the vine maple, (*Acer circinata*,) and *Cornus Nuttallii*. The upper part of the valley consists, for the most part, of prairie, covered with a luxuriant growth of grass, while the borders of the streams are lined with oaks, as in the Sacramento valley. The annual vegetation, which is quite varied, includes a large number of species found in California, with others better suited to a more northern latitude and a moister climate.

CHAPTER II.

DESCRIPTIONS OF THE FOREST TREES OF NORTHERN CALIFORNIA AND OREGON.

ÆSCULUS CALIFORNICA, *Nutt.* The California Buckeye.
Æ. CALIFORNICA, *Nutt.* *Torr. & Gray, Flor.* 1, *p.* 251.
Æ. CALIFORNICA, *Nutt.* *Sylva*, 2, *p.* 69, *t.* 74.

Fig. 1.

Fig. 1. Leaves and flowers of *Æ. Californica*, ½ natural size, and a flower of the natural size.

Description.—A shrub, or low spreading tree; leaflets 5, lanceolate or elliptical, acuminate, narrowed toward the rounded base, serrulate, glabrous, glaucous, or colored below; flowers large in a dense thyrsus, six inches long by three in diameter; petals rose-colored, spreading widely, shorter than the stamens; calyx unequally 5-parted; stamens 5–6; fruit large, spheroidal, somewhat pointed, slightly tuberculated.

The Californian buckeye grows abundantly in most parts of the Sacramento valley, particularly on the banks of streams, in ravines, and about rocky ledges. It generally forms a diffusely branching shrub, eight to ten feet high, often flowering and fruiting freely at the height of five or six feet.

The largest individual which I saw was near Benicia; an upright tree some twenty feet in height, with an open spreading head; trunk about a foot in diameter near the ground; on it were growing several branches of mistletoe, (*Viscum flavescens.*)

The flowers are larger, and much more widely expanded than in Nuttall's figure, (l. c.) In this respect it differs strikingly from the eastern species. Another peculiarity indicated in the figure given, (fig. 1,) is the successive appearance of the flowers during most of the spring and summer. As late as the last of July, I found on each thyrsus a large number of unexpanded flower buds. From the beauty of the flowers, and the long time during which they continue to appear, it would be a highly valuable acquisition to the cultivators of ornamental shrubs in the eastern States.

The wood is soft, white, and brittle, like that of the other species of the genus.

Acer macrophyllum. The Large-leaved Maple.
A. macrophyllum. *Pursh. Flor.* 1, *p.* 267.
A. macrophyllum. *Hook. Flor. Bor. Amer.* 1, *p.* 102, *t.* 38.
A. macrophyllum. *Nutt. Sylva* 2, *p.* 76, *t.* 67.

The large leaved maple is commonly distributed throughout those portions of Oregon which we visited, the Cascade and Coast mountains, and the Willamette valley. It is usually found in the evergreen forests, always far outnumbered by the firs and spruces with which it is associated, but frequently forming a marked feature of the arborescent vegetation; its immense leaves making it conspicuous wherever seen.

Though much the largest of western maples, this species never attains the dimensions of the "hard" and "soft" maples of the east.

I do not remember to have seen an individual more than eighteen inches in diameter three feet from the ground, though, from the circumstances in which it usually grows, it is taller than its diameter would indicate.

The flowers, hanging in long racemes, are very ornamental, and, with the large pale green leaves, render it well worthy of cultivation for ornament.

The leaves are frequently more than twelve inches in diameter, though usually from eight to ten.

The wood of this maple is close-grained and hard, and furnishes almost the only hard wood timber attainable in the wooded portions of Oregon; the oaks being, for the most part, confined to the open country, and having a low spreading form, so as to furnish little good timber.

Acer circinatum. The Vine Maple.
A. circinatum, *Pursh., Flor.* 1, *p.* 266.
A. circinatum, *Hook. Flor. Bor. Amer.* 1, *p.* 112, *t.* 39.

It is perhaps doubtful whether this plant should be called a tree or shrub, as it has not the upright form of most trees, and rarely attains a greater diameter of trunk than five or six inches. It is exceedingly common throughout the coniferous forests of central and western Oregon, and is sure to bring itself to the notice of the traveller by the obstacles which it presents to his passage through the forests where it grows.

It has received its name from its peculiar habit, which is so far vine-like, that the slender trunks—several springing from the same root—arch over till the top touches the ground, when it takes root. Where the clumps of vine maple are numerous, and, as is frequently the case, they are contiguous, their intermingled and rooted branches constitute an almost impassable barrier to the traveller.

The vine maple requires considerable moisture for its vigorous growth, and it therefore becomes more and more abundant as one approaches the coast. There, in many localities, it forms thickets, which are regarded by the inhabitants as well nigh impenetrable.

The foliage of the vine maple in its general aspect resembles that of the sugar maple of the east. The wood is hard, heavy, and fine grained, and is much used for small articles, when these qualities are required.

Acer glabrum, Torr., and *Acer tripartitum*, Nutt., are shrubs, which are not uncommon in the Cascade mountains.

ARCTOSTAPHYLOS GLAUCA, *Lindl.* (Plate III.) Manzanita.
A. GLAUCA, *Lindl.*, *Bot. Reg. t.* 1791.
XEROBOTRYS GLAUCUS, *Nutt.*, *Trans. Amer. Phil. Soc.*

Description.—A large evergreen shrub, growing in clumps; bark red, exfoliating; leaves ovoid, smooth, coriaceous, entire, set vertically; flowers in terminal racemes, urceolate, pinkish white; fruit spheroidal, flattened, black, smooth; seeds triangular, rough.

This shrub is highly characteristic of the Californian flora, being abundant on all the hills and mountains, and extending northward into Oregon; near the Columbia, however, it is generally replaced by *A. tomentosa*, which has much the same habit, and is very closely allied to it, but apparently specifically distinct. The manzanita has received the Spanish name which it bears from a fancied resemblance of its fruit to a little apple.

It usually grows in clumps, six, eight, or ten feet in height, divided into many trunks, which are rarely larger than one's arm, covered with a red exfoliating bark.

The evergreen leaves are oval in form, about an inch in length, thick and shining, and (unlike those of most plants) are set vertically. The flowers are urn-shaped, considerably resembling those of some species of *Vaccinium*. The fruit grows in clusters, and is first white, subsequently red, and finally black. It has the form of a flattened spheroid, a quarter to three-eighths of an inch in diameter, and is nearly filled with triangular stony seeds. These seeds are covered by a pulp, which has the consistence and taste of that of the fruit of the "Black Haw."

The *manzanita* berry is regarded as eatable, and is the favorite food of the grizzly bear. It was frequently eaten by our party, but in most circumstances is too dry, and has too little flavor to be highly relished. As an ornamental shrub, the *manzanita* is well worthy of introduction into the parks and pleasure grounds of the eastern States; and since it grows up to the line of perpetual snow on the mountains of California, it would doubtless be hardy in any part of the Union.

The wood of this shrub is very dense and hard, of a reddish color, and somewhat resembles that of the apple tree. No use is made of it in the arts at present, except that rustic seats are sometimes formed from its crooked and twisted branches; for which purpose it is exceedingly well adapted.

MANZANITA.

Arbutus Menziesii, *Pursh.* The Madroña.
A. Menziesii, *Pursh.* *Flor.* 1, *p.* 282.
A. procera, *Dougl.* *Mss.* *Hook.* *Flor. Bor. Amer.* 2, *p.* 36.

Fig. 2.
Fig, 2. Branch with leaves and fruit of *A. Menziesii*, ½ natural size.
Fig. 2*a*. Flowers of *A. Menziesii*, ½ natural size.

Description.—A small tree, 25–30 feet high, 12 inches in diameter at base; bark exfoliating, green or reddish, according to the season, very smooth; leaves oval, petiolate, entire or sub-serrate, very smooth above, glaucous below; flowers urceolate, in elongated and clustered pubescent racemes; berries red, rough, many-seeded, ornamental.

The Madroña, as it is called in California, has a wide range on the Pacific coast. It is not uncommon in the Sacramento valley, and the largest trees of it which I saw were on the banks of the Willamette, in Oregon. It ranges north of the Columbia, and in that vicinity is called the laurel.

The large, thick and shining leaves, and the smooth and colored bark, give this tree a tropical look, recalling the *Magnolia grandiflora* of the southern States by its general aspect. The berries are red, (at least were so in Oregon in November,) and resemble morello cherries; when ripe they are quite ornamental, and are said to be sometimes eaten. They, with the rich foliage, flowers, and colored bark, render it one of the handsomest trees which I saw at the west. It is already adopted as an ornament to grounds in California, and is well worthy of an effort for its introduction into the eastern States.

The wood, like that of the manzanita, is very hard and fine grained.

CORNUS NUTTALLII. Nuttall's Cornel. *Nutt. Sylva,* 3, *p.* 51 *to* 97.

The general appearance of this fine species is much like that of *C. florida* in leaf, flower, and trunk, but in the size of all its parts it is without a rival in the genus. It grows abundantly in the dense forest bordering the Willamette and Columbia, at their point of junction, where it attains a height of 75 feet, and a diameter of 12—18 inches.

The wood is dense and hard, like that of *C. florida,* and is used by the inhabitants for similar purposes.

The fruit of *C. Nuttallii* is not, as represented in Nuttall's figure, (l. c.,) similar to that of the common "dogwood," but is consolidated into a compact capitulum, each drupe being compressed into a prismatic form by its fellows. The color of the drupe is scarlet, like that of *C. florida,* the extremity being black. The heads are an inch in diameter, and have a very pretty appearance on the tree.

OREODAPHNE CALIFORNICA, *Nees.* The Californian Laurel.
TETRANTHERA? CALIFORNICA. *Hook. & Arn. Bot. Beech. p.* 159 & 389.
LAURUS? REGIA. *Dougl. in Comp. Bot. Mag. v.* 2.
UMBELLULARIA CALIFORNICA. *Nutt. Sylv.* 1, *p.* 87.

Fig. 3.

Fig. 3. Leaves, flowers, and fruit of *O. Californica,* ½ natural size.

Description.—A tree of moderate size; foliage evergreen; leaves oblong-lanceolate, pointed, scarcely acute, reticulately veined; peduncles; axillary simple; flowers numerous, involucred; fruit roundish-elliptical.

The "California laurel" forms the handsomest dicotyledonous tree within the limits of the State. The foliage is dark green and lustrous, and persistent throughout the year. The tree, as generally seen, is of small size, twenty to thirty feet in height, and rather inclined to form groups of several individuals. It has very much the general appearance of the European laurel, (*L. nobilis,*) and is quite as ornamental.

It is said to attain, in some parts of California and Oregon, much greater dimensions than any individuals which I saw, and to form a very elegant and imposing tree.

The leaves, when rubbed or burned, give out a strong aromatic odor, which excites sneezing. The residents of California are very cautious about burning the plant, more especially the leaves, as it is said that a vapor is driven from them by the fire in the highest degree injurious. Of this there is, however, much doubt.

The fruit, which is accurately represented (half size) in the figure, is not usually globular, as has been stated, but somewhat elongated and elliptical. All that I saw was green or greenish yellow, but it is said to become purple when ripe.

FRAXINUS OREGONA. The Oregon ash.
F. OREGONA. *Nutt. Sylv.* 3, *p.* 59.

This forms a low spreading tree, which grows commonly along the banks of the Columbia. I also saw it on several occasions on tributaries of the Sacramento, in the upper part of the Sacramento valley.

I never saw it attaining a greater size than a foot in diameter by thirty to forty feet in height.

ALNUS OREGONA. The Oregon alder.
A. OREGONA. *Nutt. Sylv.* 1, *p.* 28, *t.*

The Oregon alder forms a tree sometimes of fifty to sixty feet in height, and is generally distributed throughout northern California and Oregon. Like other species of the genus growing along the banks of streams, its form is upright and handsome, and the trunk sometimes two feet in diameter near the ground.

The leaves are thicker, and, in large trees, smaller than those of *A. viridis* or *A. serrulata.* The wood is brittle, and not to my knowledge employed for any useful purpose.

POPULUS TREMULOIDES. The quaking aspen.
P. TREMULOIDES. *Michx. Flor. Amer.* 2, *p.* 243.

The aspen grows throughout all parts of the region east of the Cascade mountains and Sierra Nevada which we visited. It forms a marked feature of the vegetation of the slopes of these mountains where the forests of the higher lands border the sage plains of the central desert. It is here seen in long lines of trees of small size, marking the courses of the many mountain streams which are in summer absorbed by the arid surfaces of the plains soon after leaving the mountain sides. For a time we were often deceived by the poplars and willows, regarding them as indications of the presence of water, but we soon learned that they were only a sign that water was to be found in their vicinity at some time during the year.

Alders we found to be much better guides to water, as they will only follow the courses of the streams just so far as they are permanent, and no further; and we never failed, even near the close of the dry season, to find the roots of the alders washed by living water.

Castanea chrysophylla, *Dougl.* The western chinquapin.
C. chrysophylla, *Dougl. Hook. Flor. Bor.-Amer.* 2, *p.* 159.
C. sempervirens, *Kellogg. Proc. Cal. Acad. Sc.* 1, *p.* ——.

Fig. 4.

Fig. 4. Branch, leaves, male flowers, and fruit of *C. chrysophylla*, natural size.
Fig. 4*a*. Nut of *C. chrysophylla*, natural size.

Description.—An evergreen shrub or tree of California and Oregon. Leaves broad-lanceolate, acute, thick, entire, glabrous, dark green above; below covered with a golden-yellow powder; aments clustered at the ends of branches, two inches long, usually with a few female flowers at the base; nuts triangular, pointed; testa hard, of a light-brown color; each nut enclosed in a very spinous burr; fruit agglomerated; kernel eatable.

We found the chinquapin growing in great abundance in the mountains of California and Oregon. It usually forms a low shrub, fruiting freely when not more than three feet in height. In the Cascade mountains of Oregon, however, it forms a handsome tree thirty feet in height, having a grayish-green smooth bark, very much like that of the young chestnut. It is said sometimes to attain the height of sixty feet. The contrast of color between the upper and lower surfaces of the leaves has a fine effect, making the plant well worthy of cultivation for ornament. The nut contains a kernel which has an agreeable taste, and is much sought by the squirrels. The shell of the nut is much harder than that of the eastern chinquapin, and the two species are in all respects unlike.

It is quite common to find ripe fruit and freshly-blown flowers on the same plant at the same time; indeed, I think that was the general rule when the specimen figured was collected, on the head-waters of the Des Chutes river, in Oregon, August 30. Hooker's brief description (l. c.) is applicable to the plant wherever I saw it, except that he represents the aments as confined to the axils of the leaves, and to be not more than an inch in length; whereas I often found the aments not only in the axils of the upper leaves of a branch, but exclusively occupying the extremity. The aments in my specimen are twice as long as in his.

QUERCUS FULVESCENS, *Kellogg*. The Fulvous Oak.
Q. FULVESCENS, *K. Pro. Cal. Acad. Sc.* 1, *p.* 67 and 71.
Q. CRASSIPOCULA, *Torr. Bot. Whipple's Rep. p.* 137.
Q. CRASSIPOCULA, *Bot. Williamson's Report, p.* 365, *t. IX.*

Fig. 5.
Fig. 5. Branch of *Q. fulvescens*, with young fruit, half natural size.
Fig. 5*a*. Toothed leaf of *Q. fulvescens.*
Fig. 5*b*. Mature fruit, half natural size.

Description.—Tree of medium size, spreading; leaves oblong-ovate, acute, toothed, or entire; when toothed, teeth remote, acute, callous at point, confined to upper half of leaf; veins beneath villous; petioles fulvous; gland sessile; when young, flat, wheel-shaped, nearly concealed in the cup; when mature, long-ovoid, $1\frac{1}{2}$ in. long, 1 in. broad; cup saucer-shaped, thick, velvety, fuscous, enclosing 1 1-5 of the gland.

This pretty oak occurred on the line of our route only on the banks of Canoe creek, in the western range of the Sierra Nevada, northeast from Lassen's butte. It there formed rather a large shrub than a tree. It is, however, here near the northern line of its range; and on the

Sierra Nevada of central and southern California it is said to attain a greater size, but never to become a large tree.

The leaves were thick and shining above, glaucous below, having some resemblance to those of the golden-leafed chestnut. The acorns were small, flat, and nearly concealed in the smoothish, wheel-shaped cup. At that time I supposed that it was decidedly an over-cup oak. On my return to San Francisco, in the autumn, I learned, for the first time, from my friend Dr. Kellogg, the changes which take place in the development of the acorn. This finally emerges from the cup to a degree equal to that of any other of the Californian oaks. The cup retains, to a considerable extent, its original form, but is much thickened. The name *Crassipocula*, given to this species by Dr. Torrey, is very appropriate, but was anticipated by that of Dr. Kellogg.

Of the wood of *Q. fulvescens* I obtained no information, except that the small branches are tougher, and the wood apparently denser, than in most of the oaks of the west; of which, the wood, as a general rule, is brittle.

QUERCUS KELLOGGII, *Newb.* Kellogg's oak.
Q. TINCTORIA, var. CALIFORNICA. *Torr. Bot. Whipp. Rep. p.* 138.

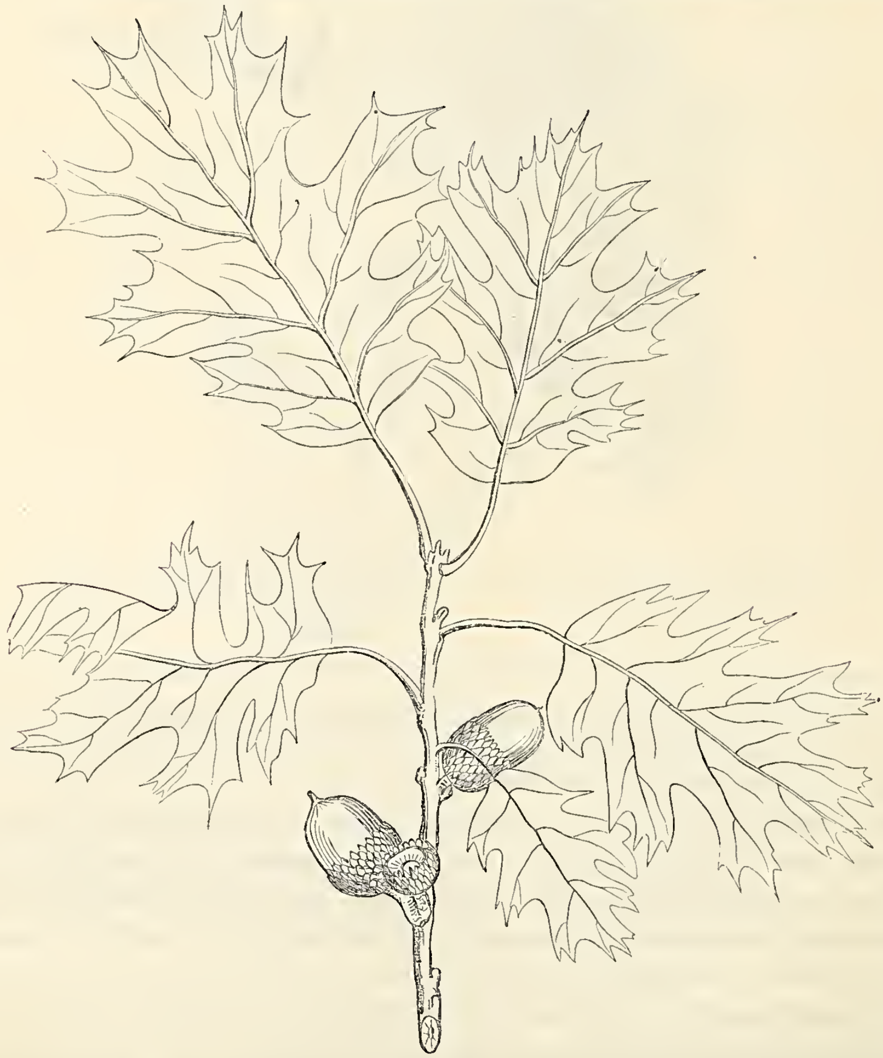


Fig. 6.

Fig. 6. Branch, leaves, and acorn of *Q. Kelloggii*, ½ natural size.

QUERCUS HINDSII.

Description.—A tree of medium size; leaves deeply sinuate, three principal lobes on either side, which terminate in several acute points, glabrous above and below. Fruit solitary or clustered, nearly sessile, gland roundish-ovoid, or, more commonly, elliptical, terminating in an accute projecting point, greenish brown in color, 1 to $1\frac{1}{2}$ inch long, cup hemispherical, covered with elongated acute scales.

This oak is found in different parts of California, but, apparently, does not extend northward beyond the Oregon line. I have specimens collected both south and north of San Francisco, in the coast mountains, and we found it occurring in considerable numbers between Fort Reading and Lassen's butte, on the western slope of the Sierra Nevada, in northern California. Where we observed it, it forms a tree of small, or, at most, moderate size, and of a straggling, irregular growth. About McCumber's it is the only deciduous tree growing in the pine forest.

Its resemblance to *Q. tinctoria* and to *Q. coccinea* of the eastern States is striking, but it is difficult to say to which it is most closely allied. The leaves are smoother and the lobes more acute than is usual with those of *Q. tinctoria;* in these respects more resembling *Q. coccinea.* In the general aspect of the trunk and bark it is, however, more like *Q. tinctoria.*

The fruit is much larger and generally of a different form from that of either of the allied species, the acorn being frequently more than an inch in length by $\frac{5}{8}$ of an inch in diameter; when fully grown they are rather cylindrical than ovoid, uniformly rounded at the ends, and with a prominent point at the summit. The cup is hemispherical, covered with ovoid acute scales.

The differences of habit from the eastern species which it exhibits, as well as the differences of leaves and fruit, lead me to regard it as distinct; and I have dedicated it to my friend Dr. A. Kellogg, of San Francisco, who is devoting himself with so much industry and success to the study of the plants of his adopted State.

QUERCUS HINDSII. (Plate I.) The long-acorned oak.
Q. HINDSII. *Benth. Bot. Sulph. p.* 55.
Q. LONGIGLANDA. *Torr. Frémont's Geog. Mem. of California.*

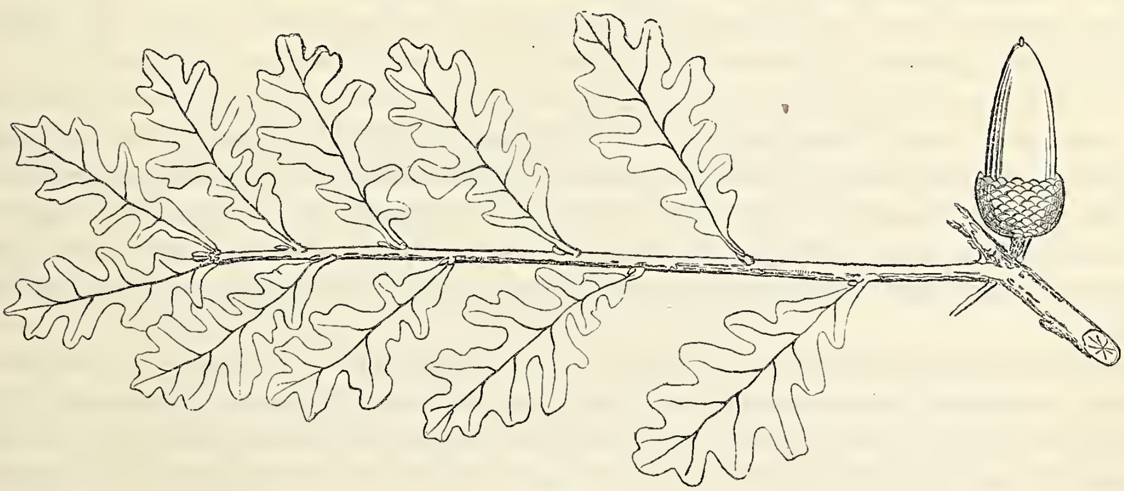


Fig. 7.

Fig. 7. Branch, leaves, and acorn of Q. Hindsii, $\frac{1}{2}$ natural size.

Description.—A very large tree, allied to *Q. alba* of the eastern States; bark thick and rough; leaves deeply and unequally lobed; lobes numerous, rounded, obtuse; young leaves pubescent on both sides; upper surface of older leaves smooth, pale green; lower surface pubescent, especially along the veins. Fruit sessile, generally solitary; cup hemispheric, thick, covered with thick tumid scales which give it a turberculated appearance; gland long-ovoid or conical, 2 inches long by $\frac{5}{8}$ inch wide; testa thin, mahogany color; nucleus not unpalatable.

This is the finest oak of California, and perhaps the most abundant. Its favorite habitat is on the slopes of the "foot hills" and along the streams which traverse the valleys of that State. In the foot hills and minor valleys of the Coast mountains and Sierra Nevada it grows in groups or scattered as single trees over the oat-covered surface, forming the most important element in those scenes of quiet beauty which so often excite the admiration of the traveller in California.

Along the streams it forms belts of timber of varying width and density, the number and size of the trees being apparently proportioned to the size of the stream and the quantity of moisture derived from it.

On the banks of the Sacramento, in a few instances, I saw this oak when considerably crowded, assuming the form and closely copying the appearance, in all respects, of the white oak of the east; but, generally, both on the hills and on the plain, it inclines to form groups, or open groves in which the trees assume the spreading form of *Q. pedunculata* in the parks of the Old World.

I think that the finest studies of trees which I have ever seen were afforded by the groups or single trees of this oak in the Sacramento valley.

The general character of this tree is pretty well represented by the accompanying plate, but it is frequently still more spreading. The trunk is often six, seven, or even eight feet in diameter, and covered with a thick and deeply cracked but light colored bark. At the height of ten or twelve feet from the ground the trunk divides into many branches, which throw out their huge arms nearly horizontally to the distance of fifty or sixty feet on either side, the extreme branches in some cases coming quite down to the ground. Near Marysville I measured one—by no means the largest one seen—of which the trunk, three feet from the ground, was six feet in diameter; the height is estimated at seventy-five feet; the circle shaded by its branches measured one hundred and twenty-five feet in diameter.

The beauty of these oaks is frequently mentioned in my notes, from which I will make a single extract, referring to those which form the belt of timber bordering Cache creek.

"This timber belt is composed of the most magnificent oaks I have ever seen. They are not crowded as in our forests, but grow scattered about in groups or singly, with open grass-covered glades between them; the trunks, often seven feet in diameter, soon divide into branches, which spread over an area of which the diameter is considerably greater than the height of the tree. There is no under growth beneath them, and as far as the eye can reach, when standing among them, an unending series of great trunks is seen rising from the lawn-like surface."

The wood of this tree, like that of most of the diciduous trees of California, is porous and brittle; resembling in its want of tenacity that of the black oak, *Q tinctoria*, of the east. This I infer to be due to the climatal conditions under which it is found, rather than to any inherent botanical peculiarity of the tree; as from its affinity with the white oak of the eastern States, if grown in the same soil and climate the wood, in all probability, would exhibit a similar character.

The fruit, though having a noticeable resemblance in the color, thickness, and consistence of the testa of the acorn, as well as in the character of the cup, to that of the white oak, from its conical form and great length, is readily distinguishable from that of any other species with which I am familiar. From their abundance and edible nature they form a very important part of the subsistence of the Digger Indians, and are collected and stored up by them for winter use; piles of many bushels being frequently seen in their *rancherias*.

QUERCUS DENSIFLORA. *Hook. & Arn.* The California chestnut oak.
Q. DENSIFLORA. *Hook. & Arn. Bot. Beechey, p.* 391.
Q. ECHINACEA. *Hook. & Arn. Bot. Whipple's Rep., p.* 137.

Fig. 8.
Fig. 8. Branch with leaves and fruit of *Q. densiflora*, half natural size.

Description.—An evergreen tree of small size; leaves lanceolate, oblong; smooth or dentate-serrate; the younger ones tomentose beneath, becoming smooth. Male flowers in elongated, densely flowered aments; fruit sessile, generally clustered; cup densely covered with spreading or recurved elongated scales; acorn ovoid, sub-trigonal acute, $1\frac{1}{4}$ inch long, $\frac{3}{4}$ inch broad; acute, testa very woody and hard, of a light yellowish-brown color.

I have been quite unable to distinguish between *Q. densiflora*, described by Hooker and Arnott, (l. c.,) and *Q. echinacea* of Dr. Torrey. There is a perfect correspondence in their descriptions, and my specimens agree with both except in the minor characters specified in the description given.

The resemblance to a *castanea* which this oak exhibits is, as mentioned by Hook. & Arn., very striking. The leaf is very like that of a chestnut, and the male aments, at the base of which a cluster of acorns grow, the bristling spines of the capsules and the sub-trigonal hard shelled acorn, closely resemble the flowers and fruit of *Castanea chrysophylla*, the chinquapin of the west. We did not find this oak north of the Sacramento valley, and its range is probably rather south than north of San Francisco. On the foot hills of the Sierra Nevada bordering the Sacramento valley it forms a low but handsome tree. Of the character and value of the wood I had no opportunity of judging.

The figure given is copied from a drawing made by Dr. Kellogg, of San Francisco, and represents the variety of foliage which most resembles that of the chestnut. An equally common form has nearly entire leaves, of smaller size, approaching more closely those of the chinquapin.

Quercus agrifolia, *Nee.* The evergreen oak.
Q. agrifolia, *Nee. Ann. Sc. Nat.* 3, *p.* 271.
Q. agrifolia, *Nutt. Sylva.* 1, *p.* 5, *t.* 2.
Q. oxyadenia, *Torr. in Sitgreaves' Rep.*, *t.* 172.

Fig. 9.
Fig. 9. A branch of *Q. agrifolia*, with leaves and fruit, half natural size.

Description.—A low spreading tree; leaves evergreen, ovate or rounded, remotely spinosely, dentate or entire, smooth above and below; acorn elongated, conical, acute; cup hemispheric or conical; scales small, appressed, oblong, obtuse, smooth.

This tree is everywhere known in California as the "scrub," or evergreen oak, although there are several others which are more shrub-like, and of which the leaves are persistent. It usually forms a low spreading tree, which resembles in size and form the apple tree of the orchards of the eastern States, the trunk being rarely more than a foot in diameter, or the altitude more than 30–40 feet. I noticed much diversity in the form of the leaves, as they were sometimes, nearly orbicular, and at others much elongated, and both toothed and entire. The leaves of the same tree, also, frequently exhibit considerable variety of form; they are always small, however, and have smooth surfaces above and below.

PLATANUS RACEMOSA

Like most of the evergreen oaks, *Q. agrifolia* is rather a southern tree. Though found in all parts of the Sacramento valley, it scarcely extends further northward than Fort Reading, while it ranges southward into Mexico.

The wood is hard and brittle, and, from the small size of the tree, is of little value for building purposes.

PLATANUS RACEMOSA. (Plate II.) The Mexican sycamore.
P. RACEMOSA, *Nutt. Sylva.* 1, *p.* 47, *t.* 15.
P. RACEMOSA, *Aud. Birds Amer. t.* 362.
P. MEXICANA, *Moric. Pl. Nov. ou. rar. d'Amer. t.* 26.

Fig. 10.
Fig. 10. Leaf and fruit of *P. racemosa*, one-half natural size.

The Mexican sycamore exhibits a striking general resemblance to *P. occidentalis* of the eastern States, and by a casual observer would be considered the same. It grows along river banks in the same way, and, like *P. occidentalis,* often divides into several trunks—branches they can hardly be called—which diverge widely and irregularly, giving to the tree a straggling and irregular growth. The general effect of the foliage is similar, and the trunk is covered with a white exfoliating bark. On closer examination, however, it will be seen that the resemblance to the eastern tree is only general, and the points of difference are so numerous and appreciable that the two species which they constitute need never be confounded.

The port, both in form and dimensions, of the sycamore of California is so like that of the east as to afford no diagnostic characters.

Along the rivers its growth is usually open and unsymmetrical, as has been mentioned; but where, as sometimes found, it grows on open and higher ground, it adopts the general habit of the trees of the country, and spreads out into a wide and tolerably compact head. The tree of which the portrait is given (Pl. II) is of this character; it is growing on the banks of Feather river, a few miles above its mouth, and situated on the alluvial bottom but some 40 feet above the stream, and a little separated from the belt of timber—principally sycamores—which line its banks. This tree had a diameter of trunk of over 6 feet, an altitude of about 100 feet, and a spread of branches nearly equal to its height, constituting one of the noblest specimens of vegetation I have ever seen.

The leaf of the Mexican sycamore, in form, color and texture, is considerably different from that of its eastern representative. It is deeply cut, as represented in the figure, and is darker green and smoother than that of *P. occidentalis.* The fruit is also in racemes of three to six, instead of being solitary, as in that species.

The bark is whiter than I have ever seen it in *P. occidentalis*, being sometimes as white as milk on all parts of the trunk and branches. The dark, polished, and digitate leaves contrast finely with the white bark, and give to the tree a much more tropical look than that of our species.

The figure given by Nuttall (l. c.) represents the leaf as pubescent or tomentose. I think that is never its character, except when very young; at least in different parts of California where I saw the tree the foliage constantly exhibited the characters which I have described.

The Mexican sycamore is apparently more southern in its habit than most of the trees with which it is associated in California, the centre of its range being, probably, about the southern line of that State. We found it bordering the Sacramento river and its tributaries in all parts of the Sacramento valley, but did not meet with it further north.

The wood of the sycamore of the west, like that of the common species and that of most of the decotyledonous trees with which it is associated, is very brittle. Of its want of tenacity, we had a striking illustration when encamped under the tree represented on the plate.

Our beds were spread on the ground under its branches, nearly touching each other. During the evening—a fresh breeze blowing, but not a high wind—we were warned by a cracking overhead that danger was impending, and had just time to "stand from under," when a branch about eight inches in diameter came crashing down directly where we had been lying.

Pinus contorta. (Plate V.) The twisted pine.
P. contorta. *Dougl. in Lond. Encycl. of Trees, p.* 975, *fig.* 915.
P. contorta. *Loud. Arboret,* 4, *p.* 2292, *figs.* 2210 *and* 2211.
P. inops, (*P. distorta, Dougl.*) *Hook. Flor. Bor.-Amer.* 2, *p.* 161.

Description.—A tree of moderate or small size, of a conical, and frequently very strict figure; branches numerous, small; leaves in twos, short, yellow-green in color; cone generally ovoid acute, sometimes spherical, three-quarters of an inch to one and a quarter inch in length, persistent for several years; scales bearing short and acute spines; seeds roundish, dark; scale elongated entire.

We first met with this pine on the banks of Canoe creek, a tributary of Pit river, in northern California. After leaving that locality we saw no more of it till we reached the banks of Klamath river above Upper Klamath lake. Here it was abundant, and continued common to the Columbia.

On Canoe creek it grows in the natural meadows bordering the stream, forming a moderately

PINUS CONTORTA.

sized tree, the largest having an altitude of 50 or 60 feet, and a diameter of trunk of 12 inches three feet from the ground. The form of the tree is erect and strict; the foliage yellow green, moderately dense; leaves in twos, two inches long, and covering all the smaller branches; the cones $1\frac{1}{2}$ inches long, narrow ovoid; scales bearing short sharp spires, which are obsolete at the base of the cone. The old cones are persistent, sometimes loading the branches and giving a peculiar appearance to the tree. On Klamath river are many scattered trees having the same character and station as those on Canoe creek, but by far the greater number are gathered into the low grounds near the stream, where they form dense thickets or pine swamps of trees, generally 25 to 40 feet high and 6 to 10 inches diameter, so closely set as seriously to obstruct our passage through them.

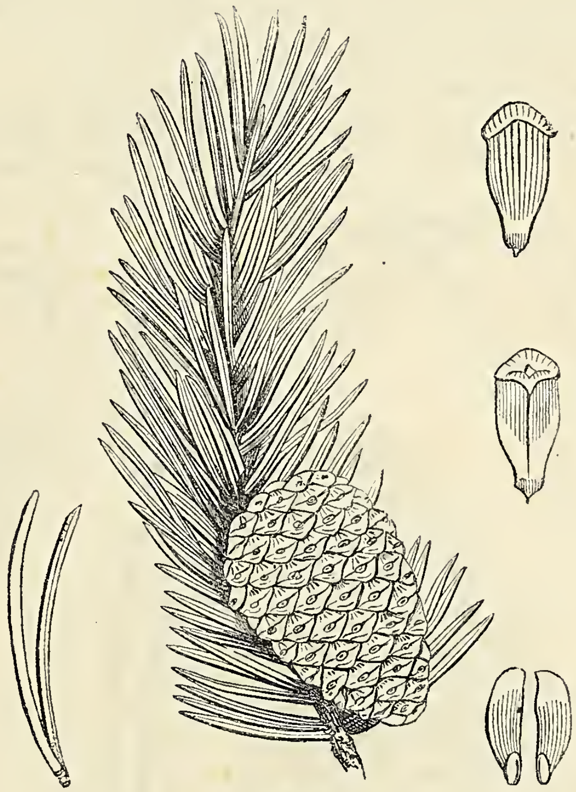


Fig. 11.
Fig. 11. Cone, leaves, scales, and seeds of *P. contorta*, natural size.

On the lowlands bordering the western shore of Upper Klamath lake, this pine exclusively composes the forest which formed the wall-like limit of the level and grass covered prairies which spread many miles back from the water's edge, the highland more remote being covered with the much larger trees of *P. ponderosa.*

The pumice plain lying between the Klamath lakes and the Des Chutes river, the driest and most barren region which we crossed, is sparsely covered with the western cedar (*J. occidentalis*) and *P. contorta*, here lower and more spreading, its lower branches resting on the ground. Of these trees many were dead, though standing, and all then exhibited very strikingly a character which may have suggested the name "*contorta*" to Douglas, but which is common to many conifers, though perhaps nowhere so conspicuous as in this tree, viz: the curving downward and inward of the dead branches, reversing the natural upward curve of their extremities while living.

In the Cascade mountains *P. contorta* forms a large part of the forests in the lower valleys, where it is sometimes seen nearly as closely set and as slender as canes in a cane-brake. It is common on the lower slopes and rises, scattered and dwarfed, to about the altitude of 6,000 feet; but its favorite station is evidently the moist valleys and plains.

This tree approaches *P. inops* so closely that it is perhaps doubtful if it should be separated from it. The cones and foliage are, to my eye, undistinguishable, and the cones are similarly persistent. The habit of the western tree is, however, somewhat unlike that of its eastern representative. It is never so spreading, and in some of the localities I have mentioned is more slender than any other pine with which I am acquainted.

PINUS PONDEROSA. (Plate IV.) The western yellow pine.
P. PONDEROSA, *Dougl. Loud. Arboret, p.* 2243, *figs.* 2133 *and* 2134.
P. BRACHYPTERA, *Engel. Bot. Wislz. Exp., p.* 5.
P. ENGELMANNI *Torrey. Bot. Whipple's Rep., p.* 141.
P. BEARDSLEYI, *Murray. Edenb. New Philos. Jour.*, 1855, *p.* 286.
P. BENTHAMIANA, *Hartweg. Jour. Hort. Soc. Lond.*, 4, *fig.* 213.

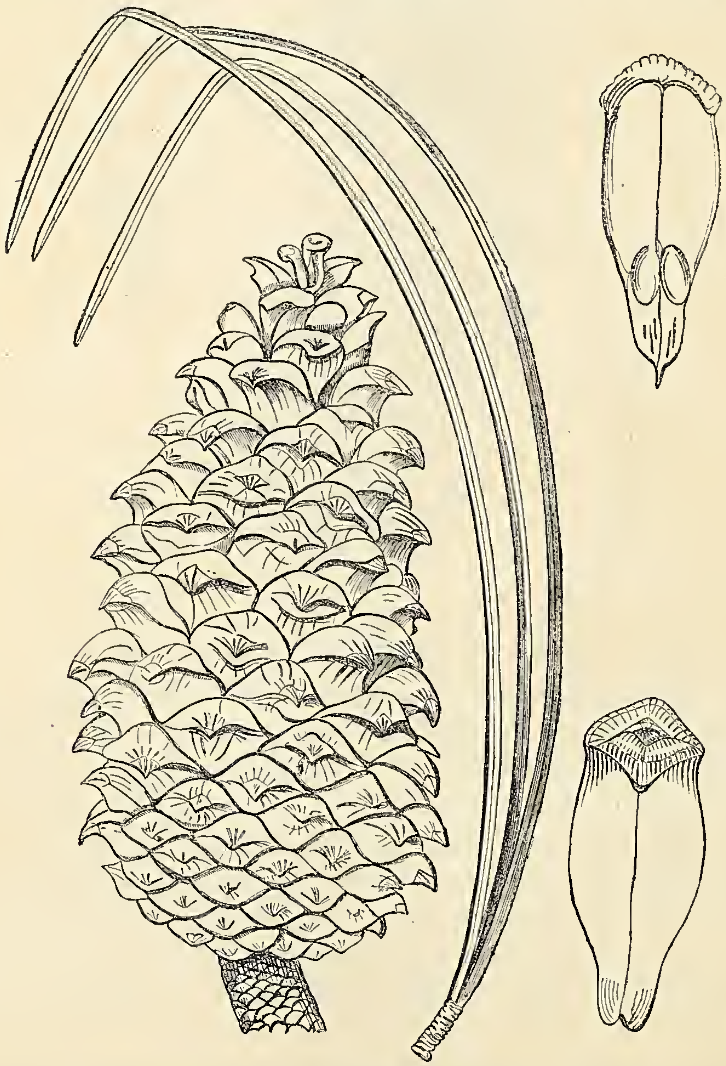


Fig. 12.
Fig. 12. Cone, scales and leaves of *P. Ponderosa*, natural size.

PINUS PONDEROSA

This is the most widely distributed of all the pines which are found in California or Oregon; and over very large areas it is not only the most common but the only species. I can only explain the confusion which exists in reference to it in the notes on the botany of the far west which have been published, by the supposition that its favorite habitat, though immensely extended, lying so far inland, has scarcely been entered by the botanists who have visited the inhabited portions of California or Oregon.

The range of this tree is from the mountains of New Mexico, (San Francisco, &c.,) northward to and beyond the Columbia, and from the coast in California, where it is comparatively rare to the Rocky mountain chain on the east.

In the Sacramento and Willamette valleys I did not see it; but in the Sierra Nevada it is abundant, associated with *P. Lambertiana*, *Abies grandis*, *Libocedrus decurrens*, on the slopes; in many places exclusively composing the forests of the higher portions of the range, descending to mingle with the species I have named both to the east and west.

As we passed northeastwardly from Fort Reading, California, across a portion of the Sierra Nevada, at the foot of Lassen's butte, we found this species, known there as the "yellow pine," as we ascended, succeeding to *P. Sabiniana*, (which grows near the banks of the Sacramento and on the lower hills,) composing the first pine forests we saw in the country. At McCumber's it forms an important element in the magnificent forest of that region, of which I have already spoken; and still higher on the flanks of Lassen's butte it composes the entire forest, rising nearly to the line of perpetual snow. As we descended into Pit river and Klamath basins we found it still abundant, forming by far the most constant feature in the vegetation of our route from Pit river to the Columbia. Near or distant, trees of this kind were always in sight; and in the arid and really desert regions of the interior basin we made whole days' marches in forests of yellow pine, of which the absolute monotony was unbroken either by other forms of vegetation, or the stillness by the flutter of a bird, or the hum of an insect. The volcanic soil, as light and dry as ashes, into which the feet of our horses sank to the fetlock, produces almost nothing but an apparently unending succession of large trees of *P. ponderosa*.

The yellow pine, as it grows in these sterile regions, is a noble tree; and though never rivalling the gigantic sugar pine in its dimensions, it claims among western pines the second place. At McCumber's we saw many of this species six, and even seven, feet in diameter, three feet from the ground; and near the base of Mount Jefferson, in Oregon, I saw one which was twenty-five feet in circumference at the same height.

The port of *P. ponderosa* is somewhat more spreading than *P. Lambertiana*, though far less so than *P. Sabiniana*. Where these last two species grow together, the contrast in form is very striking, as is also the color and character of the foliage.

The leaves of *P. ponderosa* are in threes, from four to ten inches in length, serrated on their edges, and, being confined to the extremities of the branches, from which they radiate in all directions, give the foliage a peculiarly tufted appearance. The color of the leaves is a dark yellow green, and readily distinguishable from the *deep* blue green of *P. Lambertiana*, or the *light* blue green, or glaucous hue, of *P. Sabiniana*. The successive appearance and decadence of clusters of leaves at the end of the branches gives to the smaller ones a beaded character, which distinguishes it from all other western pines. The smaller branches, and especially the central shoot in young trees, are strongly marked with the scales of the fallen leaves; closely resembling in some cases the leaf scars of the lepidodendroid fossils of the coal period.

The cones of *P. ponderosa* are from three to six inches in length, ovoid in form, the bosses of the scales bearing small acute recurved spines. The cones grow singly or in clusters of from two to four, generally at the extremities of the smaller branches, and are not pendent, as in the group of pines to which *P. Lambertiana* and *P. strobus* belong. The seeds are somewhat larger than apple seeds, and form the principal subsistence of several kinds of birds.

The average length of the cones of *P. ponderosa* is perhaps four inches, though in the same grove of trees I have seen all the variations I have mentioned. On the flanks of Lassen's butte we found a pine prevailing over an area of several square miles, differing in nothing, as I could perceive, from the common *P. ponderosa*, except that the cones were all double the average size; I could not doubt, however, that it was a mere variety of the common species.

The bark of *P. ponderosa* affords one of its most noticeable and distinctive characters. It is light yellowish brown, (cork color,) and is divided into large plates, four, six, or eight inches in breadth, which are flat and smooth, and enable one to distinguish the trunk of this tree at a considerable distance. These plates of cork-like bark are made the repositories of acorns by the woodpeckers, and it is a very common thing to see large numbers of these trees having the bark of the trunk cut into a honeycomb by thickly set holes as large as thimbles, or as thickly studded with inserted acorns.

The wood of the yellow pine is generally highly resinous, and, though heavy, is brittle and less valuable than that of the sugar pine. Like the "pitch pine" of the eastern States, it is, however, sometimes of excellent quality, containing little resin, soft and tough. The yellow pine exhibits a tendency to twist, which is very noticeable in a forest of these trees, the grain of trunk and branches being often seen coiled into the closest possible spiral.

This is undoubtedly the tree described by my friend Dr. Engelmann under the name of *P. brachyptera*, the specimens on which his description was based having the wings of the seeds unusually shortened. In the normal form the seed-wings are not shorter than in other pines having cones of equal size.

Although I have taken Douglas' name, which was the first applied to this tree in the far west, I have been inclined to doubt whether it should not be considered a mere variety of *P. rigida*. I have not been able to find any constant differences between the fruit or foliage of the two species. The western tree is, however, much more robust, growing taller and larger, the bark smoother, and the wood generally less resinous.

The same differences are also noticeable between *Abies Canadensis* of the west and east, and may very well depend on a soil and climate which is particularly favorable to the growth of coniferous trees.

The various phases exhibited by *P. rigida,* going from New England to Georgia, show the influence of soil and climate in modifying its habit. It should also be observed that its range is very great in the eastern States, and that it extends from Louisiana westward nearly to New Mexico, where *P. ponderosa* occurs—a fact which strengthens the probability that they are identical, and that, as a single species, this tree bridges over the continent south of the central desert, in the same way that *Abies Canadensis* stretches across from Lake Superior to Oregon, north of that area.

I have before me, as I write, specimens of the cones and foliage of *P. ponderosa* from the immediate vicinity, and perhaps from the very trees, where Douglas obtained the cone and leaves which he sent to Europe; and on the Columbia I observed the tree where I know he had botanized. There is, therefore, no possibility of being in error as to the tree which he designated by the name of *P. ponderosa.* The cone sent home by Douglas was immature and deformed, and no pine at the west bears cones of this character, unless, as in that unfortunate case, as a monstrosity.

The pine described by Mr. Murray under the name of *P. Beardsleyi* is evidently one of the most common forms of *P. ponderosa.* The differences which he suggests are such as are often exhibited by the trees of the same grove. The leaves are long or short, the cones large or small, the wood hard and resinous, or soft, according to the soil in which it grows.

PINUS SABINIANA. Sabine's pine—nut pine.
P. SABINIANA, *Dougl. in Comp. to Bot. Mag.* 11. *p.* 150.
P. SABINIANA, *Lambert, Pinus, Ed.* 2*d*, 2, *p.* 146, *t.* 80.
P. SABINIANA, *Hook, Flor. Bor. Amer.* 2, *p.* 162.
P. SABINIANA, *Nutt. Sylva.* 3, *p.* 110, *t.* 702.

Fig. 13.

Fig. 13. Cone of *P. Sabiniana*, $\frac{1}{3}$ natural size.
Fig. 13*a*, *b*. Leaves and seed of *P. Sabiniana*, natural size.

The "nut pine," as this tree is commonly called in California, is scarcely less interesting or important, in a scientific or economical point of view, than the great Lambert pine. It does not rival that species in the immensity of its size, nor in its value for timber, but the form of the tree is peculiar, and quite unlike that of any other western pine which we saw, and the cones are considerably larger and more ponderous than that of any other species; and, what is of more importance to the Indians, they contain such stores of eatable nuts as to become a staple article of subsistence in many extensive districts.

The "nut pine," or, as it is sometimes called from the toughness of the wood, the "wythe pine," nowhere forms forests, but is disseminated very generally over California. It was found by our party in the valleys of the coast ranges, as far north as Fort Lane, in Oregon, though in the interior it does not occur on our route between Pit river and the Columbia. It chooses, in preference, regions unoccupied by other trees, and is generally found scattered sparsely over rough and rocky surfaces, where almost no other plant would take root.

Douglas, and, copying him, Nuttall, give to this tree almost an alpine station, which does not at all accord with my observations. This was the first pine I saw in California, and we found it growing in Napa, Sonoma, and other valleys of the coast range, and on the borders and at the head of the Sacramento valley, but little above the level of tide water. Subsequently we met with it at various points in northern California, but never at any considerable altitude.

On our route it occurred most abundantly in the *pedregal* country bordering Pit river, where that stream forces its way through the spur of the Sierra Nevada into the Sacramento valley; a region which rivals, in the magnitude of its volcanic phenomena, the islands of Haiwaii or Sicily. It is covered with piled up masses or congealed floods of lava, which, rough, ragged, and bare, seem to bid defiance alike to the approaches of animal or vegetable life. Only here and there, in the crevices or hollows of the rocks, narrow and shallow accumulations of sterile soil had taken place, which sustained scarce any vegetable growth, except thickets of the evergreen *manzanita* and scattering trees of the nut pine; both, however, doing their utmost to redeem the district from its hopeless sterility, by producing their berries and nuts in such profusion as to attract and feed large numbers of birds, bears, and Digger Indians.

Nuttall unaccountably failed to see the nut pine in California, and, therefore, repeats without comment Douglas' description of it. This is to be regretted, for Nuttall's discriminating eye would at once have detected the discrepancies which exist between the tree as it grows and the published description of it.

After speaking of its alpine habit, which our observations disprove, and of its range northward to the Blue mountains, on the upper Columbia, in which he was guided only by the nuts collected by the Indians, and probably misled by referring the nuts of the nut pine of that region to this tree, Douglas says: "The stems of these pines are of a very regular form, and grow straight and tapering to the height of 40 to 140 feet, and are from three to twelve feet in circumference, and, when standing apart, clothed with branches down to the ground."

An extract from my notes, with the accompanying sketch, (fig. 13,) taken when surrounded by these trees, will show what is the sort of *P. sabiniana* in all parts of California where we saw it.

"*July* 28.—To day saw great numbers of the nut pine, sometimes in groves and clusters, more generally as single trees, scattered about among the rocks. The form of the tree, as well as its foliage, are peculiar, and readily serve to distinguish it from all other pines I have seen. It has nothing of the conical figure of most coniferous trees, but the trunk soon divides into spreading branches, and the tree has the port of an oak or maple, sometimes even approaching the form of the Italian stone pine. The foliage is pale bluish-green and thin, and the whole aspect of the tree light and airy.

"The cones are usually solitary, ovoid in form, sometimes as large as one's head, and very ponderous, they are covered with spurs, or strong curved spires, an inch or more in length, of which the broad bases cover all the exposed portion of the scales. The seeds are as large as large beans and very palatable, having, however, a slightly terebinthine taste."

This description, which subsequent observations fully confirmed, included nearly everything necessary to be said of the tree. It will be noticed that it differs in several respects from that given by Douglas, so much so that if there were any other tree in California to which his description could better apply, I should be inclined to consider the common "nut pine" as distinct from his *P. sabiniana.*

He represents the form of the tree as conical, the cones, much as I have described them, but in verticils of three to nine. The leaves eleven to fourteen inches in length in threes, sometimes four in a sheath; while in those I saw, the form was diffuse, the cones solitary, the leaves eight to ten inches long, always in threes. The description of *P. coulteri,* given by Don in *Lin. Trans., vol.* 17, *page* 440, in some respects agrees better with that of the California nut pine than does Douglas' description just cited. This tree (*P. coulteri*) he describes as having "an altitude of eighty to one hundred feet, with large *permanently spreading branches*—ternate leaves larger and broader than those of any other known species—and of a glaucous hue. Cones oblong, solitary, very large—twelve inches in length by six in diameter—comparable to sugar loaves, the spirous processes of the scales three to four inches in length, as thick as one's finger, seed as large as an almond, eatable."

Without authenticated specimens for comparison, I would not presume to decide on the identity or difference of *P. coulteri* and *P. sabiniana;* still from the description of *P. coulteri,* I should infer that this was only an unusually large and strong form of the nut pine of northern California, and notwithstanding the discrepancies of description. Authenticated specimens of *P. sabiniana* which I have seen, being undistinguishable, to my eye, from those I brought from California, it would seem probable that the "nut pine," of northern California, is the *P. sabiniana* of Douglas and *P. coulteri* of Don. If so, Douglas' name must take precedence, as it was first bestowed. It is, perhaps, necessary to say in this connexion that there are so many "nut pines" in the far west, that without discrimination the use of the term will beget confusion. Aside from the three leaved species, of which I have spoken, there are in New Mexico the *piñon* of the Mexicans—*P. edulis* of Englemann—which is two leaved; in the Rocky mountains and Cascade range, *P. monophyllus,* Torry and Frémont, which is one leaved; and *P. flexilis,* Torry and James, which are five leaved, all of which produce seeds as large and palatable as those of *P. Cembra* of Europe.

The timber furnished by *P. sabiniana* is of little value. It is not wanting in tenacity, but its spreading form reduces the dimensions and value of the trunk, and the wood is resinous and the grain irregular.

As an ornament to cultivated grounds it is well worth attention. The form and foliage of the tree are pleasing, and the huge and bristling cones filled with eatable nuts are among the most curious and interesting forms of vegetable fructification, and would not inappropriately find a place among the ornaments and delicacies of the table. When we think that thousands of beings, red skinned but human, look to these pine trees for their winter store of food—after grasshoppers, their most esteemed aliment—we shall cease to regard the cultivation of pine trees for their fruit an absurdity.

PINUS LAMBERTIANA. The sugar pine.
P. LAMBERTIANA, *Dougl. in Linn. Trans.* 15, *p.* 500.
P. LAMBERTIANA, *Dougl. Lamb. Pinus, Ed.* 2, 1, *p.* 57, *t.* 34.
P. LAMBERTIANA, *Endl. Syn. Conif. p.* 150.
P. LAMBERTIANA, *Loud. Arboret* 4, *p.* 2288, *figs.* 2203–2207.
P. LAMBERTIANA, *Nutt. Sylva* 3, *p.* 122, *t.* 14.

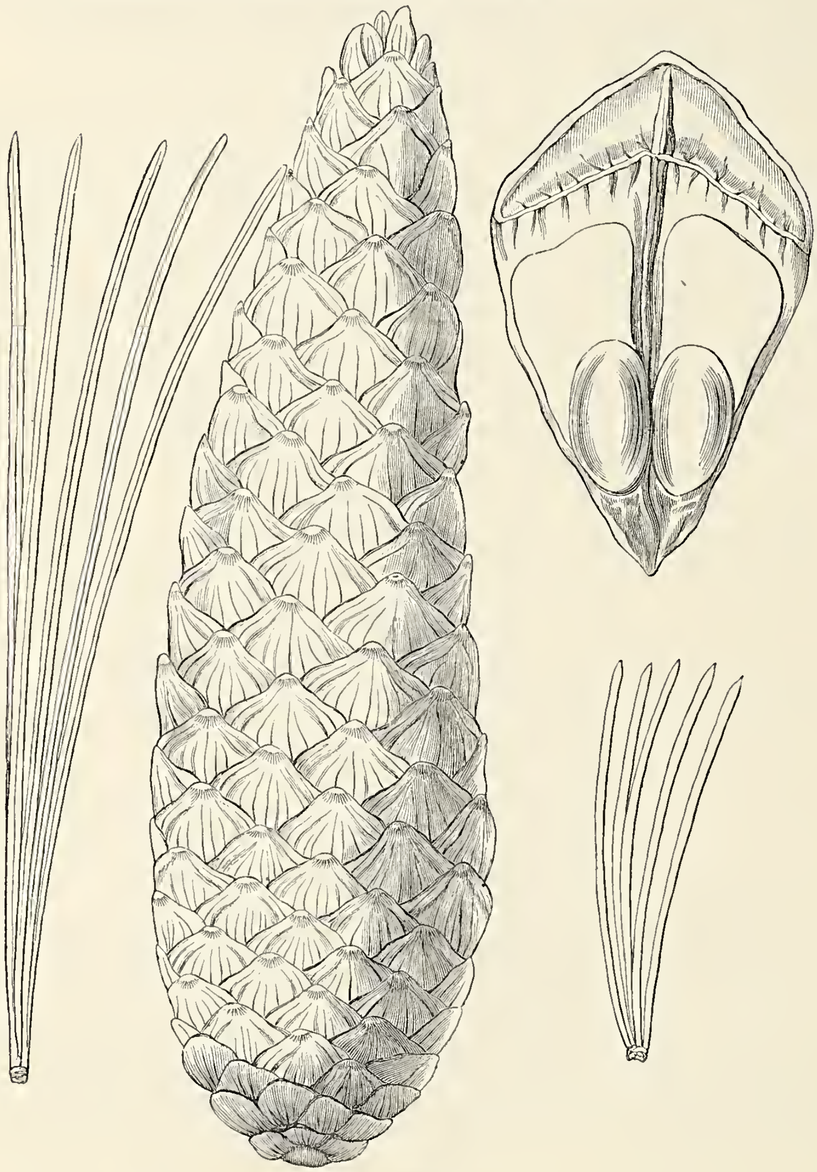


Fig. 14.

Fig. 14. Cone of *P. Lambertiana*, ½ natural size.
Fig. 14*a*, *b*. Leaves, scale, and seeds of do., natural size.
Fig. 14*c*. Short leaves of do., natural size.

This pine, undoubtedly the most magnificent species of the genus to which it belongs, is widely distributed over the country lying between the Rocky mountains and the Pacific, and is there universally known as the sugar pine. Its range extends from the Mexican line on the south to the vicinity of the Columbia river. It is disseminated through nearly all parts of the Sierra Nevada within their limits, and is not rare in the coast ranges between San Francisco and the Umpqua river. It is also generally spread over the transverse ranges of mountains—Siskiyou, Umpqua, and Calapooya—which connect the Cascades and coast ranges; and probably the finest trees of it which exist are in the vicinity of Humboldt bay and Rogue river, on the coast.

I have never seen it anywhere existing in such numbers as of itself to form forests, but generally occurring associated with other species which far surpass the sugar pines in numbers, while they, in turn, exceed all their fellows in dimensions. Scattered here and there through the forest, they seem, in their towering grandeur, like so many chiefs surrounded by their subjects and slaves.

The sugar pine is closely allied, in all its botanical characters, to the white pine (*P. strobus*) of the eastern States; though like all the conifers of the Pacific coast, it exhibits a symmetry and perfection of figure, a healthfulness and vigor of growth, such as are perhaps not attained by the trees of any other part of the world.

The young trees of the sugar pine give early promise of the majesty to which they subsequently attain. They are unmistakably young giants, even when having a trunk with a diameter of a foot or more; their remote and regularly whorled branches, like the stem, covered with smooth grayish-green bark, showing that, although so large, the plant is still "in the milk," and has only began its life of many centuries.

The mature tree is one of the most magnificent exhibitions of vegetable life that nature has produced; rising sometimes to an altitude of 300, and having a diameter of 20 feet, it is scarcely inferior to the *Sequoias*, the confessed monarch of the vegetable kingdom. It should be said, however, that it rarely attains such extreme dimensions. Where abundant, and the general growth vigorous, it is rare to find a tree more than 10 feet in diameter, and 200 feet in height. The sugar pine conspicuously exhibits one of the most general and striking characters of the *Coniferæ*—the great development of the trunk at the expense of the branches. Nearly the whole growth of the root is thrown into the trunk, which generally stands without flaw or flexure, a perpendicular cone, all its transverse sections accurately circular; sparsely set with branches, which in their insignificance seem like the festoons of ivy which wreath the columns of some ancient ruin.

The foliage is less dense than that of many pines, the leaves in fives, 3 inches in length, and of a dark blue green color. As in *P. strobus*, toward the summit of the tree a few of the branches are frequently longer than those below, and suspended from the extremities of these, singly or in clusters, hang the cones. These are of a size commensurate with that of the tree, being sometimes 16 and even 18 inches in length by 4 inches diameter. More commonly they are 12 to 14 inches in length by 3 inches in diameter. They bear a general resemblance to the cones of the white pine, still more to those of *P. excelsa* from the Himalayas. They are generally slightly curved, and are composed of densely imbricated thin scales, of which the exposed portion is rounded in outline and without spines. They are commonly less resinous than those of *P. strobus*. The wood of the sugar pine is very similar in character to that of the white pine; white, soft, homogeneous, and usually straight grained. It is the most highly esteemed for inside work, of all the varieties of lumber found in California.

At McCumber's and Shingletown, in northern California, the saw-mills are set in what must be a lumberman's paradise—a forest composed of trees of remarkable size, perfection, and uniformity; sugar and yellow pine, with the western balsam fir, and *Libocedrus*, of which the eye may take in at a glance even hundreds which reach or exceed the utmost capacity of the mills, and many which would furnish sticks a yard square and a hundred feet long, as straight as an arrow, and almost without a knot.

The resin of the sugar pine is less abundant than that of the *P. ponderosa*, is white or transparent like that of *P. strobus*. That which exudes from partially burnt trees, for the most part, loses its terebinthine taste and smell, and acquires a sweetness nearly equal to that of sugar. This sugar gives the tree its name, and is sometimes used for sweetening food. It has, however, decided cathartic properties, and is oftener used by the frontier men as a medicine than a condiment. Its resemblance in taste, appearance, and properties to *manna*, strikes one instantly; and but for a slight terebinthine flavor, it might be substituted for that drug, without the knowledge of the druggist or physician, its physical and medical properties are so very like.

PINUS CEMBROIDES. The American Cembra pine.
P. CEMBROIDES, *Zucc. Jour. Hort. Soc.* 1, *p.* 236.

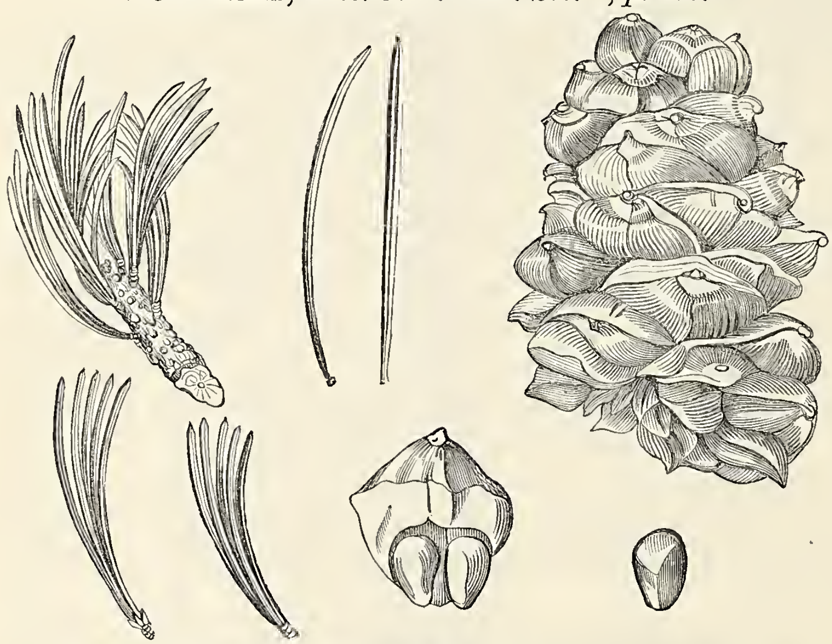


Fig. 15.
Fig. 15. Cone, leaves, scale, and seed of *P. Cembroides*, natural size.

While exploring the passes of the Cascade mountains, about latitude 44° north, we first met with this tree.

We crossed the mountains several times at an altitude of about 7,000 feet, the line of perpetual snow. After reaching an altitude of 5,500 feet, among the firs and spruces which cover the mountain sides began to appear pines of a species then quite new to me. As we ascended we left behind us Menzies' and Douglas' spruces, (*A. Menziesii* and *A. Douglasii*,) the western balsam and silver firs, (*P. grandis* and *P. amabilis*,) which grow so luxuriantly below, and, at the height of 6,500 feet, found the scattered clusters of trees to be composed of nearly equal numbers of the pine to which I have alluded, and of a beautiful and then undescribed spruce, which I have since called *Abies Williamsonii.* Still higher, at the extreme limit of vegetation, the bleak and barren surfaces were held by this pine in a possession undisputed by other trees, but opposed by the rigors of a climate which had bowed it to the ground, forcing it to grow in thick and tangled masses, scarcely rising above the surface; the trunks, sometimes of considerable size, creeping about among the rocks like roots.

This pine nowhere, within my observation, attained the size of a large tree; the largest individuals, with a diameter of two and a half feet, having no greater height than 50 feet. The bark of the trunk is white as milk, but moderately rough and thin, having much the appearance of the bark of the white oak (*Q. Alba*) in trees of moderate size; the bark of the branches gray, smooth, and tender, as in the white pine; the wood of the branches very flexible and tough, the leaves confined to the extremities of the branches, five in a sheath, light, blue-green, triangular, and smooth; those of each fascicle of uniform length and approximated, giving the foliage a peculiar, notched, or cropped look. The cones were so rare, that, though constantly among the trees and on the lookout myself, I had for two weeks an offer, open to all our party, of a dollar for a good cone; and no one was able to claim the reward. Fragments of cones, recent or of other years, were under every tree, but (containing seeds with kernels nearly as large as peas) they had been most carefully sought and torn up by the little pine squirrels. At the end of the two weeks' search, a smile of fortune led me to a locality where that want was fully supplied. The cones are erect or divergent, two to three inches long, ovoid in outline, oblique at the base, of a peculiar red color, very smooth and free from resin. They are composed of scales, which are thick and woody, of which the bosses project in flattened prisms, or cones of considerable length, giving an inequality of surface greater than in any of the smaller pine cones which have been described. The scales have no spines.

The seeds are wingless or nearly so; when mature, are oval in form, as large as large peas; the flavor is agreeable, and the Indians eat them whenever they can be obtained.

The description of *P. flexilis*, as given by Torrey, James, and Nuttall, agree in so many particulars with that of the summit pine of the Cascade mountains that I was at first inclined to regard them as identical. *P. flexilis*, however, where it has been observed, has not the extreme alpine habit of our trees, and the cone, as figured by Nuttall, is as different as possible from the cones which it bears. If *P. flexilis* has been accurately described, the two species, however closely allied, are distinct. The cone figured by Nuttall partakes much more of the character common to those of most of the five leaved pines, being pendulous, slender, and composed of relatively thin, appressed scales. If the cone of *P. flexilis* is of this character it may justify the comparison which he makes with that of *P. Cembra*, which, though short—sometimes almost globose—has the general features of the cones of *P. strobus*, *P. Lambertiana*, &c.; whereas the cone of *P. Cembroides?* has almost nothing in common with that of *P. Cembra* but its eatable seeds; a character which it shares with two other nut pines of the western mountains—*P. monophyllus* and *P. edulis*—the cones of which are more like those of this species than they are those of *P. Cembra*.

I have not access to the original description of *P. Cembroides*, nor are any specimens, to my knowledge, in possession of American botanists. Until a more satisfactory comparison can be made between the Oregon tree and that of Mexico it will be impossible to determine the question of their identity or difference; though it would seem improbable that a tree having the extreme alpine habit of that of the Cascade mountains should be found in any part of Mexico, they are evidently so very like each other that I have thought best for the present to consider them identical.

The description of *P. flexilis*, as given by Dr. James, (*Long's Exped., vol. 2, p.* 34,) does not agree with that given by Dr. Engelmann, (*Bot. Wisliz. Exped., p.* 5,) where it is represented as having "pendulous, squarrose, cylindrical cones," which, with its quinate leaves, "assimilate it to *P. strobus;*" but "the seed, large and eatable, leaves not serrulate and stouter. Dr. James, on the contrary, says his *P. flexilis* has, like *P. strobus*, leaves, 5 in a fascicle, but beyond that there is little resemblance. "The leaves are short and rigid, the sheaths short and lacerated, the *strobiles erect*, composed of large unarmed scales, being somewhat smaller than those of *P. rigida*, but similar in shape, and exuding a great quantity of resin," &c.

His description of the tree agrees well with that of the species under consideration, except that he does not mention the white bark. The flexible branches and short leaves confined to the extremities of the branches of *P. flexilis* are characters shared by most of the five-leaved pines, which form a group by themselves, and should perhaps constitute a sub-genus. The *red, oblique-based resinless* cones of our trees seem clearly to distinguish it.

The wood of *P. flexilis* is white and soft, and not highly charged with resin, resembling that of *P. strobus* and *P. Lambertiana*.

PICEA GRANDIS, *Dougl.* (Plate VI.) The western balsam fir.
P. GRANDIS, *Loudon, Arboret, p.* 2341, *figs.* 2245, 2246.
PINUS GRANDIS, *Dougl. ms.*
ABIES GRANDIS, *Lindl. Penny Cyclop. No.* 3.
A. GRANDIS, *Hook. Flor., Bor. Amer.* 2, *p.* 163.
A. GRANDIS, *Nutt. Sylva.* 3.

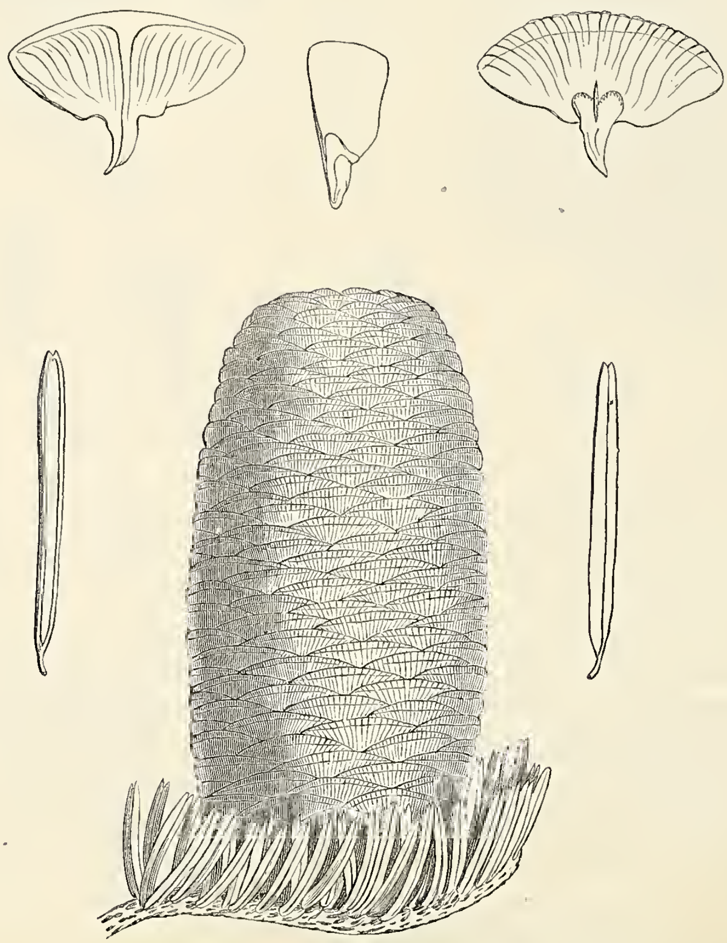


Fig. 16.

Fig. 16. Cone, leaves, scales, and seed of *P. grandis*, natural size.

PICEA GRANDIS

Among the many sad things connected with the death of the lamented Douglas, was the loss which botanical science suffered in being deprived of the full exposition which he would have given, had he lived, of the specimens which he collected during his residence in California and Oregon. Of the vast material which was transmitted to England through his industry, much was described by him; and his notes and descriptions have constituted a fund from which all have drawn who have had occasion to refer to the subject of the botany of the regions he visited. His descriptions were, however, generally brief, and only preparatory to a more elaborate work to be prepared by himself and others subsequent to his return. His specimens have since been carefully studied by Lindley, Hooker, Lambert, &c., and the published results, as might have been expected from the learning and ability of these botanists, have been of great scientific value, and as full and accurate as they could be in the circumstances. Nothing could compensate, however, for the want of his living testimony in reference to the thousand points of inquiry which would arise in the study of his specimens; and none but himself could correct the inevitable errors which attended the transport, the packing and unpacking, the handling and examination of his plants. Who that has the care of collections in natural history does not find it almost a daily necessity to replace labels and return erratic fragments to their connections?—to do what, if left to other hands, would be so done as to obscure if not falsify facts.

In speaking of *Pinus ponderosa*, I have alluded to the consequences of the fact that an abnormal and distorted cone was made to stand the sole and unqualified representative of one of the noblest and the most widely distributed of western pines. I think we have evidence that a somewhat similar mistake has occurred in reference to the cones of *Picea* (*Pinús*) *grandis* of Douglas.

This tree is described (Dougl. & Lamb. Comp. Bot. Mag. II, p. 147) as "a noble tree, akin to *P. balsamea*, growing from 170 to 200 feet high, with a brown bark; leaves emarginate at the apex; cones lateral, solitary, cylindrical, obtuse, very similar to those of *P. cedrus*, but larger, six inches long, of a chestnut brown color, &c., (Loudon, Arboret, p. 2341.) In the description of *P. amabilis* (Loud. op. c. p. 2342) the cones are said to resemble those described as belonging to *P. grandis*, but to be twice as large as those of *P. grandis* sent home by Douglas, and botanists have since been unable to distinguish between these two species, and generally regard them as forms of the same.

In the Cascade mountains, south of the Columbia, near where Douglas procured his specimens of *P. grandis* and *P. amabilis*, I found two firs growing which must be those designated by Douglas under these names. Of these one was indeed a noble tree which we had first met with in California, where, from its resemblance to *P. balsamea*, it has been called by the residents, and by several botanists, the balsam fir, and considered identical with the eastern species. It grows very abundantly in the Cascade mountains; up to and beyond the Columbia it rises to the height of 200 feet; has emarginate leaves; cones never more than three inches long, very obtuse, and having a depression at the summit, and resembles those of *P. cedrus* more than those of any other species. These cones are, however, always green or greenish brown, and never chestnut color; they are also comparatively free from resin.

The other tree to which I have referred is very unlike this, never attaining equal size, much more strict and conical in form where both grow in open grounds; the foliage more dense; the leaves darker above, more glaucous below, entire, and often acute; the cones double the size of those of the "balsam fir" of the same region; elliptical in form, rounded above, dark purple in color, and more resinous. The scales of the cones and bracts relatively much longer. Of these trees the first agrees well with the descriptions of *P. grandis,* given by Douglas and Nutall, and is the only tree which I saw in the region where Douglas obtained his specimens to which their descriptions could be applied. I have, therefore, no doubt that the western balsam fir is *P. grandis.* Of his *P. amabilis* Douglas left no description, sending home only the cones and leaves. Of these, good figures and a brief description are given by Loudon, (*Arboret,* 4, *p.* 2342.)

As will be seen from the figures now published, (fig. —,) from specimens obtained by myself, that there is an entire correspondence between Douglas' *P. amabilis* and the "silver fir" of the Cascade mountains, and I have, therefore, regarded them as identical.

The difficulty which botanists have found in distinguishing Douglas' *P. grandis* from *P. amabilis* has apparently arisen from the want of a full description of *P. amabilis,* such as Douglas alone could give. Lambert also states that the cones of *P. grandis* are 6½ inches long by 3½ broad, undoubtedly a mistake, as there is not a tree growing where Douglas obtained his *P. grandis* which has large unornamented cones, except *P. amabilis. P. nobilis* is found in the same region, but the large bract-covered cones of this species could never be confounded with either of the two species in question.

The figures of the cones of *P. grandis,* given by Loudon, (Arboret, 4, p, 2341,) are certainly considerably unlike that which I now give (fig. 16) of the cone of what I have considered as *P. grandis;* and if they are accurately copied from Douglas' specimens, and those specimens are well preserved, I should be, perhaps, inclined to believe that Douglas had found on the Columbia a fir not now known there, and that he had left unnoticed the tree which, after the Douglas spruce, is the most abundant. Every one who has attempted to preserve the perishable cones of *Picea* is aware of the great difficulty with which they are made to retain their perfect forms, and I think that the cone given by Loudon (l. c., fig. 2246) bears evidence of distortion or composition. The arrangement of the scales in vertical rows is not in accordance with *nature's* laws of phyllotaxis, at least in the pines, spruces, or firs; and the *descriptions* of the cones of *P. grandis,* given by Loudon (l. c.) and Lindley, (*Penny Cyclop. Abies,*) agree perfectly with my specimens and the figure now given, which was made not alone from preserved specimens but from drawings made in the field.

The leaves figured by Loudon are represented as acute, while they are described to be obtuse or emarginate. The seed and scale, also, as he gives them, are larger than would ever be found in a cone but 3½ inches long by 2 broad, and we may, therefore, suspect that, like the leaves, it properly belongs to *P. amabilis.*

The range of *P. grandis* is apparently very great. It is found in the Sierra Nevada, of California, down near the southern line of the State, and it is found at least as far north as the British line.

Dr. Bigelow (*Bot. Whipple's Rep.*) says the balsam fir of California is identical with *P. balsamea* of the eastern States, but gives no other description of the tree, as it grows where he observed it, than to note its dimensions—far exceeding those of *P. balsamea* and the quality of the timber furnished by it. While Dr. Bigelow's attainments as a botanist would give, with me, great weight to his testimony, I cannot but suspect that, in this instance, he was misled by the very apparent points of resemblance between the balsam firs of the east and west, and, perhaps, had not an opportunity of examining the mature cones which furnish the best diagnostic characters. In the Sierra Nevada, a few miles from the upper end of the Sacramento valley, we found the western balsam fir growing in profusion and attaining a large size, but there exhibiting the same characters as in the Cascades, near the Columbia, and clearly distinguished from *P. balsamea* by its immense size, longer leaves, and different cones. The only decided character which the two species have in common is the accumulation of the balsam in cysts in the trunks of small trees; this is, however, not peculiar to *P. balsamea* among eastern trees, as a similar balsam is secreted on the trunk of *P. Fraseri*.

Dr. Bigelow mentions the occurrence of the same balsam fir which he saw near Sonora, in California, in the more elevated portions of the San Francisco and Sandia mountains of New Mexico. If this should prove to be the same species with that observed by us further north, in California and Oregon, it would give a very extensive north and south range to the tree—a range of at least 20° of latitude. This will not seem so surprising when we consider the great differences of elevation of its northern and southern habitats, and the great differences of vegetation of the sub-tropical bases and arctic summits of the mountains of New Mexico and southern California.

That the balsam fir of central and northern California are the same, is probable from the fact that the associate trees, *P. ponderosa, P. Lambertiana, Libocedrus decurrens*, &c., are the same in each case; and the lumbermen and others who have seen the balsam firs in different parts of the Sierra Nevada have regarded them as all of one species.

We first met with *P. grandis* near McCumber's, (lat. 41°, altitude 4,000 feet,) a few miles northeast of Fort Reading, California. It there forms a conspicuous element in the magnificent forest whch I have described in speaking of the sugar and yellow pines, several of which I measured; the trunks were scarcely inferior in girth or altitude to the pines, being twenty-one feet in circumference three feet from the ground, and having an estimated altitude of 150 feet. From this point to the Columbia it was found on all the wooded mountains. The general port of the tree is very well given in the accompanying plate, (VI,) which represents the vigorous and unimpeded growth of an individual about one hundred feet in height. This portrait was taken on the eastern slope of the Cascade mountains, in Oregon, lat. 44° 12′ N., at an elevation of nearly 5,000 feet above the sea. It will be seen to be more spreading than most firs, broader near the top, and less conical. When forming part of the dense forests of the lower Columbia, it is much more slender, and the branches, instead of descending as low as represented in the plate, are confined to the top. Under such circumstances, the trunk is straight, smooth, and cylindrical, and furnishes lumber of excellent quality. On the Columbia and Willamette it is known as the "white fir," to distinguish it from the "red fir," (*Abies Douglasii.*) Most of the lumber exported from Oregon is derived from these two trees.

PICEA NOBILIS. The noble fir.
P. NOBILIS, *Loud. Arboret*, 4, *p.* 2342, *fig.* 2249.
PINUS NOBILIS, *Dougl. Lamb. Pinus*, 3, *t.* 22.
ABIES NOBILIS, *Lindl. Knight's Cyclop.* 1, *p.* 9.
PINUS (ABIES) NOBILIS, *Hook. Flor. Bor.-Amer.* 2, *p.* 162.
ABIES NOBILIS, *Nutt. Sylv.* 3, *t.* 117.

Description.—Tree large, erect, strict; branches short, rigid; leaves in many rows, short, falciform, and curved upward, very rigid, keeled on both sides, ancipital acute, pale green, not glaucous below; cones large, cylindrical, obtuse, fulvous, more or less covered by the reflected bracts; scales triangular, as broad as long, margins reflected, entire; bracts longer than the scale, reflected, fimbriated or entire, terminating in an elongated awn-like point; seed much longer than wide, somewhat angular; wing twice as long as broad, entire, pellucid.

This splendid species was introduced into England many years since by Douglas, and is now so generally cultivated and well known that any lengthy description of it is unnecessary. It is also so well marked by its short, rigid, acute leaves and large ornamental cones, that it is not likely to be confounded with any other species now known. My own observations do not, however, fully accord with those which have been published in regard to it; and the specimens which I brought home differ so much from those before obtained from the same region, and from each other, that it seems necessary that these differences should be indicated.

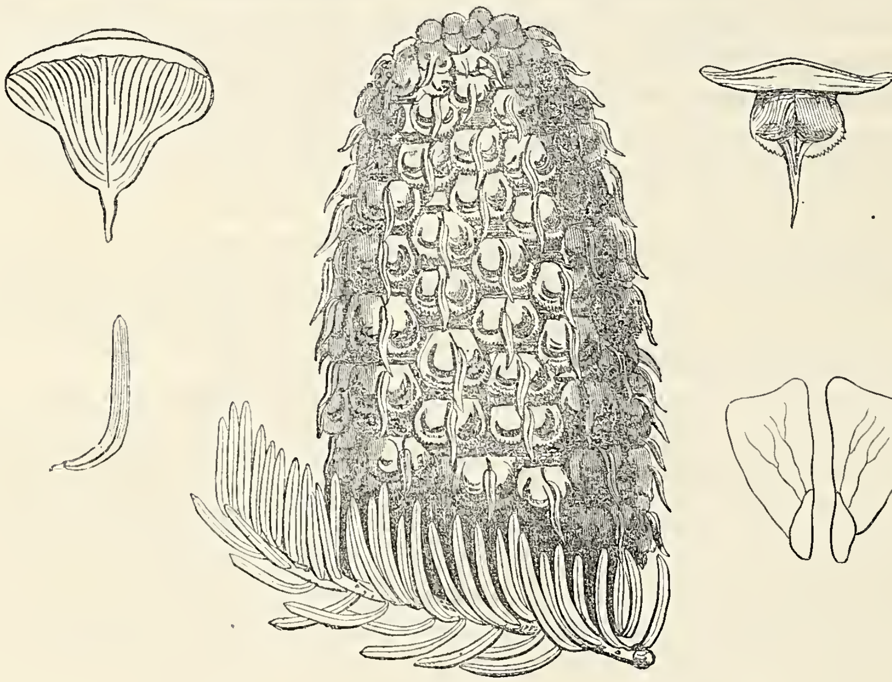


Fig. 17.
Fig. 17. Cone, scales, and seeds of *P. nobilis*, half natural size.
Fig. 17*a*. Leaf of do., natural size.

The accompanying figure (fig. 17) very accurately represents (half size) a cone obtained from a young tree in the Cascade mountains, 150 miles south of the Columbia. It will be seen that it differs from those figured by Lambert, Nuttall, and Loudon, (l. c.,) by being less completely covered by the reflected bracts, and by the form of the bracts, which are much less fimbriated, and are expanded into rounded wings on either side of the elongated point. The scales, seeds, and wings correspond very well with those figured.

The figure now given was made with great care by an excellent artist, J. H. Richard, and may be accepted as a copy of nature, even to the exact size and form of every bract. If the figure given by Nuttall and Lambert is equally true to nature, we have here evidence of considerable variation in the organs which have been considered the most distinctive character of the tree. Loudon's figure (l. c.) is evidently not intended to be an accurate representation of the subject, but only to give the general effect of the reflexed and fimbriated bracts. In his description, drawn from Douglas' specimen, Loudon represents the leaves as 2-rowed; while in my specimen the leaves are in many rows, so thickly set on all sides of the branches that their bases are separated by spaces no larger than they occupy; nor are they trigonal, as those described by Loudon, but quadrangular, without any longitudinal furrow.

A large cone was brought to me from the base of Mount Hood by Mr. C. D. Anderson, which I could refer to no other tree than this; and yet the bracts, though similar in form to those of the cone now figured, were much smaller, covering only a very small portion of the surface of the cone; and the characteristic appearance of the cone of *P. nobilis* was entirely lost. The leaves, scales, seeds, and wings were similar to those figured.

It is, perhaps, possible that the differences in the leaves and cones of my specimens and those before described are sufficent to constitute a new species; but as the general resemblance is striking, and I have no authenticated *specimens* of *P. nobilis* with which to compare them, it is perhaps better to wait till more material has been collected, which shall settle the question beyond the possibility of doubt. Several surveying parties will traverse the country occupied by *P. nobilis* within a few months, and they will doubtless supply our deficiencies in this respect. An abundance of excellent seeds were obtained from the cones I have mentioned; and should they germinate, the plants raised from them will soon give us an opportunity of studying the tree at leisure.

The general aspect of *P. nobilis* is somewhat like that of *P. amabilis*, though the foliage is of a lighter green, the leaves and branches more rigid and less graceful. The leaves are so stiff and sharp that they prick the skin like needles. The value of the wood for timber I had no opportunity of determining, but it is probably inferior to that of the Douglas spruce or balsam fig.

Picea amabilis. The western silver fir.

Pinus amabilis, *Dougl. in Loud. Arboret* 4, *p.* 2342, *figs.* 2247 *and* 2248.

Abies amabilis, *Pinetum Woburnense, t.* 44.

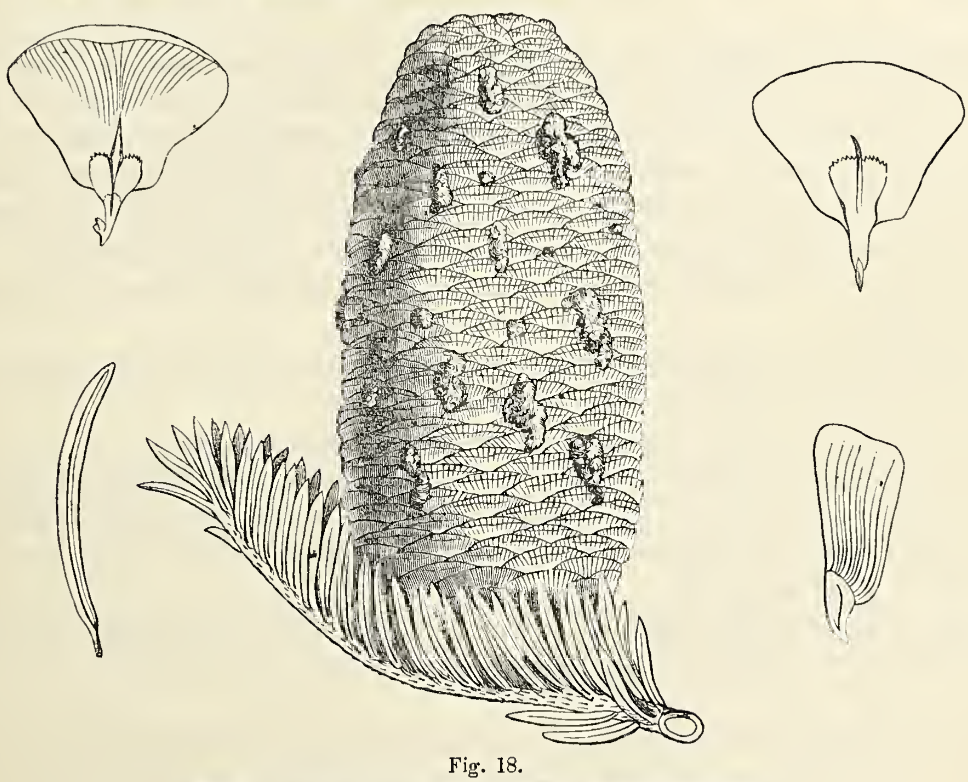


Fig. 18.

Fig. 18. Cone and branch of *P. amabilis*, one-half natural size;
Fig. 18*a*, *b*, *c*, *d*, leaf, scale, and seed of same, natural size.

This beautiful and distinct species has been generally confounded with *P. grandis*, as mentioned in the description of that species. This mistake would never have occurred if Douglas had lived to return to England, as they are really very unlike each other, both in general aspect and botanical characters.

We first met with this tree in latitude 44° N., in the vicinity of the "Three Sisters," snow peaks of the Cascade mountains, nearly 150 miles south of the Columbia.

After striking the south fork of the Des Chutes river, on our progress northward, we followed down that branch to its union with the main stream. This we followed to its source in the southern slope of the group of mountains named. Around the mountain lakes in which the Des Chutes takes its rise, we found, at first, a few small trees, and, subsequently, groups and groves of a fir, which, familiar as we were with *P. grandis*—that species having accompanied us all the way from the mountains of California,—was immediately noticed by all our party as a tree entirely new to our experience, and very different from any we had seen. From my notes, made at the time, I take the following passage descriptive of this tree:

"*Cascade mountains, latitude* 44° *N.*, *August* 30.— * * On the rocky ledges which overlook the lakes are a few trees of a fir which we have not before seen. It here forms a tree of moderate height, of strictly conical figure. The foliage is very rich and massive, a dark-green above, silvery beneath; the cones, very large, 6 by 2½ inches; elliptical, obtuse, and of a dark-purple color, with numerous patches of white resin. These erect, and situated near the summit of the tree, sometimes growing on quite small trees, seem disproportionably large, and more than once I have in the distance mistaken them for birds."

Of the many notices of *P. amabilis* which occur in my journal, I select two others which will serve to illustrate the habit and appearance of the tree as it grows in perfection in its native wilds:

"*Cascade mountains, latitude* 44° 17′ (30 miles northwest from last, on headwaters of McKenzie's fork of the Willamette river.)—Our camp to-night is on the borders of a small lake, in a region formerly covered by a dense forest, which, perhaps, thirty years since was all burned off. It has been succeeded by clusters and groves, principally of silver firs, which growing in a fertile soil, and not yet crowding each other, have everywhere assumed the symmetrical forms sometimes seen in the isolated evergreens of cultivated grounds."

The young trees of *P. amabilis* are less regular in form, and are handsomer, than any other fir I have ever seen.

The range of this tree is apparently less extensive than that of *P. grandis*, though how far it extends to the north we have no means of knowing at present.

We did not see it elsewhere than in the Cascade mountains between latitude 44° and 46°; it is found, however, north of the Columbia, and probably exists along the summit of the Cascade range as far south as Mount Pitt, about 42° 40′. I did not see it in the Willamette valley or in the Coast mountains; it is probably confined to the higher portions of these latter mountains, if, indeed, it exists on them.

The wood is white, and would, perhaps, be used for timber if it were accessible. As a timber tree, it is, however, far inferior to many other trees which grow in the valleys and on the coast of Oregon.

Cones of *P. amabilis* were brought home, and seeds have been distributed with a view to its introduction into cultivation. Should this effort be unsuccessful, it may be obtained from England, where it has been grown from seeds sent home by Douglass. I very much regret that it was never convenient for the artist of the party, Mr. Young, to take a portrait of this

J Young del.

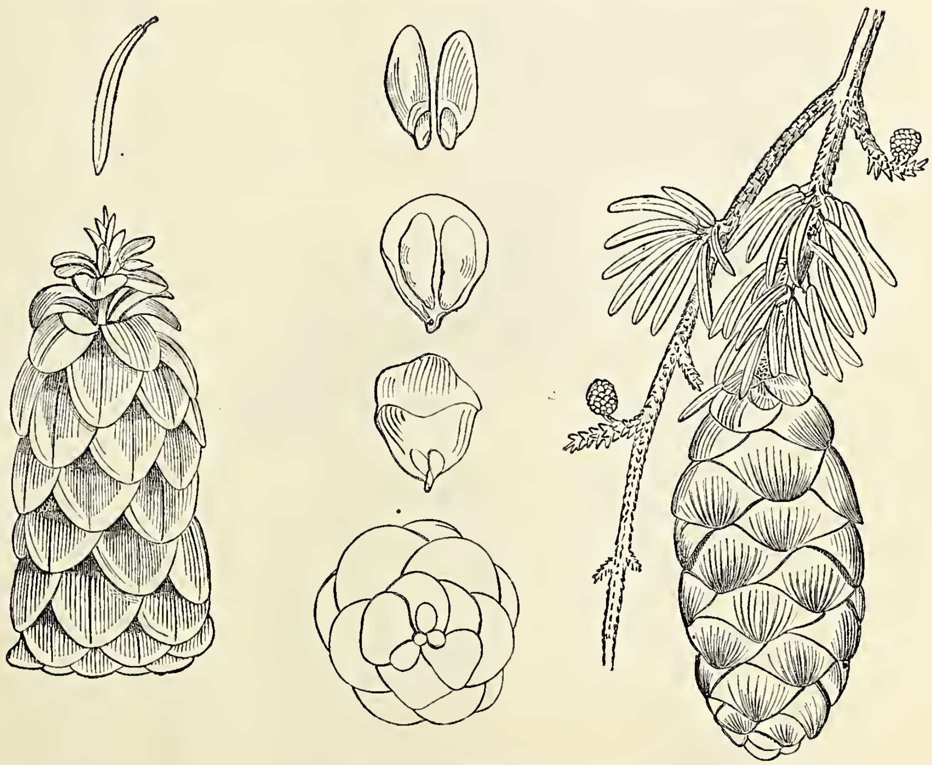
Lith. by A. Hoen & Co. Balto.

ABIES WILLIAMSONII.

tree; though one would search in vain among cultivated trees for any which should rival in the symmetry of its form, the luxuriance of its foliage, and the size and beauty of its cones, the western silver fir.

"*September* 17.—* * On the little prairie which borders one side of the lake are a few trees of the silver fir. With a strong and unimpeded growth, it has here attained a magnitude I have not elsewhere seen. It rises in denser and more symmetrical cones than any other conifer we have met with. The altitude of the largest is more than a hundred feet; the base of the cone formed, the branches resting on the ground not more than twenty. The branches are so thick as to prevent all access to the trunk without a vigorous use of the hatchet; and during the pouring rain of the last four days, we have always been able to find a dry spot beneath the shelter of its impervious foliage." From these descriptions it will be seen that the silver fir forms a dense and slender spire of dark-green foliage, which, on the older trees, is rather too formal to be pleasing, unless grouped with other species, with which its form and the color of the foliage may contrast agreeably. In the Cascade mountains I often saw it so combined with *P. grandis* and Abies Williamsonii, producing groups which seemed to me to present the extreme limit of arborescent beauty.

ABIES WILLIAMSONII, *Newb.* (Plate VII.) Williamson's spruce.



. 19.

Fig. 19. Cone, branch, leaves, scales, seeds, and male flower of *A. Williamsonii*, natural size.
Fig. 19*a*, *b*. View of side and base of old cone of *A. Williamsonii*, natural size.

Description.—A tree of large size and alpine habit; foliage somewhat fasciculate like that of the larches; leaves short, acute, compressed, with a lenticular section. Cones pendant, long-ovoid acute, $1\frac{1}{2}$ inch long, purple while young; when old, cylindrical or somewhat conical with a flattened base; scales rounded entire, large, in old cones strongly reflexed, except at the base of the cone. Seeds small, ovoid, black, wings elliptical entire pellucid; male flowers in small nearly spherical capitula.

This beautiful fir, one of the finest of the genus, was discovered by us on the summits of the Cascade mountains, latitude 44° north. It is the most alpine in its habit of all the firs; extending from the height of 6,000 feet to the line of perpetual snow. It will, doubtless, be found in similar circumstances on other parts of the Cascade range, but we saw it only about the group of mountains called the Three Sisters. It forms a tree of one hundred feet in height, of which the form is rather spreading and irregular, but remarkably graceful. The foliage is light and feathery, its color a clear, but not dark, yellow green. The cones are pendant, ovoid acute, purple, 1½ inch long by ½ inch wide, somewhat resinous when attached to the tree, but when the seed is discharged, they fall, and present the remarkable appearance of figs. 19*a* 19*b*, the scales being nearly all strongly reflexed, while a few near the base are slightly expanded and not reflexed.

I have given this beautiful tree the name of the commanding officer of the expedition, as a slight acknowledgment of the unremitting kindness which I received in my official capacity while connected with the party, as well as an imperfect expression of the personal esteem which he so uniformly gained from those who were brought into intercourse with him.

Abies Douglasii, *Lindl.* (Plate VIII.) Douglas' Spruce.
A. Douglasii, *Lind. in Penny Cyclop.* I, *p.* 32.
Pinus Douglasii, *Lamb. Pinus Ed.* 2, 2 *t.* 47.
P. Douglasii, *Loudon, Arboret,* 4, *p.* 2319.
P. Douglasii, *Nutt. Sylv.* 3, *p.* 129, *t.* 115.
P. Douglasii, *Hook. Flor. Bor. Amer.* 2, *p.* 162, *t.* 183.

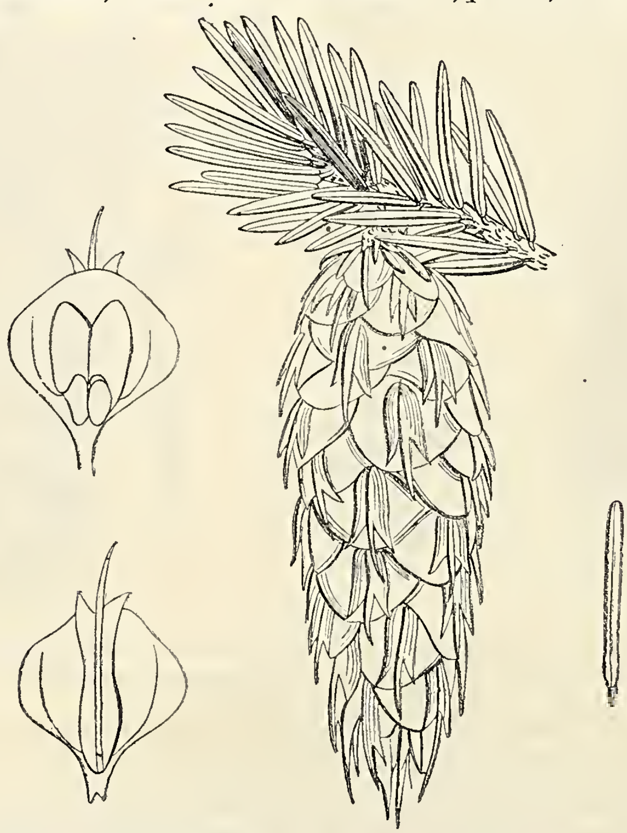


Fig. 20.
Fig. 20. Cone, leaves, and scales of *A. Douglasii*, natural size

J. Young del.

Lith. by A. Hoen & Co. Balto.

ABIES DOUGLASSII

Description.—A tree of very large size; leaves narrowly linear, one inch long, furrowed above, carinated below, with inflexed margin, slightly glaucous beneath; cones pendulous, long-ovate acute, scales few, large, lax, rounded entire; bracts elongated, strap-shaped, projecting beyond the margin of the scale, terminating in three points, of which the middle one is largest; seed elliptical, acute, nearly half the length of the wing; wing pellucid, margins entire.

This was one of the first, and is now one of the best, known of the trees of the west. From its magnitude and abundance on the Columbia, it was the first to attract the attention of the botanists who have visited Oregon, and was early introduced into England, where it is now extensively cultivated. Full descriptions have been given of it by Douglas, Lindley, Loudon, Nuttall, &c., which are, in the main, accurate. Sabine was in error, however, in supposing that the cones were erect, as in all the species they are pendant. Nuttall also represents the bracts as reflexed. They are not so, however, but always project towards the point of the cone. The figure given by Nuttall does not well represent the cones in any stage, as will be seen by comparing that figure with the one now given, which was taken from a perfect specimen, of which I brought a large number.

The size of *A. Douglasii* has not been over stated. It is, in fact, one of the grandest of the group of giants which combine to form the forests of the far west. I saw several individuals of this species which had a diameter of ten feet four feet from the ground, and an altitude of three hundred. As it usually grows in its favorite habitat, about the mouth of the Willamette, it forms forests of which the density can hardly be appreciated without being seen. The trees stand relatively as near each other, and the trunks are as tall and slender, as the canes in a cane-brake. In this case the foliage is confined to a tuft at the top of the tree, the trunk forming a cylindrical column as straight as an arrow, and almost without branches, for two hundred feet. The amount of timber on an acre of this forest very much exceeds that on a similar area in the tropics, or in any part of the world I have visited. Were it not that vegetable tissue will burn readily, the immense mass of it which encumbers the surface of an ordinary farm on the banks of the Columbia, would bid defiance to any efforts that one man could make for its removal during the term of his natural life.

To show how slender Douglas spruce ordinarily grows, I will give the measurements of a tree, which seemed of only moderate size, lying near one of our camps in the Willamette valley. It was six feet in diameter across the stump. Two hundred and sixteen feet of the trunk lay upon the ground, and the upper extremity was fifteen inches in diameter where it had been burned off.

The wood, like that of most of the spruces, is harder and less pleasant to work than that of the pines. It is, however, very stiff, makes excellent planking, joist, and timber, and for these purposes it is very largely used both in Oregon and California. The rings of annual growth are distinct and widely separated, and the tree is evidently of rapid growth. Douglas spruce covers the western slope of the Cascade mountains and the banks of the Columbia. It extends northward on the Sierra Nevada to the north line of Mexico.

Abies Menziesii. (Plate IX.) Menzies' spruce.
A. Menziesii, *Dougl. Mss. Lind. Penny Cyclop.* 1, *p.* 9.
A. Menziesii. *Loudon, Arboret,* 4, *p.* 2321, *fig.* 2332.
Pinus Menziesii. *Lamb. Pinus* 3, *t.* 19.

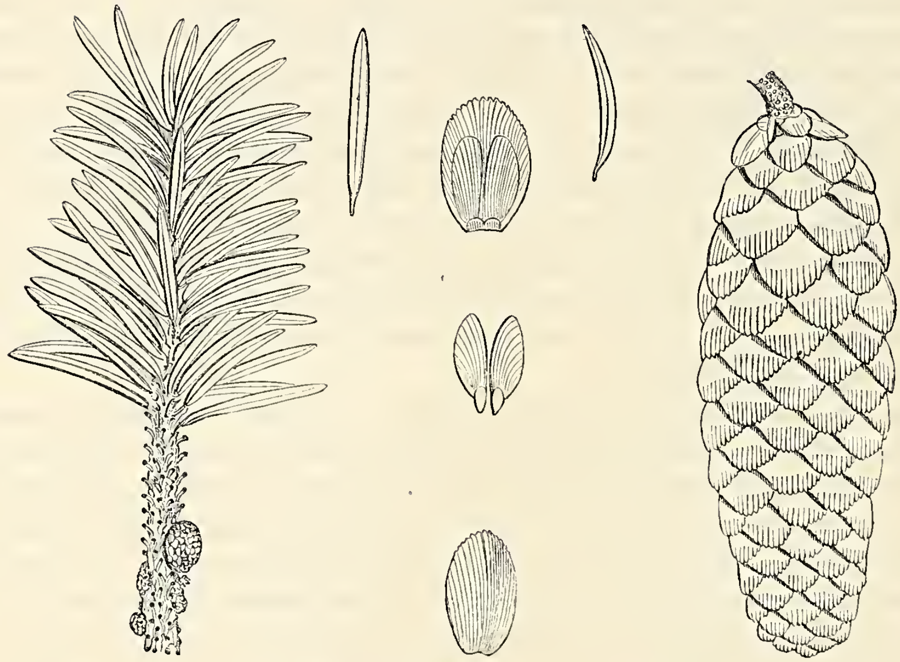


Fig. 21.

Fig. 21. Cone, scales, seeds, leaves, and branch of *A. Menziesii*, natural size.

Menzie's spruce, like that of Douglas, was long since collected by the English botanists who visited the Columbia, and is already introduced into cultivation in Europe.

It grows most abundantly and attains the largest size on the coast near the mouth of the Columbia, forming there the greater part of the forest.

It never attains dimensions so gigantic as those of *A. Douglasii*, but forms a tall and very strict tree, of which the foliage is more rigid than that of any other American abies. The leaves are so rigid and acute as sometimes to prick the skin like needles. The cones, where I have seen them, never exhibit the appearance presented in Nuttall's figure, but are much more slender, and with eroded bracts, as represented in the figure.

Thuja gigantea. The great arbor vitæ.
T. gigantea. *Nutt. Sylv. p.* 400, *t.*

The western arbor vitæ is undoubtedly the finest species of the genus. It resembles somewhat the species so common about the great lakes, *T. occidentalis*, but is not only a much larger and finer tree but the foliage is handsomer.

It grows in the greatest abundance in most parts of Oregon; within the range of my observation, much more abundantly and attaining the largest size near the coast; though said by Nuttall to grow in perfection on the Upper Columbia. The finest trees I saw of it are in the vicinity of Port Orford. It there constitutes an important part of the forest, and attains a size scarcely inferior to that of the sugar pine or Douglas' spruce.

The foliage, from the regularity of the divisions of the minor branches, and from the accuracy

J Young del

ABIES MENZIESII.

with which its scale-like leaves are fitted to each other, resembles the fronds of ferns, and is exceedingly beautiful.

Fig. 22.

Fig. 22. Leaf, cone, and seed of *T. gigantea*, natural size.

The branches are more drooping than on the common white cedar, and the tree more symmetrical and yet more graceful.

The wood is white and easily worked, and is much esteemed for lumber when the tree grows luxuriantly.

SEQUOIA SEMPERVIRENS. The redwood.
S. SEMPERVIRENS. *Endl. Syn. Conif. p.* 198.
S. SEMPERVIRENS. *Gray in Sill. Jour.*, 2*d ser.* 18, *p.* 150.
TAXODIUM SEMPERVIRENS. *Lamb. Pinus, ed.* 2, 2, *t.* 64.
T. SEMPERVIRENS. *Hook. & Arn. Bot. Beach. p.* 392.
ABIES RELIGIOSA. *Schlecht & Chamiss. in Linn.* 5, *p.* 77.

The redwood is the second in size and the first in importance of all the trees of California, though not far surpassing the sugar pine in either respect.

It is said nearly to equal in dimensions the other species of *Sequoia*, which has been specially designated as the "mammoth tree." Of all the redwoods which I saw, there was, probably, none greater than fifteen feet in diameter and three hundred feet in height, but I was told that in the vicinity of Humboldt bay individuals existed which were over twenty feet in diameter.

Fig. 23.
Fig. 23. Branch of *S. sempervirens*, with leaves, cone, and male flower ; natural size.

The value of the redwood to the people of California is, however, not dependent on its size but on the excellence of its timber and the proximity of forests of it to the ocean. It is spread over the coast mountains, for the most part to the exclusion of other trees, from the line of 42° to the northern line of Mexico, but it is nowhere found at any considerable distance from the sea.

The form of the tree is considerably like that of the sugar pine and mammoth tree, a straight, cylindrical trunk rising to a great height, festooned and ornamented, rather than loaded, with branches. Young trees, however, do not exhibit so great a disproportion between the trunk and branches.

The foliage, as is common among its congeners, the junipers, cypress, &c., is dimorphous on young trees, the leaves being long, linear, spreading, and considerably resembling those of *Taxus* and *Taxodium*. In the older trees they are closely appressed.

The cones are elliptical in form, of a length of two inches, and have a general resemblance to those of the cypresses.

The wood of the redwood is, as its name implies, dark red in color, and is considerably like that of the red cedar, *J. Virginiana*. It splits with great facility, and is frequently converted into plank and boards without the aid of a saw. It is said to be very durable, and though somewhat wanting in tenacity is of the greatest value to the inhabitants of California.

J Young del

JUNIPERUS OCCIDENTALIS.

JUNIPERUS OCCIDENTALIS. [Plate X.] The western juniper.
J. OCCIDENTALIS, *Hook. Flor. Bor. Amer.* 2, *p.* 166.
J. ANDIANA. *Nutt. Sylv.* 3, *p.* 95, *t.* 110.

This tree, which is well represented in the accompanying plate, closely resembles in its general aspect its eastern representative, *J. Virginiana*, but is distinguished from it by the larger size of its berries; by its more glandular and resinous leaves, which are also less acute; and by the character of its wood, which, in all the trees examined, was white, not at all resembling the dark and fragrant wood of the red cedar.

We found it abundant on rocky and barren surfaces east of the Sierra Nevada and Cascade mountains from Pit river to the Columbia.

The largest individual of the species noticed had a diameter of three feet near the ground and an altitude of about forty feet.

The fruit forms an important part of the subsistence of several kinds of birds, especially of Prince Maximilian's jay and Townsend's Ptilogonys.

LARIX OCCIDENTALIS. The western larch.
L. OCCIDENTALIS. *Nutt. Sylva.* 3, *p.* 143 *t.* 120.

Fig. 24.

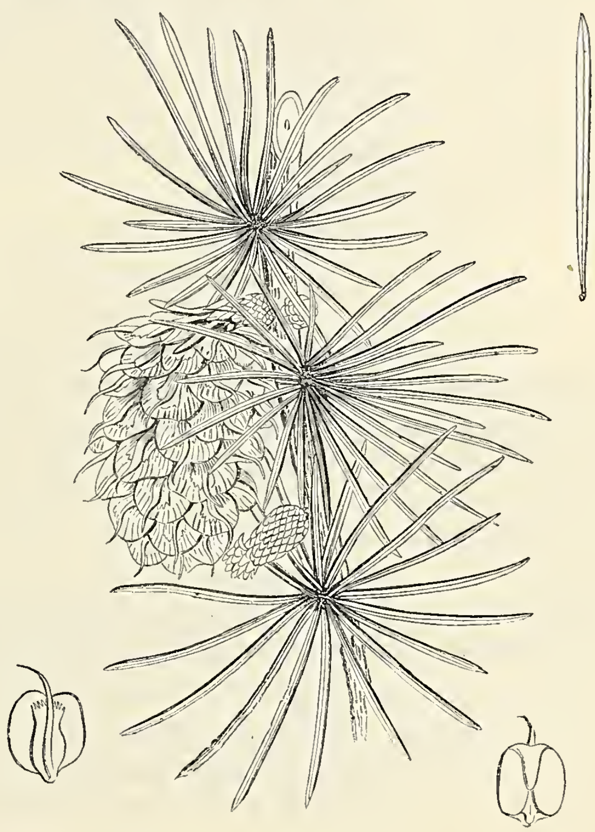


Fig. 25.

Fig. 24. Young tree of *L. occidentalis.*
Fig. 25. Leaves, cone, and scale of do., natural size.

Description.—A large tree, very tall and slender; branches short and small; foliage thin, light yellowish-green; leaves long, narrowly linear, thin carinated above and below, more slender and delicate than those of any other species; cones ovoid, $1\frac{1}{4}$ inch long, reflexed; scales shortly ovoid, truncated, or broadly emarginate ; edges thin, membranaceous ; bracts imperfectly elliptical, fimbriated, terminating in a long awn, which projects beyond the margin of the scale; male flowers ?

I have had some little doubt in referring the larch which we found in Oregon Territory to *L. occidentalis* of Nuttall, as we saw none which fully corresponded to his description. He represents the tree as having, among other characters, the shortest and broadest leaves of all the species of the genus. On the contrary, the larches, from one of which the specimen figured was taken, were remarkable for their very long, slender, and delicate leaves, in that respect excelling the "tamarack" of the eastern States, as well as the larch of Europe. The cones were, however, so nearly like those described by Nuttall that there is little probability that the trees observed by him and those seen by our party are of different species.

We first met with the larch on the Des Chutes river near its head, lat. 43° 40′ N.; from that point it extends northward to, and beyond the Columbia. The impression made upon me by this tree when we first saw it will be seen in the following extract from my note book :

"*Des Chutes Basin, September* 3.—Our camp is pitched under a tree which we have not before met with—the western larch. This is very unlike the tamarack of the eastern States, both in its ports, its foliage, and in its cones. I have not yet seen it occupying the cranberry marshes, as the tamarack is so prone to do, but it grows scattered along the borders of the streams, rising to a height of a hundred and fifty feet, with a diameter at base of two or three. The branches are very short, and the tree, as it grows in this vicinity, is more strict than any I have seen. The leaves are long and slender, the foliage very light and feathery, and the color pale bluish-green. The cones are larger than in *L. americana*, and the scales are furnished with long and slender projecting bracts."

TAXUS BREVIFOLIA. The western yew.
T. BREVIFOLIA. *Nutt. Sylva.* 3, *p.* 86, *t.* 108.
T. BACCATA, *Hook, Flor. Bor. Amer.* 2, *p.* 167, (*in part.*)
T. LINDLEYANA, *Murray, Edin. New Philo. Jour.* 1855, *p.* 294.

The differences in general aspect, exhibited by the yew of the northern States of the Atlantic coast and Mississippi valley, and that of the western coast, are so striking, that, at first sight, there seems no difficulty in distinguishing them, but, upon more thorough investigation, it is found to be a matter of no little difficulty to fix upon characters which can be regarded as diagnostic, and will serve to separate them.

Taxus Canadensis, as it grows about the great lakes, is a low, trailing shrub, on the shores of Lake Superior forming a thick and tangled undergrowth, covering the surface in the pine and hemlock forests, and seldom rising more than three or four feet from the ground ; the leaves 1 to 1¼ inch long, dark, sombre-green in color, mucronate, and with somewhat revolute margins.

The yew of Oregon and California, where we saw it in the valley of the Willamette, forms an upright tree 50—75 feet in height ; the foliage thin and rather light yellow green ; the leaves ¾—1 inch long, acuminate, and mucronate ; margins revolute ; flowers and fruit as in *T. Canadensis.*

From this comparison it will be seen that the principal differences between the eastern and western yews are found on the upright arboreal habit, the lighter foliage, and in the shorter leaves of the western plant.

If these characters were constant they would serve as the basis of a specific distinction ; but the range of variation is so great in the European yew, *T. baccata*, and in *T. Canadensis*, that we may expect to find a somewhat similar variety in those of different localities in the west. If so, the diagnostic characters mentioned will probably be found to have little value.

Fig. 26.

Fig. 26. Branch, leaves, and male flowers of *T. brevifolia*, ½ natural size.

Until such time as these—now regarded as distinct species—shall be found running into each other, it is, perhaps, better to consider them as specifically different.

The aspect of the western yew is considerably different from the arborescent yew of Europe. Its growth is more open, the foliage lighter and more feathery, and much lighter in color.

The yew is found on the Sierra Nevada, down nearly or quite to the southern line of California.

T. Lindleyana, described by Murray, (1, c,) is undoubtedly identical with *T. brevifolia;* and in his description Mr. M. has noticed the characters of the Oregon tree which I have mentioned, as distinguishing it from the yews of Europe and the eastern States.

Torreya Californica. The Californian nutmeg tree.

T. Californica. *Torr. N. Y. Jour. Pham.* 3, *p.* 49.

T. Myristica, *Hook, Bot. Mag. t.* 4780.

I did not meet with the "nutmeg tree" in California, though it occurs in the coast mountains, very near some localities which we visited. The specimens which have come into my hands were collected by other persons, to whom I am indebted for whatever knowledge I have of its habit and distribution.

It is said to be found in many localities in the coast mountains, both north and south of San

Francisco, but to be everywhere rather a rare tree. It attains but a moderate size, 50—75 feet in height, and has somewhat the aspect of a *Taxodium*, or yew, to the foliage of which its leaves have a marked resemblance. The fruit, from its texture and appearance, has been compared to a nutmeg, but is too strongly charged with turpentine to be used as a condiment.

Fig. 27.

Fig. 27. A branch, with leaves and fruit of *T. Californica*, natural size.

Very full analyses of its botanical characters are given by Nuttall and Sir W. Hooker. It is said to form a graceful and handsome tree, and, as its nuts have been made to germinate by the horticulturists of New York, we may soon expect to see it introduced into general cultivation.

CUPRESSUS NUTKATENSIS. The Nootka cypress.
C. NUTKATENSIS, *Lamb. Pinus, No.* 60.
C. NUTKATENSIS. *Hook. Flor. Bor. Amer.* 2, *p.* 165.
THUJA EXCELSA, *Bong. Veget. de Sitcha, p.* 46.

Description.—A tree of moderate size; branches sub-erect, tetragonal; leaves ovate acuminate, imbricate in four rows without tubercles; galbules as large as peas, or larger, terminating the smaller branches; scales umbonate, smooth, or radiately striate.

The only locality in which we met with this tree was on the Cascade Mountain, about latitude 44° north, though I have reason to believe that it will be found at intervals throughout the Sierra Nevada and the Cascades, in California and Oregon.

The individuals which we saw of the species were not handsome. They formed trees of moderate size, having much the appearance of *Thuja occidentalis* when growing under the most unfavorable circumstances. The trunk was gnarled and twisted, and set with dead branches; the foliage sparse and ragged, and the whole aspect disagreeable. The galbules, which were numerous, were something larger than a pea, and composed of four scales; from the centre of each a point projects.

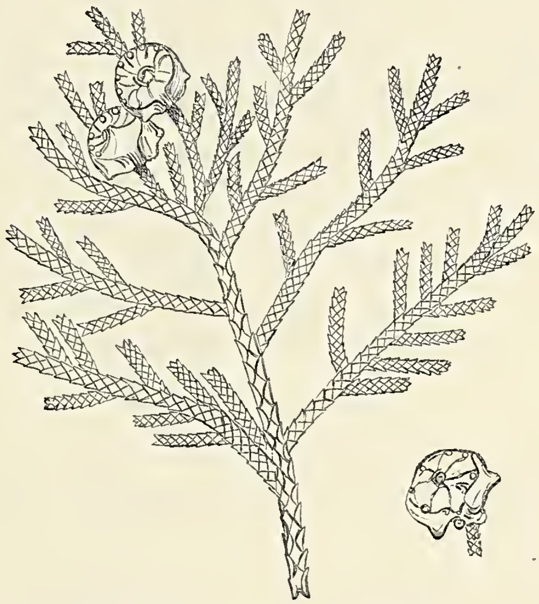


Fig. 28.
Fig. 28. Branch and galbules of *C. Nutkatensis*, natural size.

The locality where we found this tree was near the snow line, and it is possible that it was dwarfed and deformed by the severities of the climate. It is found on the low lands near the coast and on Vancouver's island. *Cupressus Lawsoniana*, described by Mr. Murray, (*Edinb. New Philos. Jour.*, 1855,) is closely allied to this species, but differs from it in having six scales

LIBOCEDRUS DECURRENS. The California white cedar.

L. DECURRENS, *Torrey in Smithsonian Contrib.* 6, *p.* 7, *t.* 3.

This tree is very extensively distributed over California and southern Oregon, where it is found in nearly all parts of the mountains of the interior. We found it more abundant and attaining the greatest size at McCumber's, in northern California. It there rivals even the sugar pine in diameter of trunk, though never obtaining an equal altitude. Many of the white cedars about McCumber's are six to seven feet in diameter three feet above the ground, with an altitude of more than one hundred feet.

The general aspect of the tree is strikingly like that of *Thuga occidentalis* as it grows about Lake Superior. The general form conical; the trunk angular, or at least not cylindrical; the bark fibrous, and the lower part of the trunk usually bristling with the dead but persistent branches. The foliage is also very like in its general aspect to that of the tree referred to, and the wood is of similar character and of about equal economical value. I noticed about McCumber's that the trees cut for the saw-mills, though externally apparently sound and healthful, were affected by a singular kind of dry-rot, by which the trunk was honeycombed and rendered valueless. This kind of decay seemed to affect the wood in a great number of detached points at the same time, and not to be connected with any external injury.

The fruit of the *Libocedrus* is very different from that of any of its congeners, and is well represented by the plate given in *P. Frémont.* (l. c.) by Dr. Torrey, except that it is always pendulous and not erect, as there represented.

No. 2.

GENERAL CATALOGUE OF THE PLANTS COLLECTED ON THE EXPEDITION.

BY J. S. NEWBERRY,

ASSISTED BY ASA GRAY AND JOHN TORREY, AS SPECIFIED IN THE PROPER PLACES.

I. EXOGENOUS PLANTS.

RANUNCULACEÆ.

Clematis ligusticifolia, *Nutt.; Torr. & Gray, Flor. N. Amer.* 1, *p.* 9. Banks of Sacramento river, Cal.; July, in flower. Klamath Basin, Pit river; August, in fruit. Dalles of the Columbia.

Ranunculus aquatilis, *Linn.; Pursh. Fl.* 2, *p.* 395; *DC. Prod.* 1, *p.* 26. McCumber's Flat; July, in flower. Pit river; July, in fruit. Common in N. Cal. and Oregon. Wherever observed, this plant had large flowers, and no emerged leaves.

Ranunculus occidentalis, *Nutt.; Torr. & Gray, Flor. N. Amer.* 1. *p.* 22. McCumber's Flat, N. Cal.

Ranunculus Purshii. (?) *Richardson, Hook. Flor. Bor.-Amer.* 1, *p.* 15. Upper Klamath lake, O. T. Plant very small, and may be distinct from *R. Purshii.*

Ranunculus Californicus, *Benth. Plant. Hartweg*, 1628. R. dissectus, *Hook. Bot. Beech. p.* 316. R. delphinifolius, *Torr. & Gray, Flor. Suppl. p.* 659. Petaluma, Cal.; common in the Sacramento valley.

Aconitum napellus, *Linn.* var. delphinifolius, *Seringe; Torr. & Gray, Flor.* 1, *p.* 34. Head of Des Chutes river. Cascade mountains, O. T.; September, in flower.

Thalictrum dioicum, *Linn.; DC. Prodr.* 1, *p.* 12; *Hook. Flor. Bor.-Amer.* 1, *p.* 3; *Torr. & Gray, Flor. I, p.* 38. Sacramento valley, Cal.

Aquilegia Canadensis, *Linn.; Torr. & Gray, Flor. N. Amer.* 1, *p.* 29. A. formosa, *Fisch. in DC. Prodr.* 1, *p.* 20. Shingletown and McCumber's Flat, N. Cal.; large, showy, grows in moist places.

Delphinium decorum, *Fisch. & Meyer, Hort. Petrop., p.* 32. Fort Reading, Cal.

Delphinium patens, *Benth. Plant, Hartweg*, 1632. Crater pass, Cascade mountains, Oregon; September 1.

Delphinium azureum, *Michx. Flor.* 1, *p.* 314. Shores of San Pablo bay; July.

Delphinium Menziesii, *DC. Hook. Flor. Bor.-Amer.* 1, *p.* 25. Hat creek, Cal.; July.

Delphinium nudicaule, *Torr. & Gray, Flor. N. Amer.* 1, *pp.* 33 & 661. D. sarcophyllum, *Hook. & Arn. Bot. Beechey, p.* 317. Sonoma, Cal.; flowers red.

Anemone Alpina, *Linn.; Hook. Flor. Bor.-Amer.* 1, *p.* 5.; *DC. Prodr.* 1, *p.* 17. Crater pass, Cascade mountains, Oregon; September, in fruit. Willamette valley; May, in flower; from Dr. Evans.

Pæonia Brownii, *Dougl.; Torr. & Gray, Flor. N. Amer.* 1, *p.* 41. P. Californica, *Nutt.* Cascade mountains, Oregon; lat. 44° 30′.

The flowers of this plant are erect, but when the seed is nearly ripe the stalks which support the carpels curve downward and outward until the carpels themselves rest on the ground accurately inverted. The dehiscence of the carpels takes place at the summit, and the bean-like seeds are carefully deposited on the ground and roofed over by the persistent carpels, probably through the winter.

On the banks of Mpto-ly-as river, near the base of Mount Jefferson, Oregon, at an altitude of 5,000 feet, in September, I found large surfaces covered with this plant, which had already been touched by the frost. Of the hundreds of clusters of pods, all were inverted and resting on the ground, completely covering the seed, which had generally fallen out. The carpels are from 3 to 5 in a cluster, the number varying in the same plant.

Actæa Spicata, *Linn.* var rubra, *Bigelow, Flor. Bost. ed. 2d, p.* 211. Cascade mountains; lat. 44° 12′.

BERBERIDACEÆ.

Berberis aquifolium, *Pursh. Flor.* 1, *p.* 219, *t.* 4. Banks of Pit river and Klamath basin.

Berberis glumacea, *Spreng.; Lindl. Bot. Reg. t.* 1425. Mahonia nervosa, *Nutt. Gen. 1, p.* 212. M. glumacea, *DC. Prodr.* 1, *p.* 19. Very abundant in spruce forests in Cascade mountains and Willamette valley, O. T. Fruit blue, acid, but eatable; called Oregon grape.

Achlys triphylla, *DC.; Hook. Flor. Bor.-Amer.* 1, *p.* 30, *t. XII.* Willamette valley; May, in flower; Cascade mountains, O. T.; September, in fruit. This singular plant grows in moist places, and has much the habit and appearance of Jeffersonia diphylla. The flower is quite fragrant.

CRUCIFERÆ.

Lepidium nitidum, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 116. San Francisco, Cal.

Nasturtium lyratum, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 73. Dalles of the Columbia, O. T.; October, in flower.

Cardamine paucisecta, *Benth. Plant. Hartw.* 1646. Petaluma, Cal.

Barbarea vulgaris, *R. Br.; Benth. Plant. Hartw. p.* 297, *No.* 1645. Shores of Klamath lake.

Erysimum elatum, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 95. Common in Sacramento valley and Klamath basin.

Capsella bursa-pastoris, *Moench.; Torr. & Gray, Flor.* 1, *p.* 117. Fort Vancouver, W. T. Introduced.

FUMARIACEÆ.

Dielytra formosa, *DC. Syst.* 2, *p.* 109; *Torr. & Gray, Flor. N. Amer.* 1, *p.* 67. Cascade mountains, O. T.; August.

PAPAVERACEÆ.

Eschscholtzia Douglasii, *Hook. & Arn. Bot. Beechey, p.* 320; *Torr. & Gray, Flor.* 1, *p.* 664. Suisun valley; July, in flower.

Eschscholtzia Californica, *Cham.; Torr. & Gray, Flor.* 1, *p.* 664. Fort Reading, Cal.; April, in flower; July, in fruit.

Platystemon Californicum, *Torr. & Gray, Flor.* 1, *p.* 65; *Benth. Hort. Trans.* (2*d series*) 1, *p.* 407. Petaluma, Cal.

Platystigma lineare, *Benth. l. c.; Torr. & Gray, Flor.* 1, *p.* 65. San Pablo bay.

NYMPÆAHACEÆ.

Nuphar advena, *Ait.; Pursh. Flor.* 2, *p.* 369; *Torr. & Gray, Flor.* 1, *p.* 58. Whole plant large; pods of the size of an egg. Common in the Klamath basin. Klamath marsh is half covered by the floating leaves. The seeds, which fill the large pods, are larger than those of the eastern plant, and form an important article of subsistence among the Indians. We saw many hundred bushels of the pods collected for winter use. The seed tastes like that of the broom corn, and is apparently very nutritious.

VIOLACEÆ.

Viola adunca, *Smith in Rees' Cycl.; Hook. Flor. Bor.-Amer.* 1, *p.* 79. Willamette valley, O. T.; October, in flower.

Viola longipes, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 140. Willamette valley, O. T.; Petaluma, Cal.; October, in flower.

Viola sarmentosa, *Dougl.; Hook. Flor. Bor.-Amer.* 1, *p.* 80. San Francisco and Sonoma.

Viola pedunculata, *Torr. & Gray, Flor.* 1, *p.* 141. San Francisco, Cal.

Viola chrysantha, *Hook. Ic.* 1, *t.* 49. *Torr. & Gray, Flor.* 1, *p.* 134. Fort Reading, Cal.

Viola Sheltoni, *Torr. in Whipple's Rep.* Banks of Yuba river, Sacramento valley; July.

Viola cucullata, *Ait.; Torr. & Gray, Flor.* 1, *p.* 139. Willamette valley; October, in flower.

Viola ocellata, *Torr. & Gray, Flor.* 1, *p.* 142. Near San Francisco, Cal.

MESEMBRYANTHEMACEÆ.

Mesembryanthemum dimidiatum, *Harv.* Common along the shores of the straits at San Francisco, where it has been probably introduced.

HYPERICACEÆ.

Hypericum Scouleri, *Hook. Flor. Bor.-Amer.* 1, *p.* 111. McCumber's, N. Cal.; July, in flower; and Klamath basin, O. T.; August, common.

CARYOPHYLLACEÆ.

Mollugo verticillata, *Linn.; Torr. & Gray, Flor.* 1, *p.* 76. McCumber's Flat, N. Cal.

Silene Drummondi, *Hook. Flor. Bor.-Amer.* 1, *p.* 89. *Torr. & Gray, Flor.* 1, *pp.* 91 & 675. McCumber's and Klamath basin; July and August.

Stellaria longipes, *Goldie, in Edinb. Phil. Jour.* 6, *p.* 185; *DC. Prodr.* 1, *p.* 400.; *Torr & Gray, Flor. I, p.* 184. McCumber's Flat, N. Cal.

Stellaria nitens, *Nutt. in Torr. & Gray, Flor.* 1, *p.* 184. Near Portland, Oregon; Oct.

PORTULACACEÆ.

Claytonia alsinoides, *Sims, Bot. Mag. t.* 1309; *Torr. & Gray, Flor.* 1, *p.* 199. Cascade mountains, O. T.; August 26.

Claytonia perfoliata, *Don. Bot. Mag. t.* 1336; *Torr. & Gray, Flor.* 1, *p.* 200 & 676. Near San Francisco, California; May.

Claytonia parvifolia, *Mocino, in DC. Prodr.* 3, *p.* 361. C. filicaulis, *Hook. Flor. Bor.-Amer.* 1, *p.* 224. McCumber's, Northern California; July.

Calandrinia Menziesii, *Hook. Flor. Bor.-Amer.* 1, *p.* 223, *t.* 10; *Torr. & Gray, Flor.* 1, *p.* 197. Fort Reading, California; April.

Spraguea umbellata, *Torr. Plant. Fremont. p.* 4, *t.* 1. McCumber's, California. Crater Pass, Cascade mountains, altitude 6,700 feet. At McCumber's this plant has acute leaves, erect flower stems, and pale cream-colored flowers. On the summits of the Cascade mountains I found the whole plant spread mat-like on the sand, small, with truncated leaves and purple flowers and stems.

STERCULACEÆ.

Fremontia Californica, *Torr. Pl. Fremont. in Smithson. Contrib.* 6, *p.* 5, *t.* 2. Near Fort Reading, California. July 27–30, in fruit.

MALVACEÆ.

Sidalcea malvæflora, *Gray. Pl. Wright.* 1, *p.* 16. McCumber's and Hat Creek, N. California; August 1 to 10; in flower.

Sidalcea hirsuta, *Gray. Pl. Wright* 1, *p.* 16. S. delphinifolia, *Gray, Pl. Fendl. p.* 19, McCumber's, July 29; in flower.

Sidalcea Hartwegi, *Gray. Pl. Fendl.*, *p.* 209; *Benth. Pl. Hartw. p.* 300. Fort Reading; April, in flower.

Malva borealis, *Wallr.; Gray. Pl. Fendl.*, *p.* 15. M. obtusa, *Torr. & Gray, Flor.* 1, *p.* 225. Common in the southern portions of the Sacramento valley.

Malva hederacea, *Dougl. in Hook. Flor. Bor.-Amer.* 1, *p.* 107. Near Benicia; July 1, in flower.

LINACEÆ.

Linum perenne, *Linn.; Torr. & Gr. Flor.* 1, *p.* 204; *Hook. Flor. Bor.-Amer.* 1, *p.* 106. Common in northern California and Klamath basin; used by the Indians for making twine, of which they make nets for catching fish and birds.

Linum Californicum, *Benth. Pl. Hartw.*, *p.* 298. McCumber's, Northern California; July. Much smaller plant than the last; flowers white.

GERANIACEÆ.

Geranium incisum, *Nutt.* G. albiflorum var. incisum, *Torr. & Gr. Flor.* 1, *p.* 208. G. albiflorum, *Hook. Flor. Bor.-Amer.* 1, *p.* 116, *t.* 40. On the banks of a small tributary of the Columbia, near the Dalles. October 1, in flower; flowers nearly white.

Erodium cicutarium. *L'Herit., DC. Prodr.* 1, *p.* 646; *Torr. & Gray, Flor.* 1, *p.* 208. Common in all parts of the Sacramento valley, in the Klamath basin, and on the Columbia. In flower from June to November.

OXALIDACEÆ.

Oxalis corniculata, (*Linn.*) *Arn.; D.C. Prodr.*, 1, *p.* 692; *Hook. Flor. Bor.-Amer.* 1, *p.* 117. Willamette valley, O. T.; October, in flower. San Francisco, California; November.

Oxalis Oregana, *Nutt. in Torr. & Gray, Flor.* 1, *p.* 211. Willamette valley, O. T.; October.

O. Acetosella, *Hook. Flor. Bor.-Amer.* 1, *p.* 118, *in part.* Flowers large, pink; whole plant larger than O. Acetosella, as it grows on the shores of Lake Superior.

LIMNANTHACEÆ.

Limnanthes Douglasii, *R. Br. in Lond. & Edinb. Philos. Mag. July,* 1833; *Benth. Hort. Trans.* (2 *ser.*) 1, *p.* 409. Shores of San Pablo bay; April.

ANACARDIACEÆ.

Rhus diversiloba, *Torr. & Gray, Flor.* 1, *p.* 218. R. lobata, *Hook. Flor. Bor.-Amer.* 1, *p.* 127. Common throughout northern California; more rare in the Klamath basin. Specimens from Fort Reading; April, in flower, July, in fruit. Berries white; called by the inhabitants of California "poison oak." Several of our party were poisoned by it, and it also affected some of our mules.

ACERACEÆ.

Acer macrophyllum, *Pursh. Flor.* 1, *p.* 267; *Hook. Flor. Bor.-Amer.* 1, *p.* 112, *t.* 38; *Nutt. Sylv.* 2, *p.* 76, *t.* 67. Cascade Mountains and Willamette Valley, O. T.

Acer circinatum, *Pursh, Flor.* 1, *p.* 266; *Hook. Flor. Bor.-Amer.* 1, *p.* 112, *t.* 39. Willamette valley, O. T.

Acer glabrum, *Torr. Ann. Lyc. Nat. Hist. N. York,* 2, *p.* 172. Cascade mountains, O. T.

Acer tripartitum, *Nutt. in Torr. & Gray, Flor.* 1, *p.* 247. Cascade mountains, O. T.

HIPPOCASTANACEÆ.

Æsculus Californica, *Nutt. in Torr. & Gray, Flor.* 1, *p.* 251, *& Sylva,* 2, *p.* 69, *t.* 64. Common throughout the valleys of California. In flower July 1st.

CELASTRACEÆ.

Euonymus occidentalis, *Nutt. in Torr. & Gray, Flor.* 1, *p.* 258. Coast near San Francisco; May, in flower. Very nearly allied to *E. atropurpureus;* perhaps not distinct.

RHAMNACEÆ.

Rhamnus Purshianus, *DC.; Hook. Flor. Bor.-Amer.* 1, *p.* 123, *t.* 43.

Frangula Californica, *Gray, Gen. Illust.* 2, *p.* 178, *& Pl. Wright.* 2, *p.* 28. R. oleifolius, *Hook. Flor. Bor.-Amer.* 1, *p.* 123. R. laurifolius, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 263. Fort Reading; July. Shore of Klamath lake; August, in fruit.

Ceanothus velutinus, *Dougl. in Hook. Flor. Bor.-Amer.* 1, *p.* 125, *t.* 45. Common in the Cascade mountains, O. T. The pubescence of this plant is very variable, and I have been unable to distinguish it from *C. levigatus.*

Ceanothus thyrsiflorus, *Esch.; Bot. Reg.* 30, *t.* 38; *Torr. & Gray, Flor.* 1, *p.* 266; *Nutt. Sylv.* 2, *p.* 43, *t.* 57. Very common about San Francisco.

Ceanothus prostratus, *Benth. Pl. Hartw. No.* 1683. Pine woods in northern California; grows in a mat on the ground.

Ceanothus cuneatus, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 267. Near Fort Reading; July, in fruit.

Ceanothus integerrimus, *Hook. & Arn. Bot. Beech. p.* 329; *Benth. Pl. Hartw. No.* 1684. Near Fort Reading; July, in fruit and flower.

VITACEÆ.

Vitis Californica, *Benth. Bot. Sulph. p.* 10, *Pl. Hartweg, No.* 1679. Banks of Sacramento river. July, in young fruit.

POLYGALACEÆ.

Polygala cucullata, *Benth. Pl. Hartw. p.* 299. P. cornuta, *Kellogg, Proceed. Cal. Acad.* 1, *p.* 62. McCumber's Flat, northern California. Much more shrubby than Bentham's plant.

FRANKENIACEÆ.

Frankenia grandifolia, *Cham. & Schlect. in Linn.* 1, *p.* 35; *Torr. & Gray, Flor.* 1, *p.* 168. Shores of San Francisco bay.

LEGUMINOSÆ.

Vicia Oregana, *Nutt. in Torr. & Gray, Flor.* 1, *p.* 270. McCumber's, N. Cal. July, in flower. Pit river; August. Klamath basin; August, in fruit.

Vicia gigantea, *Hook. Flor. Bor.-Amer.* 1, *p.* 157; *Torr. & Gray. Flor. l. c.* Near San Francisco; April, in flower.

Vicia Americana, *Muhl. in Willd. sp.* 3, *p.* 1096; *Pursh. Flor.* 2, *p.* 471; *Torr. & Gray, Flor.* 1, *p.* 269. Banks of Canoe creek, N. Cal.; August, in flower.

Vicia truncata, *Nutt. in Torr. & Gray, Flor.* 1, *p.* 270. Banks of Hat creek, N. Cal.; July. Banks of Pit river; August, in flower and fruit.

Trifolium longipes, *Nutt. in Torr. & Gray, Flor.* 1, *p.* 314. Fort Reading, N. Cal.; July.

Trifolium albopurpureum, *Torr. & Gray, Flor.* 1, *p.* 313. Fort Reading, N. Cal.; July, in fruit. Specimens were presented me by Dr. J. F. Hammond, surgeon at the fort; collected in April, in flower. Plant decumbent, spreading, a foot high; silky-pubescent; heads and flowers as in the description, but plant much stronger. One of the prettiest species which I met with.

Trifolium variegatum, *Nutt.* in Torr. & Gray, Flor. 1, p. 317. Shores of San Pablo bay, California.

Trifolium tridentatum, *Lindl. Bot. Reg. t.* 1070. In Sacramento valley and at Fort Reading.

Trifolium pratense, *Linn.; Torr. & Gray, Flor.* 1, *p.* 313. Fort Vancouver; introduced.

Trifolium repens, *Linn.; Eng. Bot. t.* 1769. Fort Vancouver, W. T.; introduced.

Trifolium fimbriatum, *Lindl. Bot. Reg. t.* 1070; *Hook. Flor. Bor.-Amer.* 1, *p.* 133. McCumber's, N. Cal.; July.

Lupinus nanus, *Dougl.; Benth. in Hort. Trans. p.* 459, *t.* 14, *fig.* 2; *Pl. Hartw. p.* 303. Shores of San Pablo bay, California.

Lupinus micranthus, *Dougl.; Agardh, in Bot. Reg. t.* 1251; *Torr. & Gray, Flor.* 1, *p.* 373.

Lupinus albifrons, *Benth. in Hort. Trans. p.* 410; *Torr. & Gray, Flor.* 1, *p.* 377; *Lindl. Bot. Reg. t.* 1642.

Lupinus latifolius, *Agardh; Torr. & Gray, Flor.* 1, *p.* 375; *Lindl. Bot. Reg. t.* 1642.

Lupinus polyphyllus, *Lindl. Bot. Reg. t.* 1097; *Hook. Flor. Bor. Amer.* 1, *p.* 164. Moist places at McCumber's, and about the Klamath lakes.

Lupinus ornatus, *Dougl. in Bot. Reg. t.* 1216; *Torr. & Gray, Flor.* 1, *p.* 378. Banks of Pit river.

LUPINUS LEPIDUS, *Dougl. in Bot. Reg. t*, 1149 ; *Torr. & Gray, Flor.* 1, *p.* 374. Banks of Hat creek, California.

LUPINUS MACROCARPUS, *Hook. & Arn. Bot. Beech. p.* 138. About San Francisco, California. Shrubby ; flowers verticillate.

LUPINUS LEUCOPHYLLUS, *Lindl. Bot. Reg. t.* 1124 ; *Torr. & Gray, Flor.* 1, *p.* 379. Dalles of the Columbia.

THERMOPSIS MACROPHYLLA, *Hook. & Arn. Bot. Beech. p.* 329 ; *Torr. & Gray, Flor.* 1, *p.* 388.

HOSACKIA BICOLOR, *Dougl.; Benth. in Bot. Reg. t.* 1257 ; *Torr. & Gray, Flor. N. Amer.* 1, *p.* 323. Shores of San Pablo bay.

HOSACKIA PURSHIANA, *Benth. Pl. Hartweg.* No. 1701 ; *Torr. & Gray, Flor. N. Amer.* 1, *p.* 325. Upper Sacramento valley and McCumber's, N. Cal.; common.

HOSACKIA OBLONGIFOLIA, *Benth. Pl. Hartweg. p.* 305. Upper cañon of Pit river.

HOSACKIA DECUMBENS, *Benth. in Linn. Trans.* 17, *p.* 346 ; *Torr. & Gray, Flor.* 1, *p.* 323.

HOSACKIA SUBPINNATA, *Benth. Pl. Hartweg. l. c.; Torr. & Gray, Flor.* 1, *p.* 326. Petaluma, California.

HOSACKIA GRACILIS, *Benth. in Linn. Trans.* 17, *p.* 365 ; *Torr. & Gray, Flor.* 1, *p.* 323. San Francisco, California.

GLYCYRRHIZA LEPIDOTA, *Nutt. Gen.* 2, *p.* 106 ; *Torr. & Gray, Flor.* 1, *p.* 297 ; *Hook. Flor. Bor.-Amer.* 1, *p.* 138. McCumber's and Pit river, California ; July.

ROSACEÆ.

NUTTALLIA CERASIFORMIS, *Torr. & Gray, in Hook. & Arn. Bot. Beechy, p.* 336, *t.* 82 ; *Torr. & Gray, Flor.* 1, *p.* 412, *Benth. Pl. Hartw. No.* 1707.

GEUM MACROPHYLLUM, *Willd. Enum.* 1, *p.* 557 ; *DC. Prodr.* 2, *p.* 550 ; *Torr. & Gray, Flor.* 1, *p.* 421. McCumber's, N. California.

SPIRAEA CÆSPITOSA, *Nutt. Torr. & Gray, Flor. N. Amer.* 1, *p.* 418 ; *Gray, Pl. Fendl. p.* 40. Crater pass, Cascade mountains ; latitude 44°, altitude 6,700 feet.

SPIRAEA DOUGLASII, *Hook. Flor. Bor.-Amer.* 1, *p.* 172 ; *Torr. & Gray, Flor.* 1, *p.* 415. McCumber's, N. California.

SPIRAEA BETULIFOLIA, *Pallas, Flor. Ross. t.* 16 ; *Torr. & Gray, Flor.* 1, *p.* 414 ; *Hook, Flor. Bor.-Amer.* 1, *p.* 172. Cascade mountains, O. T.

SPIRAEA OPULIFOLIA, *Linn.* ; *Torr. & Gray, Flor.* 1, *p.* 413. Banks of Mpto-ly-as river, O. T.

SPIRAEA ARIÆFOLIA, *Smith, in Rees. Cyclop.; Hook. Flor. Bor.-Amer.* 1, *p.* 173. Fort Vancouver and Cascade mountains, O. T.

RUBUS NUTKANUS, *Mocino; Hook. Flor. Bor.-Amer.* 1, *p.* 183 ; *Torr. & Gray, Flor.* 1, *p.* 450. McCumber's pass, N. California.

RUBUS MACROPETALUS, *Dougl. in Hook. Flor. Bor.-Amer.* 1, *p.* 78, *t.* 59 ; *Torr. & Gray, Flor.* 1, *p.* 457. Near San Francisco, California.

RUBUS PEDATUS, *Smith; Hook. Flor. Bor.-Amer.* 1, *p.* 181, *t.* 62; *Torr. & Gray, Flor.* 1, *p.* 452. On the coast above San Francisco, California.

RUBUS URSINUS, *Cham. & Schlecht, in Linnæa,* 2, *p.* 11. Petaluma.

RUBUS SPECTABILIS, *Pursh. Flor.* 1, *p.* 348, *t.* 16 ; *Hook. Flor. Bor.-Amer.* 1, *p.* 178. On the banks of the Columbia, and on the coast of Oregon generally.

COMARUM PALUSTRE, *Linn.; Fl. Dan.* 636. McCumber's, California, and Klamath basin.

POTENTILLA ANSERINA, *Linn. Sp.* 1, *p.* 495; *Torr. & Gray, Flor.* 1, *p.* 444. Shores of Klamath lake, O. T.

POTENTILLA FLABELLIFOLIA, *Hook.; Torr. & Gray, Flor. p.* 442. Cascade mountains, O. T.; altitude 6,000 feet.

POTENTILLA GRACILIS, var. FLABELLIFORMIS, *Torr. & Gray, Flor. p.* 440. McCumber's, N. California, and Klamath basin.

POTENTILLA RIGIDA, *Nutt. in Jour. Acad. Philad.* 7, *p.* 20. Banks of Hat creek, N. California.

POTENTILLA GLANDULOSA, *Lindl. Bot. Reg. t.* 1583; *Hook & Arn. Bot. Beech., p.* 338. Banks of Hat creek, N. California.

IVESIA, Nov. Gen. (Torr. & Gray.)

"Calyx 5-fidus et 5-bracteolatus, tubo concavo vel campanulato. Petala 5, oblongo-cuneata vel obcordata, decidua. Stamina 20, bi–triseriata, tubo calycis, vel tantum 5 margini disci tenuis, inserta; filamenta filiformia vel subulato-filiformia, persistentia. Ovaria plura vel plurima, receptaculo conico villoso insidentia: ovulo pendulo: stylus infra-apicalis, gracilis, articulatione deciduus: stigma simplex. Achenia lævia. Radicula supera. Herbæ Horkeliæ facie, plurifoliolatæ, albi floræ, in sectionibus 2 disponendæ, nempe:—

"§ 1. HORKELIOIDES. Perennes, e caudice crasso confertissime multifoliolatæ; floribus congestis subsessilibus; calycis 5-fidi tubo campanulato vel turbinato; petalis spathulatis parvulis; acheniis lævibus paucis (ovariis 6–12?) Species duo: I. GORDONI, (Horkelia Gordoni, *Hook. Kew. Jour. Bot.* 5, *p.* 341, *t.* 12, H.? multifoliolata, *Torr. in Sitgreaves, Zuñi Exped. p.* 159.) I. PICKERINGII, N. California; *Coll. Expl. Exped.*

"§ 2. POTENTILLOIDES. Annuæ, laxe plurifoliolatæ, laxifloræ, pedunculis ebracteatis; calyce concavo (bracteolis conformibus) subæqualiter fere 10-partito; acheniis plurimis grosse paucicostatis. Sp. 1, nempe:

"I. GRACILIS, (sp. nov.): gracilis, laxe villosa; foliis radicalibus 11–21-foliolatis; foliolis inferioribus 3–5-partitis breviter petiolulatis, summis plerumque alte bifidis subconfluentibus, segmentis lineari seu oblongo-spathulatis, caulinis parvis cum foliolis 5–9 subintegris; floribus parvis in cyma effusa sparsis; pedunculis ebracteatis filiformibus mox cernuis; petalis obcordatis calyce longioribus; stylis inferne vesiculoso-subincrassatis.—Banks of Rhett lake, one of the Klamath group. A foot high, producing many slender and nearly erect stems from a slender and evidently annual root. Leaflets thin, 3 to 6 lines long, irregular, often alternate, the lower ones rather sparse. Branches of the open cyme, as well as the peduncles, very slender; the latter fully an inch long. Flowers very small; the calyx, when spread out flat, only about 4 lines wide, flattish, and open like that of a Potentilla; the accessory lobes like the real sepals, only slightly smaller and blunter. Petals white, broad, deciduous. Stamens 20, in three ranks, five of them, viz: those opposite the true sepals inserted on the margin of a narrow and thin patelliform perigynous disk, (which is villous, like the receptacle it surrounds,) the others borne on the face of the calyx, the five opposite the petals inserted very close to the disk, but distinguishably separate from it; the remaining ten inserted higher up, just below the 10 sinuses, and answering to them, but in reality borne one on each side of the base of each interior or true division of the calyx; the persistent filaments slightly dilated at the base. Receptacle conical, hirsute. Ovaries indefinite, 30 or more, inserted by the inner angle just above the base; the style inserted a little below the rounded apex by a narrow base, above which it is more or less enlarged and glandular, or rather vesicular, and tapering gradually to the apex, tipped with a simple stigma. Achenia pretty numerous, smooth, glabrous; when mature marked by a few thick and irregular longitudinal ribs; the style deciduous by an articulation. Seed suspended from near the summit.

"Although so well marked by the characters above cited, this plant and the two of the proposed first section evidently belong to the same genus, and that intermediate between Horkelia and Potentilla. The first section is more like Horkelia, from which the 20 stamens with filiform filaments (instead of 10 with broad or deltoid filaments) distinguish it. The second, except as to the foliage, resembles Potentilla, but is distinguished by its definite stamens in three ranks, &c. Dr. Torrey indicated the essential characters of this genus several years ago, but allowed the two species then known to him to be provisionally appended to Horkelia. Dr. Newberry's discovery, however, renders it necessary to complete the separation. The present name is chosen to commemorate one of the oldest surviving botanists of the United States, the venerable Dr. Eli Ives, formerly professor of materia medica and pharmacy in Yale College, who, although he has published little directly upon botany, has rendered excellent service as a teacher of the science to a long series of pupils." *A. Gray.*

Plate XI. Ivesia gracilis. Plant of the natural size. Fig. 1. A flower. 2. A petal. 3. Section of receptacle, calyx, &c. 4. Flower spread out flat, to show the insertion and arrangement of the stamens; the ovarian receptacle cut wholly away. 5. A pistil. 6. The receptacle in fruit vertically divided. 7. A ripe achenium. 8. The same vertically divided. All the details more or less magnified.

Horkelia cuneata, *Lindl.; Torr. & Gray, Fl.* 1, *p.* 435. Shores of Klamath lake.

Horkelia congesta, *Hook.; Torr. & Gr. Flor.* 1, *p.* 434. Banks of Hat creek, northern California.

Fragaria Californica, *Cham. & Schlecht. in Linnæa*, 2, *p.* 20; F. Chilensis, *Torr. & Gray, Flor.* 1, *p.* 448, *in part.* Willamette valley.

Fragaria Chilensis, *Ehrh.; Torr. & Gray, Flor.* 1, *p.* 448. Portland, Oregon; November 1, in flower.

Rosa fraxinæfolia, *Borr.; Lindl. Bot. Reg., t.* 458; *Hook. Flor. Bor.-Amer.* 1, *p.* 199. Common in northern California and Oregon.

Pyrus rivularis, *Dougl. in Hook. Flor. Bor.-Amer.* 1, *p.* 203, *t.* 68; *Torr. & Gray, Flor.* 1, *p.* 471; *Nutt. Sylv.* 2, *p.* 22, *t.* 49. Pit river, northern California.

Pyrus Americana, *DC. Prod.* 2, *p.* 637; *Torr. & Gray, l. c.* Cascade mountains, O. T.

Cerasus mollis, *Dougl. in Hook. Flor. Bor.-Amer.* 1, *p.* 169. On Pit river and in Cascade mountains.

Cerasus demissa, *Nutt. in Torr. & Gray, Fl.* 1, *p.* 411. Common in mountains throughout northern California and Oregon.

Prunus subcordata, *Benth. Pl. Hartw.* No. 1710. Sierra Nevada, near Lassen's butte; Klamath lakes, August, in fruit; fruit large, excellent.

Amelanchier Canadensis, var. alnifolia, *Torr. & Gray, Flor.* 1, *p.* 473. Amelanchier alnifolia, *Nutt. Jour. Acad. Phil.* 7, *p.* 22.

Chamæbatia foliolosa, *Benth. Plant., Hartweg.* No. 1712; *Torrey, Pl. Frémont, p.* 11, *t.* 6. Banks of Canoe creek, July 30, in flower; a very handsome plant, and well worth an effort for its cultivation.

CALYCANTHACEÆ.

Calycanthus occidentalis, *Hook. & Arn. Bot. Beech. p.* 340, *t.* 84. Sacramento valley.

ONAGARACEÆ.

Clarkia elegans, *Lindl.; Torr. & Gray, Flor.* 1, *p.* 515. McCumber's, N. California; July 29.

Epilobium alpinum, var. alsinifolium, *Vill.; Torr. & Gray, Flor.* 1, *p.* 489. Crater pass, Cascade mountains, Oregon Territory.

Epilobium angustifolium, *Linn.* In pine woods, passim. Northern California and Oregon.

Epilobium paniculatum, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 490. Sacramento valley, Columbia and Klamath basin, Oregon Territory; July and August.

Epilobium coloratum, *Muhl.* Banks of Canoe creek, northern California; July.

Œnothera densiflora, *Lindl.* Banks of Pit river, California; July 30.

Œnothera biennis, var. canescens, *Gray.* Banks of Canoe creek, northern California; August 2.

Œnothera trichiocalyx, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 494. Lost river, Klamath basin, Oregon Territory; August 4.

Œnothera tanacetifolia, *Torr. & Gray, in Beckwith's Railroad Report, p.* 121, *t.* 4. A variety with less dissected foliage. Shores of Rhett lake.

GROSSULACEÆ.

Ribes Menziesii, *Pursh, Fl.* 2, *p.* 732; *Torr. & Gray, Fl.* 1, *p.* 545. San Francisco, California.

Ribes divaricatum, *Dougl. in Hort. Trans.* 7, *p.* 515. Hell valley, along streams.

Ribes viscosissimum, *Pursh, Fl.* 1, *p.* 163; *Torr. & Gray, Fl.* 1, *p.* 551. Fruit blue. Cascade mountains. Forks of trees.

Ribes speciosum, *Pursh, Fl.* 2, *p.* 732; *DC. Prod.* 3, *p.* 478; *Torr. & Gray, Flor.* 1, *p.* 545. Near San Francisco.

Ribes glutinosum, *Benth. Hort. Trans.* (*new ser.*) 1, *p.* 476. San Francisco.

Ribes lacustre, *Poir.; Pursh, Fl.* 1, *p.* 165. Cascade mountains. Fruit black, racemed.

Ribes sanguineum, *Pursh, Flor.* 1, *p.* 164. Common in California and Oregon.

CUCURBITACEÆ.

Megarrhiza Californica, *Torrey.* Petaluma and Sonoma, California; April, in flower.

Megarrhiza Oregana, *Torrey.* On the shores of Klamath lake and banks of Willamette river, O. T.; August and September, in fruit.

CRASSULACEÆ.

Sedum stenopetalum, *Pursh, Flor.* 1, *p.* 234; *Torr. & Gray, Flor.* 1, *p.* 560. Cascade mountains.

Sedum spathulifolium, *Hook; Torr. & Gray, Flor.* 1, *p.* 559. Port Orford, O. T.

Echeveria lanceolata, *Nutt. in Torr. & Gray, Flor.* 1, *p.* 561. Cascade mountains, O. T.

SAXIFRAGACEÆ.

Tiarella unifoliolata, *Hook. Flor. Bor.-Amer.* 1, *p.* 238, *t.* 81. Spruce forests, Cascade mountains, O. T.

Mitella pentandra, *Hook. l. c.* 1, *p.* 241. With the last.

Heuchera cylindrica, *Dougl.; Hook.* 1, *p.* 236. Cascade mountains, O. T.

Saxifraga Tolmæi, *Torr. & Gray, Flor. N. Amer. p.* 567. Crater pass, Cascade mountains, O. T.; altitude, 6,800 feet.

Saxifraga peltata, *Torrey, Bot. Expl. Exped. ined.; Benth. Plant. Hartweg,* No. 1740.

Saxifraga integrifolia, *Hook. Flor. Bor.-Amer.* 1, *p.* 249, *t.* 86. Shores of Klamath lake.

UMBELLIFERÆ.

Conioselinum Canadense, *Torr. & Gray, Flor. N. Amer.* 1, *p.* 619. Crater Pass, Cascade mountains, O. T.

Edosmia Gairdneri, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 612. Fort Reading and McCumber's, N. California.

Sanicula bipinnatifida, *Dougl.; Hook. Flor. Bor.-Amer.* 1, *p.* 358, *t.* 92. Common throughout the Sacramento valley, California.

Sanicula laciniata, *Hook. & Arn. Bot. Beechey, Suppl. p.* 347. Petaluma, California.

Eryngium articulatum, *Hook. Jour. Bot.* Common in northern California.

Cymopterus terebinthinus, *Nutt.; Hook. Fl. Bor.-Am.* 1, *p.* 266, *t.* 95. Crater pass, Cascade mountains, O. T.

Peucedanum triternatum, *Nutt.; Jour. Acad. Philad.* 7, *p.* 27; *Hook. Fl. Bor.-Am.* 1, *p.* 204, *t.* 94. Fort Reading, Cal.

Peucedanum fœniculaceum, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 627. Crater pass, Cascade mountains.

Peucedanum utriculatum, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 628. San Francisco, California.

Peucedanum caruifolium, *Nutt.; Torr. & Gray, Flor.* 1, *p.* 628. Shores of San Pablo bay, California.

Osmorrhiza nuda, *Torr. in Whipple's Report, ined.* Crater pass, Cascade mountains, Cal.

Hydrocotyle Americana, *Linn; Torr. & Gray, Flor.* 1, *p.* 599. San Francisco, Cal.

CORNACEÆ.

Cornus Nuttallii, *Nutt. Sylv.* 3, *p.* 52; *Torr. & Gray, Flor.* 1, *p.* 652. The fruit of this species is quite different from that of *C. florida,* the berries being so densely glomerated as to form a solid spherical capitulum, precisely as in the genus *Benthamia,* which is, therefore, scarcely distinguishable from *Cornus,* and will perhaps not stand.

Cornus Canadensis, *Linn.; Torr. & Gray, Flor.* 1, 652. Cascade mountains, O. T.

Cornus stolonifera? *Michx.; Torr. & Gray, Flor.* 1, 650. Cascade mountains, O. T.

Cornus pubescens, *Nutt. Sylva* 3, *p.* 54. Cascade mountains, O. T.

CAPRIFOLIACEÆ.

Lonicera cœrulea, *Linn.; Torr. & Gray, Flor.* 2, *p.* 9. Des Chutes basin, O. T.; September 1.

Lonicera involucrata, (*Herb. Banks,*) *DC. Prodr.* 4, *p.* 336; *Torr. & Gray, Flor.* 2, *p.* 9. Cascade mountains, O. T.

Lonicera Californica, *Torr. & Gray, Flor.* 2, *p.* 7. San Antonio, Dr. Andrews.

Lonicera hispidula, *Dougl. Mss.; Torr. & Gray, Flor.* 2, *p.* 8. Placerville, California.

Sambucus pubens, *Michx.; Michx. Fl.* 1, *p.* 181. Cascade mountains, O. T.

Sambucus Mexicana, *Pres. in DC. Prodr.* 4, *p.* 323; *Gray, Pl. Wright,* 2, *p.* 66. Klamath basin and Cascade mountains, O. T.

Symphoricarpus racemosus, *Michx. Fl.* 1, *p.* 107. Northern California and Cascade mountains, O. T.

Linnea borealis, *Gronov.; Linn. Sp. Pl. p.* 880; *Hook. & Arn. Bot. Beech. Voy.* 1, *p.* 125. Cascade mountains, O. T.

RUBIACEÆ.

Galium Aparine, *Linn.; Pursh. Fl.* 1, *p.* 103; *Torr. & Gray, Flor.* 2, *p.* 20. Klamath lake and Dalles of Columbia.

Galium Californicum, *Hook. & Arn. Bot. Beechey, Suppl. p.* 349. Petaluma; April, in flower.

Galium boreale, *Linn.; Hook. Flor. Bor.-Am.* 1, *p.* 289. Shores of Klamath lake, O. T.

Galium rubioides, *Linn. Spec.* 1, *p.* 105; *DC. Prod.* 4, *p.* 599; *Hook. & Arn. Bot. Beech. Voy.*, *p.* 115; *Hook. Flor. Bor.-Amer.* 1, *p.* 289. Cascade mountains, O. T.

Galium asprellum, *Michx. Fl.* 1, *p.* 78; *Pursh, Fl.* 1, *p.* 103; *Torrey, Fl.* 1, *p.* 166. Banks of Canoe creek, northern California; July 29.

Cephalanthus occidentalis, *Linn.; Michx. Fl.* 1, *p.* 87. Common in Sacramento valley.

VALERIANACEÆ.

Plectritis congesta, *DC. Prod.* 4, *p.* 631. Shores of San Pablo and bay, California.

Valeriana Sylvatica, *Banks; Hook. Flor. Bor.-Am.* 1, *p.* 291. Crater pass, Cascade mountains, O. T.

COMPOSITÆ.—(By A. Gray.)

Eupatorium occidentale, *Hook. Fl. Bor. Am.* 1, *p.* 305; *Torr. & Gray, Fl.* 1, *p.* 91. On rocks, Canoe creek, northern California; a low shrubby plant.

Lessingia Germanorum, *Cham.; Torr. & Gray, l. c.* 2, *p.* 451. Upper Sacramento valley.

Lessingia virgata, *Gray, in Pl. Hartw. p.* 315; McCumber's. This very remarkable species was known only by a specimen in the collection of the United States Pacific Exploring Expedition, with which Dr Newberry's plant well accords.

Aster salsuginosus, *Richards.; Torr. & Gray, Fl.* 2, *p.* 155. Crater pass.

Aster adscendens, *Lindl. in Hook. l. c. & DC. Prodr.* 5, *p.* 231.

Aster Novi Belgii, *Linn.* Upper Des Chutes; also a dwarf state at the Dalles.

Aster simplex, *Willd.? Torr. & Gray, l. c.* Upper Des Chutes river.

Aster falcatus, *Lindl.; Torr. & Gray, l. c.* Klamath lake.

Erigeron filifolium, *Nutt.; Torr. & Gray, Fl.* 2, *p.* 177. Cascade mountains, Oregon; flowers white and pink.

Erigeron Douglasii, *Torr. & Gray, l. c.;* var. foliis latioribus, capitulis (immaturis) minoribus. Apparently the E. foliosum of Nuttall. McCumber's, Upper Sacramento.

Erigeron Canadense, *Linn.* Common in California and Oregon.

Hulsea nana, (sp. nov.): humilis; foliis pinnatifidis; pedunculo scapiformi monocephalo; involucri squamis oblongo-lanceolatis subacutis; floribus luteis; pappi paleis fimbricato-laceris.—(Tab. XII.) In beds of scoria, at the line of perpetual snow, Crater pass, Cascade mountains, lat. 44° 10′, September. This is one of the most interesting plants of Dr. Newberry's collection, and I have great pleasure in proposing that the species shall bear his name. It opportunely confirms a genus, still unpublished, (but likely soon to be given to the world,) which I characterized two years ago in manuscript, and which was founded on a single specimen of a stem or peduncle, destitute of foliage, but bearing several heads. The floral characters forbid us to refer it to any known genus, and it was, therefore, dedicated to Dr. G. W. Hulse, of Louisiana, a zealous cultivator of botany, who gathered it in the mountains of the southern part of California, back of San Diego, and sent the specimen to his friend and correspondent, Dr. Torrey. The characters of the genus, and the distinctive marks (so far as known) of the original species, are here appended. The present plant is only three or four inches high, excluding the slender shoot or root-stock, which rises through the loose scoria in which it grows.

HULSEA, *Torr. & Gray, in Bot. Mex. Bound. Surv. ined.* Capitulum multiflorum, radiatum; floribus radii ligulatis fœmineis, disci tubulosis. Involucrum hæmisphericum; squamis subtriscriatis membranaceis laxis, exterioribus paulo brevioribus. Receptaculum planum epalcaceum, alveolato-dentatum; dentibus brevibus corneis. Ligulæ 20–30, lineares. Corollæ fl. hermaph. tubo gracili viscoso-glanduloso, fauce cylindracea, limbo 5-dentato, dentibus tringulari-ovatis fere glabris. Antheræ ecaudatæ. Styli rami obtusi, longitrorsum puberuli, exappendiculati. Achenia conformia, linearia, subtetragono-compressa, deorsum attenuata, villosa præsertim ad margines. Pappus (villis achenii vix longior) e paleis 4 tenuibus hyalinis enerviis latis obtusissimis erosis vel fimbriatis. Herbæ perennes, viscoso-pubescentes, macrocephalæ, alternifoliæ; caule florifero subaphyllo; floribus flavis.

1. H. CALIFORNICA: elata; caule vel pedunculo 3–7 cephalo; involucri squamis linearibus apice attenuatis; floribus aureis; pappi paleis cuneato-rotundis apice truncato eroso-denticulatis.

2. H. NANA: Vide supra.

Plate XII, HULSEA NANA. Plant of the natural size. Fig. 1, a ray flower; 2, a disk flower; 3, corolla of the last laid open, the stamens, &c., displayed; 4, some of the glandular hairs on the corolla; 5, branches of the style of the disk flowers; 6, paleæ of the pappus; 7, section of a mature achenium; 8, the receptacle. The details variously magnified.

COREOPSIS ATKINSONIANA, *Dougl. Bot. Reg. t.* 1376. Rocks on the Oregon river.

GAILLARDIA ARISTATA, *Pursh, Fl.* 2, *p.* 573. Fort Dalles, Oregon river.

CHÆNACTIS DOUGLASII, *Hook. & Arn. Bot. Beech. p.* 354, (to which C. achilleæfolia is to be joined.) Klamath lake. Flowers white.

BAHIA LEUCOPHYLLA, *DC. Prodr.* 5, *p.* 656. McCumber's, Upper Sacramento valley.

BAHIA LANATA, *Nutt.; DC. l. c.* & var. TENUIFOLIA. With the last, &c.

BURRIELIA TENERRIMA, *DC. Prodr.* 5, *p.* 663. Sonoma.

DICHÆTA ULIGINOSA, *Nutt. in Trans. Amer. Phil. Soc.* 7, *p.* 383. With the last.

HELENIUM AUTUMNALE, *Linn.* var. GRANDIFLORUM, *Torr. & Gray.* Klamath lake and Willamette river.

SOLIDAGO GIGANTEA, *Ait.; Hook. Flor. Bor.-Am.* 2, *p.* 2. Banks of Columbia river, O. T.

SOLIDAGO CONFERTIFLORA, *Nutt.; Hook. Flor. Bor.-Am.* 2, *p.* 4. Klamath basin, O. T.

SOLIDAGO ELONGATA, *Nutt.* var. McCumber's, Upper Sacramento.

LINOSYRIS GRAVEOLENS, *Torr. & Gray, Fl.* 2, *p.* 234. Banks of upper Pit river.

CHRYSOPSIS VILLOSA, *Nutt. Gen.* 2, *p.* 150. Cascade mountains; a small form.

BLENNOSPERMA CALIFORNICUM, *Torr. & Gray, Fl.* 2, *p.* 272. Sacramento valley.

WYETHIA HELENIOIDES, *Gray, Pl. Fendl. p.* 82, *adn.;* var. capitulo multum minore. Near McCumber's, on the upper Sacramento. The foliage and aspect accord with W. helenioides, but the head is only one-quarter the size. The single one gathered, however, is from an axillary shoot, the terminal one being destroyed or lost, and it is not in a condition to permit an examination of the flowers. The plant may, therefore, for the present, remain appended to W. helenioides.

Wyethia robusta, *Nutt. in Trans. Amer. Phil. Soc.* 7, *p.* 351; *Torr. & Gray, Fl.* 2, *p.* 299, *excl. syn.* With the last. Radical leaves lanceolate, a foot long. Not well named, as the stems are quite slender next the ground. They bear, in a crowded manner, many alternate and pinnatifid leaves of oblong or spatulate outline, tapering into a margined petiole. The leaves, including the petiole, are one or two inches long; their lobes one to three lines long, oblong, obtuse, entire or obtusely toothed. Like the rest of the plant, they are viscid or glandular-pubescent. A solitary peduncle, 1½ inch long, bears a single head, which is nearly an inch in diameter. Involucre purplish; the outer scales broadly oblong-lanceolate; the inner lanceolate. Rays small, linear, about 20 in number, apparently light yellow, half an inch long. Its tube and the lower part of the disk-corollas beset with glandular hairs. Achenia 3 to 4 lines long, flat, blackish, softly and very villous, except perhaps towards the base; the hairs at the summit as long as the diaphanous paleæ of the pappus.

Oxyura chrysanthemioides, *DC. Prodr.* 5, *p.* 693. Petaluma, California.

Layia calliglossa, *Gray, Pl. Fendl. p.* 103; var.? oligochæta; pappi aristis 2–3. Petaluma, California.

Madaria elegans, *DC. Prodr.* 5, *p.* 692. McCumber's.

Lagophylla filipes, *Gray, in Mex. Bound. Surv.* Hemizonia filipes, *Hook. & Arn. Bot. Beech. p.* 356. With the last, in flower only. Fruiting specimens of this are still a desideratum.

Achillea millefolium, *L.* McCumber's, shores of Klamath lake, &c.

Matricaria discoidea, *DC. Prodr.* 6, *p.* 51. Petaluma.

Artemisia tridentata, *Nutt.* Columbia river.

Artemisia Ludoviciana, *Nutt.; var.* Gnaphalioides, *Torr. & Gray, Fl.* 2, *p.* 420. Pit river.

Artemisia dracunculoides, *Pursh.* Des Chutes basin.

Gnaphalium luteo-album, *Linn.* (G. Sprengelii, *Hook. & Arn.*, in part.) Sonoma.

Gnaphalium palustre, *Nutt.; Torr. & Gray, Fl.* 2, *p.* 427. Canoe creek.

Gnaphalium purpureum, *L.* Petaluma.

Antennaria Geyeri, *Gray, Pl. Fendl. adn. p.* 107. McCumber's. These are fine specimens of the male plant of this rare species, which Sir William Hooker confounded with a South American Gnaphalium, (G. alienum, *Hook. & Arn.*) But it is a true Antennaria.

Antennaria luzuloides, *Torr. & Gray, Fl.* 2, *p.* 431. Hat creek and McCumber's, N. Cal.

Antennaria margaritacea, *R. Br.* Lakes south of Crater pass, Cascade mountains, O. T.; August.

Senecio triangularis, *Hook. Fl. Bor.-Amer.* 1, *p.* 322, *t.* 115. Upper Des Chutes river, near the edge of the water; September.

Arnica Chamissonis, *Less.; Torr. & Gray, Fl.* 2, *p.* 449. A narrow-leaved state; shores of Klamath lake, O. T.

Arnica mollis, *Hook.; Torr. & Gray, l. c.* Crater pass, near the snow line. A state with narrower leaves than usual, and tapering to the base.

Tetradymia canescens, *DC. Prodr.* 6, *p.* 440. Fort Reading, Cal. The leaves are only a little shorter than in Douglas' plant, and the flowering branches (which are herbaceous from a shrubby base) are nearly as slender.

Stephanomeria minor, *Nutt.; Torr. & Gray, Fl.* 2, *p.* 472. Hat creek and Pit river, Cal.

Stephanomeria virgata, *Benth. Bot. Sulph. p.* 32. A much larger flowered variety, but specimens gathered by Frémont approach it. The admitted species are probably too numerous already. McCumber's, N. Cal.

Macrorhynchus laciniatus, *Torr. & Gray, l. c.* Crater pass.

Macrorhynchus Lessingii, *Hook. & Arn.?* McCumber's and Canoe creek, N. Cal.

Mulgedium pulchellum, *Nutt.; Torr. & Gray, l. c. p.* 497. Bartee's valley, N. Cal.

Xanthium strumarium, *Linn.; DC. Prodr.* 5, *p.* 523. Common throughout N. California and Oregon.

Leucanthemum vulgare, *Lam.* Fort Vancouver, W. T. (Introduced.)

Hemizonia pungens, *Torr. & Gray, Fl.* 2, *p.* 399. Sacramento valley, Cal.

Hemizonia macradenia, *DC.; Torr. & Gray, l. c.* Fort Reading, Cal.

Maruta cotula, *DC.* Marysville, California.

Bidens chrysanthemoides, *Michx.; Pursh. Fl.* 2, *p.* 566. San Francisco and Sacramento valley, Cal.

CAMPANULACEÆ.

Specularia perfoliata, *A. DC.* Fort Vancouver, W. T.

Downingia elegans, *Torr. in Whipple's Report, (ined.)* Bartee's valley, N. Cal.; August.

Githopsis calycina, *Benth. Plant. Hartweg. p.* 321. Fort Reading, Cal.

Campanula Scouleri, *Hook. Flor. Bor.-Amer.* 2, *p.* 28, *t.* 125. A small form, Cascade mountains, O. T.; larger form, McCumber's, N. Cal.

ERICACEÆ.

Arctostaphylos tomentosa, *Dougl. in Lind. Bot. Reg. Hook. Flor. Bor.-Amer.* 2, *p.* 37, *t.* 130. Cascade mountains, O. T., latitude 44°.

Arctostaphylos glauca, *Lindl. Bot. Reg. t.* 1791, Xerobotrys glaucus, *Nutt. Trans. Am. Philos. Soc.* Common throughout northern California and southern Oregon.

Arctostaphylos uva-ursi, *Spreng., Pursh Fl.* 1, *p.* 283. Pine woods, N. California and Cascade mountains.

Arbutus Menziesii, *Pursh Flor.* 1, *p.* 282. N. California, Cascade mountains and Willamette valley, O. T.

Azalea Californica, *Torr. & Gray.* A. calendulacea, *Hook. & Arn. Bot. Beech. p.* 362. Fort Reading, N California.

Menziesea empetriformis, *Smith; Hook. Flor. Bor.-Amer.* 2, *p.* 40. Crater pass, Cascade mountains; altitude 6,000—7,000 feet.

Gaultheria Shallon, *Pursh; Hook. Flor. Bor.-Amer. p.* 2, 36. Cascade mountains and Coast Range, Willamette valley, O. T.

Gaultheria Myrsinites, *Hook. Flor. Bor.-Amer.* 2, *p.* 35, *t.* 129. Cascade mountains, O. T.; altitude 6,000 feet.

Kalmia glauca, *Ait.; Hook. Flor. Bor.-Amer.* 2, *p.* 41. Crater pass, Cascade mountains; altitude 6,000 feet. Sphagnous marshes, mouth of the Columbia; September 6.

Rhododendron albiflorum, *Hook. Flor. Bor.-Amer.* 2, *p.* 43, *t.* 133. Cascade mountains, O. T.; latitude 44°.

Rhododendron maximum? *Hook. Flor. Bor.-Amer.* 2, *p.* 42. Spruce forests, Cascade and Coast mountains.

Vaccinium macrocarpum, *Ait.*; *Hook. Flor. Bor.-Am.* 2, *p.* 34. Marshes; mouth of Columbia river, O. T.

Vaccinium parvifolium, *Smith; Hook. Bor.-Am.* 2, *p.* 33, *t.* 128. Cascade mountains, O. T.

Vaccinium oxycoccus, *Linn.; Hook. Flor. Bor.-Am.* 2, *p.* 34. Sphagnous marshes, Cascade mountains, O. T.

Vaccinium ovalifolium, *Smith; Hook. Flor. Bor.-Am.* 2, *p.* 32, *t.* 127. Cascade mountains, O. T.

Vaccinium myrtilloides, *Michx.; Hook. Flor. Bor.-Am.* 2, *p.* 32. Cascade mountains, O. T.

Vaccinium ovatum, *Pursh; Hook. Flor. Bor.-Am.* 2, *p.* 33. Cascade mountains, O. T.

Vaccinium cæspitosum? *Michx.; Hook. Flor. Bor.-Am.* 2, p. 33, *t.* 126. Cascade mountains.

Chimaphilla umbellata, *Pursh; Hook. Flor. Bor.-Am.* 2, *p.* 49. N. California and Cascade mountains, O. T.

Pyrola aphylla, *Smith; Hook. Flor. Bor.-Am.* 2, *p.* 48, *t.* 137. Pine forests, N. California, and Cascade mountains, O. T.

Pyrola rotundifolia, *Linn.; Hook. Flor. Bor.-Am.* 2, *p.* 46. McCumber's, N. California.

Pyrola dentata, *Smith; Hook. Fl. Bor.-Am.* 2, *p.* 46, *t.* 136. var. integrifolia, Cascade mountains, O. T.

Pyrola minor, *Linn.; Hook. Flor. Bor.-Am.* 2. *p.* 45. Crater Pass, Cascade mountains; altitude 6,500 feet.

Pterospora Andromedea, *Nutt.; Hook. Flor. Bor.-Am.* 2, *p.* 48. Pine woods throughout N. California and Oregon.

Cassiope tetragona, *Don. in DC. Prod.* 7, *p.* 611. *Andromeda tetragona, Linn. Flor. Dan. t.* 1030; *Pursh. Flor. p.* 290; *Hook. Bot. Mag. t.* 3181; *Flor. Bor.-Amer.* 2, *p.* 58. Crater pass, Cascade mountains.

HEMITOMES, nov. gen. MONOTROPEARUM. (By A. Gray.)

Calyx disepalus, bracteoliformis. Corolla tubuloso-urceolata, 4–5-loba, post anthesin marcescens, lobis patentibus intus villosulis. Stamina hypogyna, 8 vel 10: filamenta filiformia, superne barbata: antheræ basifixæ, glandula parva apiculata, dimidiatim unilocularis; nempe, loculo fertili oblongo-lineari longitrorsum dehiscente, altero ad costam billamellatam reducto. Discus nullus. Ovarium ovoideum, pseudo-quinqueloculare, nempe placentæ 4 bilamellatæ videntur, divaricatæ, et inter se coalitæ circum locellum centralem, extus intusque creberrime ovuliferæ. Stylus elongatus: stigma depressocapitatum, integerrimum, umbilicatum, pervium. Fructus ut videtur carnosus evalvis.—Rhizophytum brunneum, carnosum; caule simplici squamato; floribus sessilibus in capitulum terminale congestis bracteatis.

Hemitomes congestum. (Plate XIII.) Upper Des Chutes valley; September.

The addition of a new genus to the small order or sub-order *Monotropeæ*, is a matter of no small interest; and this, founded on a fragmentary, but yet an adequate specimen, is the third which has come to our knowledge from the Pacific border of the United States.* The plant has much the aspect of a *Monotropa* of the section *Hypopitys;* but is remarkable for bearing its flowers in a dense, terminal, nearly hemispherical head. Each flower is subtended by a scaly bract, nearly like the scales of the stem, and about as long as the corolla. The outer flowers appear to be all tetramerous and octandrous, like the lower ones of *Hypopitys,* but some of the inner ones have a 5-lobed corolla, and, I believe, 10 stamens. A pair of narrowly-linear persistent lateral bractlets represent the calyx. The scarious-membranaceous corolla is urceolate-

* Namely, *Sarcodes* of Torrey, (which is admirably illustrated in the Plantæ Frémontianæ, p. 17, plate 10, and which was near the same time published in California by Dr. Kellogg, under the name of *Pterosporopsis,*) and *Allotropa,* the single known species of which *Allotropa virgata,* Torr. & Gray, ined. was gathered on the Cascade mountains of northern Oregon, by Dr.

tubular in the flowers inspected, which are all much passed anthesis; it is probably more tubular at first, but is afterwards swollen out below by the enlargement of the gravid ovary. The æstivation could not be made out. The greatest peculiarity of the plant is found in the anthers, which are one-celled through obliteration; the missing cell being reduced to a narrow longitudinal ridge, almost continuous with the filament. This ridge is bipartible, if not splitting spontaneously, into two narrow lamellæ, in a manner answering well to the normally longitudinal dehiscence of the fertile cell. It may possibly even contain a few grains of pollen, but probably none.

This remarkable semi-castration has suggested the generic name.* In the total absence of a disk, and in the elongated style, our plant accords with *Sarcodes.* The pervious stigma and style and the imperfect calyx are points which connect it more closely with *Monotropa,* of which it has the general aspect. There are indications that the fruit is baccate. It is difficult to make out the structure of the ovary clearly, nor is there much material to be sacrificed in the endeavor. I think, however, that our analysis is not far wrong. If correct, we have a curious anomaly in the ovary of the present plant, namely: besides the four (or in some cases five?) normal cells, there is an axile cell equally and profusely ovuliferous throughout, and reminding one of the ovary of *Obolaria* (Chloris, Bor.-Amer. p. 21, t. 3) and of *Bartonia,* (Man. Bot. Northern United States, ed. 2, p. 347.) As will be seen from the framing of the generic character, I take this to be of the same nature as the central cavity in the ovary of *Martynia.* I trust further specimens may duly come to hand, and confirm or correct this view of the structure of the ovary.

Plate XIII. Hemitomes congestum.—The plant of the natural size. Fig. 1. Side view of a flower and its bract. 2. Front view of a flower. 3. Stamens and pistil. 4. A detached stamen, the anther seen laterally. 5. Anther seen posteriorly; the ridge representing the aborted cell towards the eye. 6. Same seen laterally, and divided transversely. 7. Pollen. 8. Transverse slice of an ovary. 9. Vertical section through the whole pistil.

Sarcodes sanguinea, *Torrey, Plant. Frémont, in Smith. Contrib.* 6, *p.* 18, *t.* 10. In pine forest, base of Lassen's butte, northern California.

SCROPHULARIACEÆ.—(By A. Gray.)

Pentstemon speciosus, *Dougl.; Hook. Flor. Bor. Am.* 2, *p.* 98. Banks of Canoe creek, N. Cal.; shores of Klamath lake.

Pickering and Mr. Brackenridge, in the South-Sea Exploring Expedition under Commodore Wilkes; and, finally, the present discovery of Dr. Newberry. The six genera now known may be disposed synoptically in this way:

§ 1. *Corolla monopetala.*

* *Antheræ biloculares:*

1. *Longitrorsum dehiscentes, dorso biaristatæ.*

1. Pterospora, *Nutt.* Corolla ovata, 5-dentata. Semina apice alata.

2. *Apice foraminibus dehiscentes, muticæ. Corolla campanulata 5-loba.*

2. Sarcodes, *Torr.* Discus nullus. Antheræ elongatæ: filamenta brevia. Stylus elongatus.

3. Schweinitzia, *Ell.* Discus 10-crenatus. Antheræ breves: filamenta gracilia. Stylus brevis crassus.

** *Antheræ abortu uniloculares. Calyx imperfectus, bracteiformis.*

4. Hemitomes, *Gray:* Vide, supra.

§ 2. *Corolla 4–5-petala. Calyx imperfectus.*

5. Allotropa, *Torr. & Gray.* Petala orbiculata, basi haud gibbosa. Discus nullus. Antheræ ovatæ, biloculares, longitrorsum dehiscentes. Stylus nullus.

6. Monotropa, *Linn.* Petala cuneata vel spathulata, basi gibbosa vel saccata. Discus e dentibus 8–10 deflexis. Antheræ reniformes, confluentim uniloculares, transversim dehiscentes. Stylus columnaris.

* Viz: Ἡμιτόμης, a half-eunuch.

Pentstemon Menziesii, *Benth.; Pl. Hartw., p.* 327. On rocks, Cascade mountains, O. T.

Pentstemon procerus, *Dougl.; Hook. Flor. Bor. Am.* 2, *p.* 96. McCumber's, N. Cal., and Klamath basin.

Pentstemon heterophyllus, *Lind. Bot. Reg. t.* 1899. Sides of Lassen's butte, N. Cal., July.

Pentstemon glaucifolius (sp. nov.): glaberrimus, glaucus; caule confertim folioso basi ramoso (1–2 pedali;) foliis crassiusculis integerrimis acutatissimis lanceolatis oblongisve in petiolem brevem attenuatis, cæteris semi-amplexicaulibus plerumque cordato-ovatis vel e basi sub-cordata ovato-lanceolatis; panicula virgata multiflora; pedunculis folia floralia superantibus folioso-bibracteatis 1–3-floris; calycis segmentis ovatis subacuminatis; corolla azurea sesquipolicari sursum ampliata; filamento sterili apice dilatato hirtello.

Fort Reading, on the Sacramento river, California. Cauline leaves 1–1½ inches long, about ½ inch wide at the clasping base, tapering to the acute apex; the floral similar, gradually decreasing in size; bractlets also foliaceous. Anthers hispid-ciliate, also hirsute at the insertion. Calyx nearly as in the broader-sepalled form of *P. heterophyllus.* A most elegant and showy species, which I should have referred to Bentham's *P. azureus* from his character, except that the sterile filament is not glabrous, and in my specimen of Hartweg's, No. 1879, the leaves are all rather narrowly lanceolate: indeed I cannot distinguish that plant from *P. heterophyllus.* It is possible that Mr. Bentham had the two plants, and drew the characters of the foliage from our present plant, and of the sterile filament from the allied *P. heterophyllus.* If the sparing beard of the sterile filament cannot be relied upon, and the two run together, then the variable species well deserves the name of *heterophyllus.*

Pentstemon gracilentus (sp. nov.): glaber; caule tenero subpedali adscendente; foliis integerrimis inferioribus oblongo-lanceolatis in petiolum longiusculum attenuatis, superioribus paucis augusto-linearibus sessilibus, floralibus lineari-setaceis; panicula laxa subsimplici; cymis pedunculatis 3–5-floris; calycibus pedicellisque æquelongis pubero-glandulosis, segmentis oblongo-lanceolatis breviter acuminatis; corolla tubuloso-infundibuliformi subbilabiata cœrulea staminibusque glaberrimis; filamento sterili filiformi superne obsoletissimi barbato.

At the base of Lassen's butte, N. California. Lower leaves about two inches long, and with a petiole about one inch long; the upper few, and gradually reduced to slender bracts; corolla slender, half an inch long; anthers intermediate in structure between those of the sections Eupentstemon and Saccanthera, glabrous, except a minute denticulate ciliation at the line of dehiscence.

Pentstemon Newberryi (sp. nov.): fruticosus, glaber, cæspitoso-procumbens; foliis ovalibus seu ovato-oblongis sub-coriaceis crebre serrulatis, caulinis obtusis basi in petiolum contractis summis sessilibus acutis; racemo 7–11-floro; calycis segmentis lanceolatis sensim acuminatis pedicellum æquantibus; corolla punicea tubulosa belabiata, labio, inferiore patente trifido intus lineis 2 barbato; staminibus sub-exsertis; antheris (praesertim ad margines) lanatis; filamento sterili brevi filiformi longitudinaliter parce barbato. (Plate XIV.) On rocks, forming broad tufts near Mount St. Joseph's, N. California. A well marked species of the section Elmigera, but with woolly anthers. Leaves turning blackish in drying. Corolla deep crimson, very handsome, 1¼ inches long.

Plate XIV. Pentstemon Newberryi. A flowering stem of the natural size. Fig. 1. Corolla laid open, with the stamens. 2. A separate stamen. 3. Pistil and calyx, the ovary vertically divided. The analyses enlarged.

Chelone nemorosa, *Dougl.; Hook. Flor. Bor.-Am.* 2, *p.* 95. On rocks, Cascade mountains, latitute 44°.30′; altitude 6,500 feet.

Veronica Americana, *Schwein. in DC. Prodr.* Canoe creek, N. California.

Veronica peregrina, *Linn.; Hook. Flor. Bor.-Am.* 2, *p.* 101. N. California.

Scrophularia nodosa, *Michx.; Hook. Bor.-Am.* 2, *p.* 94. Throughout California and Oregon.

Mimulus moschatus, *Dougl. Bot. Reg. t.* 1118. McCumber's, N. California.

Mimulus Lewisii, *Pursh.; Hook. Flor. Bor.-Am.* 2, *p.* 100. Crater pass, Cascade mountains; altitude 6,700 feet. Corolla crimson.

Mimulus Scouleri, *Hook. Flor. Bor.-Am.* 2, *p.* 100. Very common in N. California.

Mimulus Cardinalis, *Dougl.; Benth. DC. Prodr.* 10, *p.* 370. Fort Reading, California.

Mimulus primuloides, *Benth.; Hook. Flor. Bor.-Am.* 2, *p.* 100. Shores of Klamath lake, Oregon Territory.

Collinsia bartsiæfolia, *Benth. in DC. Prodr.* 10, *p.* 318. Fort Reading, N. California.

Linaria Canadensis, *Spreng.; Hook. Flor. Bor.-Am.* 2, *p.* 94. Petaluma, California.

Eunanus Fremonti, *Benth.; DC. Prodr.* 10, *p.* 374. McCumber's, N. California; July 29.

Eunanus Douglasii, *Benth.; DC. Prodr.* 10, *p.* 374. Fort Reading, California.

Cordylanthus racemosus, *Nutt.* McCumber's, N. California.

Cordylanthus filifolius, *Nutt.* Sacramento valley, California.

Orthocarpus castillejoides, *Benth. in DC. Prodr.* 10 *p.* 536. McCumber's, N. California.

Orthocarpus purpurascens, *Benth. in DC. Prodr.* 10, *p.* 536. Fort Reading, California.

Orthocarpus erianthus, *Benth. in DC. Prodr.* Petaluma, California.

Pedicularis attenuatus, *Benth. in Hook. Flor. Bor.-Am.* 2, *p.* 110. Petaluma, California.

Pedicularis racemosus, *Dougl.; Hook. Flor. Bor.-Am.* 2, *p.* 108. Passes of Cascade mountains, O. T.; latitude, 44°; altitude, 6,800 feet. Var. β., whole plant very delicate.

Castilleja pallida, *Benth.; Hook. Flor. Bor.-Am.* 2, *p.* 105. McCumber's, N. Cal.; July 29.

Castilleja miniata, *Benth.; Hook. Flor. Bor.-Am.* 2, *p.* 106. Crater pass, Cascade mountains.

Castilleja affinis, *Hook. & Arn. Bot. Beech. p.* 154. Banks of Canoe creek, Cal.; July 30.

Castilleja Douglasii, *Benth. l. c.* McCumber's, N. Cal.

Castilleja hispida, *Benth. in Hook. Flor. Bor. Am.* 2, *p.* 105. Fort Reading, Cal.

VERBENACEÆ.

Verbena hastata, *Linn.* Common throughout northern California.

Verbena bracteosa, *Michx.; Hook. Flor. Bor.-Am.* 2, *p.* 14; *DC. Prod.* 11, *p.* 549. Fort Dalles, O. T.

LABIATEÆ.

Monardella candicans, *Benth. Pl. Hartweg, No.* 1911. Sacramento valley, Coast Range, and McCumber's, N. Cal.

Monardella Sheltoni, *Torrey.* McCumber's, N. California.

Trichostema oblongum, *Benth., ined. Hook. Flor. Bor.-Am.* 2, *p.* 117. Upper Pit river, Cal. Plant very fragrant.

Stachys palustris, *Linn.; Hook. Flor. Bor.-Am.* 2, *p.* 116. McCumber's, N. Cal.

Stachys ciliata, *Dougl.; Hook. Flor. Bor.-Am.* 2, *p.* 116. Cascade mountains, O. T.

Scutellaria antirrhinoides, *Benth.; DC. Prod.* Shores of Klamath lake, O. T.

Scutellaria galericulata, *Linn.* Shores of Klamath lake, O. T.

Scutellaria tuberosa, *Benth. Lab. p.* 313. Shores of San Pablo bay, California.

Micromeria Douglasii, *Benth. in DC. Prod.* 12, *p.* 223. Cascade mountains, O. T.

Mentha Canadensis, *Linn.* McCumber's, N. Cal.

Prunella vulgaris, *Linn.* Common from San Francisco to the Columbia river.

PLANTAGINACEÆ.

Plantago major, *Linn.* Fort Vancouver, W. T. (Introduced.)

Plantago Patagonica, *Jacq.;* var. Gnaphalioides, *Gray.* P. Gnaphalioides, *Nutt. Gen.* 1, *p.* 100. Whole plant very woolly. Dalles of the Columbia, O. T.

PRIMULACEÆ.

Dodecatheon Meadia, *Linn.*, var. D. frigidum, *Cham.; Hook. Flor. Bor.-Amer.* 2, *p.* 118. Sacramento valley ; Fort Reading, Cal. ; Cascade mountains, O. T.

Trientalis latifolia, *Hook. Flor. Bor.-Am.* 2, *p.* 121. Cascade mountains, O. T.

Anagallis arvensis, *Linn.* San Francisco, Cal. (Introduced.)

LENTIBULACEÆ.

Utricularia vulgaris, *Linn.* Klamath lake, O. T.

OROBANCHACEÆ.

Phelipæa comosa, *Gray, ined.* Orobanche comosa, *Hook. Fl, Bor.-Am.* 2, *t.* 169. Banks of Canoe creek.

Aphyllon uniflorum, *Torr. Gray; Gray, Bot. North. U. S.*, *p.* 290. Near San Francisco, California.

BORAGINACEÆ.—(By John Torrey.)

Eritrichium Scouleri, *Alph. DC. Prodr.* 10, *p.* 130. In fine fruit. McCumber's and Klamath lake.

Eritrichium fulvum, *Alph. DC. l. c.* Fort Reading, Oregon, April. In flower.

Plagiobothrys canescens, *Benth. Pl. Hartw. p.* 324.? Differs from Hartweg's plant, in the corolla being twice as long as the calyx. Fort Reading.

Eritrichium Californicum, *Alph. DC. l. c.* No locality recorded.

Cynoglossum grande, *Dougl.; Hook, Fl. Bor.-Am.* 2, *p.* 85. McCumber's and Fort Reading.

Amsinckia spectabilis, *Fisch. & Mey. Index Hort. Petrop.* 1835 ; *DC. Prodr.* 10, *p.* 118. Fort Reading, California.

Amsinckia, *sp.* Sonoma, California.

HYDROPHYLLACEÆ.—(By A. Gray.)

Nemophila insignis, *Lindl.; A. DC. Prod.* 9, *p.* 270. Fort Reading, California.

Nemophila parviflora, *Dougl.; A. DC. Prod.* 9, *p.* 290. Petaluma and Sonoma, California.

Nemophila atomaria, *Fisch. & Meyer; A. DC. Prod.* 9, 290. San Francisco, California.

Phacelia circinata, *Jacq.; A. DC. Prod.* 9, *p.* 298. Northern California, passim ; shores of Klamath lake.

Eutoca phacelioides, *Benth. in Linn. Trans.* 17, *p.* 276. Shores of Klamath lake.

Emmenanthe (Miltitzia) parviflora (sp. nov.): nana, depresso-ramosissima; foliis pinnati-subpartitis, lobis 5–9 integerrimis; floribus congestis brevissime pedicellatis; corolla flava calycem haud superante ; stylo brevi ; seminibus plurimis reticulatis.—Along the shores of the

Klamath lake. Root, without doubt, annual. Stems spreading nearly flat upon the ground, much branched, and, like the foliage, &c., minutely hairy and glandular. Leaves petioled, not dilated at the base; their lobes oblong or obovate, one or two lines long, the upper ones more confluent. Flowers crowded in somewhat scorpioid clusters, bractless. Pedicels much shorter than the calyx; bractlets none. Calyx in flower only about one and a half or two lines long, in fruit becoming three lines long; the sepals linear, obtuse, hairy and viscid. Corolla yellow, about the length of the calyx in anthesis, not increasing, but persistent, in fruit investing the lower two-thirds of the ripe capsule; rather narrow campanulate, 5-lobed, the short ovate lobes apparently quincuncially imbricated in æstivation, more or less hairy on the outside, within destitute of plicæ or appendages, except a very narrow and thin ring at the very base girting the base of the ovary, which rises into five slight and free lobes alternate with the stamens. Stamens inserted on the very base of the corolla, rather shorter than it: filaments a little dilated downwards: anthers short, didymous, incumbent; pollen globose. Ovary ovoid, densely hairy, truly 2-celled by the union of the placentæ in the axis; style not longer than the ovary, nearly glabrous, 2-cleft at the summit, nearly persistent: stigmas capitellate, rather large. Ovules numerous, 32—40 in each cell, namely, 16 to 20 in two rows on each half of each placentæ, amphitropous descending, more or less imbricated. Capsule three lines or a little more in length, loculicidal, ovoid, flattish parallel with the valves, incompletely 2-celled; the placentæ in contact but not coherent at maturity; adnate to the middle of the valves for the whole length, each maturing from 10 to 20 pendulous seeds. These are oblong, somewhat angled, the thin testa delicately reticulated. Embryo slender, about the length of the albumen.

As to the affinities of this plant, I cannot doubt that it is a close congener of Hooker and Arnott's *Eutoca? lutea,* although I possess no specimens of that plant. Judging from the published description and figure, this appears to differ from our plant chiefly in the slightly, if at all, lobed leaves, the larger flowers, and more conspicuous corolla longer than the calyx, the much longer style, and the fewer, only 8,(?) ovules. The seeds, moreover, are represented with spiral markings, something like those of Microgenites, as figured in Gay's Flora Chilena. The inconspicuous disk, adnate to the corolla in our plant, is not noticed in the other, but it might readily be overlooked. Upon this plant Alphonse De Candolle founded his genus Miltitzia; and the present question is, whether that genus, now strengthened by a second species, is to be adopted, or whether it should be merged in Bentham's genus Emmenanthe? It will be seen that I incline to the latter view; but should retain Miltitzia as a subgenus, distinguished by considerable difference in habit, by the ovoid (instead of the oblong) ovary, and by the 10-toothed small disk being adnate to the very base of the corolla, instead of free from it. I perceive no other characters. The yellow or sulphur-colored and marcescent corolla marks the genus.

Plate XV. Emmenanthe (Miltitzia) parviflora. Part of the plant of the natural size. Fig. 1. A flower. 2. Corolla laid open, with the stamens. 3. Pistil, the ovary transversely divided. 4. A pistil, with the ovary vertically divided. 5. Portion of a placenta, with ovules. 6. A mature capsule, with the persistent calyx and corolla. 7. Transverse section of a capsule. 8. A valve of the capsule, with placenta and seed, seen obliquely. 9. A seed. 10. The same vertically divided, showing the embryo.

POLEMONIACEÆ.

Gilia capitata, *Dougl.; Benth. in DC. Prod.* 9, *p.* 315. Fort Reading, N. California; April, in flower.

Gilia tricolor, *Benth. in DC. Prod.* 9, *p.* 312. Fort Reading, North California; April, in flower.

Gilia pulchella, (*Dougl.*) *Hook. Flor. Bor.-Amer.* 2, *p.* 74. Ipomopsis elegans, *Lindl. Bot. Reg. t.* 1281. Pine woods, N. California and Oregon; July, August.

Gilia pharnecioides, *Benth. Pl. Hartw. p.* 325. Fort Reading, N. California; April.

Gilia micrantha, *Steud.; Benth. Pl. Hartweg. p.* 324. McCumber's, N. California; July, in flower.

Gilia dichotoma, *Benth.; DC. Prod.* 9, *p.* 314. Fort Reading, California; April, in flower.

Gilia congesta, *Hook. Flor. Bor.-Amer.* 2, *p.* 75. Hat creek, N. California; July, in flower.

Gilia inconspicua, *Dougl. in Bot. Mag. t.* 2883; *DC. Prod.* 9, *p.* 312. San Francisco, California; April, in flower.

Collomia grandiflora, *Dougl. in Bot. Reg.* 14, *t.* 1174. McCumber's, N. California, and shores of Klamath lake.

Collomia gracilis, *Dougl.; Benth. in DC. Prod.* 9, *p.* 308, *& Plant. Hartweg. p.* 323. Sacramento valley, California.

Polemonium reptans, *Linn.; Hook. Bot. Mag. t.* 1887. Crater pass, Cascade mountains, O. T.

Polemonium cœruleum, *Linn.; Hook. Flor. Bor.-Amer.* 2, *p.* 71. Shores of Klamath lake. O. T.; August.

Phlox diffusa, *Benth. Plant. Hartweg. p.* 325. In dry rocky places. Canoe creek, N. California; July.

Leptodactylon pungens? *Torr.; DC. Prod.* 9, *p.* 316. Flowers pink and white. Shores of Rhett lake; August.

Leptodactylon Hookeri, *Benth.; DC. Prod.* 9, *p.* 316. Near San Francisco, California.

CONVOLVULACEÆ.

Convolvulus Californicus, *Chois. in DC. Prod.* 9, *p.* 405. Corolla yellowish-white. Hat creek, N. California; July.

Cuscuta Californica, *Hook. & Arn.; Chois. in DC. Prod.* 9, *p.* 457. Sacramento valley; July, in flower.

SOLANACEÆ.

Solanum nigrum, *Linn.* var. pubescens, *Hook. & Arn. Bot. Beech. p.* 152. Common throughout N. California, and on the Columbia river, O. T.

Solanum umbelliferum, *Eschsch.; Hook. & Arn. Bot. Beech. p.* 375. Near San Francisco.

Datura Stramonium, *Linn.* San Francisco, California. (Introduced.)

GENTIANACEÆ.—(By Asa Gray.)

Gentiana affinis, *Griseb. in Hook. Flor. Bor.-Am.* 2, *p.* 56. Shores of Klamath lake; August 22.

Gentiana calycosa? *Griseb. in Hook. Flor. Bor-Am.* 2, *p.* 58, *t.* 146. Crater pass, Cascade mountains; altitude 6,000 feet.

Gentiana acuta, *Michx*, var. stricta. Banks of Hat creek, California.

Gentiana simplex (Sp. nov.:) caule unifloro e radice annua simplicissimo parce foliato gracili (semipedali et ultra;) foliis lineari-lanceolatis oblongis crassiusculis; calyce quadrifido, segmentis lanceolatis; corolla cœrulea infundibuliformi imberbi haud coronata, lobis 4 oblongo-spathulatis integerrimis; antheris brevibus discretis; stylo brevi; stigmatibus rotundato-dilatatis; capsula stipitata; seminibus alatis. Upper Klamath lake; August.

It is not easy to fix upon the section of the genus to which this pretty and well-marked species should be referred. The discoverer not unnaturally took the plant for a *Cicendia*, notwithstanding the size of the blossom; but the stout style is persistent on the capsule and splits through in dehiscence, and all the characters are those of a Gentian. The slender stems are always simple, and bear from two to four pairs of small leaves, the uppermost remote from the solitary flower. The showy corolla is fully an inch long, and of a bright blue color. The stigmas are large and broad; the ovary tapers below into a decided stipe, which in fruit is half the length of the oblong capsule; and the seeds are broadly winged; their insertion sutural.

Plate XVI. Gentiana simplex. Three entire plants. Fig. 1. The calyx laid open, and the ovary transversely divided. 2. Upper part of the corolla laid open, with the stamens, and the upper part of the pistil. 3. A capsule, dehiscent, with its stipe. 4. Seeds. The details variously magnified.

Erythraea Muhlenbergii, *Griseb. in DC. Prod.* 9, *p.* 60. This is the "*Canchalagua*" of the natives of California, for which high medicinal virtues are claimed. It grows plentifully on the low grounds bordering Suisun bay; the flowers are rose red, numerous, and very pretty.

Menyanthes trifoliata, *Linn.* Common in marshes in the Sacramento valley.

APOCYNACEÆ.

Apocynum androsæmifolium, *Linn.* Banks of Pit river and McCumber's, California. Plant always smaller than in the Eastern States.

Apocynum cannabinum, *Linn.* Pit river, lower cañon; August 6.

ASCLEPIADACEÆ.—(By J. Torrey.)

Asclepias Frémonti, *Torrey.* McCumber's, N. Cal.

Asclepias fascicularis, var. foliis latioribus, *Decaisne in DC. Prod. p.* 569. Common in N. California and southern Oregon.

OLEACEÆ.

Fraxinus Oregana, *Nutt. Sylv.* 3, *p.* 59. Fort Reading, California.

ARISTOTOCHACEÆ.

Aristolochia Californica, *Torr. in Whippl. Rep. p.* 178. Banks of Sacramento near Fort Reading, California.

Asarum hookeri, *Field. Sert. t.* 32. Cascade mountains, O. T.

CHENOPODIACEÆ.—(By John Torrey.)

Obione argentea, *Moq. Chenop. p.* 76. Klamath lake.

Blitum rubrum, *Reich.*; *Moq. in DC. Prodr.* 13, (*pars* 1,) *p.* 83. Klamath lake.

Atriplex patula, *Linn.* Klamath.

Arthocnemum fruticosum, var. Californicum, *Moq. in DC. Prodr.* 13, *pars* 2, *p.* 151. Suisun bay, California.

POLYGONACEÆ.—(By John Torrey.)

Polygonum aviculare, *Linn.* Dalles of the Columbia; probably introduced.

Polygonum amphibium, *Linn.* var. terrestre, *Torr. Fl. N. St. p.* 403. McCumber's; July 29.

Polygonum tenue, *Michx. Fl.* 1, *p.* 238. Klamath lake.

Polygonum coarctatum, *Dougl. in Hook. Flor. Bor.-Amer.* 2, *p.* 133.

Rumex maritimus, *Linn.* Marshes, Klamath lake. The specimens are scarcely two inches high, and yet are loaded with mature fruit.

Rumex domesticus, *Hartm.; Hook. Fl. Bor.-Am.* 2, *p.* 129. McCumber's; grows in water.

Eriogonum microthecum, *Nutt. Pl. Gamb. in Jour. Acad. Phil.* (*n. ser.*) 1, *p.* 162. Psuc-see-que creek, O. T.; September.

Eriogonum niveum, *Dougl. in Benth. Eriog.* Fort Dalles, O. T.; October 5.

Eriogonum flavum, var. crassifolium, *Benth. Mss.* E. crassifolium, *Benth. in Hook. Fl. Bor. Amer.* 2, *p.* 134, *t.* 176.

Eriogonum polyanthum, *Benth. in DC. Prodr.* Fort Reading and Hat creek? This species was found also by Mr. Brackenridge and by Col. Frémont in California.

Eriogonum nudum, *Dougl. in Benth. Eriog.* McCumber's, N. California.

LAURACEÆ.

Oreodaphne Californica, *Nees.* Tetranthera? Californica, *Hook. & Arn. Bot. Beech. p.* 159. Laurus? regia, *Dougl. in Comp. Bot. Mag.* 2. Umbellularia Californica, *Nutt. Sylv.* 1, *p.* 87.

LORANTHACEÆ.

Phoradendron flavescens, var. pubescens, *Engel. in Gray, Pl. Lindh.* 2, *p.* 212. Parasitic on *Æsculus Californica*, near Benicia; July.

Arceuthobium Oxycedri, *Bieb.; Hook. Flor. Bor.-Amer.* 1, *p.* 278, *t.* 99. Common on *Pinus contorta* in northern California and Oregon.

CALLITRICHACEÆ.

Callitriche verna, *Linn.* San Francisco, California; in water.

EUPHORBIACEÆ.

Eremocarpus setigerus, *Benth. Bot. Sulph. p.* 53, *t.* 26. Croton setigerum, *Hook. Flor. Bor. Amer.* 2, *p.* 141. Gravelly banks of Sacramento river, Cal. The growing plant very fragrant.

Euphorbia maculata? *Linn.* Fort Dalles, O. T.; introduced?

NYCTAGINACEÆ.

Abronia mellifera, *Dougl.; Chois. in DC. Prod.* 13, 2, *p.* 435. Flowers rose-colored, pretty. Shores of San Pablo bay, Cal.

Abronia arenaria, *Menz.; Chois. in DC. Prod.* 13, 2, *p.* 435. Flowers yellow, fragrant. Sandy beaches, near San Francisco, Cal.

CUPULIFERÆ.

Quercus agrifolia, *Nees, in Ann. Sci. Nat.* 3, *p.* 271. Common in Sacramento valley.

QUERCUS GARRYANA, *Hook. Flor. Bor.-Amer.* 3, *p.* 159. Northern California and Oregon.

QUERCUS HINDSII, *Benth. Bot. Sulph. p.* 55. Sacramento valley, Cal.

QUERCUS KELLOGGII, *Newb.* Q. tinctoria var. Californica, *Torrey, in Whipple's Rep. p.* 138. Hills near San Francisco and Fort Reading.

QUERCUS DENSIFLORA, *Hook. & Arn. Bot. Beech. p.* 391. Q. Echinacea, *Torr. l. c.; Nutt. Sylv.* 1, *p.* 11, *t.* 5. Foot hills, Sierra Nevada, Cal.

QUERCUS FULVESCENS, *Kellogg, Proc. Cal. Acad.* 1, *p.* 67, 71. Q.crassipocula, *Torr. l. c.* Banks of Canoe creek.

QUERCUS (SP. ———.) We passed through thickets of a small oak, near Lassen's butte, N. Cal., which is apparently undescribed. Our specimens were unfortunately lost in crossing the Cascade mountains. The leaf and fruit resemble those of *Q. Garryana*, but the plant grows but 5 or 6 feet high.

CASTANEA CHRYSOPHYLLA, *Dougl. in Hook. Flor. Bor.-Amer.* 2, *p.* 159. N. California and Cascade mountains, O. T.

CORYLUS ROSTRATA, *Ait.* Common in Oregon Territory.

MYRICACEÆ.

MYRICA CALIFORNICA, *Cham. & Schlecht in Linnea, p.* 535. On the coast near San Francisco, California.

BETULACEÆ.

BETULA GLANDULOSA, *Michx.* Sphagnous marshes, Cascade mountains, O. T.; latitude 44°.

BETULA OCCIDENTALIS, *Hook. Flor. Bor.-Amer.* 2, *p.* 155; *Nutt. Sylv.*, *p.* 22. Banks of Psuc-see-que creek, Des Chutes basin, O. T.

ALNUS OREGANA, *Nutt. Sylv.* 1, *p.* 28, *t.* On the Sacramento and Columbia rivers.

ALNUS VIRIDIS, *DC. Fl., Fr.* 3, *p.* 304. Cascade mountains, O. T.

SALICACEÆ.

POPULUS TREMULOIDES, *Michx. Flor. Amer.* 2, *p.* 243. Along streams, N. California and Oregon.

POPULUS ANGUSTIFOLIA, *Torr. Ann. Lyc. Nat. Hist.* 2, *p.* 249. Banks of Columbia river.

POPULUS MONILIFERA, *Ait.* Banks of Sacramento river, California.

SALIX HINDSIANA, *Benth. Pl. Hartw. No.* 1956. Banks of Sacramento river, California.

SALIX LASIANDRA, *Benth. Pl. Hartw. No.* 1954. Banks of Sacramento river, California.

SALIX PENTANDRA, *Nutt. Sylva*, 1, *p.* 61, *t.* 18. Banks of the Willamette river, O. T.

SALIX SPECIOSA, *Nutt. Sylv.* 1, *p.* 58, *t.* 17. Banks of Columbia river, O. T.

PLATANACEÆ.

PLATANUS RACEMOSA, *Nutt. Sylva*, 1, *p.* 47, *t.* 15. Sacramento valley, California.

URTICACEÆ.

URTICA GRACILIS, *Ait.* McCumber's Flat, N. California.

URTICA URENS, ? *Linn.* Banks of Canoe creek, N. California.

CONIFERÆ.

Pinus Lambertiana, *Dougl.; Lamb. Pinus, ed.* 2, *p.* 57, *t.* 34. Throughout northern California and Oregon.

Pinus Sabiniana, *Dougl.; Lamb. Pinus, ed.* 2*d*, 2, *p.* 146, *t.* 80. Foot hills of Coast mountains and Sierra Nevada, in California.

Pinus ponderosa, *Dougl.; Loud. Arboret.* 4, *p.* 2243. Throughout California and Oregon.

Pinus contorta, *Dougl.; Loud. Encyc. Trees, fig.* 1814–1815. Common in the Sierra Nevada and Cascade mountains, in Oregon and California.

Pinus cembroides, *Zucc.; Jour. Lond. Hort. Soc.* 2, *p.* 246. On summits of Cascade mountains, O. T.

Pinus insignis, *Dougl.; Loud. Arboret.* 4, *p.* 2265. Near San Francisco and southward.

Picea nobilis, *Dougl.; Loud. Arboret.* 4, *p.* 2343. Cascade mountains, O. T.

Picea grandis, *Dougl.; Loud. Arboret.* 4, *p.* 2341. Cascade mountains, O. T.

Picea amabilis, *Dougl.; Loud. Arboret.* 4, *p.* 2342. Cascade mountains, O. T.

Abies Douglasii, *Lindl. Penny Cyclop.* 1, *p.* 32. Throughout Oregon, and mountains of interior of California.

Abies Menziesii, *Dougl.*; *Loud. Arboret.* 4, *p.* 2321. Common in Oregon and mountains of California.

Abies Williamsoni, *Newb.* On summits of Cascade mountains, O. T.

Sequoia gigantea, *Torr. in Sill. Jour.* 2*d ser.*, 18, *p.* 150. Foot hills of Sierra Nevada, Cal.

Sequoia sempervirens, *Endl. Syn. Conif. p.* 198. Coast mountains of California.

Libocedrus decurrens, *Torr. in Smithson. Contrib.* 6, *p.* 7, *t.* 3. Common in mountains of northern California.

Thuja gigantea, *Nutt. Sylva,* 3, *p.* 111. Throughout mountains of Oregon.

Taxus brevifolia, *Nutt. Sylva,* 3, *p.* 86, *t.* 108. In Cascade mountains and Sierra Nevada.

Juniperus occidentalis, *Hook. Flor. Bor.-Amer.* 2, *p.* 166. Great Basin east of Cascade mountains, and Sierra Nevada.

Juniperus communis, *Linn.* Summits of Cascade mountains, O. T.

Cupressus Nutkatensis, *Hook. Flor. Bor.-Amer.* 2, *p.* 165. Summits of Cascade mountains, O. T.

Torreya Californica, *Torr. in N. Y. Jour. Pharm.* 3, *p.* 49. In Coast mountains, Cal.

Larix occidentalis, *Nutt. Sylva,* 3, *p.* 143, *t.* 120. Cascade mountains, O. T.

II. ENDOGENOUS PLANTS.

BY JOHN TORREY.

ARACEÆ.

Symplocarpus Kamtschaticus, *Bong.; Hook. Flor. Bor.-Am.* 2, *p.* 169. Peat bogs, Cascade mountains, O. T.; lat. 44°.

TYPHACEÆ.

Typha latifolia, *Linn.* Common from Sacramento valley to Columbia.

NAIDACEÆ.

Potamogeton natans, *Linn.* Klamath lake.

ALISMACEÆ.

Triglochin maritimum, *Linn.* Bartee's valley, northern California, August 1.

Alisma plantago, *Linn.* In marshes throughout northern California and Oregon. Apparently entirely identical with the eastern plant.

Sagittaria variabilis, *Engelm.; Gray, Bot. N. U. S. p.* 461. Pit river, Klamath lakes, and Columbia river; July to November. The bulb of this plant is an important article of food among the Oregon Indians, by whom it is called *Wapatoo.*

MELANTHACEÆ.

Anticlea Douglasii, *Torr. in Whipple's Report.* Petaluma, California; February.

Xerophyllum tenax, *Pursh. Fl.* 1, *p.* 243, *t.* 9. Cascade mountains, Oregon Territory.

Tofieldia glutinosa, *Pursh. Fl.* 1, *p.* 246. Crater pass, Cascade mountains.

Veratrum viride, *Ait. Kew.* (*ed.* 1,) 3, *p.* 896. Meadows, McCumber's; August.

LILIACEÆ.

Dichelostemma congesta, *Kth. Enum.* 4, *p.* 470. Brodiæa congesta, *Smith, in Linn. Trans.* 10, *p.* 3, *t.* 1. Fort Reading, California, March 18. Flowers slightly fragrant.

Calochortus uniflorus, *Hook. & Arn. Bot. Beechey, p.* 398, *t.* 94. Petaluma, California; April.

Calochortus macrocarpus, *Dougl. in Hort. Trans.* 7, *p.* 276, *t.* 8. Banks of Canoe creek, California, August.

Brodiæa grandiflora, *Smith, in Linn. Trans.* 10, *p.* 2. McCumber's; August 29. Var. brachypoda, *Torr. in Whipple's Report.*

Hesperoscordon lacteum, *Lindl. Bot. Reg. t.* 1639. McCumber's; July 29.

Fritillaria lanceolata, *Pursh.; Hook. Fl. Bor.-Amer.* 2, *p.* 181, *t.* 193. Pine Wood pass? In fruit. Flowering specimen.

Chlorogalum pomeridianum, *Kunth. Enum.* 4, *p.* 682. McCumber's. This is the celebrated *Soap plant.*

Smilacina stellata, *Desf.* Head of Des Chutes river; September; in fruit.

Clintonia uniflora, *Torr.* Smilacina uniflora, *Hook. Fl. Bor.-Am.* 2, *p.* 175, *t.* 190. Upper Des Chutes river. The fruit is a large, solitary, blue berry.

SMILACEÆ.

Trillium ovatum, *Pursh, Fl.* 1, *p.* 249. Petaluma, California; February.

ORCHIDACEÆ.

Epipactis gigantea, *Hook. Flor. Bor.-Amer.* 2, *p.* 202, *t.* 202. McCumber's and Mpto-ly-as river.

Spiranthes decipiens, *Hook. Flor. Bor.-Amer.* 2, *p.* 203, *t.* 204. Spruce forests, Cascade mountains; September.

Spiranthes cernua, *Rich.* Near Pit river (August) and McCumber's (July.)

Platanthera leucostachys, *Lindl. Gen. & Sp. Orch. p.* 288. Canoe creek, California; August 1.

Platanthera stricta, *Lindl. l. c.* Crater pass, Cascade mountains; September 1.

IRIDACEÆ.

Iris hæmatophylla, *Fisch.? ; Hook. Flor. Bor.-Amer.* 2, *p.* 206. McCumber's.

Iris macrosiphon, *Torr. in Whipple's report.* Sonoma, California; February.

Sisyrhynchium grandiflorum, *Dougl. in Bot. Reg. t.* 1364. Locality not recorded.

Sisyrhynchium Bermudiana, *Linn.; Torr. Fl. N. York* 2, *p.* 291. McCumber's.

JUNCACEÆ.

Luzula campestris, *DC. Fl. Franc.* 3, *p.* 161. McCumber's, northern California.

Luzula parviflora, *Desv. Jour. Bot.* 1, *p.* 144. Crater pass, Cascade mountains; altitude 6,500 feet; September 1.

Juncus castaneus, *Smith;* var. sepalis capsulam superantibus. Crater pass, Cascade mountains, O. T.

Juncus bufonius, *Linn.* Fort Dalles, O. T.; September.

Juncus tenuis, *Willd. Sp.* 2, *p.* 214. McCumber's, California.

CYPERACEÆ.

Carex lanuginosa, *Michx. Fl.* 2, *p.* 175. McCumber's, California.

Carex cæspitosa, *Linn.* Crater pass, Cascade mountains, September; altitude of 6,700 feet.

Carex pyrenaica, *Wahl.* With the last. Differs from the ordinary state of the plant in being apparently dioecious. No male flowers were found in the specimens. It is a rare species in North America.

Scirpus lacustris, *Linn.* Extremely abundant, covering immense areas in the Sacramento valley, Klamath basin, and on the Columbia. The *Tulé* of the Mexicans.

GRAMINEÆ.

Alopecurus geniculatus, var. aristulatus, *Torr. Fl. N. St. p.* 97. Klamath marshes; August.

Beckmannia cruciformis, *Host.* McCumber's.

Festuca scabrella, *Torr. in Hook. Fl. Bor.-Am.* 2, *p.* 252, *t.* 233. This grass is abundant over all the Des Chutes and Klamath basins, and on the Cascade mountains, and is the famous "bunch grass" of the emigrants.

Polypogon, (Sp. nov.?) McCumber's and Pit river. This is not a very rare grass in California; it has the habit of *P. Monspeliense,* but differs from the genus in the glumes being scarcely awned, and in the rudimentary upper palea.

Elymus arenarius, *Linn.* Banks of Pit river, and in many other parts of California. Sometimes eight feet in height; so high that, riding through it, it reached to the top of our heads while seated on our horses. It grows in all parts of California where there are deserted Indian lodges, and is, therefore, called by the inhabitants "rancheria grass." The seed is threshed out, and eaten by the Digger Indians.

Hordeum jubatum, *Linn.* Rhett lake, and throughout northern California and Oregon.

CRYPTOGAMOUS PLANTS.

EQUISETACEÆ.

Equisetum hyemale, *Linn.* Canoe creek, Northern California. Fertile stems sometimes paniculately branched at the summit; each branch bearing a terminal head of fructification.

Equisetum fluviatile. On the Columbia river and San Francisco, California.

Equisetum eburneum, *Schreb.* Coast mountains south of San Francisco.

FILICES.

Adiantum tenerum, *Willd.* Near San Francisco, California.

Adiantum pedatum, *Linn.* Cascade mountains, O. T.; range south of the Columbia.

Aspidium munitum, *Kaulf.* Cascade mountains. In fine fruit; September.

Aspidium dilatatum, *Swartz, Syn. Fil.* Cascade mountains, O. T.; September.

Allosorus acrostichoides, *Presl.* On congealed lava, passes of the Cascade mountains.

Cheilanthes vestita, *Swartz.* A dwarf state of the plant; in tufts on rocks, Cascade mountains; altitude 7,000 feet; September.

Blechnum boreale, *Swartz.* Cascade mountains; latitude 44°; September.

Pteris Aquilina, var. lanuginosa, *Bong.* McCumber's; July.

III. MOSSES AND LIVERWORTS.

BY W. S. SULLIVANT.

MUSCI.

Sphagnum molluscum, *Bruch.* Cascade mountains, O. T.

Sphagnum acutifolium, *Ehrh.* Bogs on Columbia river, O. T.

Sphagnum squarrosum, *Pers.* Bogs, Cascade mountains, O. T.

Polytrichum juniperinum, *Hedw.* Cascade mountains, O. T. Common.

Aulacomnion androgynum, *Schw.* Cascade mountains, O. T.

Mnium punctatum, *Hedw.* Cascade mountains, O. T.

Orthotricum Lyelli, *Hook. & Tayl.* Var. foliis longioribus. Cascade mountains, O. T.

Weisia cirrhata, *Hedw.* Cascade mountains, O. T.

Dicranum, (sp. undeterminable.)

Neckera Menziesii, *Hook.* Cascade mountains, O. T.

Hypnum splendens, *Hedw.* Cascade mountains, O. T.

Hypnum Oreganum, *Sull.* Cascade mountains, O. T.

Hypnum triquetrum, *Linn.* Cascade mountains, O. T.

Hypnum Nuttallii, *Wils.*

Hypnum ———? Cascade mountains, O. T.

Hypnum undulatum, *Linn.*

Hypnum brevirostre? Cascade mountains, O. T.

HEPATICÆ.

Madotheca Douglasii, *Tayl.* Cascade mountains, O. T.

Scapania nemorosa, *Nees.* Cascade mountains, O. T.

Aneura, (undeterminable.)

IV. LICHENS.

BY EDWARD TUCKERMAN.

Evernia vulpina, *Ach.* On *Juniperus* and *Libocedrus.*

Evernia ochroleuca, var. sarmentosa, *Fr.* On *Picea grandis;* Cascade mountains, O. T.

Evernia Fremonti, *Tuckerm* On *Pinus contorta* and *P. ponderosa;* shores of Klamath lake.

Sticta pulmonaria, *Ach.* On trees; banks of the Columbia.

Cetraria glauca, *Ach.* Trunks of trees and stones; Cascade mountains.

Cladonia cornuta, *Fr.* Decayed wood; banks of the Columbia.

Cladonia fimbriata, *Fr.* On the earth; banks of the Columbia.

Cladonia digitata, *Hoffm.* With the last.

Lecidia parasema, *Fr.* Trunks of trees; banks of the Columbia.

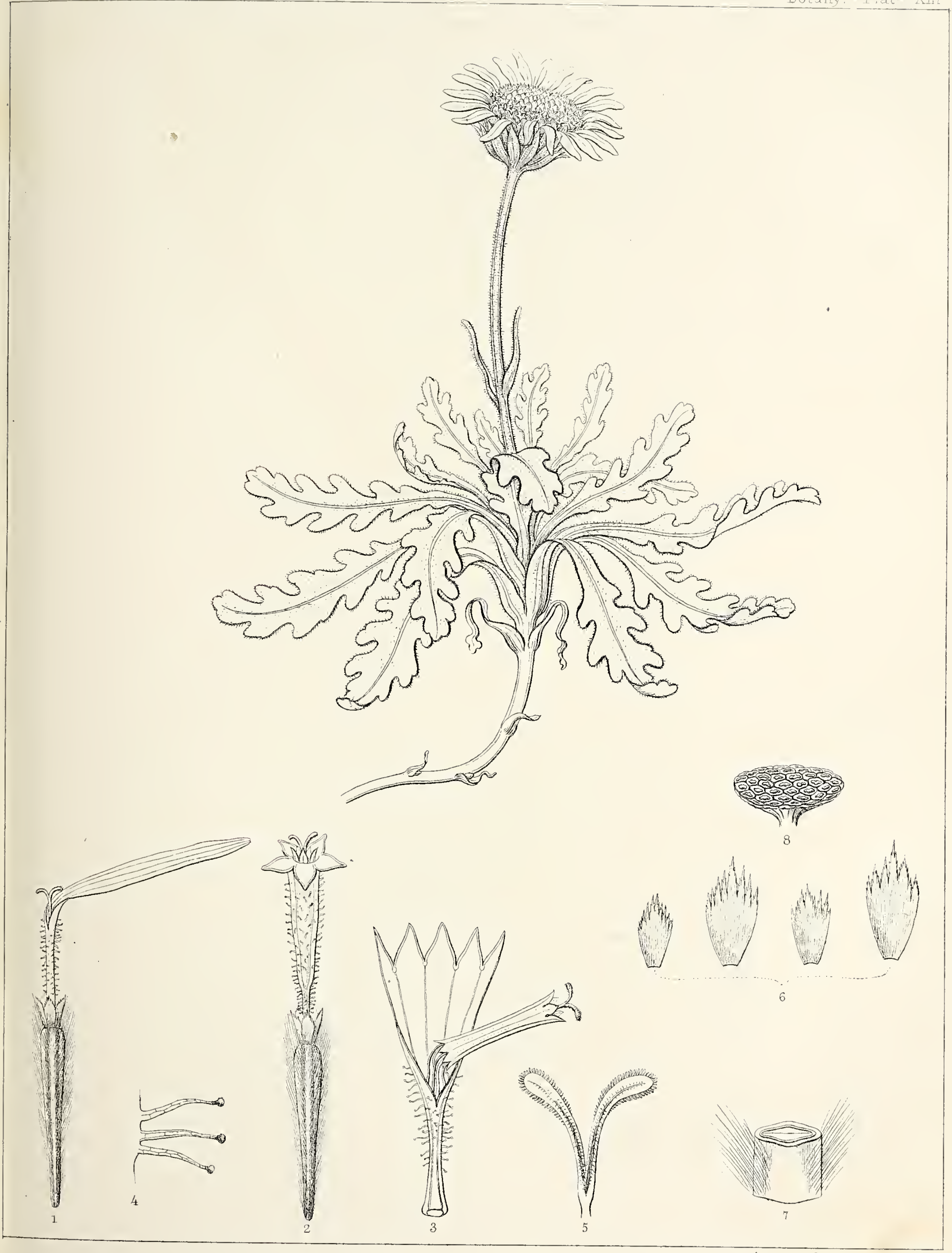
Sphœrophoron globiferum, *DC.* On the ground; Washington Territory.

Ackerman Lith. 379 Broadway N.Y.

IVESIA GRACILIS.

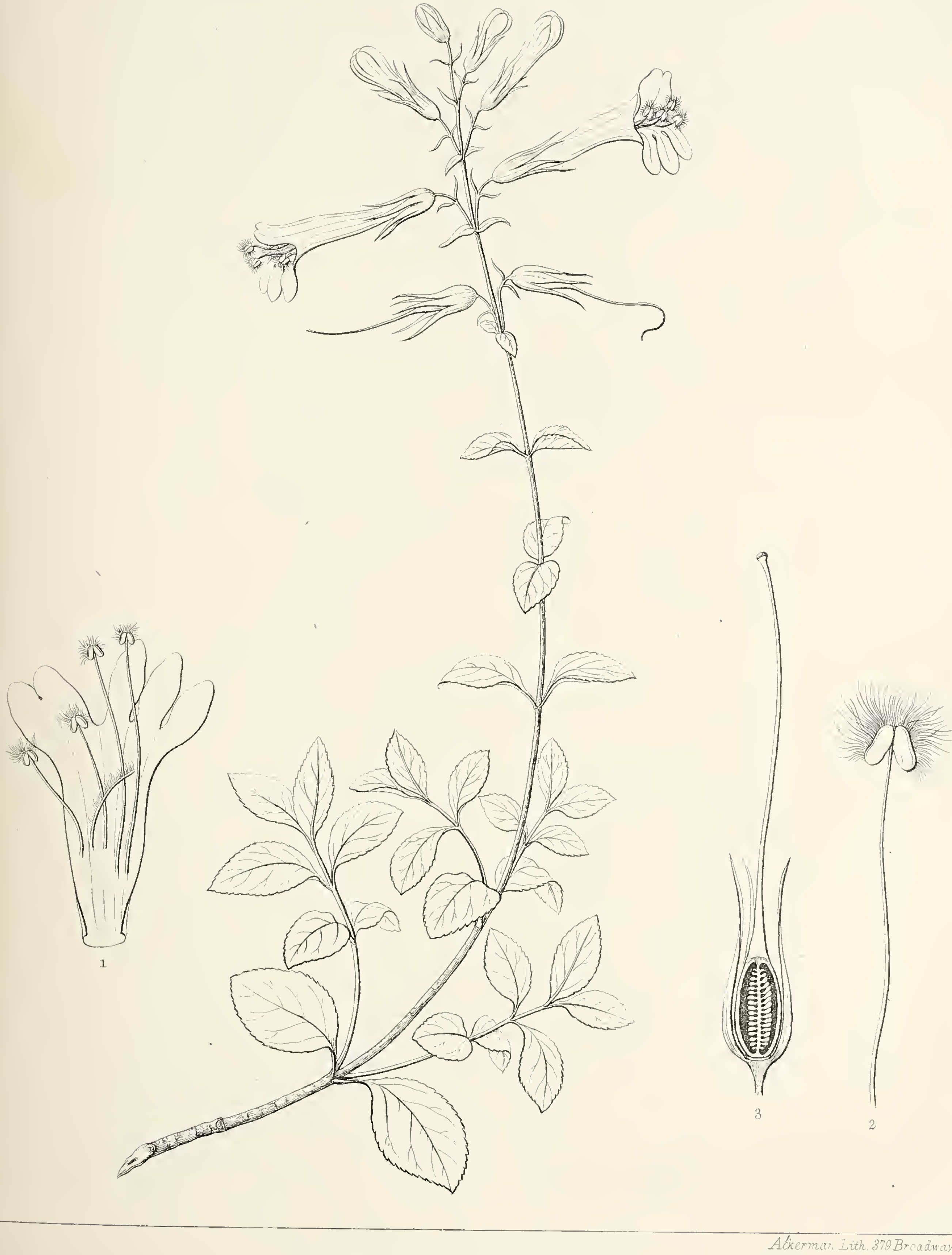
Ackerman Lith. 379 Broadway N.Y.

HEMITOMES CONGESTUM.



Ackerman Lith. 379 Broadway N.Y.

HULSEA NANA.



Ackerman Lith. 379 Broadway N.Y.

PENTSTEMON NEWBERRYI.

Ackerman Lith. 379 Broadway N.Y.

EMMENANTHE PARVIFLORA.

Ackerman Lith. 379 Broadway N.Y.

GENTIANA SIMPLEX.

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PART IV.

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

WAR DEPARTMENT.

ROUTES IN CALIFORNIA AND OREGON EXPLORED BY LIEUT. R. S. WILLIAMSON, CORPS OF TOPOGRAPHICAL ENGINEERS, AND LIEUT. HENRY L. ABBOT, CORPS OF TOPOGRAPHICAL ENGINEERS, IN 1855.

ZOOLOGICAL REPORT.

WASHINGTON, D. C.
1857.

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BY DR. CHARLES GIRARD.

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BY S. F. BAIRD,

ASSISTANT SECRETARY OF THE SMITHSONIAN INSTITUTION.

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PREFATORY NOTE TO PART IV.

The information collected by the expedition in the department of Natural History is embodied in this portion of the Report. It is proper to state that the credit for whatever of value the papers may contain is due, in a great measure, to the Smithsonian Institution. The outfit and instructions of the zoologist were prepared, and the specimens themselves arranged and preserved by this Institution. Under its supervision and within its walls the necessary illustrations have been executed, the determination of species made, and the reports themselves revised for publication.

The zoologist of the expedition, Dr. E. Sterling, of Cleveland, Ohio, dissolved his connection with the party on reaching Fort Dalles, in consequence of ill health. Subsequent to that time the duties of zoological collector were chiefly performed by Dr. J. S. Newberry. The latter gentleman left the party soon after Dr. Sterling, and returned, by water, from Oregon to San Francisco. In consequence of his absence and of the Indian disturbances on the route, a comparatively small zoological collection was made in the region traversed west of the Cascade Range. Mr. C. D. Anderson, however, secured and preserved several valuable specimens on this portion of our line of survey. While waiting for the arrival of the party, Dr. Newberry zealously occupied himself in making a valuable and extensive collection in the markets and the vicinity of San Francisco.

The expedition is also largely indebted to Lieutenant W. P. Trowbridge, Corps of Engineers, and to other gentlemen who have taken advantage of a long residence in the west to collect and preserve zoological specimens. Their contributions have been transported to Washington, deposited in the Smithsonian Institution, and described in the following reports with those made by the collectors of the party.

HENRY L. ABBOT,
Lieut. Corps of Top. Engineers.

No. 1.

REPORT UPON FISHES COLLECTED ON THE SURVEY.

BY CHARLES GIRARD, M. D.

I. FAMILY PERCIDAE.

1. AMBLOPLITES INTERRUPTUS, Grd.

PLATE II, figs. 1–4.—*General Report upon Fishes.*

Posterior extremity of maxillary bone reaching a vertical line drawn back of the pupil. Posterior margin of caudal fin subemarginated. Origin of anal fin situated opposite the eleventh ray of the dorsal. Interrupted dark bands on the sides; two vittae diverging from the eye, one running towards the opercular spot, the other obliquely downwards.

Known as *Perch* in the markets of San Francisco. The fish is very much esteemed as an article of food.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
279	1	Adult..	Sacramento river, Cal....	1855	Dr. Newberry.......	....	Alcoholic.

II. FAMILY HETEROLEPIDAE.

2. CHIROPSIS PICTUS, Grd.

PLATE XX, figs. 1–4.—*General Report upon Fishes.*

Dorsal fins contiguous; caudal fin subtruncated posteriorly. Ground color dark brown, with numerous vermilion spots, bordered with black, upon the sides and lower fins; under surface of head, throat, and belly, whitish or yellowish.

Called *Sea Trout* and *Rock Fish* at San Francisco; it is a comestible and very fine fish.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
267	1	Adult..	San Francisco, Cal.	1855	Dr. Newberry.......	....	Alcoholic.

3. OPLOPOMA PANTHERINA, Grd.

PLATE XVIII, figs. 1–3.—*General Report upon Fishes.*

Body elongated and tapering. Upper surface and sides of head granular; preopercular spines few, small, and obtuse. Posterior extremity of maxillary extending beyond the orbit. Origin of anterior dorsal fin situated in advance of the convexity of the preopercle. Scales extending over the base of both the caudal and pectoral fins. Blackish brown above, reddish brown beneath; dorsal and lateral regions spotted with black.

No vernacular name of this species has, so far, come to our knowledge.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
275	1	Adult.	Cape Flattery, W. T. ----	1855	Lieut. Trowbridge---	--------	Alcoholic.

4. OPHIODON ELONGATUS, Grd.

PLATE XVIII, figs. 4–7.—*General Report upon Fishes.*

Body lanceolated. Head subconical and depressed; mouth deeply cleft; posterior extremity of maxillary extending to the vertical of the posterior rim of the orbit. Spinous portion of dorsal fin much longer than the articulated portion; anal fin a little longer than the soft portion of the dorsal; caudal slightly emarginated posteriorly; extremities of pectorals nearly even with the tips of the ventrals. Color above olivaccous brown, scattered all over with blackish, subcircular spots; beneath yellowish.

We have heard of no vernacular name, as yet, for this fish.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
277	2	Adult.	Humboldt bay, Cal. -----	1855	Lieut. Trowbridge---	--------	Alcoholic.

III. FAMILY COTTIDAE.

5. COTTOPSIS GULOSUS, Grd.

General Report upon Fishes.

Origin of anterior dorsal fin situated opposite the insertion of the upper ray of the pectorals. First ray of anal fin placed under the fourth of the second dorsal. Extremities of pectorals extending beyond the origin of the anal. Skin generally smooth; lateral line undergoing a sudden fall upon the peduncle of the tail. Reddish brown, spotted, and transversally barred with black; beneath, unicolor.

This is a "fresh water bull head," or "miller's thumb."

List of specimens.

Catalogue number.	No. of specimens	Sex and age.	Locality.	When collected	Collected by—	Original number.	Nature of specimens
292	2	Adult.	Upper Pit river, Cal. -----	1855	Dr. Newberry-------	--------	Alcoholic.

6. COTTOPSIS PARVUS, Grd.

General Report upon Fishes.

Origin of first dorsal situated posteriorly to the insertion of the upper ray of the pectorals. First ray of anal placed under the fourth of the second dorsal. Extremities of pectorals extending to the anterior margin of the anal. Skin generally prickly; lateral line slightly deflected upon the peduncle of the tail. Olivaceous, maculated with blackish.

Here is another kind of "fresh water bull head," or "miller's thumb."

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
293	2	Adult.	Monterey, Cal. ----------	1855	Lieut. Trowbridge ---	--------	Alcoholic.
294	4	♂ ♀	Presidio, Cal. -----------	1853	--------do----------	--------	------ --------

7. OLIGOCOTTUS MACULOSUS, Grd.

General Report upon Fishes.

Head subconical. Mouth moderately cleft; posterior extremity of maxillary extending to a vertical line intersecting the pupil. A stoutish bicuspid process upon the convexity of the preopercle. Two acute nasal spines. Dorsal fins contiguous. Origin of anal situated in advance of the anterior margin of second dorsal. Yellowish brown above, mottled or variegated with blackish; a series of blotches of a deeper hue along the dorsal region. Lower half of the sides vermiculated. Abdomen of a bright saffron hue in the male. Inferior surface of head with traces of black markings. Throat and abdomen unicolor, as also the ventrals and anal. Dorsals, caudal, and pectorals transversally barred with black.

A fish not known among fishermen; hence we are not aware of its having received a common name.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
298	6	Adult.	Bay of San Francisco, Cal.	1855	Lieut. Trowbridge ---	--------	Alcoholic.

8. OLIGOCOTTUS GLOBICEPS, Grd.

General Report upon Fishes.

Head rounded anteriorly. Mouth moderately cleft; posterior extremity of maxillary extending to a vertical line drawn posteriorly to the pupil. Rudimentary spines upon the preopercle. Two acute nasal spines. Dorsal fins separated. Origin of anal situated a little posteriorly to the anterior margin of the second dorsal fin. Reddish brown; upper regions maculated with black; beneath unicolor and lighter.

We know of no vernacular name for this species.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
300	4	♂ ♀	S. Farallones, Cal. ------	1855	Lieut. Trowbridge---	--------	Alcoholic.

9. LEPTOCOTTUS ARMATUS, Grd.

Plate XV, fig. 2.—*General Report upon Fishes.*

Head much depressed; upper jaw longer than the lower; posterior extremity of maxillary extending a little beyond the vertical of the posterior rim of the orbit. A preopercular process, provided with three spines, directed upwards. Blackish brown above, whitish beneath; dorsals, caudal, and pectorals yellowish, barred with black; anterior dorsal with a black spot posteriorly; ventrals and anal whitish.

"Marine Bull Head" is a name applied to this and other species of the same family.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number	Nature of specimens.
311	1	Adult.	San Francisco, Cal. ------	1855	Dr. Newberry-------	--------	Alcoholic.

10. LEIOCOTTUS HIRUNDO, Grd.

Plate XVI, figs. 2 and 3.—*General Report upon Fishes.*

Snout declivous and rather pointed; posterior extremity of maxillary provided with two or three barbels, and reaching a vertical line drawn a little beyond the anterior rim of the orbit. Superior regions blackish brown; whitish under the abdomen, and yellowish under the tail.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
313	1	Adult.	Island of San Miguel, Cal.	1855	Lieut. Trowbridge---	--------	Alcoholic.

11. SCORPÆNICHTHYS MARMORATUS, Grd.

Plate XVI, fig. 1.—*General Report upon Fishes.*

Membranous flaps upon the upper and posterior part of the orbit, upon the snout, and at the posterior extremity of the maxillaries; the latter extending to a vertical line passing immediately behind the eye. Two spines of moderate development upon the preopercle. Fins all well developed. Ground color either light or dark brown, marmorated with black.

Sold in the markets under the name of *Sculpin.*

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
315	2	Young.	San Francisco, Cal.	1855	Dr. Newberry		Alcoholic.

12. ASPICOTTUS BISON, Grd.

Plate XV, fig. 1.—*General Report upon Fishes.*

The posterior extremity of the maxillary extends to a vertical line drawn midway between the posterior edge of the pupil and the posterior rim of the orbit. The scutellæ constituting the lateral line are crowded and vertically elongated. Upper regions dark brown, mottled or blotched with black; beneath dull yellowish, with meandriform dark lines under the head and throat; ventrals uniform yellowish white; other fins mottled yellow and black.

Known as *Sculpin* among the San Franciscans.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
323	1	Adult.	Fort Point, Cal.	1855	Lieut. Trowbridge		Alcoholic.

13. HEMILEPIDOTUS SPINOSUS, Ayres.

General Report upon Fishes.

Upper surface and sides of head provided with membranous flaps; eye quite large; posterior free extremity of maxillary extending to a vertical line drawn at the posterior rim of the pupil. Dorsal band of scales composed of six rows or series; lateral band of seven, five below and two above the lateral line. Ground color dark reddish brown, with darker transverse bands and blotches.

Another *Sculpin,* in the vernacular language of the California settlers.

List of specimens.

Catalogue number.	No. of specimens	Sex and age.	Locality.	When collected.	Collected by—	Original number	Nature of specimens.
326	6	Adult.	San Francisco, Cal.	1855	Dr. Newberry		Alcoholic.
365	1	do	do	1855	Dr. Ayres	33	do

14. ARTEDIUS LATERALIS, Grd.

PLATE XXII*a*, figs. 5 and 6.—*General Report upon Fishes.*

Surface of head smooth. Preopercle armed with a flat bicuspid spine. Band of dorsal scales narrow, originating at the thoracic arch and extending to near the terminus of the base of the second dorsal. Anterior margin of the first dorsal situated in advance of the thoracic arch. Deep chestnut brown above, maculated with yellowish; beneath yellowish.

Too small a fish to have attracted the notice of fishermen.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
366	1	Adult.	San Francisco, Cal.	1855	Dr. Ayres	36	Alcoholic.

15. ARTEDIUS NOTOSPILOTUS, Grd.

PLATE XXII*b*, figs. 5 and 6.—*General Report upon Fishes.*

Surface of head subtuberculous and scaly. Preopercle armed with a flat tricuspid spine. Anterior margin of first dorsal situated in advance of the beginning of the dorsal band of scales, which is broad, and extends from the thoracic arch to near the terminus of the base of the second dorsal. Olivaceous, with a series of saddle-like and black patches; abdomen dull yellow or white.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
367	1	Adult.	San Francisco, Cal.	1855	Dr. Ayres	36	Alcoholic.

IV. FAMILY SCORPAENIDÆ.

16. SEBASTES ROSACEUS, Grd.

PLATE XXI.—*General Report upon Fishes.*

Upper surface of head provided with horizontal and acute ridges; posterior extremity of maxillary extending to a vertical line intersecting the pupil. Origin of dorsal fin situated in advance of the base of the pectorals. Uniform reddish, lighter beneath than above.

Called *Rock Fish* or *Rock Cod* at San Francisco, and sold under these names in the markets.

List of specimens.

Catalogue number.	No of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
344	1	Adult.	San Francisco, Cal. ------	1855	Dr. Newberry-------	--------	Alcoholic.

17. SEBASTES FASCIATUS, Grd.

PLATE XXII.—*General Report upon Fishes.*

Upper surface of head provided with large spinous ridges ; posterior extremity of maxillary extending beyond the pupil. Origin of dorsal fin situated in advance of the base of the pectorals. Ground color greenish yellow or sulphur yellow, clouded with dark patches spotted with whitish ; a dorsal fasciole of the ground color extends from the third or fourth dorsal spine to the base of the caudal.

Indiscriminately called *Rock Fish* or *Rock Cod* at San Francisco.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
346	1	Adult.	San Francisco, Cal. ------	1855	Dr. Newberry-------	--------	Alcoholic.

18. SEBASTES AURICULATUS, Grd.

General Report upon Fishes.

Upper surface of head provided with small horizontal and acute spines ; posterior extremity of maxillary extending to a vertical line drawn posteriorly to the orbit. Origin of dorsal fin situated in advance of the base of the pectorals. Blackish brown above, lighter beneath ; a black spot upon the upper part of the opercle.

Another *Rock Fish* or *Rock Cod:* all being very much esteemed.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
349	2	Adult.	San Francisco, Cal. ------	1855	Dr. Newberry-------	--------	Alcoholic.

19. SEBASTES PAUCISPINIS, Ayres.

PLATE XXII*a*, figs. 1–4.—*General Report upon Fishes.*

Head and body very much compressed ; former wedge shaped ; tip of lower jaw very prominent ; spines of the upper surface of skull inconspicuous ; posterior extremity of maxillary extending to a vertical line drawn posteriorly to the orbit; opercle and preopercle spinous. Origin of dorsal fin a little in advance of the base of the pectorals. Reddish brown above, lighter beneath.

This is a much rarer *Rock Fish* than the preceding ones.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
487	1	Adult.	San Francisco, Cal. ------	1855	Dr. Ayres ----------	3	Alcoholic.

V. FAMILY GASTEROSTEIDAE.

20. GASTEROSTEUS PLEBEIUS, Grd.

General Report upon Fishes.

Body partly plated; peduncle of tail not keeled. Dorsal spines three, of moderate development, and strongly serrated upon their edges; insertion of anterior one taking place immediately behind the base of the pectorals. Insertion of ventrals placed slightly in advance of the second dorsal spine; ventral spine serrated on both edges, its extremity not reaching the tips of the *ossa innominata.* Posterior margin of caudal subcrescentic.

"Burnstickle" of the English; "Sticklebacks" of the American people.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
331	4	Adult.	San Francisco, Cal. ------	1855	Dr. Newberry-------	--------	Alcoholic.

21. GASTEROSTEUS SERRATUS, Ayres.

General Report upon Fishes.

Body entirely plated; peduncle of tail keeled. Dorsal spines three; high and slender; conspicuously serrated upon their edges; anterior one inserted a little in advance of the base of the pectorals. Insertion of ventrals situated a little in advance of the second dorsal spine; their own spine being serrated upon both edges, more conspicuously above than below, and extending beyond the tips of the *ossa innominata.* Posterior margin of caudal concave.

Another kind of "Stickleback."

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
334	1	Adult.	Bay of San Francisco, Cal.	1855	Dr. Newberry-------	--------	Alcoholic.

22. GASTEROSTEUS INOPINATUS, Grd.

General Report upon Fishes.

Body partly plated; peduncle of tail consequently not keeled. Dorsal spines three; slender, and slightly serrated upon their edges; insertion of anterior one taking place above the base of the pectorals. Insertion of ventrals placed immediately in advance of the second dorsal spine; ventral spine serrated on both edges, but less conspicuously below than above, and its extremity terminating about evenly with the tips of the *ossa innominata*. Posterior margin of caudal subcrescentic.

Still another "Stickleback."

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
337	24	Adult.	Presidio, Cal	1853	Lieut. Trowbridge		Alcoholic.

VI. FAMILY SCIAENIDAE.

23. LEIOSTOMUS LINEATUS, Ayres.

PLATE XXII*b*, figs. 1–4.—*General Report upon Fishes.*

Mouth large; posterior extremity of maxillary extending to a vertical line intersecting the posterior rim of the pupil. Superior and posterior edge of the opercle terminating into two flat spines. Extremities of pectorals nearly even with the tips of the ventrals. Scales large. Greyish brown above; greyish silvery beneath, with oblique waving lines of umber brown.

The names of *Corvina*, *Cognard*, and *Little Bass* are given to this species by fishermen.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
368	2	Adult	San Francisco, Cal	1855	Dr. Ayres	5	Alcoholic.
369	2	Young	do	1855	Dr. Newberry		do

VII. FAMILY ATHERINIDAE.

24. ATHERINOPSIS CALIFORNIENSIS, Grd.

PLATE XXII*c*.—*General Report upon Fishes.*

Head small and subquadrangularly pyramidal, constituting the sixth of the entire length. Base of anal fin much longer than that of the second dorsal. Greyish brown above; light brown or silvery beneath. Fins olivaceous, unicolor.

So called *Smelt* by the San Franciscans.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
352	2	Adult.	San Francisco, Cal.	1855	Dr. Newberry	....	Alcoholic.

VIII. FAMILY SCOMBRIDAE.

25. TRACHURUS SYMMETRICUS, Grd.

General Report upon Fishes.

Head forming the fourth of the total length; posterior extremity of maxillary extending to the anterior rim of the orbit. Shields of lateral line smallest upon its bent, under the anterior third of the second dorsal. Greenish brown above, lighter on the sides, silvery beneath; a brownish black blotch at the superior and posterior angle of the opercle; fins unicolor.

There is, as yet, no vernacular name to designate this fish.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
488	1	Adult.	San Francisco, Cal.	1855	Dr. Ayres	26	Alcoholic.

IX. FAMILY BLENIDAE.

26. BLENNIUS GENTILIS, Grd.

PLATE XXV*a*, fig. 4—*General Report upon Fishes.*

A small canine on each side of the upper jaw. A supraorbital membranous flap. A slight depression between the spinous and the soft portions of the dorsal fin. Lateral line terminating under the eleventh spiny ray. Ground color yellowish brown, maculated with purple.

This is a "blenny," unknown to the Californian settlers.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
489	1	Adult.	Monterey, Cal..........	1853	Lieut. Trowbridge...	....	Alcoholic.

27. GUNNELLUS ORNATUS, Grd.

PLATE XXV*b*, figs. 6 and 7.—*General Report upon Fishes.*

Dorsal and anal fins contiguous to the caudal; anal spines, two; ventrals reduced to two exceedingly small spines. Head quite small. An occipito-ocular dark vitta continued vertically beneath the orbit to the hyoid apparatus. Ground color yellowish ; about thirteen dorsal roundish spots of blackish brown, and about eighteen lateral, squarrish ones, of light brown.

The only species of true "Gunnels" as yet known along the coast of California.

List of specimens.

Catalogue number	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
490	1	Adult.	Presidio, Cal.	1853	Lieut. Trowbridge		Alcoholic.

28. APODICHTHYS FLAVIDUS, Grd.

General Report upon Fishes.

Exterior row of maxillary teeth larger than the internal row, which is sometimes rudimentary. Mouth large ; posterior extremity of maxillary bone extending to a vertical line drawn posteriorly to the orbit. Origin of dorsal fin situated opposite the base of the pectorals. Caudal fin small. Color uniform greyish yellow ; a black fillet extending from the occiput to the upper rim of the orbit, and from beneath the orbit obliquely to the angle of the mouth.

Not noticed by fishermen.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
495	1	Adult.	San Francisco, Cal.	1856	Dr. Ayres	22	Alcoholic.

29. APODICHTHYS VIRESCENS, Ayres.

General Report upon Fishes.

Exterior row of maxillary teeth larger than the internal row. Mouth moderate ; posterior extremity of maxillary bone extending to a vertical line drawn within the posterior rim of the orbit. Origin of dorsal fin situated in advance of the base of the pectorals. Caudal fin moderate. Color greenish olive, or bright pea green, maculated with black ; a black fillet from the occiput to the upper edge of the eye, and from beneath the eye, obliquely, backwards and downwards, to the angle of the mouth.

Like the preceding species, it has remained unnoticed by fishermen.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
496	2	Adult.	San Francisco, Cal.	1856	Dr. Ayres	22	Alcoholic.

30. XIPHIDION MUCOSUS, Grd.

General Report upon Fishes.

Three lateral and one abdominal mucous ducts. Head subconical; mouth large; posterior extremity of maxillary bone extending to a vertical line drawn across the posterior rim of the orbit. Ground color olivaceous, clouded or maculated with blackish brown. Two postocular dark vittæ crossin the cheek.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
493	17	Adult & young.	S. Farallones, Cal.	1856	Lieut. Trowbridge		Alcoholic.

31. CEBIDICHTHYS VIOLACEUS, Grd.

Plate XXV*b*, figs. 4 and 5.—*General Report upon Fishes.*

Upper surface of head narrow, declivous laterally; a fleshy crest along the cranial ridge. Mouth large; posterior extremity of maxillary bone extending to a line drawn across the posterior rim of the orbit. Origin of anal fin situated opposite the anterior margin of the soft dorsal. Ground color uniform brownish violet; an occipito-ocular vitta of deep purplish violet; two other vittæ of the same hue extend—one from the postero-inferior rim of the orbit, the other from the anterior rim—obliquely backwards, across the cheek and opercular apparatus.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Col cted by—	Original number.	Nature of specimens.
497	1	Adult	San Francisco, Cal.	1856	Dr. Ayres	28	Alcoholic.

32. LUMPENUS ANGUILLARIS, Grd.

Plate XXV*b*, figs. 1–3.—*General Report upon Fishes.*

Head slender, continuous with the outline of the body; gape of mouth slightly oblique; posterior extremity of maxillary bone extending to a vertical line drawn midway between the anterior rim of the orbit and the pupil. Origin of dorsal fin situated opposite the base of the pectorals. Pectorals and caudal spear-shaped. Greenish olive, upper regions maculated; caudal fin transversally barred.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
507	1	Adult.	San Francisco, Cal	1855	Dr. Newberry		Alcoholic.
508	1	do	do	1855	Dr. Ayres	23	do

33. ANARRHICHTHYS FELIS, Grd.

PLATE XXV*a*, figs. 1–3.—*General Report upon Fishes.*

Profile of head uniformly convex. Eye large and circular. Mouth deeply cleft; posterior extremity of maxillary bone extending to a vertical line drawn across the posterior rim of the orbit. Origin of dorsal fin situated anteriorly to the base of the pectorals. Caudal fin lanceolated; head and body mottled with light ashy grey and dark olive green, disposed in irregular circles, lines, and blotches, which extend also to the dorsal fins.

Might, very properly, be called "Californian Wolf Fish."

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
511	3	Young.	San Francisco, Cal.	1856	Dr. Ayres	12	Alcoholic.

X. FAMILY GOBIDAE.

34. GOBIUS LEPIDUS, Grd.

PLATE XXV*a*, figs. 5 and 6.—*General Report upon Fishes.*

Body elongated, slender, and very compressed. Head sub-conical; jaws equal; gape of mouth oblique; posterior extremity of maxillary extending to a vertical line drawn back of the pupil. Interocular space narrow. Reddish brown; fins blackish.

This is one of the "Goby" tribe, heretofore unnoticed.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
362	1	Adult.	San Francisco, Cal.	1855	Dr. Newberry	--------	Alcoholic.

XI. FAMILY CYCLOPTERIDÆ.

35. CYCLOGASTER PULCHELLUS, Grd.

General Report upon Fishes.

Snout bluntly rounded; posterior extremity of maxillary extending to a vertical line drawn in advance of the pupil. Inferior edge of pectoral fins falciform. Origin of dorsal fin placed somewhat posteriorly to the upper edge of the base of the pectorals. Anterior margin of the anal situated nearer the extremity of the snout than the tip of the caudal. Light olive brown above, with longitudinal waving lines of darker brown; abdomen and throat whitish; sides exhibiting white dots.

Improperly called "Sucking Fish."

List of specimens.

Catalogue number.	No of specimens	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens
519	1	Adult.	San Francisco, Cal.	1855	Dr. Ayres	39	Alcoholic.

XII.—FAMILY OPHIDIDÆ.

36. AMMODYTES PERSONNATUS, Grd.

General Report upon Fishes.

Head constituting about the fifth of the total length; posterior extremity of maxillary extending to the anterior rim of the orbit. Eyes rather large. Origin of dorsal fin situated in advance of the extremities of the pectoral fins; the caudal fin is posteriorly subcrescentic. Color, greyish brown above, silvery beneath; base of caudal black.

A kind of "Sand Launce."

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
612	2	Adult.	Cape Flattery, W. T.	1855	Lieut. Trowbridge	--------	Alcoholic.

XIII. FAMILY GADIDÆ.

37. MORRHUA PROXIMA, Grd.

PLATE XL*a*, figs. 5–8.—*General Report upon Fishes.*

Snout subconical, thickish; upper jaw protruding beyond the lower one. Posterior extremity of the maxillary extending to a vertical line, which would intersect the pupil. Dorsal and anal fins all distinct from one another. Anterior anal longer than the second dorsal. Caudal fin posteriorly subtruncated. Color, yellowish-ash or brown above; sides and belly silvery-white.

A true "cod fish," the only one as yet observed in California and Oregon.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
526	5	Adult.	Presidio, Cal.	1853	Lieut. Trowbridge	--------	Alcoholic.
527	5	do	do	1855	Dr. Newberry	--------	do

38. HOMALOPOMUS TROWBRIDGII, Grd.

PLATE XL*a*, figs. 1–4.—*General Report upon Fishes.*

Snout pointed; mouth deeply cleft; posterior extremity of maxillary extending to a vertical line drawn through the posterior rim of the pupil. Eye large. Second and third dorsals continuous; anal fins continuous also. Extremity of pectorals reaching the anterior margin of the anal fin. Color, greyish-brown bove; silvery-grey beneath.

"California whiting."

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
285	1	Adult.	Astoria, O. T. ------------	1856	Lieut. Trowbridge---	--------	Alcoholic.

XIV. FAMILY PLEURONECTIDÆ.

39. PLATICHTHYS RUGOSUS, Grd.

General Report upon Fishes.

Eyes moderate, situated on the left side; interocular space moderate. Peduncle of tail long. Origin of dorsal fin corresponding to a vertical line intersecting the middle of the pupil. Scales very rugose and plate like; lateral line slightly arched above the pectoral fins. Left side dark reddish brown; fins olivaceous, dorsal and anal, with alternate vertical bands of black; caudal with longitudinal bands of the same hue; ventrals and pectorals unicolor; right side dull yellow.

This and the following four species belong to the "Flounder" tribe.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
606	5	Adult.	Presidio, Cal. -----------	1853	Lieut. Trowbridge ---	--------	Alcoholic.

40. PLATICHTHYS UMBROSUS, Grd.

General Report upon Fishes.

Eyes rather large, and situated upon the right side; interocular space narrow. Peduncle of tail short. Origin of dorsal fin corresponding to a line intersecting the anterior rim of the pupil. Scales normal, though some of them are quite rugose; lateral line conspicuously arched above the pectoral fins. Right side uniform blackish brown; left side light brown; dorsal, anal and caudal fin obsoletely maculated.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
607	1	Adult.	Cape Flattery, W. T.	1856	Lieut. Trowbridge	--------	Alcoholic.

41. PAROPHRYS VETULUS, Grd.

General Report upon Fishes.

Body quite elongated and sub-elliptical; peduncle of the tail slender. Posterior extremity of the maxillary extending to a vertical line drawn inwardly to the anterior rim of the orbit. Origin of anal fin placed posteriorly to the base of the pectorals; dorsal and anal fins nearly even posteriorly. Scales minute; lateral line very conspicuous. Color of body and head reddish ash; fins olivaceous, maculated.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
608	1	Adult.	Port Orford	1856	Lieut. Trowbridge	--------	Alcoholic.
609	1	---do---	Astoria, Oregon	1856	--------do--------	--------	------do------

42. PSETTICHTHYS MELANOSTICTUS, Grd.

General Report upon Fishes.

Body elongated and rather slender. Eyes moderate, situated on the right side; interocular space moderate. Lower jaw somewhat longer than the upper; posterior extremity of the maxillary extending to a vertical line drawn in front of the pupil. Anterior rays of dorsal fin higher than those immediately succeeding; dorsal and anal fins even posteriorly. Origin of anal fin situated somewhat posteriorly to the base of the pectorals, and provided with a small spine. Scales quite small, cycloid in structure; lateral line very slightly raised above the pectorals. Ground color cinereous, interspersed with crowded black dots.

List of specimens.

Catalogue number.	No. of specimens	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
610	1	Young.	Astoria, Oregon	1856	Lieut. Trowbridge	--------	Alcoholic.

43. PSETTICHTYS SORDIDUS, Grd.

PLATE XL*b*.—*General Report upon Fishes.*

Body elongated and subelliptical. Eyes large, situated on the left side; interocular space very narrow. Jaws nearly even when the mouth is closed; posterior extremity of the maxillary extending to a vertical line intersecting the pupil. Anterior rays of dorsal fin gradually increasing in height; dorsal and anal fins nearly even posteriorly; origin of anal situated on a line passing immediately behind the base of the pectorals, and preceded by a very small spine. Scales moderate in size; lateral line almost straight from head to tail. Ground color of a soiled yellow, the scales being margined with black.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
611	4	Adult.	Coast of California-------	1853	Lieut. Trowbridge----	--------	Alcoholic.

XV. FAMILY EMBIOTOCOIDÆ.

44. EMBIOTOCA LINEATA, Grd.

PLATE XXXI and PLATE XXVI, figs. 5 and 6.—*General Report upon Fishes.*

Body subelliptically elongated; anal fin elongated, with its external margin nearly straight, diminishing gradually in depth posteriorly, its origin being situated opposite the sixth articulated ray of the dorsal; tip of pectorals reaching a vertical line intersecting the base of the last but one dorsal spine. Eye of medium size; posterior extremity of maxillary even with the vertical of anterior rim of orbit; frontal region slightly depressed above the eyes; branchiostegals five in number. Sixty two scales in the lateral line. Ground color of upper region dark olive or reddish brown; reddish yellow beneath; sides of abdomen with light longitudinal stripes intersecting the point of union of the rows of scales; anal deep purple, with a yellowish vitta along its base.

This and the following four species belong to the tribe of "viviparous fishes."

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
536	1	Young.	San Francisco, Cal. ------	---1855---	Dr. Newberry-------	--------	Alcoholic.

45. EMBIOTOCA ARGYROSOMA, Grd.

General Report upon Fishes.

General aspect elongated; head rather small, subconical, anteriorly rounded; eye circular and well developed; posterior extremity of maxillary reaching a vertical line drawn in advance of the anterior rim of the orbit. Tip of pectoral fin not extending as far as the anterior articulated rays of the dorsal. About sixty scales in the lateral line. Six branchiostegals. A brilliant r gentine tint over the entire body, though made a little darker along the dorsal region by a greyish or purplish hue; fins olivaceous, unicolor.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
547	2	Adult.	San Francisco, Cal. ------	1856	Lieut. Trowbridge---	--------	Alcoholic.

46. HYSTEROCARPUS TRASKII, Gibbons.

General Report upon Fishes.

Body subelliptical in its profile; nape convex; frontal line depressed; eye circular, of medium size; posterior extremity of maxillary extending to a vertical line drawn in advance of the anterior rim of the orbit. In the male the upper regions are dark or purplish brown, unicolor; yellowish olive, spotted with black, on the lower portion of the flanks; throat and belly golden yellow. In the female the back is ash colored, with irregular black patches, approximating somewhat to interrupted bands across the sides; belly lemon yellow.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
561	1	Adult.	Fort Reading, Cal.-------	----------	Dr. Newberry-------	--------	Alcoholic.
562	2	Young.	--------do--------------	----------	Dr. Hammond ------	--------	------do------

47. HOLCONOTUS RHODOTERUS, Agass.

PLATE XXXV.—*General Report upon Fishes.*

General aspect elongated, neither elliptical nor fusiform. Frontal region subconcave. Head subconical; mouth small; posterior extremity of maxillary not quite reaching the anterior rim of the orbit. Eye rather large and circular. Branchiostegals five. About forty-four scales in the lateral line. Bluish grey or olive above; silvery or yellow upon the sides, with rose colored spots disposed in longitudinal series.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
569	1	Adult.	Astoria, Oregon ---------	1856	Lieut. Trowbridge---	--------	Alcoholic.

48. ENNICHTHYS MEGALOPS, Grd.

PLATE XXXVII.—*General Report upon Fishes.*

General appearance gibbous. Dorsal sheath very short. Mouth large and oblique. Eyes very large, circular. Four rows of scales upon the preopercle. Branchiostegals six. Eighty-five scales in lateral line. Ash or greyish brown above. Sides and belly dull yellow or white. A diffused spot upon the anterior third of the anal. Other fins yellowish. Tip of pectorals blackish or deep purple.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
553	1	Adult.	Astoria, Oregon ----------	1856	Lieut. Trowbridge....	--------	Alcoholic.

XVI. FAMILY CYPRINIDAE.

49. MYLOCHEILUS CAURINUS, Grd.

PLATE XLVI, figs. 1–4.—*General Report upon Fishes.*

Snout rounded and subconical, though rather blunt. Posterior extremity of maxillary extending to a vertical line drawn across the posterior rim of the nostril. Anterior basal edge of ventrals situated opposite the third developed ray of the dorsal. Brownish black above; yellowish gold beneath; two lateral darker bands, the inferior one extending no further back than the vent.

"Columbia river Dace."

List of specimens.

Catalogue number.	Correspond'g numbers.	No. of specimens.	Sex and age	Locality.	When collected.	Collected by—	Nature of specimens.
213	2770, 2771	12	Adult.	Astoria, Oregon----------	1855	Lieut. Trowbridge	Alcoholic.

50. MYLOPHARODON ROBUSTUS, Ayres.

PLATE XLVII.—*General Report upon Fishes.*

Upper surface of head very declivous; snout tapering, almost wedge shaped. Posterior extremity of maxillary extending to a vertical line drawn across the anterior rim of the orbit. Eye of medium size. Pectoral and ventral fins broad and stout. Anal fin nearly as large as the dorsal. Ground color olivaceous, darker above than below.

Sold in the markets of San Francisco under the name of "Salmon Trout."

List of specimens.

Catalogue number.	Correspond'g number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Nature of specimens.
244	2796	1	Adult.	San Francisco, Cal. ------	1855	Dr. Newberry---	Alcoholic.

51. CATOSTOMUS OCCIDENTALIS, Ayres.

General Report upon Fishes.

Eye and mouth of medium size; labial papillæ small and rather inconspicuous. Isthmus very broad. Dorsal fin longer than high. Anterior margin of ventrals corresponding to the middle of the dorsal fin. Posterior extremity of anal reaching the rudimentary rays upon the inferior lobe of the caudal; latter moderately forked. Upper regions of a greyish lead tint; beneath, of a soiled yellow or white.

A true "Sucker."

List of specimens.

Catalogue number.	Correspond'g number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Nature of specimens.
241	2794	2	Adult.	San Francisco, Cal.	1855	Dr. Newberry...	Alcoholic.

52. CATOSTOMUS LABIATUS, Ayres.

General Report upon Fishes.

Eye small; mouth of medium size; labial papillæ conspicuously developed. Dorsal fin higher than long. Pectoral fins quite elongated and well developed. Insertion of ventrals situated opposite the posterior third of the base of the dorsal. The scales are large. Upper regions black; lower half of sides black, clouded upon a yellow ground, whilst the belly and inferior surface of the head are yellow—almost unicolor.

Another true "Sucker," and so called by fishermen.

List of specimens.

Catalogue number.	Correspond'g number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Nature of specimens.
239	2792	1	Adult.	Klamath lake, Oregon...	1855	Dr. Newberry...	Alcoholic.

53. ORTHODON MICROLEPIDOTUS, Grd.

Plate LIII, figs. 1–4.—*General Report upon Fishes.*

Head moderate, its upper surface flattened and declivous towards the snout, which is obtusely wedge shaped. Mouth moderate, broad; posterior extremity of maxillary extending to a vertical line intersecting the nostril. Isthmus very narrow. The anterior margin of the dorsal is placed somewhat in advance of the insertion of the ventrals. Peduncle of tail slender. Ventrals broad. Greyish brown above, whitish or yellowish beneath.

Has no vernacular name, so far as we have heard.

List of specimens.

Catalogue number.	Correspond'g number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Nature of specimens.
206	2764	1	Adult.	San Francisco, Cal.	1855	Dr. Newberry...	Alcoholic.

54. ALGANSEA BICOLOR, Grd.

General Report upon Fishes.

Head, mouth, and eye of moderate size; posterior extremity of maxillary extending to a vertical line drawn across the nostril. The isthmus is narrow. The anterior edge of the insertion of the ventral fins is somewhat in advance of the anterior margin of the dorsal. Scales large. Back and sides of a metallic bluish black tint, intermingled upon the lower half of the flanks with a golden hue; the inferior region is pure white or yellow.

List of specimens.

Catalogue number.	Correspond'g number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Nature of specimens.
192	2750	1	Adult.	Klamath Lake, Oregon ---	1855	Dr. Newberry---	Alcoholic.

55. LAVINIA EXILICAUDA, B. & G.

PLATE LIV, figs. 1–4.—*General Report upon Fishes.*

Body very much compressed, deep upon its middle; peduncle of tail rather slender; head small; eye moderate; posterior extremity of maxillary not reaching the anterior rim of the orbit. Isthmus small. Insertion of ventral fins situated in advance of the anterior margin of the dorsal; pectorals rather small; caudal deeply furcated. Reddish brown above, silvery grey on the sides, the scales being minutely dotted upon their margin; beneath yellowish.

The "Herring" of the California fishermen.

List of specimens.

Catalogue number.	Correspond'g number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Nature of specimens.
209	2766	2	Adult.	San Joaquin river--------	1855	Dr. Newberry---	Alcoholic.

56. TIGOMA BICOLOR, Grd.

General Report upon Fishes.

Body anteriorly compact, diminishing posteriorly; head well developed; mouth large; posterior extremity of maxillary extending to a vertical line drawn between the anterior rim of the eye and the nostril; eye moderate. Origin of ventral fins placed slightly in advance of the anterior margin of the dorsal. Scales large. Dorsal region bluish grey; sides and belly silvery white, sometimes golden.

List of specimens.

Catalogue number.	Correspond'g number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Nature of specimens.
234	2788	2	Adult.	Klamath Lake, Oregon---	1855	Dr. Newberry---	Alcoholic.

57. TIGOMA CRASSA, Grd.

PLATE LXII.—*General Report upon Fishes.*

Body plump and contracted. Head rather small; snout short and rounded; eye small; mouth moderate; posterior extremity of maxillary extending to a vertical line drawn across the posterior rim of the nostril. Pectorals and ventrals small. Scales large. Upper region bluish or purplish black; sides greyish black; beneath yellow.

Known as "chub" amongst the fishermen.

List of specimens.

Catalogue number.	Correspond'g number.	Number of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Nature of specimens.
216	2777	1	Adult.	Sacramento river, Cal. ----	1855	Dr. Newberry---	Alcoholic.

58. CHEONDA CÆRULEA, Grd.

General Report upon Fishes.

Body subfusiform in profile. Head of moderate development; snout slender and conical. Mouth rather deeply cleft; posterior extremity of the maxillary extending to a vertical line drawn across the anterior rim of the orbit. Eye rather large. Isthmus narrow. Fins small. Scales moderate. Upper regions of a greyish azure; inferior regions of a dull silvery white; black dots being scattered all over the back, sides, and belly.

List of specimens.

Catalogue number.	Correspond'g number.	Number of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Nature of specimens.
237	2790	1	Adult.	Lost River, Oregon ------	1855	Dr. Newberry. --	Alcoholic.

59. PTYCHOCHEILUS OREGONENSIS, Grd.

General Report upon Fishes.

Body subfusiform in profile. Head rather small, elongated, slender upon the snout. Mouth deeply cleft; posterior extremity of the maxillary extending to a vertical line intersecting the anterior rim of the orbit. Eye of moderate development. Pectoral and ventral fins rather small. Back and upper surface of head dark reddish brown; flanks and belly white, with a silvery tint.

List of specimens.

Catalogue number.	Correspond'g number.	Number of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Nature of specimens.
198	2763	3	Adult.	Willamette river, Oregon.	1855	Dr. Newberry---	Alcoholic.

60. PTYCHOCHEILUS GRANDIS, Grd.

General Report upon Fishes.

Body very much elongated, subfusiform. Head well developed and elongated also. Mouth deeply cleft; posterior extremity of the maxillary extending to a vertical line intersecting the pupil. Eye small. Isthmus very narrow. Fins well developed. Scales moderate. Upper regions olivaceous; flanks and belly silvery or golden.

Sold under the name of "Salmon Trout" at San Francisco.

List of specimens.

Catalogue number.	Number of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
204	1	Adult.	San Francisco, California	1855	Dr. Newberry	--------	Alcoholic.

XVII. FAMILY SALMONIDÆ.

61. SALMO SCOULERI, Rich.

General Report upon Fishes.

A head is all we have seen of this species, hence it was not deemed expedient to formulate its characters upon such scanty materials. It is called "Ekewan" by the natives of the Columbia river.

List of specimens.

Catalogue number.	Number of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
613	1	Adult.	Des Chutes river	1855	Mr. Anderson	--------	Dried.

62. FARIO AURORA, Grd.

PLATE LXVIII.—*General Report upon Fishes.*

Body fusiform, compressed. Head forming the fourth of the length, caudal fin excluded. Upper jaw longest. Branch of maxillary gently undulating; its posterior extremity extending to a vertical line passing considerably behind the entire orbit. Anterior margin of dorsal fin equidistant between the tip of the snout and the base of the caudal. Ground color greyish silvery above; sides and belly yellowish orange; dorsal fin spotted.

List of specimens.

Catalogue number.	Number of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
583	2	Adult.	Astoria, Oregon	1855	Lieut. Trowbridge	--------	Alcoholic.

63. FARIO ARGYREUS, Grd.

PLATE LXX.—*General Report upon Fishes.*

Body very much compressed, rather deep upon its middle region, and quite tapering posteriorly. Head moderate, constituting the fifth of the entire length. Jaws equal. Maxillary slightly curved; its free extremity extending to a vertical line drawn posteriorly to the orbit. Anterior margin of dorsal fin nearer the extremity of the snout than the insertion of the caudal fin. Bluish grey above; silvery along the middle of the flanks; yellowish beneath.

List of specimens.

Catalogue number.	Number of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
579	1	Adult.	Cape Flattery, Oregon....	1855	Lieut. Trowbridge...	....	Alcoholic.

64. FARIO GAIRDNERI, Grd.

PLATE LXXI, figs. 1–4.—*General Report upon Fishes.*

Body fusiform in profile, very compressed. Head comprised four times in the length, the caudal fin excluded. Upper jaw longest; maxillary curved, extending to a vertical line intersecting the posterior rim of the orbit. Anterior margin of dorsal fin equidistant between the extremity of the snout and the base of the caudal. Caudal fin forked. Back silvery grey; sides silvery, and belly yellowish white. Body obsoletely spotted with black; similar black spots may be seen on the dorsal and caudal fins.

List of specimens.

Catalogue number.	Number of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
578	1	Adult.	Klamath river	1855	Dr. Newberry.......	....	Alcoholic.

65. FARIO STELLATUS, Grd.

PLATE LXIX, figs. 5–8.—*General Report upon Fishes.*

Body elongated and fusiform. Head well developed, contained four times and three-quarters in the total length. Jaws equal. Maxillary gently curved, reaching a vertical line drawn posteriorly to the orbit. Anterior margin of dorsal fin a little nearer to the extremity of the snout than the insertion of the caudal. Back light olive; belly light yellowish white; head, body, and fins, profusely spotted with black.

The "salmon trout" of the Oregon settlers.

List of specimens.

Catalogue number.	No. of specimens	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
591	2	Adult.	Upper Des Chutes river...	1855	Dr. Newberry.......	....	Alcoholic.

66. SALAR IRIDEA, Grd.

Plate LXXIV.—*General Report upon Fishes.*

Body subfusiform in profile, otherwise compressed. Head well developed, constituting somewhat less than the fourth of the total length. Jaws subequal, posterior extremity of maxillary extending to a vertical line drawn a little beyond the orbit. Anterior margin of dorsal fin equidistant between the extremity of the snout and the insertion of the caudal. Reddish brown above, with numerous and small black spots; yellowish white beneath.

The "brook trout" of California.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
594	1	Adult.	Chico creek, Cal	1855	Dr. Newberry		Alcoholic.
595	2	...do...	San Francisco, Cal	1855	Dr. Ayres	27	......do......

67. ARGENTINA PRETIOSA, Grd.

Plate LXXV, fig. 5.—*General Report upon Fishes.*

Posterior extremity of maxillary extending to a vertical line drawn in advance of the pupil. Eye large and circular, its diameter being contained about four times in the length of the side of the head. Origin of dorsal fin somewhat nearer the extremity of the snout than the tip of the caudal fin, which is forked. The adipose is situated opposite the posterior fourth of the anal. The origin of the ventrals is placed somewhat behind a vertical line drawn at the anterior margin of the dorsal fin. Scales of moderate development. Upper surface of head and back yellowish. Outlines of scales dotted with black. Sides of head and middle of flanks of a shining silvery tint. Lower half of flanks and belly dull yellowish.

One of the genuine "smelt" tribe.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
604	2	Adult.	San Francisco, Cal.	1855	Dr. Newberry		Alcoholic.

68. COREGONUS WILLIAMSONI, Grd.

Plate LXVI.—*General Report upon Fishes.*

Head and mouth small; posterior extremity of the maxillary not extending as far as the anerior rim of the orbit. Scales large, disposed upon eighteen longitudinal series upon the line of greatest depth, nine above and eight below the lateral line, which is perfectly straight. Color silvery white, with a bluish grey tint over the dorsal region.

Williamson's white fish.

List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
601	2	Adult.	Des Chutes river, O. T.---	1855	Dr. Newberry-------	--------	Alcoholic.

69. ACIPENSER ACUTIROSTRIS, Ayres.

Body subfusiform. Head slender and depressed; snout tapering and acute. Eleven dorsal shields from the occiput to the anterior margin of the dorsal fin; twenty-seven shields in the lateral series, and nine between the pectorals and the ventral fins. Greyish black above; yellowish white beneath.

List of specimens.

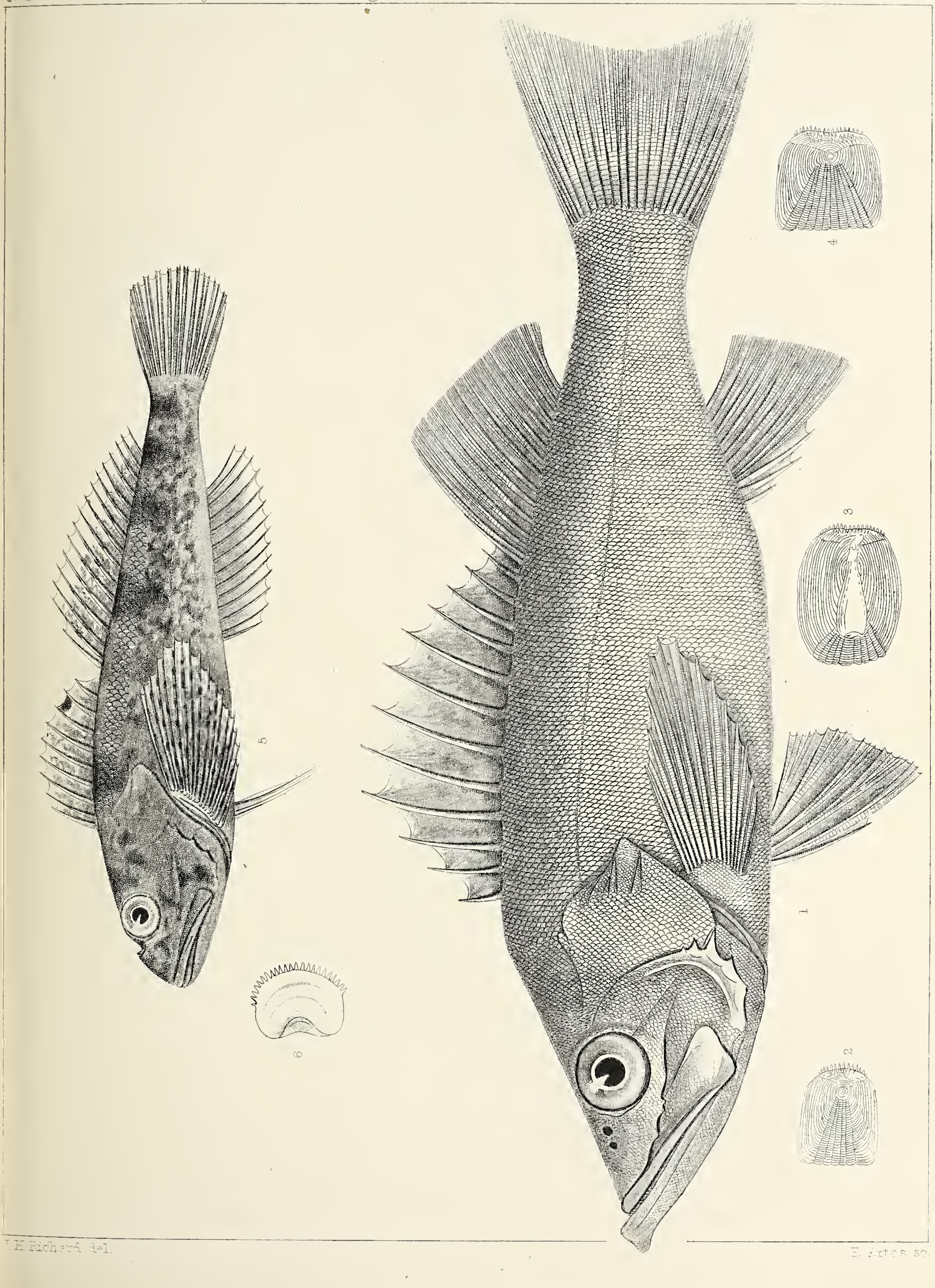
Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original number.	Nature of specimens.
614	1	Adult.	San Francisco, Cal. -----	1855	Dr. Newberry-------	--------	Alcoholic.

70. ACIPENSER MEDIROSTRIS, Ayres.

Body fusiform. Head stoutish; snout rounded anteriorly, and abbreviated. Eleven dorsal shields from the occiput to the anterior margin of the dorsal fin; thirty-seven shields in the lateral series, and nine between the pectorals and ventral fins. Reddish brown above; yellowish beneath.

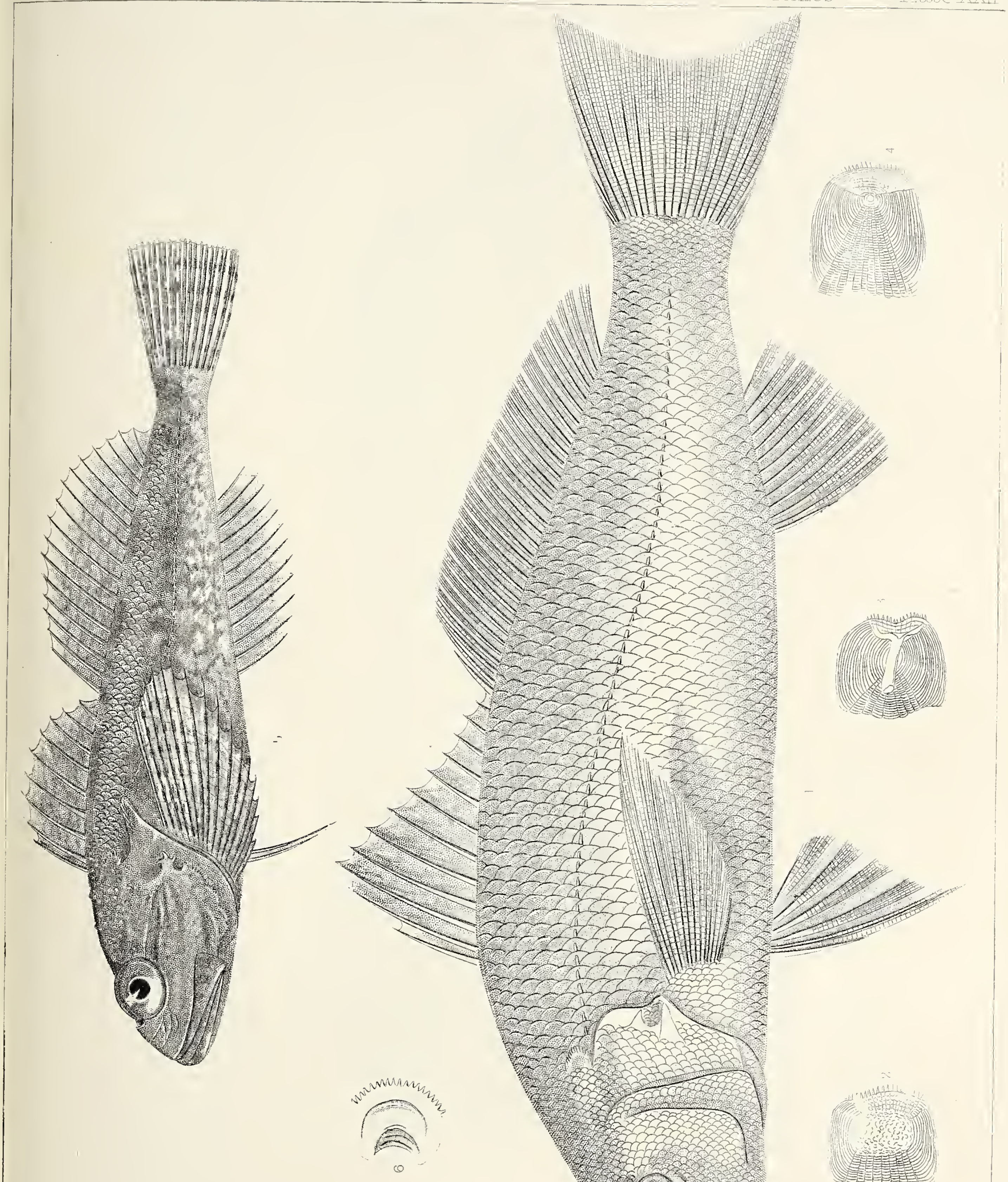
List of specimens.

Catalogue number.	No. of specimens.	Sex and age.	Locality.	When collected.	Collected by—	Original umber.	Nature of specimens.
615	1	Adult.	San Francisco, Cal. -----	1855	Dr. Newberry-------	--------	Alcoholic.



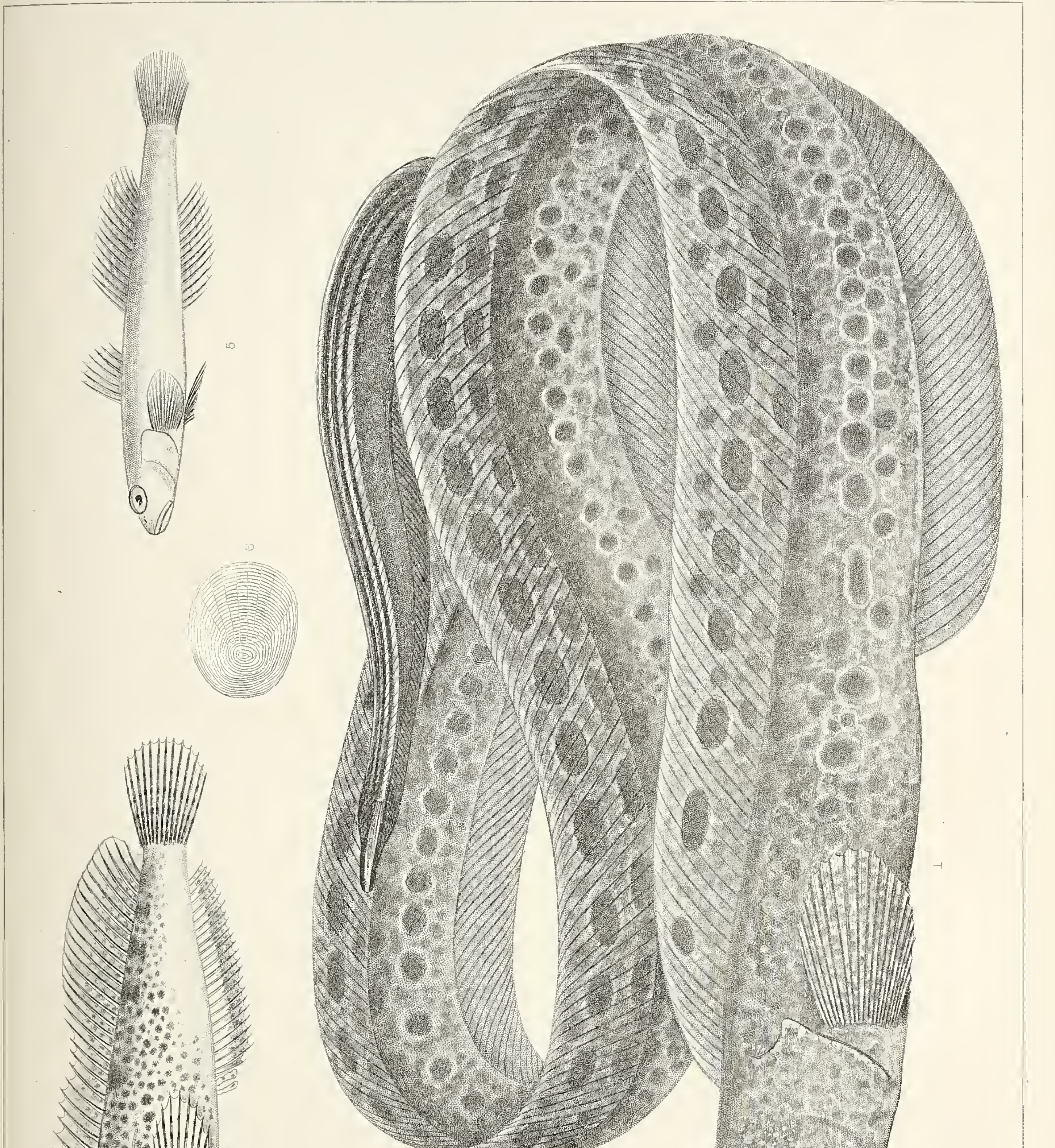
J. H. Richard del.

E. Artes sc.

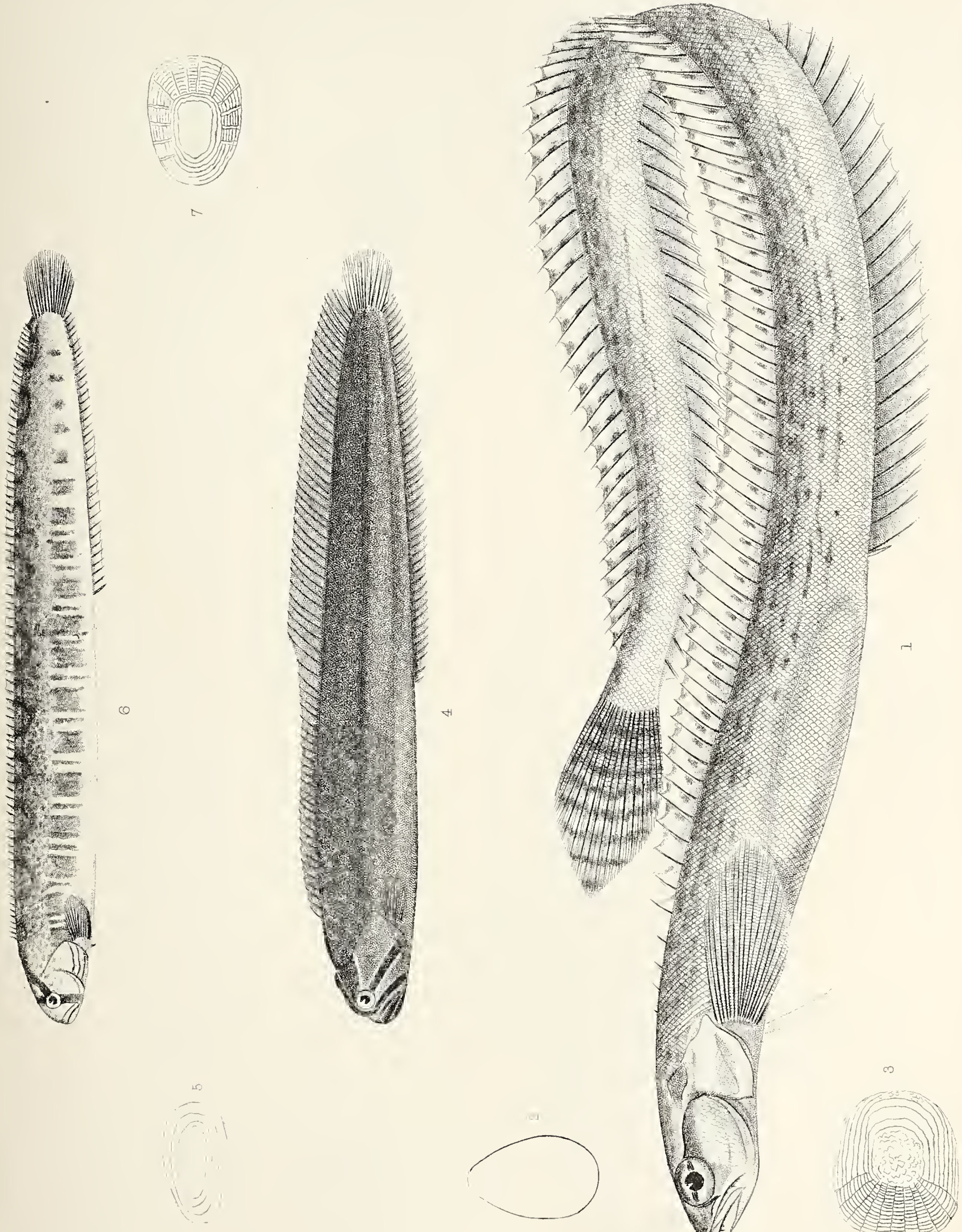


J.H.Richard, del.

F. Artos s.



J. H. Richard del. C. Metzeroth sc.



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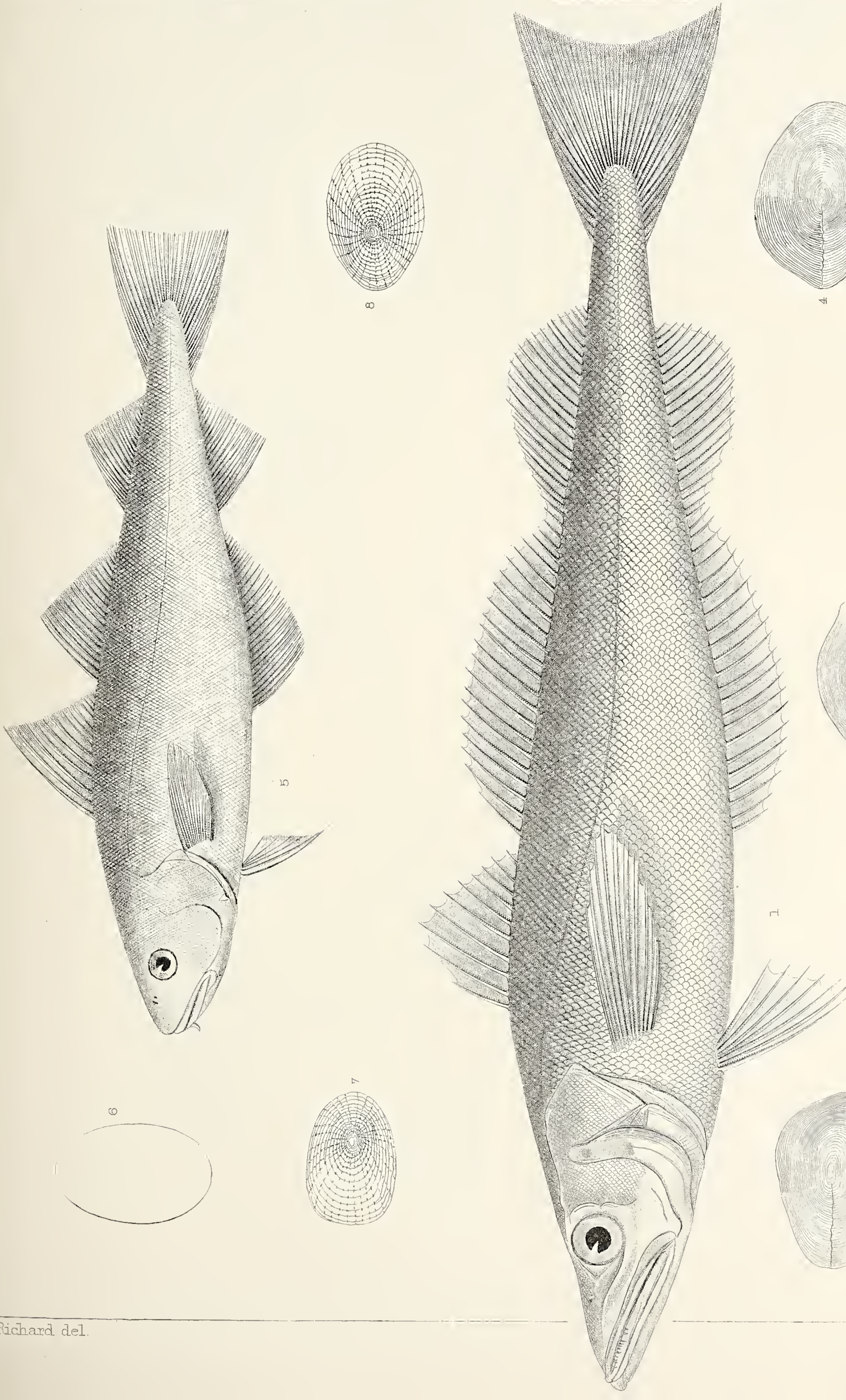

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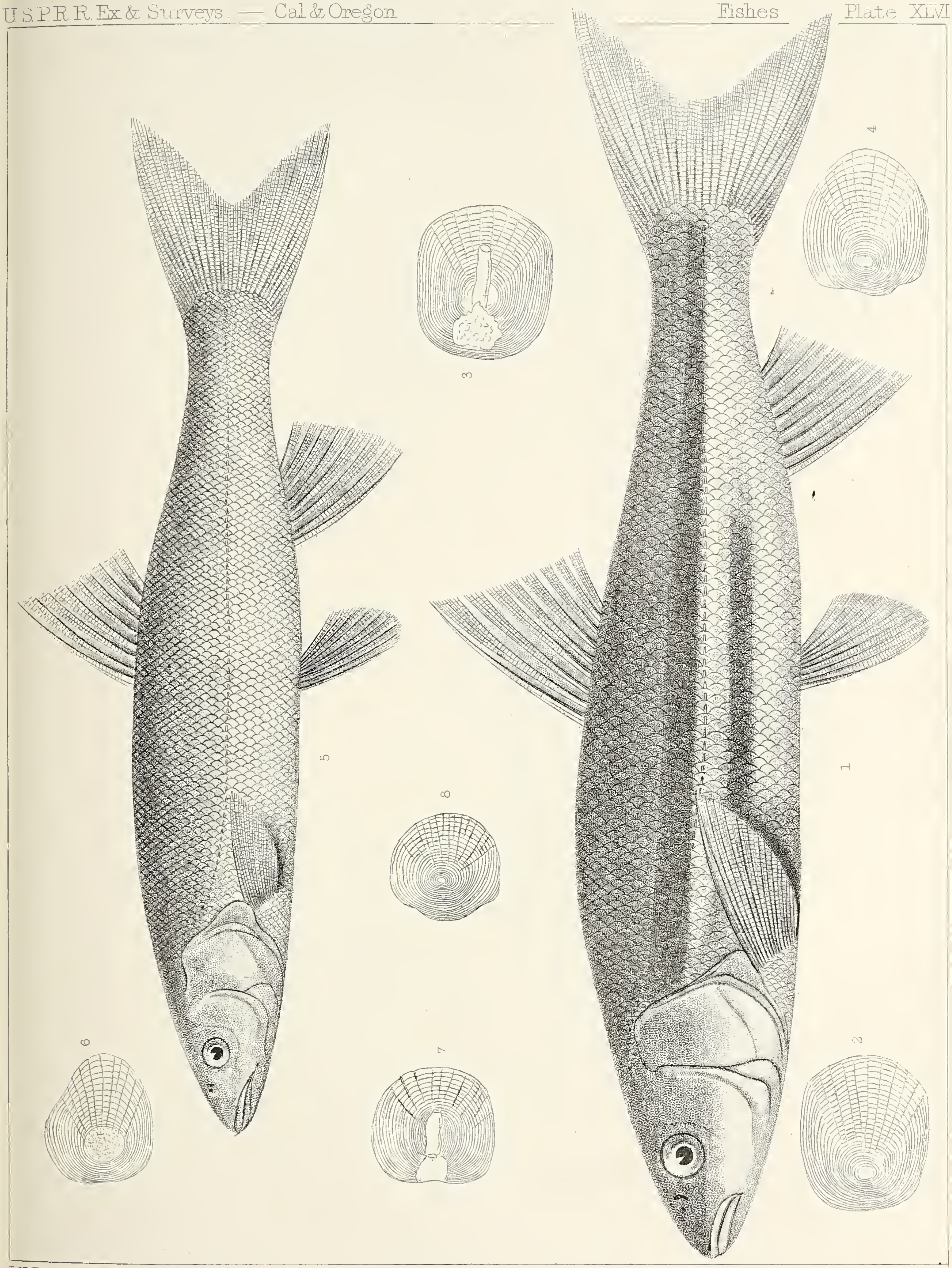

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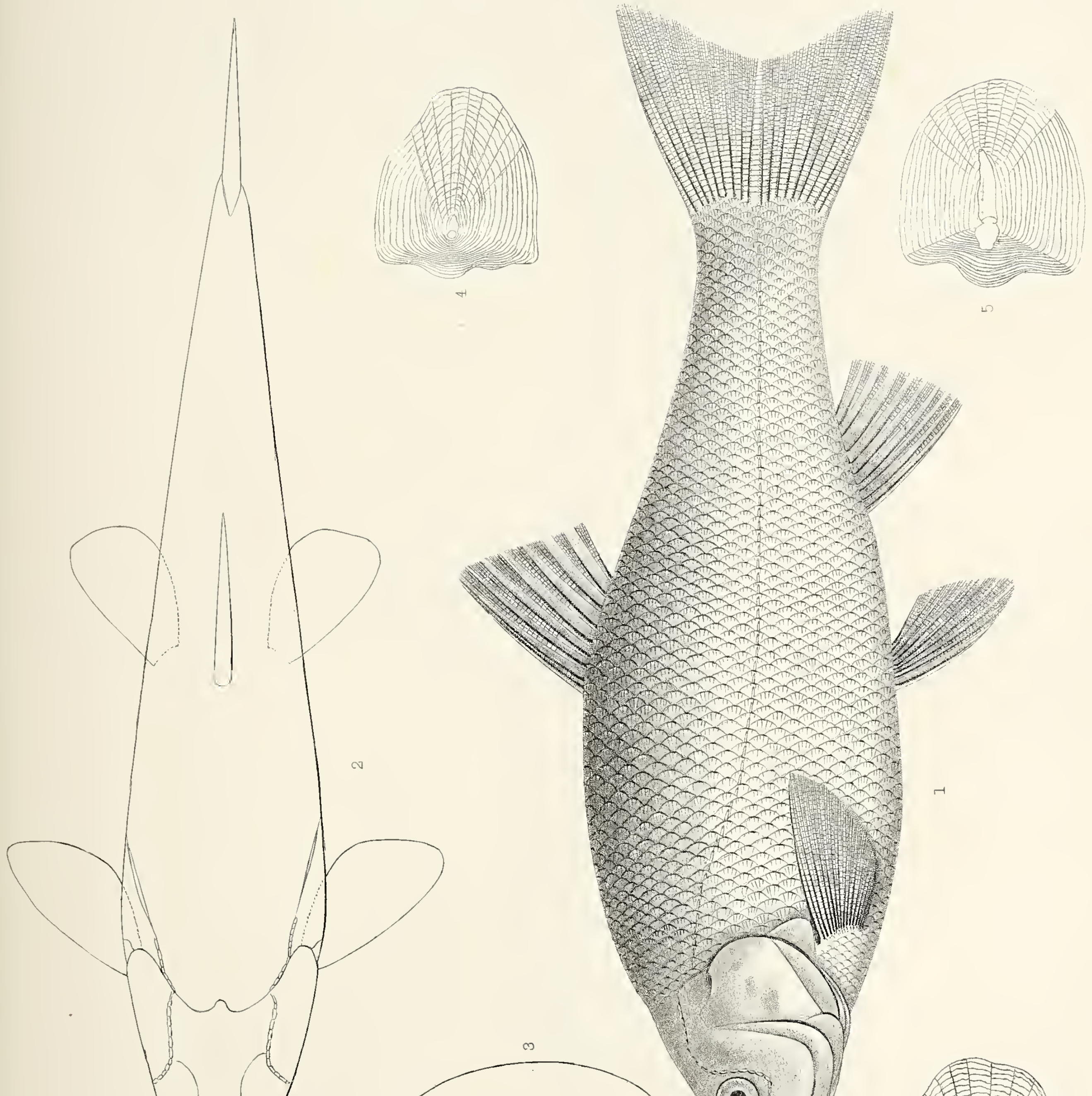

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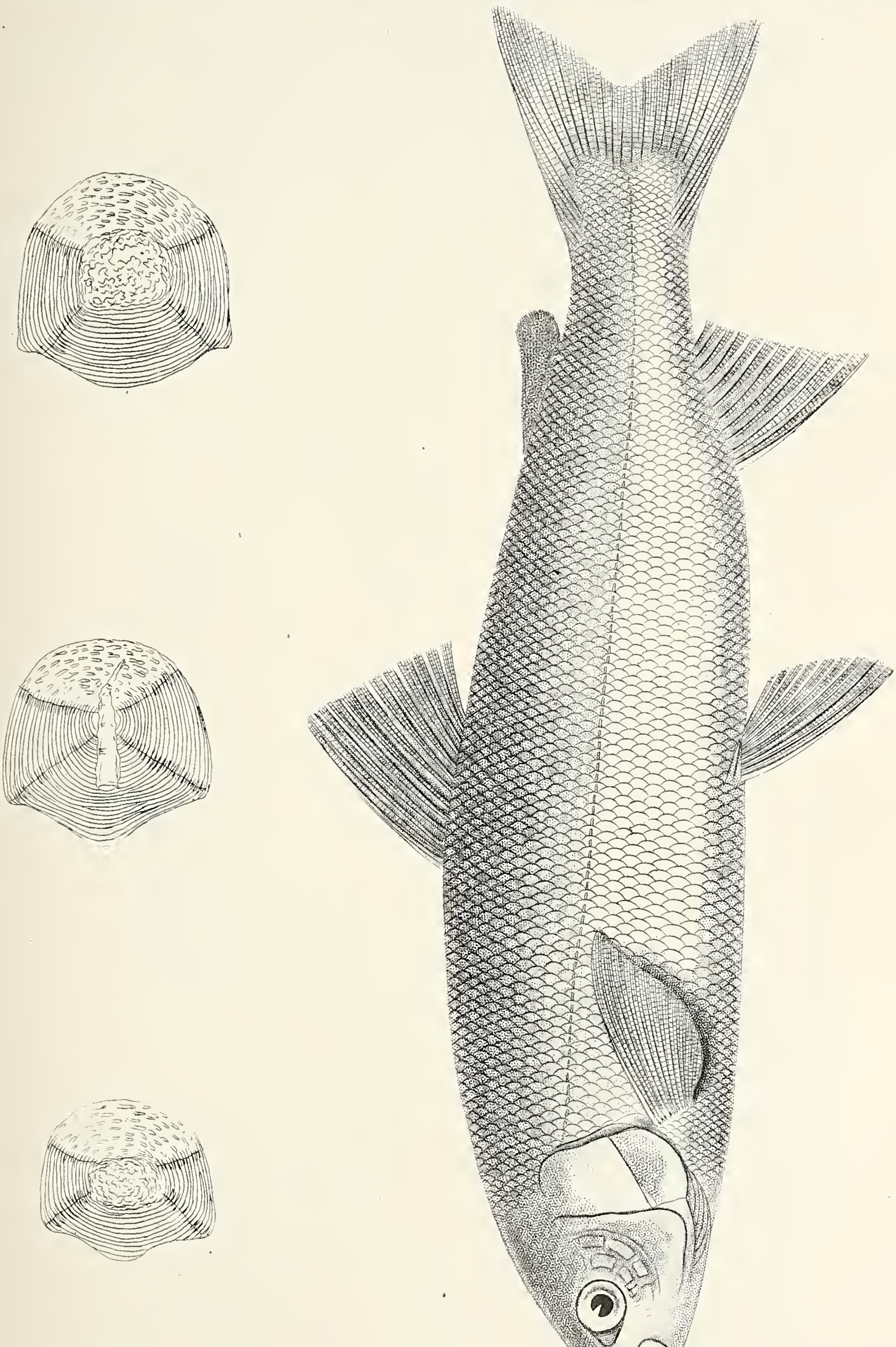

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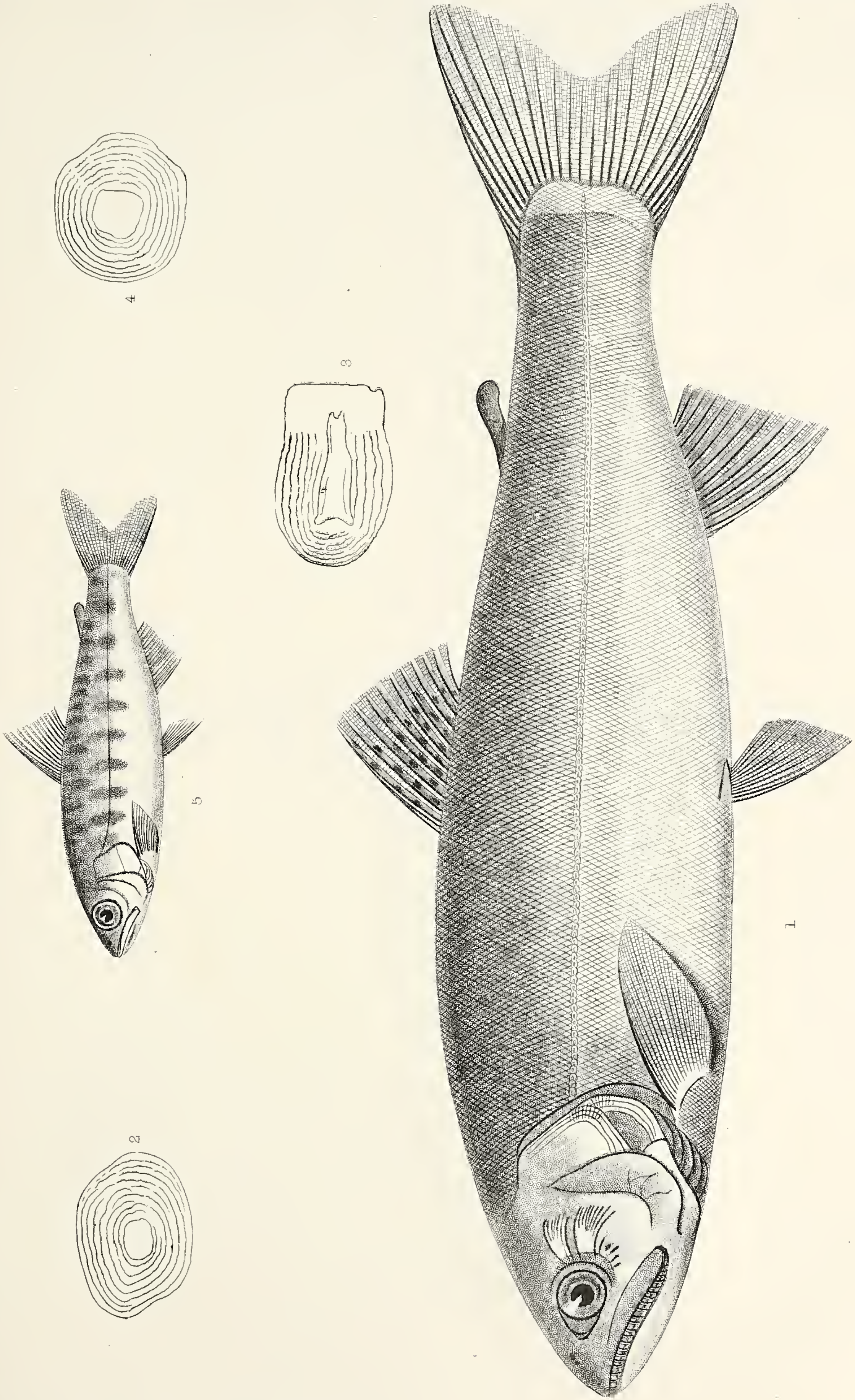
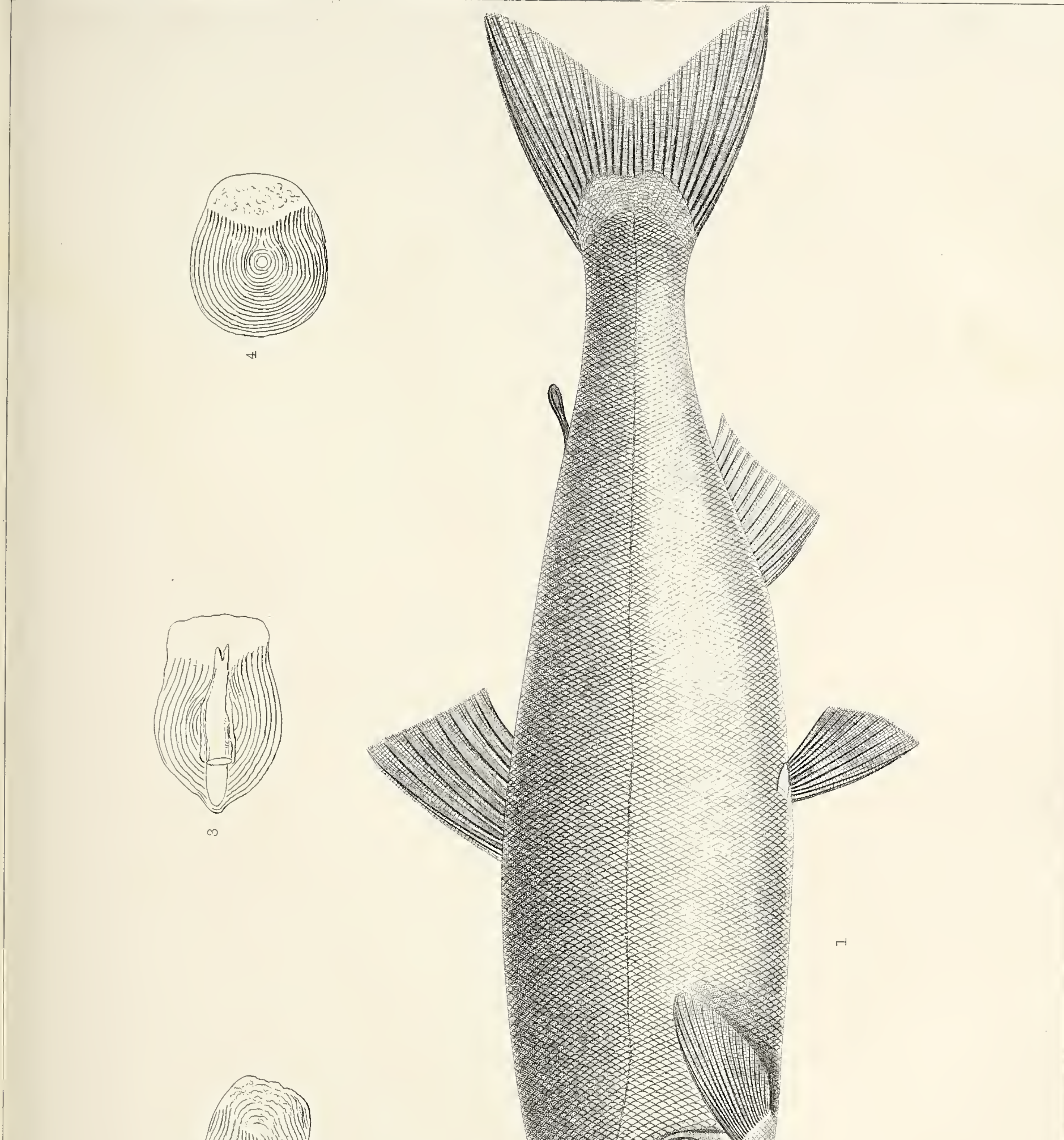


J. H. Richard del.

C. Metzeroth sc.



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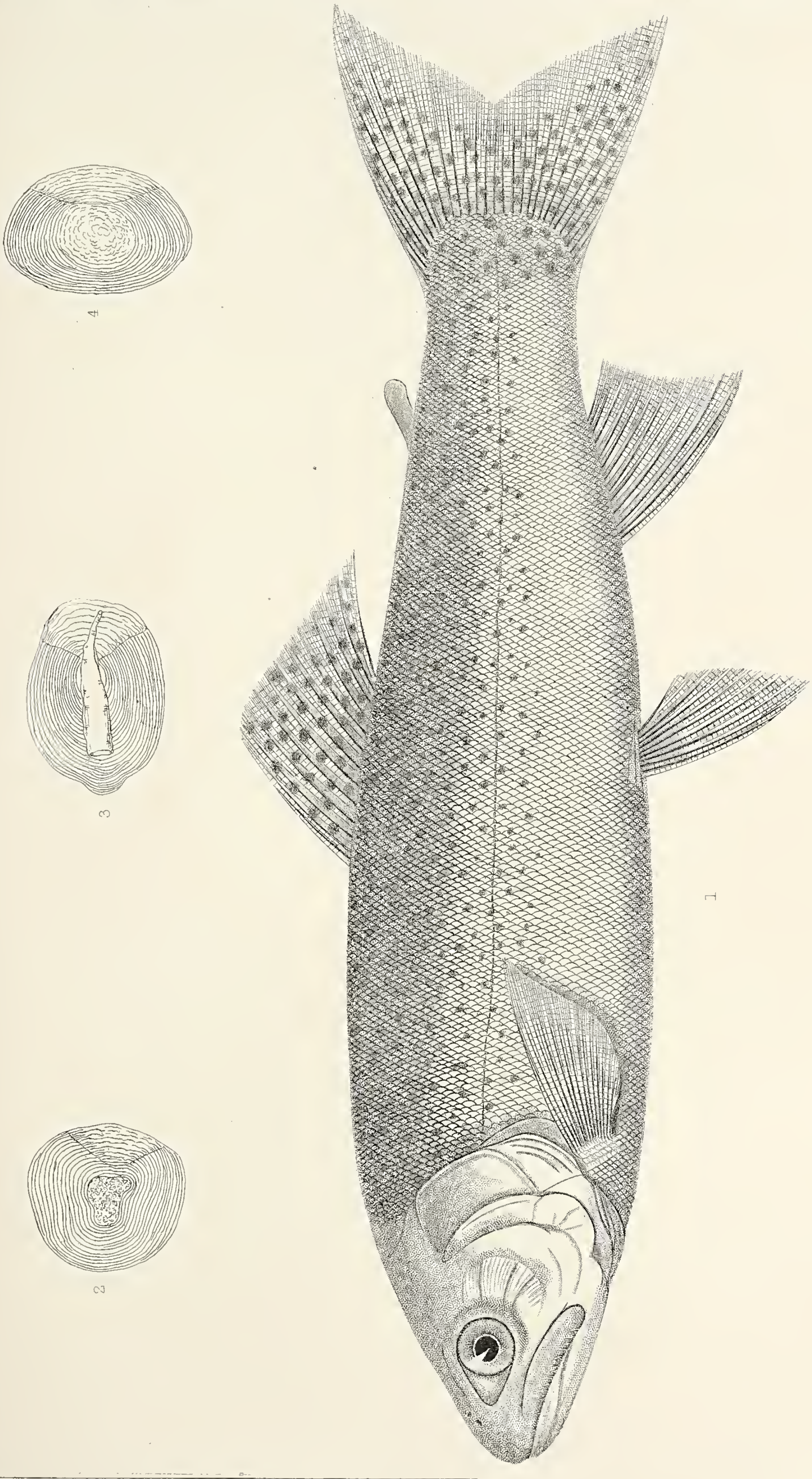


J.H.Richard del.

E. Artos sc.

No. 2.

REPORT UPON THE ZOOLOGY OF THE ROUTE.

BY J. S. NEWBERRY, M. D.*

CHAPTER I.

REPORT UPON THE MAMMALS.

SOREX VAGRANS, Cooper.

Baird, General Report Mammals, 1857, 15.

Sp. Ch.—Ears moderately large, though little more than half as long as the adjacent fur. Fur rather full and long, hairs on the back measuring $2\frac{1}{2}$ lines. Tail longer than the body alone, about five-sixths as long as head and body together, scantily haired at tip. Third lateral tooth above smaller than fourth. Anterior upper incisor with a rounded internal lobe in broad contact with its fellow. Color above, olive brown, varied with hoary; beneath, dusky yellowish white; sides a little paler than the back. Head and body ten inches. Tail $1\frac{5}{8}$. Hind foot about .47 of an inch.

A single specimen, probably belonging to this species, was taken in the Cascade mountains.

SOREX SUCKLEYI, Baird.

Baird, General Report Mammals, 1857, 18.

Sp. Ch.—Ears quite large, about as long as the adjacent fur. Longest hairs measuring barely two lines. Feet rather small. Tail considerably longer than the body, exclusive of head; well coated with hair. Caudal vertebræ 16. Third lateral tooth above smaller than the fourth. Width of skull rather more than half its length. Length of palate three-eighths this length. Color above, light chestnut brown; beneath, grayish white. Length $2\frac{1}{4}$ inches. Tail $1\frac{1}{2}$? Hind foot .46 of an inch.

One specimen of this species was collected on the Upper Des Chutes river, in Oregon.

SCALOPS (SCAPANUS) TOWNSENDII.

Oregon Mole.

Baird, General Report Mammals, 1857, 68.

Sp. Ch.—Teeth 44. Eye small, but not covered by the integument. Tail rather scantily haired. Nostrils opening on the upper surface of the tip of the snout. Palm large and broad. Color nearly black, with faint purplish or sooty brown reflections. (Sometimes, perhaps, glossed with silvery?) Length six to seven inches.

Specimens of this species were collected at San Francisco.

* The species enumerated in this report have been determined, and their diagnoses prepared, by Prof. S. F. Baird, Assistant Secretary of the Smithsonian Institution.

FELIS CONCOLOR, Linn.

The American Panther.

Felis concolor, Linn. Mantissa, 1771, 522; pl. ii.
Baird, Gen. Report Mammals, 1857, 83.

Sp. Ch.—Body considerably larger than that of the common sheep Tail more than half the length of head and body. General color above, a uniform pale brownish-yellow, finely mottled by dark tips to all the hairs. Beneath, dirty white A black patch on the upper lip, separated from the nose by a triangular white space. Convexity of ear black; tip of tail dusky. No spots or blotches on the body in the adult; a few obsolete ones in the half-grown young. Kittens with the body densely spotted and the tail ringed.

The cougar is perhaps as common in California and Oregon as east of the mountains, and is essentially the same animal. The specimens I saw varied considerably in color, but otherwise there seemed to be no difference. A cougar which I saw and attempted to shoot, on Pit river, was of a bright yellowish-red, much like that of the summer coat of the Virginia deer; while a large and beautiful one, kept caged in San Francisco, was of a light mouse-color, scarcely tinged with red.

This animal was entirely untameable, manifesting to his keeper, as well as to strangers, unmitigated ferocity; he was, however, as I believe all cougars are, very cowardly. The one I saw on Pit river ran from us, and took refuge in a cliff of volcanic rock; exhibiting as much timidity as a hare.

We saw their tracks nearly every day of our march, but only on one other occasion the animal. A very large one was seen by a soldier, cautiously following the trail of our guide, who had passed a short time before; he was following by scent like a dog.

LYNX RUFUS.

American Wild Cat.

Felis ruffa, Guldenstaedt, Nov. Comm. Petrop, XX, 1776, 499.
Felis rufa, Schreber, Säugt. III 1778, 412; pl. cix A (*Rothluchs* in text.)
Lynx rufus, Raf. Am. Month. Mag. II, 1817, 46.
Aud. & Bach. N. A. Quad. I, 1849, 2; pl i.
Baird, Gen. Rep. Mammals, 1857, 90.

Sp. Ch.—Fur moderately full and soft. Above and on sides pale rufous, overlaid with greyish; the latter color most prevalent in winter. A few obsolete dark spots on the sides and indistinct longitudinal lines along the middle of the back. Collar on the throat like sides, but much paler. Beneath, white spotted. Inside of fore and hind legs banded. Tail with a small black patch above at the end, with indistinct subterminal half rings. Inner surface of ear black, with a white patch.

The wild cat is a very common animal in California and Oregon, and was killed or seen by our party in a number of different and distant localities. In the immediate vicinity of San Francisco, California, on the shores of San Francisco and San Pablo bays, wild cats abound, frequenting the shore and subsisting on fish or water fowl. While shooting ducks and other water birds about Benicia I several times saw them. At one time, while in a small boat floating quietly along shore, in the straits of Carquines, on rounding a point we came suddenly upon a lynx, which was walking along the beach picking up his breakfast. We were within twenty yards of him, and the first intimation which he received of our presence was a full charge of bird shot in the face and eyes. He seemed very much surprised at the salute, springing suddenly four or five feet into the air, and then with surprising agility scrambling up the almost perpendicular face of the rocky wall bordering the straits, and before I could seize another gun, lying in the bottom of the boat, he had disappeared in the bushes.

At Yreka a fine specimen was killed by a member of our party, and in the Klamath lake basin the Indians had large numbers of their skins, of which the squaws make their robes. We found it quite up to the Columbia, but on that river, and especially thence northward, it is mostly replaced by the larger species, *Lynx fasciatus*.

LYNX FASCIATUS, Raf.

Red Cat.

Lynx fasciatus, Raf. Am. Monthly Mag. II, 1817, 46.
Baird, Gen. Rep. Mammals, 1857, 96.

Sp. Ch.—Fur very soft and full. Ears pencilled. Color, rich chestnut brown on the back, a little paler on the sides and on the throat. A dorsal darker band and collar on throat, as dark as the sides. Region along central line of belly, (rather narrow one,) dull whitish, with dusky spots extending to lower part of sides. No spots or bands discernible on the upper part of sides. Ears black inside, with a very inconspicuous patch of greyish. Terminal third of tail above, black.

In the region traversed by our party, south of the Columbia river, we hardly entered the range of this large lynx. We saw but a single individual, and that one was not killed.

The banded lynx, like the Canada lynx, (*L. canadensis*,) though a large and powerful animal, is cowardly, and has never been known to attack man. It is more boreal than the red lynx, and exists from the vicinity of the Columbia to a considerable distance beyond the British line. His subsistence is made up of all the smaller animals inhabiting the region where he is found, together with birds and fish when he can catch them. He is supposed by the hunters and Indians sometimes to kill the deer unaided, but this wants confirmation.

CANIS OCCIDENTALIS var. GRISEO-ALBUS.

Gray Wolf.

Baird, General Report Mammals, 1857, 104.

Though much less common than the "coyote," the large grey wolf is found in all the uninhabited parts of California and Oregon. Very few were seen by members of our party, none were killed, and we had everywhere evidence that this species is much less numerously represented on the Pacific coast than on the Upper Missouri. In the Cascade mountains we saw tracks of some of these wolves of most portentous size. All the large wolves seen by any of our party were grey, and all the skins which I saw in the possession of Indians or whites were also grey, and it is probable that the white and black varieties are never found in California. On the upper Columbia, in Oregon and Washington Territories, where the wolves are more numerous and the winters are colder, the same variations occur which are common on the upper Missouri.

CANIS LATRANS, Say.

Prairie Wolf: Coyote.

Canis latrans, Baird, Gen. Rep. Mammals, 1857, 113.

The prairie wolf is exceedingly common in all the open country of California and Oregon. In the wooded districts it is less abundant, but on almost every night of our march we were serenaded by its melancholy, wailing cry.

The sage plains bordering the Klamath lakes and in the Des Chutes basin, surfaces for the most part destitute of trees and covered with clumps of artemisia, are inhabited by considerable numbers of rabbits and hares, particularly *L. artemisiæ* and *L. campestris*. These animals form some portion of the subsistence of the coyotes, which are there very numerous. While encamped there we often heard them at night hunting in packs, and yelping in chorus, apparently by their numbers surrounding, and by their cries confusing, their prey.

During the summer the coyotes subsist in a great degree on grasshoppers, and we frequently saw them engaged in catching these insects. This they effect by springing with great quickness and bringing the fore paw down on them. They eat also mice, lizards, and frogs, and resemble so much in their diet, and in their timid, sneaking, thievish nature, the Digger Indian, that the hunters put them on an equality, and consider them in some way related to each, or at least make them equal objects of contempt and detestation. To call the "Digger" a dog, is, in the hunter's estimation, to elevate him; to compare him with a coyote is to degrade; one scarcely knows which.

If one can content himself with so ignoble game, the coyote hunted on horseback affords very good sport.

While our party was crossing from Hamilton, on Feather river, to the Sacramento, Mr. Anderson and myself took a wide sweep to the right of the trail in hope to get a shot at an antelope or deer. We saw no game whatever, except coyotes, if, indeed, they can be called game; and my companion, a keen sportsman who had often hunted the large wolf on the prairies of Texas, proposed that we should have a steeple chase. I assented, and we were soon racing over the prairie, each in chase of a wolf, at a speed that brought them ere long under our horses' feet. We found considerable difference in the speed of different individuals; but, generally, they are readily overhauled by a good horse, and, by a shot from the saddle, may be killed without difficulty.

The color of the coyote, in most localities, is a light brownish yellow, with a very few black hairs along the back; we saw, however, in the Des Chutes basin, some which were larger and darker, as was the skin of one from Yreka, which I brought home.

We several times saw large numbers of burrows, about the size of those of the badger, closely set together, and occupying, perhaps, a quarter or half acre. These had evidently been formed by an animal of considerable size which seemed to have abandoned them entirely. Bartie, our guide, informed me that these were the breeding places of the coyotes, where the females go, at certain seasons, to bring forth their young. How true this may be, I cannot say; but the coyote seemed the only animal inhabiting the country in sufficient numbers to form such colonies.

The cry of the prairie wolf is precisely that of the Indian dog of the west—a sharp bark, followed by a succession of yelps running into each other, and ending in a long-drawn quavering howl, at times indescribably melancholy. While camping on a tributary of Pit river, in a region infested with hostile Indians, I was one evening fishing for trout alone, a mile or more from camp, and, detained by the fascination of unusually good sport, I still lingered till the stars began to appear, when a coyote, coming to the top of a ledge of trap rock on the opposite side of the stream, favored me with a succession of howls so mournful and sinister that I was fain to look upon it as an evil omen, and gathering up my fish and groping my way back to camp was quite disposed to congratulate myself on arriving there without adventure.

VULPES MACROURUS, Baird.

Great Tailed Fox.

BAIRD, General Report Mammals, 1857, 130.

The red fox inhabits all parts of Oregon and California, but I suspect is less abundant in the central and southern portions of California than further north. At least we met with the living animals, as well as the skins prepared by the Indians, in much greater numbers about the Klamath lakes, and in the Des Chutes basin, than in California.

In this region the red fox exhibits all the varieties which have been noticed in the eastern States; the typical red fox, with more or less of black on back, head, and feet; the black, the cross, the silver grey, all are well known to the hunters, who assert that they have found all these varieties in the same litter. The silver grey has long been, with the exception of the sea otter, the most valuable fur obtained by the Hudson Bay Fur Company; good skins formerly commanding from twenty-five to thirty dollars, and fine *pairs* of skins even much more than this. Now, they, in common with all peltries, have suffered a considerable decline in price.

I obtained a fine specimen of the silver fox at our depot camp on the upper Des Chutes river. He was killed by a soldier, who had given him the benefit of his musket load, a ball and three buckshot, when close upon him, by which the poor animal's existence was evidently brought to a sudden close.

VULPES VELOX.

Kit Fox.

Baird, General Report Mammals, 1857, 133.

The "swift fox," *lucus a non lucendo*, is another member of the group of animals whose peculiar habitat is the dry, desert-like country lying on either side of the Rocky mountains, extending to the Cascade range on the west, and to the timbered lands of the lower Missouri on the east. In the basin of the upper Columbia it is more common than any other species, and I saw, while in that vicinity, a great number of the skins obtained by the hunters and Indians. We had no opportunity of observing the animal except in confinement, nor of testing, by actual experiment, the truth of the report which gives to this small, short-limbed fox such fabulous speed. All those, however, who were familiar with them, as found on the prairie, agreed in saying that its swiftness has been greatly overrated; that it is even less swift than its congeners, the red and grey foxes; all of which the appearance and structure of the animal fully confirm.

The home of this species is evidently the dry, sterile, almost treeless region, which I have mentioned above. We found no traces of it to the westward of the Cascade range in Oregon, or in any part of California.

VULPES (UROCYON) VIRGINIANUS.

Gray Fox.

Canis virginianus, Erxleben, Systema Regni-Animalis, 1777, 567 (from Catesby.)
Vulpes virginianus, Dekay, N. Y. Zool. I, 1842, 45; pl. vii, f. 2.
Aud. & Bach. N. A. Quad. I, 1849, 162; pl. xxi.
Baird, Gen. Rep. Mammals, 1857, 138.

Sp. Ch.—Head and body a little over two feet in length. Tail rather more than half as long. Tail with a concealed mane of stiff bristly hairs. Prevailing color mixed hoary and black; convexity and base of ears, sides of neck, edge of belly, and considerable portion of fore legs rusty or cinnamon. Band encircling the muzzle, much dilated on the chin, black. Throat and lower half of face pure white. Tail hoary on the sides; a distinct stripe above and the tip black; rusty beneath.

In Ohio, Kentucky, and Michigan, the most densely wooded of the middle States, the pioneer settler found only the grey fox, or at least that species occupied the territory so nearly exclusively that they considered any others as, like themselves, interlopers. As the forest gradually fell before the axe of the woodman, and broad and continuous stretches of waving grain replaced the thickly set trunks of oak, ash, and hickory, the grey fox became gradually more rare, while the swifter, stronger, and more cunning red fox by degrees almost entirely usurped its place. Hence the farmers supposed they had themselves introduced this farm yard pest, and that it had been the companion of their migration from the east; and, as it was then confounded with the common fox of Europe, (*V. vulgaris,*) it was supposed to be an importation, which ultimately would drive off its weaker relative and possess the continent.

Since, however, the red fox has been found in various places in the far west, and spread over all the region west of the Rocky mountains, and the red fox of America has been pronounced different from the red fox of Europe, this theory falls to the ground, and we must look for some other cause to account for the usurpation of the habitat of the gray fox by the red.

The grey fox is evidently best fitted by nature for the occupation of a wooded country; he even has, to a certain degree, the power of climbing trees, not possessed by *Vulpes fulvus,* while he rarely or never forms burrows, having no cover but such as the forest furnishes, and thus is comparatively unprotected in an open country, where the red fox would be quite at home. To these differences of habit, rather than to any other cause, I would attribute the change of distribution noticed in the two species.

In California and Oregon the gray fox is quite common, at least in the wooded portions. Of the several specimens obtained from there, none present any marked differences from the gray fox of the eastern States.

One specimen was collected in Napa valley.

VULPES (UROCYON) LITTORALIS, Baird.

Coast Fox; Short-Tailed Fox.

Baird, Gen. Rep. Mammals, 1857, 143.

Sp. Ch.—Scarcely more than half the size of the common grey fox (*Vulpes virginianus*). Tail one-third the length of body. Above, hoary and black; sides of neck, fore legs, and lower part of sides, dull cinnamon; chin and sides of muzzle black. Tail with a concealed mane of stiff hairs, and with a black stripe above.

This species was first discovered on the Island of San Miguel, off the California coast, by Lieut. Trowbridge, United States army. His attention was first called to it by its familiarity and fearlessness, its small size, and remarkably short tail. On setting a trap, one was immediately taken, and for some days kept in confinement; he escaped, however, and the next night was retaken in the same trap which had first secured him, being identified by the leather strap which remained on his neck. The same thing occurred several times in immediate succession, the fox evincing a total want of the vulpine cunning which so generally sets at defiance the trapper's art. A number of specimens were obtained by Lieutenant Trowbridge, and, after careful examination, Professor Baird has determined it to be distinct from any species hitherto known. The colors of the animal are, in general, those of the gray fox, from which it differs in size, length of tail, in habit, and in certain osteological characters, which are fully set forth in the specific description given by Professor Baird.

So far as known, it inhabits exclusively the island of San Miguel.

BASSARIS ASTUTA.

Civet Cat.

Baird, Gen. Rep. Mammals, 1857, 147.

This beautiful animal, which, at the time Audubon's description was written, was supposed to be peculiar to Texas and Mexico, has since been found somewhat abundantly in California.

The district in which it occurs, if not exclusively, certainly most abundantly, is that including the foot hills of the Sierra Nevada, on the eastern side of the great trough of the San Joaquin and Sacramento. In this half wooded region, the home of the gold hunter, it is well known, and apparently has much the character given by Audubon to the same animal in Texas. The miner calls it the "mountain cat;" it frequently enters his tent and plunders his provision bag. When caught, as it often is, it becomes so familiar and amusing, and does so much to relieve the monotony of the miner's life, that it is highly valued, and commands quite a large price.

The bassaris is, perhaps, equally efficient as a mouser with the common cat; is much more playful, and to a large number of the members of every community who are *cat haters* might be a desirable substitute.

MUSTELA AMERICANA, Turton.

American Sable; Pine Marten.

Mustela americanus, TURTON'S Linnæus, I, 1806, 60.
BAIRD, Gen. Rep. Mammals, 1857, 152.
Mustela martes, JOS. SABINE, Zool. App. to Narr. Franklin's Journey, 1823, 651.
AUD. & BACH. N. A. Quad. III, 1853, 176; pl. cxxxviii, (L. Huron.)

SP. CH.—Legs and tail blackish. General color reddish yellow, clouded with black; above becoming lighter towards the head, which is sometimes white. A broad yellowish patch on the throat, widening below so as to touch the legs. Central line of belly sometimes yellowish. Tail vertebræ about one-third the head and body. Outstretched hind feet reach about to the middle of the tail with the hairs. Feet densely furred.

We obtained two specimens of the pine marten on the head waters of the Des Chutes river, in Oregon. They were in a small pine tree; one was shot, and the other killed by a blow with a club as he descended. From the Indians, and from the officers of the Hudson's Bay Company, I learned that the animal is not uncommon in Oregon and Washington Territories, and that considerable numbers of their skins are annually brought in by the hunters. In California it would seem to be more rare, as we saw and heard nothing of it while on our march. Bartee told me, however, that he had on one occasion met with it while mining gold on Yuba river, in that State. The miners were in great want of food, their supply of provisions having failed, in which emergency Bartee had started out with his rifle in search of game. He found nothing to shoot, however, but three pine martens, all in one tree, two of which he killed, the third escaping. When taken into camp, skinned and cooked, the half starved miners tried to eat them, but they proved so tough and unsavory that they were thrown away in disgust.

MUSTELA PENNANTII, Erxl.

Fisher; Black Cat.

BAIRD, Gen. Rep. Mammals, 1857, 149.

We did not meet with the fisher living, but saw many skins of individuals which had been killed in Washington and Oregon Territories.

It is very rare in Oregon, more common in Washington Territory and in the British provinces, but nowhere at the west abundant.

At the Klamath lakes we found the natives using quivers for their arrows made from the skin of the fisher. I saw but one or two of these skins, however, most of those in possession of the Indians being of lynx, otter, raccoon, wolf, dog, &c.

PUTORIUS XANTHOGENYS.

Yellow Cheeked Weasel.

Mustela xanthogenys, GRAY, Ann. and Mag. N. H. XI, 1843, 118.—IB. Zool. Sulphur, 1844, 31; pl. ix.
Putorius xanthogenys, BAIRD, Gen. Rep. Mammals, 1857, 176.

SP, CH.—Similar to *P. frenatus.* Tail vertebræ about half the length of the body; the hairs about one-eighth this length. Head chesnut brown, little darker than the back; the three patches on the face reddish yellow; body chesnut brown above, reddish white beneath; tip of tail black.

About San Francisco this small species is very common and well known to the residents. I supposed it to be the bridled weasel (*P. frenata*) when I obtained it, especially as I knew that species to be common in northern Mexico. It is, however, apparently distinct, being much lighter about the head. It varies, however, very much in color at San Francisco, some individuals being much darker than others, and closely approaching the Mexican species.

The habits of *P. xanthogenys* are precisely those of the common eastern weasel, and they are reported to be as busily employed in the destruction of rats about San Francisco as weasels are with us.

Our specimens were obtained in the San Francisco market.

PUTORIUS VISON.

Common Mink.

Mustela vison, BRISSON, Quad. 1756, 256.
Putorius vison, AUD. & BACH. IV, An. Quad. 1, 1849, 250; pl. xi, f. 1.
BAIRD, Gen. Rep. Mammals, 1857, 177.

SP. CH.—Tail about half as long as the body. General color dark brownish chesnut; tail nearly black; end of chin white, but not the edge of upper jaw.

I obtained specimens of the mink from Klamath lake, and it was seen again by our party in the Des Chutes river. It is found in all parts of Oregon, and probably of California, though certainly less abundantly in the last mentioned State. The specimens obtained from Klamath lake were not as dark as the handsomest skins I have seen from the British provinces; they were, however, killed in August, and for the season the fur was very fine and thick.

Mr. McTavish, the intelligent factor of the Hudson Bay Company at Vancouver—from whom I received much valuable information relative to the numbers and distribution, as well as to the habits of the fur-producing animals of the northwest—told me that the company obtain large numbers of mink skins from Washington and Oregon, and that it is the most valuable of all the more common furs. The price now paid to the hunters is the same for a mink skin as for that of a beaver; but to the trader the mink skin is much the most valuable, the beaver skins being hardly worth the price of transport.

LUTRA CALIFORNICA, Gray.

California Otter.

Lutra californica, GRAY, Charlesworth's Mag. N. H. I, 1837, 580.
BAIRD, Gen. Rep. Mammals, 1857, 187.

SP. CH.—Naked muffle wider than long; under surfaces of feet scarcely hairy; the naked terminal pads not isolated from the other bare portion by hair.

The otter and beaver are generally regarded by those who have given the matter no special attention as closely allied animals, and are supposed to have precisely the same habits and habitats; whereas they belong to different orders, and are nearly as widely separated as mammiferous quadrupeds can well be. The beaver is a rodent, and the type of the order, the marmot, hare, and squirrel being his congeners. His food is exclusively vegetable, and he inhabits the banks of running streams because water affords him the means of protection and locomotion, not because it furnishes him with food. With the exception of his great incisors, which are fitted for cutting wood alone, his teeth are all grinders, and more perfectly such than the teeth of herbivorous ruminants. In disposition he is mild and inoffensive, and it is but with difficulty he can be induced, even in self defence, to use his dental chisels. On the contrary, the otter is exclusively carnivorous, living on fish, and never on vegetable food; he swims and dives with even greater facility than the beaver, and less often inhabits small running streams than rivers and lakes. He has the dentition and the disposition of the carnivora, and will defend himself stoutly against any animal which may attack him.

The otter exists on all parts of the Pacific coast, both on the sea shore and in the inland streams and lakes. In the Cascade mountains, where neither otter nor beaver had been much hunted, and where both were abundant, we found the beaver in the streams, but the otter in great abundance in the mountain lakes where these streams take their rise. There they subsist on the western brook-trouts and a *Coregonus* with a crayfish, *Astacus klamathensis*. These fish are exceedingly active, and an otter must be very swift to catch them. I brought a fine specimen from this locality which measured five feet from the extremity of the nose to the tip of the tail. His skin was very beautiful, and when in the water the hair over all the surface was beautifully iridescent.

In the Klamath lakes the otter is quite common, and several of their skins were procured by our party from the Indians. In these lakes their food is a large sucker (*Catostomus occidentalis*) and a species of *Gila*, both rather sluggish fishes, and such as would be easily caught.

At the present time the fur of the otter is much more in demand than that of the beaver. When I was at Vancouver the prices paid in goods to the hunters by the Hudson Bay Company were for beaver skins 50 cents, for otter $2 50 each.

The western otter has been described by Gray under the name of *Lutra californica;* the otter of the eastern States, long since called by Sabine *L. canadensis*, he seems not to have seen. The most conspicuous difference between the eastern and western otters is the greater amount of hair on the palms and soles of those from the west. Since, however, this difference is so slight, and the otter is found quite across the continent without break or interval in the series, I am inclined to consider them as all specifically identical, though presenting several shades of variation. On the Upper Missouri, where the stream is muddy and not well supplied with fish, the otters are few in number, small in size, and the fur pale and inferior.

Our specimen of this species was collected in the Cascade mountains, about 160 miles south of the Columbia.

ENHYDRA MARINA, Fleming.

Sea Otter.

BAIRD, Gen. Rep. Mammals, 1857, 189.

Of this little known but interesting animal we had no opportunity of obtaining fresh specimens, and but little information which was satisfactory. From Mr. McTavish I learned that it is occasionally taken on the coast of Oregon and Washington Territories, but not more than two skins are usually obtained by the Hudson Bay Company, at that point, in a year. Further down the coast they are more abundant, and the capture of the sea otter off southern California employs quite a number of men and several boats. I saw, in San Francisco, a number (one hundred or more) of their skins, some of enormous size and great beauty. The largest were full six feet long, and had evidently once belonged to animals considerably larger than those upon which descriptions have been based. This lot of skins was offered us at thirty dollars each ; less than half the price they formerly bore.

A curious fact, as illustrative of the aquatic habit of the sea otter, was related by one of the hunters. He said he had seen the female with very small young at sea, forty miles from shore, but that generally they are found on soundings, and particularly where the gigantic kelp (*Macrocystis*) raises its cable-like stem, and expands its broad leaf on the surface of the water. After the seal this animal is undoubtedly the most aquatic of the carnivorous mammalia.

MEPHITIS OCCIDENTALIS, Baird.

California Skunk.

Mephitis occidentalis, BAIRD, Gen. Rep. 1857, 194.
? *Mephitis mesomelas*, ST. HILAIRE, Voy. de la Venus, Zoologie, I, 1855, 133 ; plate.

SP. CH.—Size of a cat. Tail vertebræ two-thirds the length of head and body. Bony palate with small narrow emargination in the middle of its posterior edge. Color black, with a white nuchal patch, bifurcating behind and reaching to the tail, which is entirely black.

Aside from the little zorilla, one or more species of a larger size inhabit California. *M. bicolor*, as I have said in speaking of that species, inhabits the more southern portions of the State, where it is associated with at least one larger species. North of Benicia skunks are not unknown, as we had both ocular and nasal evidence, for it not unfrequently happened, as on our march we dipped down with our train into some quiet valley, that the breath of evening or early morning would come to us freighted with the odors characteristic of the genus. I saw several of these animals which had been killed, but they were so much decomposed as to render their identification difficult if not impossible.

MEPHITIS BICOLOR.

Little Striped Skunk.

Mephitis bicolor, J. E. GRAY, Charlesworth's Mag. N. H. I, 1837, 581.
Mephitis zorilla, LICHTENSTEIN.
AUD. & BACH. N. Am. Quad. III, 1854, 276, (not figured.
BAIRD, Gen. Rep. Mammals, 1857, 197.

SP. CH.—Smallest of North American species. Tail vertebræ less than half the body ; with the hairs, not much more than half. Black, with a broad white patch on forehead, and crescent before each ear ; four parallel dorsal stripes interrupted and broken behind ; a shorter stripe on side of belly, running into a posterior transverse crescent, which are white. Tail black throughout to base of hairs, except a pure white pencil at the end.

This elegant little skunk, so handsomely marked and clothed in a coat so soft and silken, presents, in all but the most striking characteristics of the genus, a marked contrast to the larger species so common in the eastern States, (*M. chinga.*)

It is a southern species, of the range of which San Francisco is probably about the northern limit. From San Francisco southward it becomes more common, extending quite into Mexico, and probably across the continent into Texas.

This animal is so prettily marked, that, on looking over our collections, even ladies, ignorant of its name, have not failed to admire it; and, indeed, the same thing has occurred in reference to the larger species, (*M. chinga* and *M. mesoleuca.*) If we were divested of certain prejudices, and these animals of certain perfumes, it is probable we should regard them, as they certainly deserve, as very handsome creatures.

To any collector in zoology who may happen to have, as an idiosyncracy, a dislike of some odors, it may be useful to know that there are several ways of taking skunks without causing them to emit their perfume. The best way is to catch the animal in a box trap, and to plunge the trap unopened into water, by that means drowning the skunk. If killed suddenly *very dead* by a rifle ball or shot, they are inodorous. Another mode sometimes practised, and *sometimes* successful, is to attack the skunk with a small dog, and while his attention is engaged, to walk boldly up, and seizing him by the tail, raise him instantly into the air, when he may be despatched by blows on the head, his system of defence in such circumstances being inoperative.

TAXIDEA AMERICANA.

American Badger.

Ursus taxus, SCHREBER, Säugt. III, 1778, 520, fig. 142, B. (From Buffon.)
Meles taxus, var. *β americanus*, BODDAERT, Elenchus Anim. I, 1784, 136.
Meles americanus, ("BODD.") ZIMMERMANN, Pennant's Arktische Zoologie I, 1787, 74.
Taxidea americana, BAIRD, Gen. Rep. Mammals, 1857, 202.
Ursus labradorius, GM. Syst. Nat. 1, 1788, 102.
KERR's Linnæus, 1792, 187.
SHAW, Gen. Zool. Mamm. I, 1800, 469; pl. cvi.
Meles labradoria, MEYER, Zool. Archiv. II, 1796, 45.
AUD. & BACH N. A. Quad. I, 1849, 360; pl. xlvii.

SP. CH.—Head grizzled grey, black on the end of snout and along the eyes. A median white line from near the nose to the nape. Legs and a crescentic patch before the ears black. Cheeks and under parts generally white.

In traversing the arid surfaces of the sage plains of eastern California, Utah, and Oregon, there is, perhaps, no one thing which the traveller may be more sure of seeing every day of his journey than the burrow of a badger; and, after cursing the country, and the folly which led him to cross these barren, hot, and dusty surfaces, there is nothing he will more certainly do, whether on foot or mounted, than tumble into one of these same badger holes, and yet the chances are more than equal that he never sees a living badger on which to revenge himself; for the badger is a shy and timid animal, and the country which he inhabits is so open, it rarely happens that he is surprised at a distance from his burrow. During our march of several hundred miles through the country inhabited by the badger this did occur, however, on one or two occasions, and gave rise to some ludicrous scenes. The badger, though far from formidable, is too well provided with teeth to be handled without gloves; and knowing that his only safety when attacked is in plunging to the bottom of his burrow, his pig-headed pertinacity in endeavoring to reach it is such, that an unarmed man finds it difficult to stop him.

Mr. Anderson, who gave me most efficient aid in collecting, came one day suddenly upon a badger at some distance from his hole; of course he made for it with all possible speed, which, it should be said, is not so great but that a man could easily overtake one. Mr. Anderson first endeavored to trample him under his horse's feet, but, though he ran over him several times, the badger avoided the hoofs, and received no injury. As we had not then obtained a specimen, he was particularly anxious to secure this one, so he drove his horse before him, and brought him to bay. He then jumped off, and went towards him, hoping, by means of kicks and his sheath-knife, to despatch him, but the badger, instead of retreating, came at him open-mouthed, and with such a show of ferocity that he was fain to let him pass, trusting to find a club to kill him with; but in that region clubs do not "grow on every bush," for most of the bushes are sage bushes, and before he found any sort of a stick the badger had reached his hole. Two days after I became indebted to him for a fine specimen, which a long rifle shot had dropped at the entrance of his burrow. Another, while leisurely following an old trail, apparently on a journey, was overtaken and killed by some of our soldiers. Seeing, perhaps, the hopelessness of the attempt, he made no effort to escape, but a vigorous defence, and was only despatched with some difficulty.

The burrows of the badger penetrate the light volcanic soil of the western plains in all directions; and often it has occurred that while riding unsuspectingly over an unbroken surface my horse has suddenly sunk into one of these old burrows the whole length of the fore or hind legs, sometimes extricating himself only with considerable effort.

It may seem surprising that an animal of so little prowess, so little speed and cunning, should find a subsistence in a region so nearly barren of animal and vegetable life as that which I have described; but the number of Spermophiles and Arvicolae which are found there is surprising, considering the circumstances in which they live, and I suspect they furnish him the greater part of his food, his unequalled power and skill in burrowing enabling him with comparatively little trouble to follow them to the bottom of their holes and devour them at leisure. The number of badgers inhabiting any given space is small, as they seem to be a singularly solitary animal; and a large part of the burrows which they make, and which we see, and perhaps fall into, are never occupied by them as domicils, but are made in pursuit of food.

Of the considerable number of badgers and badger skins which I saw at the west, scarce any two were of precisely the same color. Some were of a pale dirty brown, while others were of a rich dark chestnut, with the hairs of the back tipped with silver. When irritated, the badger shakes up his thick coat of hair, as the owl and hen their feathers, in order to appear as large and formidable as possible. At such times, the back is flattened and the sides expanded, the long hair projecting like the shell of a turtle or the eaves of a house. The hair is so arranged also as to display the variety of color to the greatest advantage, and under such circumstances a good specimen of a badger becomes a very handsome animal.

Our specimen of badger was collected at Klamath lake.

PROCYON HERNANDEZII, Wagler.

Black-footed Raccoon.

Procyon hernandezii, Wagler, Isis, XXIV, 1831, 514.

Wiegmann, in Archiv, III, i, 1837, 367.—Ib. Annals and Mag. N. H. I, 1838, 133.

Wagner, Suppl. Schreber, II, 1841, 157; also in Schreber Säugt. III, pl. cxliii, A, (interpolated.)

Baird, Gen. Rep. Mammals, 1857, 212.

? *Procyon nivea*, Gray, Charlesw. Mag. N. H. I, 1837, 580. (Albino.)

Sp. Ch.—Larger than *P. lotor.* General color greyish white, with a tinge of yellowish; long hairs tipped with black. Under fur dark brown. A large oblique black patch on the side of the face continuous with a paler one under the chin. Sides and under part of the muzzle, posterior margin of the cheek patch, and the ear, whitish. Tail tapering to tip, with five or six annuli and the tip black; the annuli half as wide only as the rusty whitish interspaces. Hind feet exceeding four inches; the upper surface mostly dark brown. Naked part of the soles three inches.

Varies in lighter colors and substitution of rusty brown or chestnut for the black tints.

This raccoon, regarded as distinct from the eastern species, inhabits all parts of California, Oregon, and Washington Territories; specimens having been obtained from widely separated localities, and its characteristic track observed in almost every place to which game resorted to drink. It is, however, less abundant on the Pacific slope than is the eastern species in most parts of the valley of the Mississippi; being confined to the wooded districts, and found most abundantly in the foot hills of the Sierra Nevada, in California. Considerable numbers are sold in the San Francisco market, to be eaten, commanding a price of from one to three dollars each. I could not learn that the skin was ever made an article of traffic in California. I saw a number of raccoons in confinement in San Francisco, all of which exhibited precisely the movements, the habits, the attitudes, and the temper of the eastern raccoon, and I noticed no striking peculiarity of form or color.

Specimens were obtained in the San Francisco market.

URSUS HORRIBILIS, Ord.

Grizzly Bear.

Ursus horribilis, Ord, Guthrie's Geography, 2d Am. Ed. II, 1815, 291, 299.
Baird, Gen. Rep. Mammals, 1857, 219.
Ursus ferox, ("Lewis & Clark,") Richardson, F. B. A. I, 1829, 24; pl. i.
Aud. & Bach, N. A. Quad. III, 1853, 141; pl. cxxxi

Sp. Ch.—Size very large. Tail shorter than ears. Hair coarse, darkest near the base, with light tips. An erect mane between the shoulders. Feet very large; fore claws twice as long as the hinder ones. A dark dorsal stripe from occiput to tail, and another lateral one on each side along the flanks, obscured and nearly concealed by the light tips; intervals between the stripes lighter. All the hairs on the body brownish-yellow or hoary at tips. Region around ears dusky; legs nearly black. Muzzle pale, without a darker dorsal stripe.

To the westward of the Rocky mountain range, the grizzly bear seems to have appropriated to himself the southern of our Pacific provinces, leaving the more northern territories to his less powerful congeners, the black and brown bears. The reasons for this peculiar distribution of species are not very obvious, but it is evidently an exhibition of that system in nature which provides by giving a wide range of habit to the different animals for the development of a large amount of animal life in every important division of the almost infinitely varied surface of the earth. That the habitat of the grizzly is not determined by temperature we know, for his thick and shaggy coat affords a better defence against cold than the finer and thinner fur of the black bear, and in the Rocky mountains the range of the grizzly extends at least as far north as the line of the British possessions.

Differences in the food of the two species, where the food is so nearly identical, seem hardly adequate to account for their distribution. It appears to me rather to turn on the more sylvan habit of the black bear, his greater aptness at climbing, and his evident preference for a country covered by a heavy growth of timber. He is the bear of the forest, while the grizzly is the bear of the "chapparal;" the latter choosing an open country, whether plain or mountain, whose surface is covered with dense thickets of "manzanita," or scrub oak—which furnish him with his favorite food—and clumps of service bushes and low cherry, and whose streams are bordered by tangled thickets of grape vines and wild plum.

Whatever the cause, the fact is unquestionable, that west of the Rocky mountains the grizzly bear becomes very rare after passing the parallel of 42°. They are rather unpleasantly abundant in many parts of the Coast Range, and Sierra Nevada, in California, where large numbers are annually killed by the hunters, and where not a few of the hunters are annually killed by the bears. About Shingletown and McCumber's flat, northeast of Fort Reading, and around the base of Lassen's butte, they are very numerous. This region is partially covered with a forest of rather scattered trees of immense size, of sugar and yellow pine, western balsam fir and *libocedras*, with wide intervals covered with a dense growth of *manzanita*, *ceanothus*, and low scrub oak. These thickets are the favorite haunts of the bear, and are intersected in every direction by their well-beaten paths.

After crossing the divide and descending into the interior basin, from which Pit river issues through its lower cañon, grizzly bear "signs" became more rare, but were noticed on every day's march till we reached Klamath lake. Here the country becomes more productive, the mountain slopes being covered with bushes of service berry, gooseberry of several kinds, plum and cherry trees, all loaded with fruit, upon which the numerous tracks proved many bears were feeding.

At San Francisco a large number of "grizzlies" are kept in confinement in different parts of the city, and while there I frequently amused myself by watching them and studying their habits. Two of these were quite large, and said to weigh, respectively, eight hundred and one thousand pounds; and they, with a cougar, an elk, a *navajo*, (four-horned sheep,) an ocelot, and a bald eagle, went to make up a kind of menagerie, where I frequently spent an hour.

These grizzlies were under perfect control, and were knocked about entirely without ceremony by the showman, yet unresentingly, and he would even go so far as to ride upon their backs. He used to give interest to each day's entertainment by getting up a wrestling match between the bears, when they would tumble one another about with considerable spirit, yet usually very goodnaturedly. The reward which more than any other stimulated them to effort was tobacco, of which they seemed very fond. If undisturbed, however, they were very lethargic, lying the whole day through, each rolled up into a huge ball of fur, nearly as high as the animal when standing.

A very beautiful bear, eighteen months old, and weighing nearly five hundred pounds, was confined by a long chain near a slaughter house, in the environs of San Francisco, and just beside the road I was every day compelled to travel. He had always been well fed, was very fat, and, for a bear, very good natured. Every day some one of the butchers would have a wrestling match with him, into the sport of which he would enter with great zest, yet never evincing anything like ferocity; indeed, to all mankind, he had been, so far, entirely harmless. Not so, however, toward the pigs. For pork he seemed to have a special fondness, and he exhausted all his bearish cunning to draw within the circle, of which his chain was the radius, the vagrant shoats which ranged around the slaughter house. He would leave his food half eaten or untasted, that it might attract the pigs, while he, retreating under the cart to which he was chained, watched their motions with all the silent cunning of a cat. Woe to the unlucky pig which, drawn by the bait, came within that magic circle! he ceased to grow old from that hour.

Like most bears he was also very fond of sweets, of which a poor laborer, living in the vicinity, had satisfactory, or rather unsatisfactory proof. Sometimes the bear would break his slender chain, and range about the place at his own free will, doing no harm, but sometimes frightening people, until he was caught and tied up again. One day, when the bear was at liberty, this poor laborer was passing, just at evening, with his hard-earned pay converted into a sack of sugar, which he carried on his shoulder to his family. He heard a step behind him, to which he paid no attention till he felt violent hands laid on his sack of sugar. Turning round, what was his consternation to find himself face to face with a large bear. Of course he was frightened, dropped his bag and ran. When afterwards he returned, having gained courage and assistance, as might have been anticipated, the sack was empty.

The track of the hind foot of the grizzly bear is very like that made by the foot of a negro; one of the thousand things which give the bear a kind of human character. His attitudes and motions, his arm-like use of the fore leg, his fun and malice, and, if we may believe the hunters, his festive games, wrestling matches and dances, are very human.

URSUS AMERICANUS.

Black Bear; Cinnamon Bear.

Ursus americanus, BAIRD, Gen. Rep. Mammals, 1857, 225, 228.

The black bear inhabits all portions of Washington and Oregon Territories, extending its range into California only near the coast. Near Fort Jones it has been occasionally killed, but south of that point it is replaced by the grizzly. In passing from California to Oregon, by way of the Klamath lakes, we found no traces of it till we reached the headwaters of the Des Chutes river; there we saw no grizzly "sign," but the black bear was evidently very abundant. Several were seen by the members of our party, but they were very shy, and none were killed. The light volcanic soil, composed of disintegrated pumice, of the region bordering the main fork of the Des Chutes, as it issues from the Cascade mountains, sustains little vegetation except the yellow and spruce pines, (*P. brachyptera* and *P. contorta*,) and receives and retains the impress of the feet of passing animals with almost the fidelity of snow. On this surface, therefore, we had an authentic record of the fauna of the region. The elk, the mule, the white-tailed deer, the antelope, the badger, the red fox, the coyote and large gray wolf, Townsend's hare, the artemisia hare, all had there made their marks—even the striped squirrels, *Spermophilus lateralis* and *Tamias townsendii*, had recorded their visits to the bushes of red gooseberry and ceanothus, which furnish them with food. Among these hieroglyphics, by far the most conspicuous, and perhaps most numerous, were those in which the black bear had told us of his various wanderings. His tracks, deeply sunk in the yielding surface, resembled those of a horse, only set more closely together; and during the interval that had elapsed since winter's rains and snows had obliterated all former records, the bear had passed and repassed so frequently that the ground in some localities was tracked up like a barn yard.

The subsistence of the bears of the region I have described is evidently, for the most part, vegetable. The manzanita, (*Arbutus laurifolia*,) the wild plum and cherry, which fruit profusely and are very low, and especially the whortleberry, which covers whole hill-sides in the Cascade mountains, furnishing an unheard of quantity of large and fine fruit; all these assist in making up their bill of fare. Rarely, too, we saw trees of the yellow pine bearing marks of bears' teeth, where they had torn off the bark to get at the succulent inner layer, which is capable of sustaining life, and to which the Indians very generally have recourse when pressed by hunger. I have known the black bear of the eastern States strip off the bark of the hemlock spruce (*A. canadensis*) for the same purpose.

The brown or cinnamon bear, generally regarded by naturalists as a variety of the black species, inhabits the same territory and shares the habits and the food of the black bear.

I made every effort to secure good specimens of the brown bear in order to settle the question of its relations, for the hunters and Indians whom I consulted generally regarded them as distinct, but I could only obtain the prepared skins. Lieutenant Crook, United States army, a thorough sportsman and a careful and accurate observer, tells me that he killed a brown bear in Scott's valley, California, *in a tree, engaged in tearing off a branch from which a hornet's nest was sus-*

pended, evidently designing to possess himself of the nest that he might eat the young insects which it contained. This is precisely the habit of the black bear, to which the cinnamon bear, if distinct, must be very closely allied The color, though a striking peculiarity, is subject to considerable variation ; and the *texture* of the coat is very similar in black and brown bears, and very different from the thicker, coarser, and rougher covering of the grizzly. I saw a black bear skin, brought by Lieutenant Day, United States army, from the head of Salmon river, Oregon Territory, which was as soft and lustrous as silk.

The size of the black bear of the west is about the same as in the eastern States ; the brown bear is represented as being rather larger and longer limbed. Both are hunted with much less fear and caution than the formidable grizzlies.

OTARIA ——— ?

The Sea Lion.

This large seal is quite abundant on the few rocky islands which lie off the coast of Oregon and California. In passing from Crescent City to San Francisco we saw immense numbers of them on the detached rocks a few miles from shore, near Cape Mendocino. Some of these rocks were covered with them, basking in the warm morning sunshine. As the steamer approached, they began to be disturbed, moving about with considerable facility, and making a hoarse kind of growling or barking in chorus ; in their movements, their color, and their cries, resembling a crowd of black and brown bears. As we came nearer, most of them scrambled to the edge of the rocks and threw themselves, sometimes from the height of eight or ten feet, into the sea, one or two, perhaps old or disabled individuals, usually remaining and keeping up a defiant growl while we were passing. In the water they still kept together, showing only their relatively small heads, swimming and diving with great ease and rapidity. There was considerable diversity of size and color among them. Some were evidently quite young, and others larger than the largest grizzly bear. he variation of color was from dark brown, almost black, to light fulvous.

At the Farallones islands, forty miles off the coast, and opposite San Francisco, this, with several other species, is very abundant. They there attain a weight of two thousand pounds and over, and are exceedingly ferocious. During the nuptial season the fierce and bloody battles between the males make of these islands a perfect pandemonium, and all the old males, bloody and scarred, carry on their sides and shoulders evidences of their recent or remote conflicts.

They are sometimes killed with fire arms, though, from their great size and tenacity of life, it is rare that a mortal wound is inflicted. While we were in San Francisco, in June, 1855, Dr. Wm. O. Ayres, of that city, visited the Farallones, bringing back a variety of interesting matter, both of specimens and facts, illustrative of the fauna of those islands. Among other things, the skull of a sea lion, in reference to which, as he presented it to the California academy, he made the following remarks:

"This specimen is of interest as illustrating, in one particular, the habits of these animals. The left zygomatic arch has been perforated by a bullet, and the lower part of the left inferior maxillary bone shattered by another ; both of these injuries having been received so long since that the action of the absorbents has almost smoothed the splintered edges of the bones. Inside of the wound of the zygoma was found the piece of lead which had caused it, and which was at once recognized, from certain peculiarities of form, as one which had been fired, without fatal effect, at a sea lion, on the same rocks, in the summer of 1854. We have thus a demonstration that these huge seals return, in some instances at least, year after year to the same localities. They leave the Farallones in November, and return in May, being absent about six months. How far they migrate during that interval we have, at present, no means of determining. The one from which the skull was taken was estimated to weigh about a ton.''

PHOCA ——— ?

Seal.

This seal penetrates San Francisco, San Pablo, and Suisan bays, and even follows up the Sacramento river for some distance.

While duck shooting on San Pablo bay, we were many times amused, and sometimes a little startled, to see a round head, as large as that of a man, suddenly and silently raised above the water near us, and a pair of goggle eyes, just enough human to make them horrible, staring at us, recalling all sorts of stories of strangled innocence rising to confront the murderer. Usually, after taking a good look at us, the head would sink as silently as it rose, leaving us in a pleasant state of uncertainty whether it was ghost or demon that had formed the apparition. After a longer or shorter interval that bullet head and goggle eyes would appear on the other side of the boat, rising and sinking in the same ghostly way, and giving no hint, but leaving to the imagination what might be appended to this curious head piece.

A similar apparition startled me one quiet Sabbath morning when sitting on the trap rocks at the Dalles of the Columbia; the more, as I should as soon have expected to see a whale as a seal at that distance from the Pacific and above the Cascades.

DIDELPHYS CALIFORNICA, Bennett.

California Possum.

BAIRD, Gen. Rep. Zool. 1857, 233.

Guided only by my own observations, and by what I could gather from verbal testimony, I should have said that the opossum does not exist in California or Oregon. We have, however, the positive evidence of other witnesses that it does exist there; and, therefore, my negative evidence goes for nothing unless as an indication of its rarity.

On the light volcanic soil of southeastern Oregon, over which we travelled for days together, a surface which takes a track almost as well as snow, though I looked carefully for the tracks of the opossum, so peculiar that they could hardly be mistaken or overlooked, I never saw it in all that region; nor did any of our party.

I am therefore convinced that if the opossum exists west of the Rocky mountains, it is much more rare than in the eastern States.

SCIURUS FOSSOR, Peale.

California Gray Squirrel.

Sciurus fossor, PEALE, Mamm. and Birds U. S. Ex. Ex. 1848, 55.
AUD. &. BACH. N. Am. Quad. III, 1854, 264; pl. cliii, f. 2.
BAIRD, Gen. Rep. Mammals, 1857, 264.
Sciurus heermanni, LECONTE, Pr. A. N. Sc. Phila. VI, Sept. 1852, 149.

SP. CH.—Size of *S. vulpinus*, but more slender. Tail vertebræ as long as the body; with the hairs, much longer. Five upper molars. Above, grizzled bluish gray and black; beneath, white, without any differently colored separating line. Tail black, with the exterior white; the whole under surface finely grizzled. Back of the ears and adjacent tuft on the occiput, chestnut.

This large and handsome squirrel inhabits the pine forests of all parts of California in which pine forests exist. We did not observe it in any part of Oregon, and if it is found there it must be rare. It is nowhere very abundant, but is rather common in the coniferous forests of northern California, where it is hunted by the scattered residents with great zest, both for the sport which it affords, and because of its excellence for the table.

It is eminently a tree squirrel, scarcely descending to the ground but for food and water, and it subsists almost exclusively on the seeds of the largest and loftiest pine known, *P. Lambertiana*, the "sugar pine" of the western coast. The cones of this magnificent tree are from twelve to sixteen inches in length, and contain each one hundred or more seeds of the size and shape of the small white bean of commerce. These cones would be unmanageable by the squirrel in the tree, and he has the habit so common in the family of dropping them to the ground, where he can dissect them at leisure. This he usually does in the early morning, climbing to the extremities of the topmost branches where the cones hang, and cutting off a sufficient number to supply his wants for the day. He then descends, and commencing at the base of the cone, tears off the scales in succession, and skilfully possesses himself of the seeds which they conceal. He is, however, compelled to supply other wants than his own, for the smaller pine squirrel, *S. douglasii*, and the ground squirrel, *Tamias townsendii*, appropriate a large share of his booty. When oak trees are near and acorns are ripe, he has recourse to them for subsistence, as often as opportunity offers, robbing the woodpeckers of their stores, in which, also, he has the active co-operation of his more diminutive congeners.

From the fact that he feeds upon the ground it has been supposed that he was less active and less fitted for climbing than most tree squirrels. This, I think, is not true. He is exceedingly quick and graceful in his movements, and if less frequently seen to spring from tree to tree than the black and grey squirrels of the eastern States, it is because he inhabits coniferous trees, which are remarkable for the insignificance of the branches compared with the size of the trunk, the limbs never stretching out and interlocking, as those of the oak and maple and other trees in which our more common species live.

Possessing all the vivacity of the genus, his size, the neatness and beauty of his colors, and especially the graceful curl of his long and distichous tail, render him, perhaps, the finest squirrel found in our country.

Specimens were obtained from Stockton and Fort Jones.

SCIURUS DOUGLASII, Bach.

Oregon Red Squirrel.

Sciurus douglasii, ("Gray,") Bachman, Pr. Zool. Soc. Lond. VI, 1838, 99.—Ib. Jour. Acad. Nat. Sc. Phila. VIII. ("Bach.") Aud & Bach. N. Am. Quad I, 1849, 370; pl. xlviii.
Baird, Gen. Rep. Mammals, 1857, 275.
Sciurus suckleyi, Baird, Proc. Acad. Nat. Sc. Phila, VII, April, 1855, 333.

Size that of *Sciurus hudsonius*, or a little larger. Ears well tufted; tail shorter than the body, scarcely flattened. Soles naked in the centre. Above, dull rusty, and black, mixed; the latter quite predominant; beneath, clear bright buff, without mixture of dark or annulated hairs. A dark stripe on the sides. Tail dull chesnut centrally, darker above; then black and margined all round with rusty white. Hairs at tip of tail entirely black, except at their extremity.

More northern specimens in winter have the soles densely hairy to the toes, the fur much fuller and softer, the under parts with dusky annulations, the general hue grayer Size about that of *S. hudsonius*, or a little larger. Head short, broad. Whiskers longer than the head; black. Thumb, a mere callosity; fingers well developed, the central two longest and nearly equal; the inner rather longer than the outer; claws large, compressed, and much curved; palms naked. On the hind feet the inner toe is shortest, reaching only to the base of the claw of the outer, which comes next in size; the fourth is longest, the third and second little shorter. Claws all large and much curved. In summer the soles are naked, except along the edges and the extreme heel; in other words, there is a narrow central line of naked skin from near the heel; they are more hairy in winter. The ears are moderate, with short close hairs on their concavity; the back of the ear is covered with long hairs, those near the upper margin longest, and projecting beyond nearly five lines in some specimens; these tufts are nearly black. The tail is small, shorter than the body, moderately flattened; the hairs rather short, and, as on the rest of the body, coarse and stiff.

Among the magnificent trees of the Cascade mountains, near the head of the Des Chutes river, some new to science and all novel to us, and feeding on their seeds, were numbers of, as I at first supposed, the same little pine squirrel we had so often seen in California, somewhat changed, however, I thought, both in color and habits; its color paler and less brilliant, and having, in a great degree, lost the black line of the side; in manners, far more familiar. The first I attributed to climate; the second, to his ignorance of the usages of civilized society; he not having learned that man wages a relentless war against just such beautiful and harmless little animals as himself. These differences, if not specific, certainly indicated a different variety.

I was sometimes greatly amused at the antics of one of these little fellows. As I approached the tree on which he sat, instead of retreating, he would sit still and scold, or even come out on a branch within a few feet of my head, as though curious to examine, and determined to drive away this strange animal which had invaded his solitude. Perched on the end of the branch, constantly scolding and twisting from side to side, he would balance himself on his feet as though about to spring upon me; then, his fears getting the better of his valor, he would scamper away and hide himself behind the trunk. Reassured by a few moments of quiet on my part, he would bristle up and again rush out to the end of the limb, apparently finally resolved to throw himself down upon me. This he would never do, however; and at length, having failed to produce any impression upon me by his graces and grimaces, his bluster and bravado, he would scramble up the tree and into some hole, apparently in intense disgust, scolding as long as I was near.

SCIURUS DOUGLASII, Var.

California Pine Squirrel.

This little squirrel, the Californian representative of the red squirrel of the eastern States, (*S. Hudsonicus,*) is quite equal to that species in activity. It is found in the evergreen forests throughout California and southern Oregon, perhaps extending its range to the Columbia, though we found it replaced in the Cascade mountains by another variety much resembling it, but less highly colored.

This little fellow is everywhere known as the pine squirrel, though the name is not strictly correct, as it lives on almost all kinds of evergreen which furnish edible seeds. Evergreen squirrel would be better, but that some hypercritical person might object to calling that *evergreen* which was *never* green. The name pine squirrel might, however, be disapproved of on the same grounds, as I can testify that he is far from being a wooden animal. Let us, however, call him pine squirrel, at least for the present, and follow him to his haunts.

In the forests of redwood, (*Sequoia sempervirens,*) on the Coast Range, north of San Francisco, he finds a most agreeable residence; and among the great sugar pines (*P. Lambertiana*) of the Sierra Nevada and the Trinity mountains he is well known, and is a favorite symbol of rapidity with the epithet-loving hunters of the frontier, having, in their phraseology, taken the place of chain lightning, than which he is regarded as a shade swifter. He is usually shy, and frequently difficult to shoot. I have sometimes, while moving stealthily through the forest, surprised one of these little fellows seated and engaged in his favorite occupation, tearing to pieces a pine cone, and surrounded by bushels of chips, indicative of his industry. At such times he utters a short, sharp, solitary bark, something like the chirp of the striped ground squirrel, but louder and harsher. His attitude is the embodiment of grace, and his erect ears, his full, black, brilliant eye, the neatness of his colors—greenish grey above, red below, with a sharply defined black line separating the two—altogether render him one of the prettiest of the genus; so pretty is he, indeed, that my gun has often refused to do its duty before such a sprightly innocent so entirely in my power.

I have several times watched these little fellows while gathering their food. Like the larger pine squirrel, their habit is to go into the tree and cut off and throw down a number of the cones, and then descending to tear them up at leisure. Unlike *S. fossor*, however, this squirrel has a burrow either under or in fallen logs, where the pine seeds are carried and stored for winter. By this habit, it is allied to the ground squirrel, (*Tamias 4-vittatus,*) which is its constant associate in the region which it inhabits.

TAMIAS.

Striped Ground Squirrel.

TAMIAS TOWNSENDII.

Townsend's Striped Squirrel.

Tamias Townsendii, Bachman, Jour. Phila. Acad. Nat. Sc. Phila. VIII, i, 1839, 68.
Baird, Gen. Rep. Mammals, 1857, 301.
Aud. & Bach. N. Am. Quad. I, 1849, 159; pl. xx.
Tamias hindsii, Gray, Annals & Mag. N. H. X, 1842, 264.
Tamias cooperii, Baird, Pr. Ac. Nat. Sc. Phila. VII, April, 1855, 334.

Sp. Ch.—Larger than *T. striatus.* Tail, with hairs, nearly or quite as long as the body. Sides of head striped. Above and on the sides rufous brown, with five dark stripes reaching to the tail, the intervals between which are scarcely or but seldom paler than the ground color; beneath, dull white. Ears dusky brown, hoary posteriorly. Tail bright chestnut beneath, margined with ashy white, within which is a band of black. Length, five to six inches. Hind foot, 1.40 to 1.50. Varies in rather paler colors, ash colored interspaces, and sometimes the back with black hairs interspersed, so as to obscure, or nearly conceal, the dorsal stripes.

TAMIAS QUADRIVITTATUS.

Missouri Striped Squirrel.

Sciurus quadrivittatus, Say, in Long's Exped. R. Mts. II, 1823, 45.
Tamias quadrivittatus, Aud. & Bach. N. Am. Quad. I, 1849, 195; pl. xxiv.
Baird, Gen. Rep. Mammals, 1857, 297.
Tamias minimus, Bachman, Jour. Acad. Nat. Sc. Phila. VIII, i, 1839, 71.

Sp. Ch.—Tail, with the hairs, nearly or quite as long as the body. A greyish white stripe along the top of the head, with branches passing above and below the eye. The stripe bordered above and below by darker ones, and separated behind the eye by a dark line. A grey or hoary patch behind the ears. Sides of body deep ferruginous; back with five about equidistant dark stripes, nearly black on the posterior part of the body, their intervals forming four greyish white lines of similar dimensions to them. Tail, when flattened out, ferruginous externally, then black, then ferruginous. Body beneath, dirty greyish white. Length, four to five inches. Hind foot, 1.20 inch.

These little striped squirrels we found in the pine woods from Fort Reading to the Columbia, and I doubt if any day passed during our journey in which they were not seen by some of our party. Their cry is somewhat like that of our eastern species, *T. striatus,* but not so loud, nor so frequently repeated. In California, their subsistence is derived from the oaks and pines, and from the seeds of the everywhere abundant "manzanita." In northern California and Oregon, in summer and fall, they feed on the seeds of the pines and firs to some extent; but their great storehouse of provisions is formed by the thickets of large species of *Ceanothus*, (*C. laevigatus* and *C. velutinus*,) the seeds of which are the favorite food of all the ground squirrels inhabiting, the region where they grow.

In the Cascade mountains are immense stretches of country where the pine and fir forests have been destroyed by fire—the trees not burned, but killed, and all thrown down by the wind, covering the ground with an almost impenetrable labyrinth of interlocking trunks. Over this surface spring dense and continuous thickets of *Ceanothus*, and great numbers of clumps of gooseberry bushes, which are loaded and reddened by an unparalleled profusion of large scarlet berries, very beautiful to the eye, but perfectly flat and insipid to the taste. These thickets are the favorite haunts of the little ground squirrels, and they, with the ruffled grouse, find good use for all these scarlet berries. My attention was first called to the fact of their feeding on these berries by the blood red imprints of the squirrels' feet on the smooth and barkless trunks of the fallen pines; and as these tracks multiplied, I began to wonder at the ferocity of the squirrels of this region, which covered the country with blood. As the gooseberry bushes became more numerous, I detected the connexion between their fruit and the crimson tracks, and at the same time found a good reason for the production in such extreme abundance of fruit so entirely useless to man, and apparently so little relished by the man-like bears.

SPERMOPHILUS DOUGLASII.

Columbia Ground Squirrel.

Arctomys (Spermophilus) douglasii, Rich. F. B. A. I, 1829, 172.
Spermophilus douglasii, Aud. and Bach. N. Am. Quad. I, 1849, 373; pl. xlix.
Baird, Gen. Rep. Mammals, 1857, 309.

Sp. Ch.—Similar in most all respects to *S. beecheyi*, but with the space on the nape and back, between the light colored more lateral patches, of a uniform dark brown, nearly black.

The "ground squirrels," as the different species of *Spermophilus* are commonly called, are, to a stranger in California, a new and interesting feature of the zoology of the country. He has probably heard of the villages of "prairie dogs" on the plains of central North America, and has listened with interest or incredulity to the stories of these strange communities made up of such incongruous materials as mammals, birds and reptiles, spermophiles, owls, and rattlesnakes. If he should happen at any time to traverse the valley of the Sacramento, in California, he will be no lover of nature if he be not gratified, and even delighted, to see with his own eyes, and to examine closely, the villages of owls and spermophiles which he will be sure to pass.

These squirrel colonies, composed of individuals of the species *S. douglassii* and *S. beecheyi*, are not organized on the same plan or in similar places with those of the prairie dog (*Cynomys ludovicianus*.) The prairie dog inhabits open prairies, its villages being composed of closely set burrows, frequently spread over a surface of miles in extent. This species is not found in California, where the spermophiles are all long-tailed, and more or less arboreal in their habits. Nor are they, by any means, as social as the prairie dogs; a single individual being frequently found living at a distance from all others, usually under some tree, into which he often climbs, and from which you will probably dislodge him by your approach, as his burrow is his citadel, to which he betakes himself on the least alarm.

We first saw the spermophiles in considerable numbers in the belts of timber which border Suisun, Cache, and Putos creeks. These streams come down from the Coast Range and cross, with sinuous courses, the plain which forms the western half of the Sacramento valley, till they meet the Sacramento and into it discharge themselves. The Sacramento valley here, as generally, is nearly level and destitute of trees, except such as border the streams. These belts of timber vary in width, from a single line of trees along the water's edge, to strips of forest one and even two miles wide on either side. Except the willows and sycamores on the river bottoms, these timber belts are composed of magnificent oaks of a species peculiar to California, (*Quercus longiglandis*,) which has a wide spreading growth like the English oak, as it grows at Hampton Court and Windsor.

The trunk, rarely less than two, frequently seven or eight feet in diameter, rises eight, ten or twelve feet from the ground, and then divides into huge arms, which throw themselves out at right angles, and, bending low to the ground, cover a surface of one hundred or more feet in diameter. These trees are not thickly set, but usually scattered over the turf-covered ground in graceful groups of giants, whose branches touch each other with intervening open glades, sunny and smooth, of one, two, or three acres. Under these oaks not a bush can be seen; and below the limbs, where the trees are thickest, there is nothing to impede the view over the grass-covered surface but the colossal trunks which gather in the perspective and limit vision. Here the spermophiles live in thousands; under each tree a sub-colony which have, parent and child, pierced the earth with their burrows until they have thrown up, of the excavated material, a mound, not often more than from twelve to eighteen inches in height, yet very perceptible to the eye.

These squirrels are long-tailed and long-eared for spermophiles, and have much the form and action of the true squirrels. They are very timid, starting at every noise, and on every intrusion into their privacy dropping from the trees, or hurrying in from their wanderings, and scudding to their holes with all possible celerity; arrived at the entrance, however, they stop to reconnoitre, standing erect as squirrels rarely, and spermophiles habitually do, and looking about to satisfy themselves of the nature and designs of the intruder. Should this second view justify their flight, or a motion or step forward still further alarm them, with a peculiar movement, like that of a diving duck, they plunge into their burrows, not to venture out till all cause of fear is past. Should you in the meantime have seated yourself with your back against a tree, and have remained for a time as immovable as the trunk against which you lean, you will soon see sundry little heads protruded from the burrows, with as many pairs of eyes and ears skilled to detect the least sign of danger from their equally feared enemies, the coyote, the California vulture, the red-shouldered and red-tailed hawk, and man himself. If, however, your silence and quietness persuade them that you are none of these, they will swarm forth from their holes, and at first timidly, but, gaining confidence, more fearlessly, engage in all the sports and antics for which the *Sciuridae* are noted, and in which none excel the species under consideration. It is a pretty sight, and one to which I have often treated myself, to sit down quietly under these old oaks and watch the squirrels running about over the grass and trees, gamboling and playing together. As far as the eye could reach through the vista the sprightly movements of these innocent animals could be discerned.

Their most important element of subsistence is the acorn, which the trees produce plentifully, and which the squirrels store up in their holes. In the absence of acorns, they have recourse to such roots and seeds as they can glean in the vicinity of their habitations. In the neighborhood of cultivated grounds they inflict material injury on the growing crops; one farmer, on Cache creek, telling me that the squirrels had eaten up full half his wheat. The number then swarming over his fields and fences was incalculable.

S. douglasii is a brighter and handsomer species than *S. beecheyi*, with which it is commonly confounded. It has, too, a dark, almost heart-shaped spot on the shoulders, which is wanting in *S. beecheyi*. It is apparently more boreal in its range, as the most common species about San Francisco and Santa Clara is *S. beecheyi*, while in the Upper Sacramento valley, and the Klamath lake basin we found only *S. douglasii*. I saw in the pedregal region of Pit river a smaller species, different from both, and possibly new, but I could not secure specimens.

The owl which lives with the spermophiles is *Athene hypugaea*, the same found with the prairie dogs. Rattlesnakes we did not see with them, but they are common enough everywhere, and may live with the owls and squirrels. The idea so prevalent that the owls and squirrels occupy the same burrow at the same time is probably erroneous, the owl generally taking possession of the deserted burrows of the squirrels. The rattlesnakes are probably not very observant of the rights of property, but make themselves at home wherever they find comfortable lodgings and meals furnished at the cost of the least labor to themselves.

Specimens were collected at Klamath lake, O. T.

SPERMOPHILUS BEECHEYI.

California Ground Squirrel.

Arctomys (Spermophilus) beecheyi, RICHARDSON, Fauna Boreali-Americana I, 1829, 170; plate xii, B.

Spermophilus beecheyi, BAIRD, Gen. Rep. Mammals, 1857, 307.

SP. CH.—Size of the cat squirrel, *S. cinereus*. Ears large, prominent. Tail more than two-thirds as long as the body. Above, mixed with black, yellowish brown, and brown in indistinct mottlings; beneath, pale yellowish brown. Sides of head and neck, hoary yellowish, more or less lined with black; a more distinct stripe of the same, from behind the ears on each side, extending above the shoulders to the middle of the body. Ears black on their inner face. Dorsal space between the stripes scarcely darker than the rest of the back. Length, 9 to 11 inches; tail, with hairs, 7 to 9. Hind feet, 2 to 2. 30 inches.

In speaking of *S. douglasii*, I have given the generalities of the habits of both species, for they are nearly the same. The two species are not distinguished by the people of the country, and are frequently found in the same place. The dark spot on the back of *S. douglasii*, with its more northern habit, will serve to distinguish it. The colors of *S. beecheyi* are all less bright and handsome than those of the allied species, of which the dappling is clean white on a dark ground, while in *S. beecheyi* the colors are much as in *Cynomys ludovicianus*, all dull and dirty.

The flesh of both species is fat, tender, and well flavored, and usually regarded as preferable to that of the tree squirrels. It is, however, much more rarely brought to the market of San Francisco than *Sciurus fossor*, I was told, because so many of them had been poisoned by the farmers. To rid themselves of so great pests, they have used strychnine freely, thereby exciting a natural distrust of any which might be offered for sale.

SPERMOPHILUS LATERALIS.

Say's Squirrel.

Sciurus lateralis, SAY, Long's Exped. R. Mts. II, 1823, 46. (Arkansas river, lat. 38°.25; long. 105°.20; July 16.)

Spermophilus lateralis, AUD. & BACH. N. Am. Quad. III, 1853, 62; pl. cxiv.

BAIRD, Gen. Rep. Mammals, 1857, 312.

SP. CH.—Ears conspicuous, high. Tail, with hairs, more than half as long as head and body; depressed. Middle region of the back finely grizzled yellowish grey and black, without any lines; on each side two distinct black stripes, enclosing a yellowish white one, all of about the same diameter. Posterior half of the thigh and rump dark chestnut brown, without stripes. Top of the head chestnut. Under surface of tail bright chestnut; margined with brownish yellow, within which is a black band. Length about 7 inches; tail with hairs, about 4; hind foot, from heel, 1.42 inches.

This Tamias-like species was first described by Say, and not obtained by any of the recent government expeditions till we found it in the Des Chutes basin.

The markings, the motions, and the habits of *S. lateralis* are very much like those of the striped squirrel, (*T. quadrivittatus,*) with which it is found. It is, however, more closely confined to the ledges of rock than is any species of *Tamias;* indeed, I never saw it except when on or immediately about piles of trap rock; and its preference for such localities, its unfailing habit of betaking itself to them for refuge when alarmed, and its facility in climbing over large loose rocks, make it decidedly a rock squirrel.

The specimens which I killed were feeding with the Tamias on the seeds of a large Ceanothus, (*C. laevigatus,*) and were very fat and well flavored, as I can testify from actual experiment, for we were at that time at a distance from the main party, and entirely out of provisions, except flour and rice, and were glad to get squirrels and trout, though both small, to add to our bill of fare. They were obtained on the upper Des Chutes, in Oregon.

APLODONTIA LEPORINA, Rich.

Sewellel.

BAIRD, Gen. Rep. Mammals, 1857, 353.

This singular animal, called by Richardson the *Sewellel,* seems limited to a narrow district when compared with most of those which, with it, inhabit the region it occupies. In Washington Territory it is found from the coast to the Rocky mountains. It is doubtful whether it will be found south of the Columbia, either on the coast range, in the Willamette valley, or on the Cascades. Eastward, however, toward the base of the Rocky mountains, it may occur. I have seen two specimens, one taken near Shoalwater bay, Washington Territory, by Dr. J. G. Cooper, and the other obtained near the base of the Rocky mountains, which were absolutely black, presenting a striking difference in color from those obtained by Lewis & Clark, Douglas, and others, which were brown, and of nearly the shade of the muskrat.

CASTOR CANADENSIS, Kuhl.

The Beaver.

BAIRD, Gen. Rep. Mammals, 1857, 355.

The beaver once inhabited all portions of the globe lying in the northern temperate zone; yet from England, continental Europe, China, and all the eastern portion of the United States, it has been entirely exterminated, and a war so universal and relentless has been waged upon this defenceless animal, his great intelligence has been so generally opposed by the intelligence of man, that it has seemed certain, unless some kind Providence should interpose, that the *Castor,* like his gigantic congener, the *Castoroides,* would soon be found only in a fossil state. Happily, that Providence did interpose, through a certain ingenious somebody who first suggested the use of silk in place of fur, for the covering of hats. The beaver were not yet exterminated from western America; and now since they are not "worth the killing" in those inhospitable regions where there is no encouragement for American enterprise or cupidity, we may hope that they will always there retain existence in a home exclusively their own.

In the streams flowing from the Rocky, the Blue, and the Cascade mountains—the old "stamping ground" of Bill Williams and that host of Blackfoot-hating, death-defying, "mountain men," whose adventures and escapes, half fiction and half fact, cover so broad a page of modern story—the sagacious beavers are still numerous; but it was in the fastnesses of the Cascades, one hundred and fifty miles south of the Columbia, in the clear, cold streams which, trickling down from the eternal snows, flow, now bright and sparkling, now deep and still, through mountain meadows green as emerald, and daisy-decked, in a region never before profaned by the foot of a white man, and unoccupied by savages, that we found the beaver in numbers, of which, when applied to beavers, I had no conception. The sides of these streams were literally lined with their habitations, though we never saw their houses, and seldom a dam made by them, but usually their burrows pierced the sides of the stream, a sufficiently large and long excavation being made to form warm, roomy, and comfortable quarters. From the point where these burrows terminate in the water, trails lead off to thickets of willow or pine, where the beavers find their food. These thickets exhibit the most surprising proofs of the power and industry of these animals: whole groves of young pine trees cut down within a few inches of the ground, and carried off bodily. So well was the work done that one could hardly resist the conviction that the woodman's axe had not there been plied vigorously and well. These trees, when felled, are cut into convenient lengths and carried to the burrows, there to be stripped of their bark, and then thrown into the stream. We often saw trees of considerable size cut down by the beavers; the largest which I noticed was a spruce pine twelve inches in diameter.

In California the beaver is also quite common, though less so than in Oregon. It is found in the streams flowing into the Sacramento, both from the coast range and from the Sierra Nevada. On Cottonwood creek, which comes down from the coast range, near Fort Reading, they abound, and have cut the cottonwood trees, which line the banks of the stream, of a diameter of from fifteen to eighteen inches.

To any one who has never seen the beaver in his native haunts the accounts of his mechanical skill and general intelligence, as exhibited in his dams and "clearings," must seem almost fabulous; and when he has seen these with his own eyes he cannot fail to feel that the profound respect entertained by the Indians and trappers for this sagacious animal is in a great degree deserved.

The value of beaver skins has so much depreciated that they were offered to some of our party, by the bale, at twenty-five cents each.

THOMOMYS BOREALIS.

Geomys borealis, RICH., Report British Asso. for 1836, V. 1837, 156.—(Said here to come from Saskatchewan.)
Pseudostoma borealis, AUD. & BACH., N. Am. Quad. III, 1853, 198; pl. cxlii.
Geomys townsendii, (RICH. Mss.) BACH., J. A. N. Sc. Phila. VIII, I, 1839, 105.
Thomomys borealis, BAIRD, Gen. Rep. Mammals, 1857, 396.

A single specimen of this very doubtful species was collected at Canoe creek, California. It will, in all probability, prove to be only a variety of *T. douglasii*.

JACULUS HUDSONIUS.

Jumping Mouse.

Dipus hudsonius, ZIMMERMANN, Geographische Geschichte, II, 1780, 358, (based on Pennant's long-legged mouse of Hudson's Bay.)
Meriones hudsonius, AUD. & BACH., N. Am. Quad. II, 1851, 251; pl. lxxxv.
Jaculus hudsonius, BAIRD, Gen. Rep. Mammals, 1857, 430.

SP. CH.—Above, light yellowish brown; lined finely with black; entire sides yellowish rusty, sharply defined against the colors of the back and belly. Beneath, pure white; feet and under surface of tail whitish. Body measuring 2.75 to 3.50 inches; tail, 4.50 to 6.00 inches; hind feet, 1.10 to 1.30 inches.

A specimen of this species, collected at Canoe creek, California, agrees with all other western ones in a decided superiority in size to eastern ones.

MUS DECUMANUS, Pallas.

Brown Rat; Norway Rat.

Baird, Gen Report Mammals, 1857, 438.

Introduced by the ships touching at San Diego, Monterey, San Francisco, and the ports on the Columbia river, the Norway rat has probably been for many years a resident of California and Oregon. It is now, at least, unpleasantly abundant at all these places, and seems to have been ready to sanction by its presence every step of progress made by the Anglo-American in the occupation of the interior.

At San Francisco, California, and Portland, Oregon, the brown rat swarms about the wharves and cellars in apparently as great numbers as in the Atlantic cities.

The old residents of San Francisco, that is to say, those who have been there five years, say, that formerly that port of entry was occupied by a colony of white rats, of which no specimens have, to my knowledge, been preserved. It was probably nothing more than a white variety of the brown rat which is now so common there. As most persons are aware, the house mouse (*Mus musculus*) and Norway rat are both prone to exhibit this variation of color, which is hereditary, and if the white stock can be isolated, forms a permanent variety.

I could not learn that the black rat (*Mus rattus*) has ever been a resident of the Pacific coast. The testimony in this case is, however, purely negative.

MUS. MUSCULUS, Linn.

The House Mouse.

Baird, Gen. Rep.

The little house mouse, like most other luxuries of civilization, is now enjoyed in all the habitations of whites on the Pacific coast. In the mansions of the Digger Indians probably few could be found, for the double reason that this fastidious animal would hardly find such quarters agreeable, and that the omnivorous habits of the Indians would imperil their existence. The mouse seems to have arrived with the first ships touching at the western ports, as the colonists say they have "*always*" been abundant.

HESPEROMYS GAMBELII, Baird.

California Mouse.

Baird, Gen. Rep. Mammals, 1857, 464.

Sp. Ch.—Very similar to *H. leucopus* in size and proportions. Feet perhaps shorter. Ears larger. Tail generally less than head and body, sometimes a very little longer. Above, yellowish brown, much mixed with dusky, but without a distinct broad wash of darker on the back. The entire outside of the fore leg below the shoulder white?

One specimen of this species was collected on Klamath lake, O. T.

ARVICOLA TOWNSENDII, Bachman.

Oregon Ground Mouse.

Arvicola townsendii, Bachman, J. A. N. Sc. Phila. VIII, 1839, 60.
Aud. & Bach., N. Am. Quad. III, 1853, 209; pl. cxliv. fig. 1.
Baird, Gen. Rep. Mammals, 1857, 527.

Sp. Ch.—Very large, (head and body 5½ inches.) Ears large; two-thirds as long as hind foot; well furred. Tail, including the hairs, rather less than half the head and body; the tail vertebræ twice the length of hind foot. Thumb claw conspicuous. Toes long; one-third the whole foot. Fur measuring a little over one-third of an inch, with a slight gloss.

Above, dark fuscus brown, with but little yellowish brown visible. Sides paler; beneath, ashy white. Tail almost uniformly brown throughout. Feet liver brown. Skull, 1.27 + 71, or as 100 : 56.

One specimen collected at Crater pass, Cascade mountains.

ARVICOLA LONGIROSTRIS, Baird.

BAIRD, Gen. Rep. Mammals, 1857, 530.

SP. CH.—Size large, (4½ inches.) Skull, 1.08 inch. Fur long, .55 of an inch above. Ears rather small, three-fourths the length of hind foot, sparsely coated with short hairs. Feet very short; hinder ones less than three-quarters of an inch long. Tail two-fifths the body, the vertebræ twice as long as the hind foot. Above, dull yellowish chestnut, or rufous brown, mixed with black, yet without any distinct rusty. Beneath, dirty whitish ash. Line separating the colors rather distinct. Feet light brown. Tail nearly unicolor, paler beneath at the base. Skull, 1.08 + .61, or as 100 to .55. Muzzle of skull very long. Distance between upper molars and incisors more than one-third the whole length of the skull.

The single specimen collected of this new species was found on the upper Pit river of California.

ARVICOLA MONTANA, Peale.

Arvicola montana, PEALE, Mamm. & Birds of U. S. Ex. Ex. 1848, 44.
AUD. & BACH., N. Am. Quad. III, 1854, 302.
BAIRD, Gen. Rep. Mammals, 1857, 528.

SP. CH.—Size of *A. riparia*, or a little less, (4.75 inches.) Fur about half an inch long. Ears short, as long as fore foot, about half the hinder; sparsely coated with longish hairs. Feet short: hinder ones .80 of an inch. Tail long; about two-fifths of the head and body; vertebræ more than twice as long as the hind foot. Above, dull yellowish brown, uniformly and equally mixed with black; lighter on the sides. Beneath, dull whitish ash. No rusty tints. Tail distinctly bicolor. Skull, 1.12 + .62, or as 100 : 56. Distance between upper molars and incisors less than one-third the whole length of the skull.

The numbers of arvicola inhabiting the natural meadows bordering the streams of many parts of California and Oregon are surprisingly great. The little hillocks of earth thrown up form their burrows, in some localities almost touch each other. They are particularly abundant on the banks of Klamath river and the Des Chutes, and in the mountain meadows of the Cascades. Their burrows are very deep and extensive. While one morning sitting by our camp fire, on the banks of a stream in the Cascade mountains, I noticed one of these little field mice busily throwing up earth from below while enlarging his burrow. Though numerous, they are very shy and not easy to take; having failed in my efforts to secure this one as he came to the surface, I had recourse to a measure which I had, when a boy, sometimes successfully practised on the "chipmuck" of the eastern States. It was but a step to the stream, and we had two large camp kettles, holding about three gallons each; with these, assisted by Mr. Fillebrown, I attempted to drown him out, but, though we poured at least twenty gallons of water in nearly a continuous stream into the hole, we were unable to dislodge him.

Mr. Albert H. Campbell, who spent much time in California connected with the government surveys, related to me similar efforts which he has made to drown them out, uniformly without success. Another experiment of his is equally indicative of the capacity of their burrows. The *Arvicolæ* of southern California subsist, in a great degree, on the stems of a malvaceous plant which grows to the height of three to four feet. If a stalk of this plant be cut and inserted into their burrow, it will, if all is quiet, be soon drawn down, the branches cut off, and the whole disappear. Mr. Campbell informs me that he has sometimes seen six or more of those stalks, three feet long and as large as the little finger, drawn successively into the burrow of one of these animals.

FIBER ZIBETHICUS, Cuv.

The Muskrat.

Baird, Gen. Rep. Mammals, 1857, 561.

I have yet to obtain evidence of the existence of the muskrat in California, or even in Oregon, though I suspect it may be found in some parts of that Territory. In the Sacramento valley, in the Klamath lake region, in the basin of the Des Chutes, places apparently fitted by nature to be paradises of muskrats, shallow rush-grown lakes and rush-bordered canal-like streams, just where, in the eastern States, muskrats would abound, though I looked carefully, I never saw the animal, his track, his habitations, nor even his characteristic heaps of emptied shells of *Unio* and *Anodonta*. I therefore concluded that in all this region the muskrat does not exist.

At Steilacoom, Washington Territory, and from there across the country to Fort Colville, and thence to the Rocky mountains and the head of Snake river, the "musquash" is found, if not plentifully, at least generally. Specimens from several localities which I have seen differ in nothing, to my eye, from the muskrat of the eastern States.

ERETHIZON EPIXANTHUS, Brandt.

Yellow-haired Porcupine.

Erethizon epixanthus, Brandt, Mem. Acad. St. Petersburgh, 1835, 389, 416; table i, animal; table ix, fig. 1—4, skull.—Ib. Mamm. exot. 55, (same as preceding.)
Schinz, Synopsis Mamm. II, 1845, 266.
Waterhouse, N. H. Mamm. II, 1848, 442.
Baird, Rep. Mammals, 1857, 569.

Sp. Ch.—General color dark brown, nearly black; the long hairs of the body tipped with greenish yellow. Nasal bones nearly one-half or two-fifths the length of upper surface of the skull.

The porcupine is an inhabitant of all our western territories. Most abundant in Oregon and Washington; it is not uncommon in the wooded portions of California. The fine specimen which I brought home was killed at Fort Reading, California, by Dr. J. F. Hammond, U. S. A.

The food of the porcupine is exclusively vegetable; in the eastern States, in winter, it feeds on the bark and small branches of hemlock, birch, poplar, &c.; in California, whenever driven by the snows to the trees for subsistence, it eats the cotton-wood, and in Oregon both that and the hemlock.

LEPUS CAMPESTRIS, Bach.

Prairie Hare.

Lepus campestris, Bach., J. A. N. Sc. Phila. VII, ii, 1837, 349.—Ib. VIII, i, 1839, 80.
Baird, Gen. Rep. Mammals, 1857, 585.
Lepus townsendii, Bachman, J. A. N. Sc. Phila. VIII, i, 90; pl. ii.
Aud. & Bach., N. Am. Quad. I, 1849, 25; pl. iii.
Lepus virginianus, Rich., F. B. Am. I, 1829, 224.

Sp. Ch.—Larger than *Lepus americanus*. Ears about one-fifth longer than the head. Fur soft and full, especially in winter. Tail as long as the head. Hind feet considerably longer than the head; somewhat longer than the ears.

In summer, back, rump, sides of limbs, external and internal bands of the ear, and the throat, yellowish grey, varied more or less with brown. Beneath white. Tail entirely white, above and below; in some specimens only with a faint wash of ash above. Nape and interior surface of ears white, except as stated; the latter tipped with black.

In winter, pure white all over, with a yellowish tinge. Ears white, tipped with brown; the external and internal bands rusty grey. Fur on the ears and elsewhere much longer and fuller than in summer. Fur on the upper part and sides pure white on the basal half.

The prairie or Townsend's hare is unknown in the valleys of California, though we found it a short distance south of the parallel of 42°, so that it may be said to inhabit that State. In the upper part of the Sacramento valley, and even in the hills northeast of Fort Reading, we found the "jackass rabbit" (*L. californicus*) everywhere abundant, the only *hare*, in the common acceptation of the term, known to exist there—*L. artemisiae, audubonii, and trowbridgii*, being all called rabbits. Crossing the "divide" near Lassen's butte, and coming down into the interior or Klamath basin, on the upper branches of Pit river, we lost sight of the Californian hare, to see no more of it till our return south, months afterwards. In its place, another species, almost as large, and quite as handsome, but of a bluish grey, instead of a reddish brown, began to be occasionally seen, at first very rarely, afterwards oftener, as we approached the Columbia, but never anywhere in the region we visited becoming so abundant as the Californian hare in some parts of its habitat.

I saw the first individual of this species on the shores of Wright lake. As we descended from a line of hills toward the water, a sort of stampede took place among the game of all kinds, which had congregated from a vast region of now barren or burned prairie and mountain. The air was filled with flocks of birds, ducks, waders, grouse and quails; while the guns were popping in all directions. Among the animals which fled, alarmed by those before me, I noticed a large blue-grey hare, entirely unlike anything I had before seen, running up the hill toward me. Forgetful of my horse, and of my own fatigue, and only anxious to secure the prize, I galloped around a knoll on my right to intercept him. When I crossed his track, however, he was far away, and running at a speed which, familiar as I was with the Californian hare, astonished me. This was *Townsend's hare*, further south than it had before been noticed, and near the southern limit of its range. A few days afterward Mr. Anderson shot one on the shores of Great Klamath lake, which I preserved.

The flesh of Townsend's hare, when fat, is excellent; and though living among the sage bushes, I did not notice that it had contracted any bitterness, as does the large grouse (*T. urophasianus*) which inhabits the same regions. And yet it is difficult to imagine what they can find to eat, unless it is the artemisia, for that is almost the only green thing in some localities where they are found.

All the specimens I saw of this species had the colors I have assigned to it. This was, however, as I suppose, only the summer coat. In the winter it is said to become white; in that respect differing from the Californian hare.

LEPUS CALIFORNICUS, Gray.

California Hare.

Lepus californicus, Gray, Charlesw. Mag. N. H. I, 1837, 586, (named only in Pr. Zool. Soc. Lond. IV, 1836, 88.
Aud. & Bach. N. Am. Quad. III, 1853, 53; pl. cxii.
Baird, Gen. Rep. Mammals, 1857, 594.
?*Lepus richardsonii*, Bach. J. A. N. Sc. VIII, I, 1839, 88.
Wagner, Suppl. Schreb. IV, 1844, 111.
Lepus bennettii, Gray, Zool Sulphur, Mamm. 1844, 35; pl. xiv. (In color rather nearer *L. californicus*)

Sp. Ch.—Size large. Ears and hind feet much longer than the head, (the ears longest.) Tail as long as the head. Limbs elongated, not very densely furred. Fur rather soft. Upper parts light cinnamon and black. Sides of the body anteriorly, chest, and outer surfaces of limbs cinnamon, with a slight mixture of black. Under parts whitish cinnamon on the median line, darker externally and on the inner surfaces of the limbs. Tail dull cinnamon, the upper part and a line running up a short distance on the rump, black. Extremity of the dorsal surface of the ear, with the adjacent edges, black. Internal and external bands dusky; rest of the dorsal surface of the ear, with the posterior edge, fulvous white; rest of the external surface, with the anterior fringe, pale cinnamon. Under surface of the head lighter than the chest. Bases of the hairs and fur above, greyish white; below, white; on the sides, light plumbeous. Nape, dusky greyish.

In the open country of California, either in the meadow-like plains of the valleys, or in the low hills sprinkled with oaks and clumps of "greasewood," this beautiful hare, familiarly known as the "jackass rabbit," is exceedingly common. In favorite localities, some miles from the "ranchos," in the Sacramento valley, I have sometimes seen a half dozen of them, in the morning, sporting together. Like most hares and rabbits, however, it is for the most part nocturnal in its habits, and is not often seen during the heat of the day, unless driven from its form by some alarm. It has received its common name from the enormous size of its ears, which, in some individuals that I have seen, were full seven inches in length, a size which seems ludicrously disproportionate, and when the animal runs is sure to excite laughter in one who sees it for the first time. As might be inferred from this immense auditory apparatus, the Californian hare is exceedingly timid; and were it not that he is also particularly stupid, his long ears and long legs would generally keep him out of the range of the sportsman's gun. As it is, they are killed in great numbers, and the markets of the towns are, at the proper season, well supplied with them. When fat, they are excellent eating, fully equal to any of the leporine quadrupeds.

While we were encamped at Fort Reading, California, these hares were quite numerous on the prairie near the post, and it was a favorite amusement with the members of our party to hunt them. On a surface nearly without cover it would seem hopeless to attempt to shoot animals so shy and fleet, but, fortunately, when alarmed, they were nearly as likely to run towards the hunter as from him, and so were sometimes killed.

The prevailing colors of the Californian hare are a rich chestnut brown in winter, and a lighter yellowish brown in summer, being nearly the same with those of the black-tailed deer which inhabits the same territory, and, like that deer, too, its most conspicuous mark is a black tail. It closely resembles the Texan hare (*L. callotis*) in size and color; but it is quite certain that the two species are distinct.

Like the Columbian black-tailed deer, the Californian hare is confined to the westward of the Cascade range and of the Sierra Nevada, inhabiting the valleys of California generally, and near the coast being found as far north as the Oregon line.

LEPUS ARTEMISIA, Bachman.

Sage Rabbit.

Lepus artemisia, Bachman, J. A. N. Sc. Phila. VIII, i, 1839, 94.—Ib. in Townsend's Narrative, 1839, 329.
Waterhouse, Nat. Hist. Mamm. II, 1848, 126.
Aud. & Bach. N. Am. Quad. II, 1851, 272; pl. lxxxviii.
Baird, Gen. Rep. Mammals, 1857, 602.
Lepus artemisiacus, (Bach.) Wagner, Suppl. Schreber, IV, 1844, 114.
? *Lepus nuttalli*, Bach. J. A. N. Sc. Phila. VII, 1837, 345; pl. xxii.—Ib. VIII, 1839, 79.—Ib. Townsend's Narr.

Sp. Ch.—Among the smallest of the American rabbits; considerably less than *L. sylvaticus*. Ears about as long as the head. Tail moderate. Hind feet longer than the head; very deusely padded. Fur soft and full. Above mixed black aud brownish white; the black much developed posteriorly. Sides rather paler. Thighs and rump grey. Tail above like the back. Back of the neck and fore legs rust color. Throat and sides of the neck with a tinge of pale rusty; along the edge of the abdomen this color concentrated almost into a lateral stripe; paler than the back of the neck. Edge of the ear whitish; external and internal bands greyish brown. The internal face rusty at base, then hoary, as on the exterior, for much of the surface. A narrow margin of black along the tip. Fur nowhere passing from the basal lead color to dark brown without an intermediate bar of yellowish brown.

The sage rabbit has, perhaps, the widest range of all the American species of the genus. Throughout the open country between San Francisco and the Columbia river we found it the most common species. Near San Francisco it is less abundant than Trowbridge's and Audubon's rabbits and the Californian hare, but as we proceeded to the north we left these species behind us—the first two immediately after quitting Benicia, the last in the hills of northern California—while the sage rabbit continued with us into a new zoological district, where nearly all his associates were different from those below. From the Cascade mountains it ranges eastward nearly to the Mississippi.

The sage rabbit is considerably smaller than the common grey rabbit of the eastern States, and his color is generally lighter, rather a blue than red grey, with a characteristic patch of light red thin fur on the nape of the neck. They are very numerous on the sage plains, and are hunted by foxes, coyotes, eagles, hawks, owls, and Indians.

I obtained a fine specimen on the extreme headwaters of the Willamette river, at an elevation of about 5,000 feet, which had been struck by hawk or owl and killed, but the murderer had left him, perhaps frightened off at our approach. The flesh of the sage rabbit is white and good, not at all flavored by the *artemisia* among which he lives.

Specimens were collected on Rhett and Klamath lakes.

LEPUS AUDUBONII, Baird.

Audubon's Hare.

Baird, Gen. Rep. Mammals, 1857, 608.

Sp. Ch.—Size a little less than that of *L. sylvaticus.* Ears longer than the head. Hind feet rather short, longer than the ears; fully furred beneath. Tail rather long. Above, mixed yellowish brown and black, paler on the sides and throat. Beneath, pure white. Thighs and rump greyish. Back of neck rusty; fore legs somewhat similar. Hairs lead color at the base, on the middle of the back, (over the loins,) passing directly through dark brown to black, then yellowish brown; on the sides, rump, and fore part of back, the passage into the first brown or black ring is through greyish, yellowish, or reddish brown.

This handsome hare is widely distributed over the west. It is the largest of the "rabbits" of California, considerably exceeding in size the artemisia and Trowbridge's. It is killed somewhat abundantly in the hills bordering the Sacramento valley, and is usually to be found in the market of San Francisco, where I obtained specimens.

It is about the size of the grey rabbit of the east, (*L. sylvaticus*,) and the colors are similar, though that of Audubon's hare may be called a yellowish, while that of the eastern rabbit is a brownish, grey.

LEPUS TROWBRIDGII, Baird.

Lepus trowbridgii, Baird, Pr. A. N. Sc. Phila. VII, April, 1855, 333.—Ib. Gen. Rep. Mammals, 1857, 610.

Sp. Ch.—Size small, less that of *L. audubonii.* Head small. Ears about equal to it in length. Tail very short, almost rudimentary; hind feet very short, well furred, considerably shorter than the head. Color above, yellowish brown and dark brown; beneath, plumbeous grey. Sides not conspicuously different from the back, but paler. Back of neck pale rusty. Ears greyish and black on the external band; ashy grey elsewhere, with little indication of darker margin or tip.

This pretty rabbit was first obtained by Lieut. Trowbridge, U. S. A., a gentleman who has done, perhaps, more than any other individual to develop the natural history of the Pacific coast, and to him Professor Baird has very appropriately dedicated the species. This species is quite common in the market of San Francisco, being killed in that vicinity, and is the smallest of all the rabbits which are found there. It is readily distinguishable by the remarkable shortness of its legs; its colors are darker than those of Bachman's hare or the sage rabbit, and there can be no doubt that it is a perfectly distinct species. Of its habits I could learn nothing of interest. I saw it frequently in the scattered bushes on the sand hills back of the city of San Francisco, where it resembled in movements and appearance the immature *L. sylvaticus.*

Of its distribution I can say little. To the northward from San Francisco we did not find it, and its range is probably rather south than north of that point.

Our specimens were obtained in the markets of San Francisco.

ALCE AMERICANUS, Jardine.

The Moose.

BAIRD, Gen. Rep. Mammals, 1857, 631.

The moose does not exist in any part of California or Oregon Territory, and the Columbia river may be said to form the southern limit of its range west of the Rocky mountains. We saw the horns of moose killed in Washington Territory, but could not learn from the whites or Indians that any had ever been killed south of the river.

This is one of several animals common to the two sides of the continent, such as the elk, black bear, large grey wolf, grey fox, beaver, mink, &c., which have so much of a northern habitat as to permit them to inhabit the entire breadth of the continent north of that great barrier to smaller and more southern species of mammals and birds, the great basin and the wide-spread desert of the upper Missouri, Yellowstone, and Platte.

A similar inosculation of the faunae of the east and west takes place in northern Mexico, south of the great basin, where the bassaris, the black-footed raccoon, the Texan skunk, &c., with a great number of birds, are found quite across from Texas into California.

CERVUS CANADENSIS, Erxl.

Elk.

BAIRD, Gen. Rep. Mammals, 1857, 537.

The elk was once perhaps more widely distributed over the North American continent than any other quadruped; it existed throughout the entire territory lying between the northern provinces of Mexico and Hudson's bay, and between the Atlantic and Pacific oceans. Within the United States east of the Mississippi very few are left, except in the region bordering Lake Superior. On the western tributaries of the Mississippi it is still very common, and perhaps equally so in California and Oregon. West of the Rocky mountains, it was formerly most abundant in the valleys of California, where it is still far from rare. In the rich pasture lands of the San Joaquin and Sacramento, the old residents tell us, it formerly was to be seen in immense droves, and with the antelope, the black-tailed deer, the wild cattle, and mustangs, covered those plains with herds rivalling those of the bison east of the mountains, or of the antelope in south Africa.

The favorite haunts of the elk in California are the wide stretches of "tule" bordering the rivers and lakes of the valleys I have mentioned. It is said that, unlike most large quadrupeds, the elk can never be "bogged," and he traverses these marshy districts with a facility possessed by no other animal.

During the rutting season, when the bucks are rushing through the tule in search of the females, a common mode of hunting them is to mount a horse, and riding along the edge of the marshes to call the buck by an imitation of the cry of the doe. He comes plunging on his course, marked for a long way by the trembling rushes, till, led on by the fatal signal, he bursts out of the cover with streaming sides, and, tossing his antlers, looks around to find the object of his search. This is the moment improved by the hunter to plant in his shaggy breast the fatal bullet.

The elk of the western coast differs in nothing, so far as I could see, from that of the eastern States; unless it may be that in some localities it attains a larger size than any killed in the valley of the Mississippi. Near Humboldt bay elk are abundant, and I am assured by intelligent men that eight hundred, and even one thousand pounds is not an unusual weight, and that individuals have been killed there which are said to have weighed even twelve hundred pounds. Of those which I saw, however, either killed by our own party, or brought into the market of San Francisco, none weighed over about six hundred or seven hundred pounds; but we saw the tracks of elk in the Cascade mountains which were scarcely less in size than those of a bullock.

The flesh of the elk is certainly not so good as that of some others of the cervine quadrupeds, but still is far from bad. A large, though young and fat buck, killed by Lieut. Crook, U. S. A., afforded us venison which was tender, juicy, and very sweet.

CERVUS LEUCURUS, Doug.

White-Tailed Deer.

Baird, Gen. Rep. Mammals, 1857, 649.

While traversing the region in which this problematical species has been said to exist I was constantly on the lookout for facts or specimens which should decide the question of its right to be considered a distinct species; and although I was unsuccessful in obtaining evidence which will be considered conclusive for the solution of this problem, I was able to get such evidence in the case as to convince myself, at least, that the *Cervus leucurus* of Douglas, or, at least, the "white-tailed deer" of the upper Columbia, is nothing more nor less than our *Cervus virginianus*.

At our depot camp, on the south fork of the Des Chutes river, near where we first met with the mule deer, (*C. macrotis*, *Say*,) the first and only specimen of the white-tailed deer was killed by our hunters. This was a dappled fawn, in size and markings to our eyes undistinguishable from the young of the Virginian deer. The tail was not disproportionately long, was of a reddish brown above, and pure white below, the hair on its sides being longer, so as to give it greater relative breadth than in the mule deer or the Columbian black-tailed deer; and unlike the tail in both these species, there was not a black hair on any part of it. Subsequently, when ascending the main fork of the Des Chutes, we encamped, early in the day, in a thick clump of pines, in a bend of the river. After dinner I took my gun and fishing tackle and strolled along up the stream. I saw everywhere most abundant "sign" of beaver, which seemed to occupy both sides of the river in a continuous colony. I had caught specimens of the only fishes which seemed to inhabit that part of the stream, the western speckled trout, and a new white fish, (Coregonus,) now, for the first time, found on the Pacific slope. I had been sitting very quietly for a long time, watching the motions of a brood of young phalaropes which were sporting on the stream, when, chancing to turn my head, I saw in the centre of a small prairie, not more than seventy-five yards from me, a full grown white-tailed doe. She was entirely unaware of my presence. My view was quite unobstructed, and, since I had nothing but small shot in my gun, I contented myself with a careful examination of her form and markings. She was stepping slowly along, stopping at intervals, with head raised and ears turned forward, evidently attracted towards our camp, not far distant, but completely concealed by the trees, by sounds or scents, which excited at the same time her curiosity and her fears, these two emotions being vividly represented in her animated looks and movements, and presented a picture which everyone who has seen much of this timid, yet inquisitive animal will not fail to recall. It was late in August, (the 28th,) and she had not yet shed her summer coat, which was light fulvous above, whitish below; as a whole, much lighter than Audubon's figure, or the specimen in the collection of the Philadelphia academy, in both of which the coloring of the winter coat is seen.

In size, the animal I was then observing considerably exceeded the only two specimens existing in collections, (both of which are immature,) being about that of the Virginian deer of the eastern States. I had been watching her for, perhaps, ten minutes, when I saw our guide, Bartee, approaching the prairie from the opposite side, with his rifle on his shoulder, and quite unconscious of the proximity of the game for which he had been searching. My motions to attract his attention alarmed the deer, and with a buck, which had been all the while still nearer me, she ran across the prarie, her broad white tail erect and swinging, and disappeared in the forest. The buck was larger than the doe, of the same color, with much curved, many pronged horns, and, like her, with a white tail, which did not seem disproportionately long.

We saw no more of the white-tailed deer. Among the many pairs of antlers of animals killed by the Indians which we noticed in the Des Chutes basin there were some twice forked horns, which I considered to be those of the mule deer, and others, more curved and many pronged, closely resembling horns of *C. virginianus*, which we supposed to be those of *C. leucurus*.

These facts, though not perfectly conclusive as to the existence or otherwise of such a species as *C. leucurus*, seem to indicate that the Virginian deer inhabits the western slope of the Rocky mountains with the mule deer, as they together inhabit the eastern slope of the same range, either as distinct from, or identical with, *C. leucurus*.

I will leave the discussion of this subject to others, to whom it more properly belongs, only suggesting that:

1st. *C. leucurus*, Douglas, is not now the most common species on the Willamette or Cowlitz rivers, as of those killed there by our party, or during our stay in that region, all were *C. Lewisii*, Peale, the Columbian black-tailed deer, and we were told that no other species was found there

2d. Richardson never saw *C. virginianus* in the United States; and at the north, where he locates *C. leucurus*, now *C. virginianus* is found in abundance, and *C. leucurus* is unknown. We may, therefore, suspect that he has confounded them.

3d. Lewis and Clark considered the white-tailed deer of the west as a variety of *C. virginianus*.

4th. The two animals upon which Audubon's description is based are both young and, of necessity, small, and are in dark, winter pelage. The diagnostic characters which he gives are, small size, dark color above, light below, small size of gland of leg, tuft of white hair between legs, &c.; every character being presented by the young of the Virginian deer in their winter coat.

CERVUS MACROTIS, Say.

Mule Deer.

Cervus macrotis, SAY, Narr. of Long's Exped. II, 1823, 88.
BAIRD, Gen. Rep Mamms. 1857, 656.

SP. CH.—Larger than *C. virginianus*. Horns doubly dichotomous, the forks nearly equal. Ears nearly as long as the tail. Gland of hind leg half as long as the distance between the articulating surfaces of the bone.

Hair in winter, ashy brown with light grey tips and annulations. Beneath, like the back, except about axillae and groin. Entire rump with basal two-thirds of tail all round white. The tail is cylindrical, a little longer than the ears, very slender, naked beneath, except at the end, which is a black tuft.

When exploring the course of the Des Chutes river, Oregon Territory, in September, 1855, we followed up the main fork westwardly, to its source in the Cascade mountains. On this excursion we first met with the "mule deer." As we were, one morning, winding along the river bank, we saw a doe some distance before us go down to the water to drink. Our party stopped, while Bartee crept forward to get a shot. The deer drank hastily and started directly back up the hill by the path she had descended; fearing to lose sight of her, Bartee stopped her by a shout, when she turned her head directly toward him, and he fired at the distance of two hundred yards. The deer went crashing off through the brush, and as we had plainly seen the plash of the ball in the water a long way beyond where she stood, we thought he had missed. Bartee, however, knew better what dependence to place on his eye and his Hawkins' rifle, and beckoning us to come on, he ran forward to take her trail. We followed, but with no great confidence of success. On reaching the trail, we found it blood-marked, and, before we had gone a dozen rods further, the wild death cry of the deer gave us the best possible evidence of the accuracy of Bartee's aim. When we reached the deer she was quite dead; the ball had entered the breast, traversing the lungs and the heart diagonally, and passed out near the last rib. It was a doe of rather large size, evidently suckling a fawn which she had left "cached" somewhere in the manzanita bushes; and, having gone to the river to drink, was returning with maternal haste to her charge, when the fatal bullet had deprived her of life. The incident suggested some sad reflections not readily dissipated by thoughts of our necessities, which had become pressing; but we were partially consoled by the assurance from Bartee that fawns, at that season, were old enough to shift for themselves.

This deer was new to me, and entirely different from any I had seen in California, as well as from the Virginian deer of the eastern States. From my notes, made at the time, I take the following description:

Wednesday, August 29.—Bartee killed suckling doe of rather large size, compared with Californian deer. Ears very large, (eight inches long,) rump sloping. Shedding summer coat, composed of long, coarse, reddish brown hair, which was of much the character of the hair of the antelope, like threads cut short off. Under coat soft and fine, of a bluish grey; white patch on rump, like that on antelope, but less broad. Tail of moderate length, (nine inches,) reddish-brown on top, white on sides, and black at tip, without hair below. Gland of hind legs very long. Though animal was poor, the flesh was very tender and well flavored.

This, though so great a novelty to the Californians of our party that they suggested that it must be a hybrid between the antelope and the Californian black-tailed deer, was the mule deer, *Cervus macrotis*, Say. I was then with a detachment detailed for a special purpose, and had no antiseptics for the preservation of the skin, and the zoologist of our party was in our depot camp. I carried the skin until it began to decompose, and I was obliged to content myself with the head and skin of head, legs and tail. These I preserved, and they coincide with Say's description of those parts in the mule deer of the upper Missouri.

The physical geography of the Des Chutes basin unites that territory to the Rocky mountain desert, and its fauna generally will be found to have greater affinity with that of the Rocky mountains and upper Missouri than with that of California. It is not surprising, therefore, that we find *C. macrotis* westward to the base of the Cascade mountains, or, in other words, to the base of the wall which forms the western limit to the enclosure of the interior basin.

CERVUS COLUMBIANUS, Rich.

Black-tailed Deer.

Cervus macrotis, var. *columbianus*, Richardson, F. B. Am. I, 1829, 255; pl. xx.
Cervus columbianus, Baird, Gen. Rep. Mammals, 1857, 659.
Cervus macrotis, Rich. F. Bor. Am. I, 1829, 254; pl. xx.
Cervus lewisii, Peale, Mammalia and Birds U. S. Ex. Ex. 1848, 39.
Cervus Richardsonii, Aud. & Bach. N. Am. Quad. II, 1851, 211.—Ib. III, 1853, 27; pl. cvi.
? *Cervus* (*Cariacus*) *punctulatus*, Gray, Pr. Zool. Soc. Lond. XVIII, 1850, 239; pl. xxviii.—Ib. Knowsley Menag. 1850, 67.
Black-tailed fallow deer, Lewis & Clark.

Sp. Ch.—About the size of *C. virginianus*, or less. Horns doubly dichotomous, the forks nearly equal. Ears more than half the length of the tail. Gland of the hind leg about one-sixth of the distance between the articulating surfaces of the bone. Tail cylindrical, hairy and white beneath; almost entirely black above. The under portion of the tip not black. Winter coat with distinct yellowish chestnut annulation on a dark ground. Without white patch on the buttocks. There is a distinct dusky horse-shoe mark on the forehead anterior to the eyes.

The Columbian black-tailed deer is found in all parts of California, and is the only species of which I could get any definite information in that State. Of the deer which I saw in California, living and dead, amounting to some hundreds, all were unmistakably of this species. The general colors, as given by Audubon, the black crescent on the forehead, the slender, dichotomous horns of the male, the tail black above and white below, and not like that of the Virginian deer elevated in running, but carried down and invisible—all served to mark the species distinctly, and to separate this from any deer I had seen.

Near the coast the black-tailed deer probably extends to the British possessions, as I have seen specimens from Cape Flattery and Puget's Sound, where it is common. It is also very abundant in the Willamette valley, as well as in the valleys of the Umpqua and Rogue rivers. To the eastward of the Cascade range it is rarely if ever seen, being there replaced by the mule deer (*C. macrotis*) and the white-tailed deer (*C. virginianus?*) In the interior basin, through which the Des Chutes river flows, and on the eastern slope of the Cascades, a region comparatively dry, sterile, and, in summer, hot, we found only the mule and white-tailed deers; and in crossing the Cascade range, we found only the Columbian black-tailed deer, and that very abundant.

In size this species perhaps somewhat exceeds *C. virginianus*, but the difference in that respect is not great. A full grown and fat buck will sometimes weigh two hundred pounds, but this is a very unusual size; the average weight of the buck may be set down at one hundred and twenty-five pounds; of the doe, at about one hundred pounds.

The flesh of those brought into the San Francisco market seemed to me dry and tasteless, and decidedly inferior to that of the Virginian deer, and such is, I think, the estimate generally put upon it by the inhabitants of that city; but a very large and fat buck, killed by our party on the shores of Klamath lake, furnished us with venison which we voted was as tender, juicy, and delicious as any we had ever tasted. It is barely possible, however, that abstinence and mountain air in some degree qualified our estimate of its excellence.

The colors of the black-tailed deer, of both the winter and summer coats, are brighter and handsomer than those of the eastern species.

The summer coat is composed of rather long and coarse hair, of a fulvous brown, approaching chestnut on the back; in the month of September this begins to come off, exposing what the hunters call "the blue coat," which is, at first, short, fine and silky, and of a bluish grey, afterwards becoming a chestnut brown, inclining to grey on the sides, and to black along the back. Audubon was evidently mistaken in saying that there was no glandular opening on the leg of this species, as I have found it a constant character in all the individuals which I examined in California with reference to this mark.

ANTILOCAPRA AMERICANA, Ord.

The Prong-horned Antelope.

Baird, Gen. Rep. Mammals, 1857, 666.

To any one who has "crossed the plains" the prong-horned antelope can be no stranger. Occupying the interior desert which lies between the "States" and California as its favorite place of abode; found abundantly, and, of game, almost exclusively on those arid and barren plains across which the path of the emigrant passes, it has often happened that the delicious venison of the antelope has been to the wayfarer not only a luxury, but for days and weeks a vital necessity.

Though found in nearly all parts of the territory of the United States west of the Mississippi, it is probably most numerous in the valley of the San Joaquin, California. There it is found in herds literally of thousands; and though much reduced in numbers by the war which is incessantly and remorselessly waged upon it, it is still so common that its flesh is cheaper and more abundant in the markets of the Californian cities than that of any other animal.

In the Sacramento valley they have become rare, and the few still remaining are excessively wild.

On nearly every day's march, between the valley of the Sacramento and the Columbia, we saw either the antelope itself or its peculiar track in the sand. This track differs so distinctly from that of the deer as to be recognizable at a glance. The point of the hoof is very sharp, while the hinder part of the foot is much expanded, and each half rounded posteriorly, so that the imprint of the entire hoof is elegantly cordate, the track of every species of deer being much narrower.

The antelope, though perhaps more fleet and timid than the deer, is not equally sagacious, and may sometimes be killed with surprising facility, as a single instance will serve to illustrate: At the southern end of Klamath marsh, near a splendid spring, we remained to give our animals the benefit of the good water and the fine pasturage of clover and bunch grass. We had been traversing a region occupied by great numbers of Indians, who had rendered the game very scarce, and we had been unable to obtain any fresh meat for some time. In these circumstances, Bartee, our guide, to whom a want of venison was intolerable, mounted his mare and started off, vowing that he would not return without deer or antelope. The sun was just setting, and we began to despair of our hoped-for supper of venison, when a shout from our packers, who were out picketing the mules, attracted our attention, and we soon saw the old man, who seldom hunts in vain, slowly emerging from the forest leading his horse, which was loaded with four antelope. His story was this: He had made a wide circuit without finding game, and while on his return, some five miles from camp, he had discovered through the trees a band of six antelope going to a spring to drink. Knowing they would return the same way, he concealed himself, and, as they approached, shot the leader of the band. The remainder seemed somewhat surprised, stopped, and looked around, but soon resumed their march. Bartee was ready and fired again, killing another. While he remained concealed, they were simply confused by the firing, and did not offer to run away. In this manner he killed five of the six, when, knowing that he had as much venison as his horse could carry, he spared the other, which ran off only when he came up to disembowel those he had killed.

The flesh of a young and fat antelope is delicious, but that of the older bucks is strong. The head of an antelope baked in the ground is regarded as a great delicacy, but to me it has an earthy taste that is far from pleasant.

The hair of the antelope is very peculiar, having as a general characteristic a peculiarity noticed in some portions of the hair of the elk, Rocky mountain sheep, and mule deer. It is tubular, and exceedingly light and spongy; indeed, so unlike the hair of most animals, that we hesitate to call it hair, and instinctively compare it with the quills of the porcupine, from which, however, it differs by an entire want of rigidity and acuteness.

OVIS MONTANA, Cuvier.

The Rocky Mountain Sheep.

BAIRD, Gen. Rep. Mammals, 1857, 673.

The Rocky mountain sheep is found at two points in the vicinity of our line of march from San Francisco to the Dalles of the Columbia, viz: at Shasta Butte and on the rocky hills about Rhett and Wright lakes, latitude 42°.

On the slopes and shoulders of Mount Shasta the *Ovis montana* exists in large numbers; so much so that one spur of the mountain has been named "Sheep Rock," and there hunters are always sure of finding them. It is said that the Rocky mountain goat is also to be found there, but of that I have very great doubts.

About Rhett lake I was much surprised to find the big-horn, as this sheep is there called, for the country, though rough and rocky, has very few high mountains. During the dry season, however, when much of the pasturage of the country has been burned off, and when most of the streams are dry, and water has become confined to oases in the desert, there is a great concentration of animal life in the vicinity of Wright and Rhett lakes. When we passed them in August, deer, antelope, elk, rabbits, grouse, water fowl, and waders, were exceedingly abundant, and with other animals was the Rocky mountain sheep. We saw them, but killed none; as always happens in such cases, when they came within shot no one had a gun at hand to shoot them. We, however, found their immense horns lying on the ground, and in them had conclusive evidence of their habitual presence in that locality.

In skins of the big-horn brought from the head of Salmon river by Lieutenant Day's party, I observed a peculiarity which has not been so marked in the other skins which I have seen. On the back and shoulders was a fine soft fur, which generally lies close to the skin and scarcely observable; when drawn out it forms a staple of from two to three inches in length, finer than the finest Saxony wool; while the remainder of the hair is particularly coarse and spongy, like that of the antelope.

BOS AMERICANUS, Gmelin.

The Buffalo.

BAIRD, Gen. Rep. Mammals, 1857, 682.

It will, perhaps, excite some surprise that I include the buffalo in the fauna of our Pacific States, as it is a common opinion that the buffalo is, and has always been, confined to the Atlantic slope of the Rocky mountains. This is not true; and it is to correct this impression that this note is made.

The range of the buffalo does not *now* extend beyond the Rocky mountains, but there are many Indian hunters who have killed them in great numbers to the west of the mountains, on the headwaters of Salmon river, one of the tributaries of the Columbia.

While I was at the Dalles, the party of Lieut. Day, U. S. A., came in from an expedition to the upper Salmon river, and I was assured by the officers that they had not only seen Indians who claimed to have killed buffalo there, but that, in many places, great numbers of buffalo skulls were still lying on the prairie.

This is another instance of the penetration of animals, characteristic of the upper Missouri, through into the basin lying between the Rocky mountains and Cascades. The mule and white-tailed (Virginian?) deer, the muskrat, Townsend's hare, the striped spermophile, (*S. lateralis*,) &c., seem to indicate that the Cascades present a more formidable barrier for the limitation of species than the Rocky mountain chain.

CHAPTER II.

REPORT UPON THE BIRDS.*

CATHARTES CALIFORNIANUS.

Californian Vulture.

A portion of every day's experience in our march through the Sacramento valley was a pleasure in watching the graceful evolutions of this splendid bird. Its colors are pleasing ; the head orange, body black, with wings brown and white and black, while its flight is easy and effortless, almost beyond that of any other bird. As I sometimes recall the characteristic scenery of California, those interminable stretches of waving grain, with, here and there, between the rounded hills, orchard-like clumps of oak, a scene so solitary and yet so home-like, over these oat-covered plains and slopes, golden yellow in the sunshine, always floats the shadow of the vulture.

This vulture, though common in California, is much more shy and difficult to shoot than its associate, the turkey buzzard, (*C. aura*,) and is never seen in such numbers or exhibiting such familiarity as the two species, *C. aura* and *C. atratus*, the efficient scavengers which swarm in our southern cities. We had, however, on our first entrance into the field, many opportunities of shooting this bird, but were unwilling to burden ourselves with it. After we left the Sacramento valley, we saw very few in the Klamath basin, and none within the limits of Oregon. It is sometimes found there, but much more rarely than in California. In size, the Californian vulture is second only to the condor, attaining a length of four feet, and a stretch of wing of ten feet, or more. A fine specimen was presented to Dr. Sterling on his return to San Francisco, and was for some time kept alive. He succeeded, however, in tearing from his legs the cord which confined him, and escaped. He ate freely the meat given him, and was a magnificent bird.

CATHARTES AURA.

The Turkey Buzzard.

As in all other parts of the United States, the turkey buzzard is found in California and Oregon. Not, perhaps, anywhere collected in as large numbers as are sometimes seen in the more southern of the eastern States ; the paucity of animal life being the probable cause of its rarity ; yet in the vicinity of the towns and about the great rivers it is quite common.

In the Klamath basin it is more rare ; that dry and sterile region affording few attractions

* As the final determination of the species of birds collected by the expedition has not yet been completed by Prof. Baird, the names here given are to be considered merely as temporary. In his general report upon the birds of the Pacific Railroad Surveys, hereafter to appear, the names and pages of the species in this article will all be carefully quoted, and any errors of determination thus rectified.

for it; and on the Des Chutes we saw scarce any of them; but on the Columbia their numbers increase, and below the Cascades they were very plenty.

For the purpose of examining this bird in California, to determine for myself its identity or otherwise with the turkey buzzard of the east, I took occasion to shoot one which was flying over us in the upper part of the Sacramento valley. He made no motion indicating that he had been struck by my shot, but sailed on with widely expanded and motionless wings as before. Gradually, however, he began to descend in wide and regular circles, till, finally, without a wing-flap, he settled as lightly as a feather on the prairie and remained motionless.

I went to him, and found him resting in the grass, his wings still widely and evenly expanded, but the head drooping and life extinct. It was a male, large, in fine plumage, and apparently identical with ours; then, too late, I regretted that I had been the cause of a death so calm and dignified.

HYPOTRIORCHIS COLUMBARIUS.

The Pigeon Hawk.

The pigeon hawk is common about San Francisco, where I obtained specimens, and also at San José, where it was obtained by Dr. Cooper.

We found it paired and nesting about the Klamath lakes, and it likewise occupies all the region south of the Columbia, in Oregon.

TINNUNCULUS SPARVERIUS.

The Sparrow Hawk.

Like the last, this little hawk is spread over the entire western coast. In the Sacramento valley, in the interior basin, and in the mountains and valleys of Oregon, we found it everywhere quite as abundant as in the eastern States.

In the Sacramento valley I once saw a hard fought battle between a sparrow hawk and a yellow-billed magpie; unfortunately I could not stay to see the conflict ended.

ASTUR COOPERI.

Cooper's Hawk.

Common about San Francisco and Benicia, and extending north of the Columbia.

ASTUR ATRICAPILLUS.

Goshawk.

This hawk is not uncommon about San Francisco and in southern California. We saw it but rarely on our march northward, yet I think its range extends to the Columbia.

ACCIPITER FUSCUS.

The Sharpshin Hawk.

Common in California—San Francisco, Sacramento valley, San Diego. (Lieut. Trowbridge.)

CIRCUS HUDSONIUS.

The Marsh Hawk.

This bird is rather common in the Sacramento valley, and abundant beyond all parallel on the plain of upper Pit river. I presume I saw several hundred marsh hawks, in a day's march, crossing the level prairie above the upper cañon of that stream. They were either flying over the prairie or along the stream, or sitting in pairs on the abrupt bank of the river, feeding on frogs, snakes, and mice. The range of the species extends north as far as the Columbia, and perhaps beyond.

BUTEO MONTANUS.

Western Red-Tailed Hawk.

We found this bird on the upper Sacramento, Pit river, and in the Cascade mountains of Oregon. I also saw specimens from Shoalwater bay, W. T., and San José, California, procured by Dr. Cooper; so that it may be said to inhabit all portions of our Pacific possessions.

BUTEO ELEGANS?

Red-Breasted Buzzard.

This hawk is common in those parts of northern California and eastern Oregon traversed by our party.

HALIÆTUS LEUCOCEPHALUS.

The Bald Eagle.

The bald eagle throughout the far west reigns monarch of the feathered tribes. It is not rare in California, along the Sacramento and San Joaquin rivers; is very common at the Cascades of the Columbia and at the Falls of the Willamette, Oregon, and still more abundant about the chain of lakes which cover so large a surface in the Klamath basin. We found it in the Cascade range, among the mountain lakes, and, indeed, in all places where fish, its favorite food, is attainable.

On the shores of upper Klamath lake, quite to my regret, a large number of these noble birds were shot by our party. So long, century after century, parent and offspring, had they reigned there in undisputed supremacy, with no enemy more formidable than the arrow-armed Indian, of whose missiles they had learned the range, that they exhibited little of the shyness so characteristic of the tribe to which they belong. On some point of rock, or dwarfed pine, projecting from the wall of trap which, to the height of 1,000 feet, borders the eastern shore of the lake, beyond bow shot, the bald eagles sat, and viewed our approach with calm indifference, permitting themselves to be brought within easy range of the rifles, and, too many of them, falling a sacrifice to man's passion for doing what he can, simply because he can.

The favorite fishing places of the eagles are the ripples, or rapids, of the streams, where fish, particularly salmon, lying or passing in shoal water, come within reach of their talons. At the rapids below the Falls of the Willamette a number of bald eagles may always be seen procuring their food.

The quills of this bird make better pens than those of any other I have ever seen.

PANDION CAROLINENSIS.

The Fish Hawk.

The fish hawk pursues its finny prey on all the streams and lakes of California and Oregon. Along the Sacramento it is associated with a great number of aquatic birds, cormorants, gulls, terns, &c., some of which seem strangely out of place so far inland, and after leaving all other fishing birds behind us, far up on Pit river, around the Klamath lakes, in the Cascade mountains, on the Columbia and Willamette, we still found the fish hawk, and his more powerful, but less skilful rival, the bald eagle. In the month of August we saw, in the Klamath basin, several pairs of fish hawks feeding their young, which were still in the nest, though, apparently, nearly old enough to leave it.

In the Cascade mountains we found the fish hawk, where it must have subsisted alone on fish taken from the small, rapid, trout streams; while in other localities it seeks its food in deep and wide bodies of water.

STRIX PRATINCOLA.

Barn Owl.

This owl is apparently more abundant on the western coast than in the eastern States, and more common in California than in Oregon. It is more frequently met with about San Francisco, San Diego, and Monterey, than any other species. Its habits at the west are similar to those of the eastern owls of the same species, occupying barns, out-houses, churches, &c., and, in the absence of these places of resort, living in hollow trees and holes in cliffs. I found it on San Pablo bay inhabiting holes in the perpendicular cliffs bordering the south shore. It also inhabits the Klamath basin, though apparently not in great numbers.

BUBO VIRGINIANUS, Var.?

The Great Horned Owl.

The great horned owl is one of the most widely distributed of American birds. Though less abundant than in the forests of the eastern States and Mississippi valley, it is still quite common in all parts of California, Oregon, and Washington. The specimen brought in was killed at Fort Reading by Dr. Hammond, U. S. A., who, while stationed at that post, very successfully investigated the natural history of the vicinity. I saw other specimens from southern California, and we were sometimes serenaded by its characteristic note while camping in the Cascade mountains.

BRACHYOTUS CASSINII.

Marsh Owl.

Found throughout California and Oregon, this species is especially common in the Klamath basin. On the level meadow-like prairies of upper Pit river we found it associated with the marsh hawk (*Circus hudsonius*) in considerable numbers. They were generally sitting concealed in the grass, and rose as we approached. I was much amused by the movements of one of these owls, at which I had fired unsuccessfully. A large number of hawks (*C. hudsonius*) and a large dark *Buteo* rose at the report of my gun, and flew about in circles, filling the air high over my head. The owl joined the crowd, and flew around as high and fast as the best. He was, however, evidently looked upon as an intruder, and when he came near a hawk in his circumvolutions he was sure to be buffetted; but as long as I could distinguish him, he was still sailing round among the hawks, badgered by all of them.

We found the same species again on the shores of Klamath lake and in the Des Chutes basin, among grass and sage bushes. In these localities it is very commonly associated with the burrowing owl, *Athene hypugœa*.

SYRNIUM CINEREUM.

The Great Cinereous Owl.

This large and handsome owl is generally disseminated over the western part of the North American continent, at least we obtained proofs of its existence in the Sacramento valley, in the Cascade mountains, in the Des Chutes basin, and on the Columbia, in Oregon.

NYCTALE ACADICA.

The Acadian Owl.

This little owl is found in Oregon, but we saw nothing of it in California, where it is, however, said to exist.

ATHENE HYPUGÆA.

The Burrowing Owl.

The burrowing owl is found in many parts of California, where it shares the burrows of Beechey's and Douglas' spermophile. We found it in several places between San Francisco and Fort Reading, and again in the Klamath basin, though at the northward less frequently than in the Sacramento valley. South of San Francisco, they are found at San Diego and Monterey. We usually saw them standing at the entrance to their burrows. They often allowed us to approach within shot, and, before taking flight, twisted their heads about, and bowed with many ludicrous gestures, thus, apparently, aiding their imperfect sight and getting a better view of the intruder. When shot at and not killed, or when otherwise alarmed, they fly with an irregular, jerking motion, dropping down, much like a woodcock, at some other hole.

GLAUCIDIUM INFUSCATUM.

The Sparrow Owl.

I procured specimens of this diminutive owl on the Cascade mountains, in Oregon, where it is not very uncommon. It occurs also in California, for we saw several specimens in San Francisco, which had been obtained in that State, but we did not meet with it in the Sacramento valley. It is apparently, in a great measure, confined to wooded districts, which will account for our not finding it in the open country of California.

It flies about with great freedom and activity by day, pursuing the small birds, on which it subsists, apparently as little incommoded by the light as they are.

ANTROSTROMUS NUTTALLII.

Nuttall's Whip-poor-will.

This species is found in all parts of California and Oregon. On the shores of Rhett lake we came upon the nest of this bird, if nest it could be called, in which were two young ones nearly old enough to fly. The mother fluttered off as though disabled, by her cries and strange motions leading one of our party far down the hill-side, and away from her young; which done, she flew away well and swiftly, much to his surprise. Meantime we had found the pretty creatures for whom she had been so solicitous. They resembled the young of the eastern species, which I have often found in precisely similar circumstances. They were of a grey-brown color marbled with black, had large, dark, soft eyes, and were quite passive when caught. To the credit, be it said, of the rude men into whose hands they had fallen, their mild looks and silent appeals were not unheeded, and they were carefully deposited where they were found, with a kind wish that their mother might return to them.

CHORDEILES VIRGINIANUS.

The Night Hawk.

The night hawk is common in all parts of the country which we visited, lying between San Francisco and the Columbia. We saw it nearly every evening, and sometimes during the day, pursuing its insect food precisely as in the eastern States.

ACANTHYLIS VAUXII?

The Chimney Swallow.

The chimney swallow is common in California, but we saw nothing of it in Oregon. We, however, could obtain no specimens, owing to the height at which it generally flew.

HIRUNDO RUFA.

The Barn Swallow.

Not uncommon about houses and out-buildings in California and Oregon.

HIRUNDO LUNIFRONS.

The Cliff Swallow.

Common in Oregon and California. I found it nesting in the cliffs on the shore of San Pablo bay, and in the city of San Francisco, California, and it is quite abundant in the Willamette valley, in Oregon. In the sterile basin to the eastward of the Cascade Range swallows are much less numerous than in the fertile valleys near the coast. The insects, which form their food, are also noticeably rare in the interior, and the aggregate of animal life is in all departments small.

HIRUNDO BICOLOR.

The White-bellied Swallow.

Found in the vicinity of San Francisco, California.

HIRUNDO THALASSINA.

Violet Green Swallow.

Not uncommon in the valleys of California, and on the Columbia, in Oregon.

COTYLE RIPARIA.

The Bank Swallow.

Not uncommon throughout California. We occasionally saw this and the next species occupying their characteristic burrows. We probably sometimes confounded them, as they are only to be distinguished by careful inspection.

COTYLE SERRIPENNIS.

The Rough-winged Swallow.

Found in California, and as far north as the Columbia river.

PROGNE PURPUREA, Linn.

The Purple Martin.

Not uncommon about San Francisco and the towns in the Sacramento valley.

PROGNE CHALYBEA. ?

More abundant in California than the last, and commonly mistaken for it.

CERYLE ALCYON.

The Belted King Fisher.

Common throughout California and Oregon. Dr. Gambel restricts it to the rocky shores and islands near the coast, but we found it frequenting nearly every stream in our route from San Francisco to the Dalles.

CERTHIA AMERICANA.

The Brown Tree Creeper.

Common in the wooded districts throughout California and Oregon. On the upper Des Chutes in September, apparently migrating southward.

SELASPHORUS RUFUS.

The Nootka Humming Bird.

Occasionally seen in California and Oregon, and often associated with the last.

TROCHILUS ANNA.

Anna Humming Bird.

Abundant in California.

PARUS ATRICAPILLUS. ?

The Black-capped Tit, or Chicadee.

Common throughout California and Oregon.

PARUS MONTANUS.

The Rocky Mountain Chicadee.

I saw what I supposed to be this bird feeding with the black-capped titmouse and *Sitta pygmea* among pine trees in the Des Chutes basin, in lat. 44° N., September, 1855.

SITTA CAROLINENSIS.

Carolina Nuthatch.

Common in the wooded districts of California and Oregon.

SITTA PYGMEA.

Pigmy Nuthatch.

This diminutive creeper we saw in most wooded places where water was near and any considerable amount of animal life was visible. We frequently, however, travelled for days through forests of yellow pine, where animal life was almost wholly wanting, and where no sounds, except those made by our party, or the mournful sighing of the wind in the tops of the pine trees, ever fell upon our ears. Through extensive districts, even the flutter and chirp of the omnipresent creeper was wanting ; not even the hum of a solitary insect was heard ; but everywhere a death-like monotony, a solitude and silence most depressing to the spirits and barren of results.

TROGLODYTES PALUSTRIS.

Marsh Wren.

We found the nests of this bird in the rushes on the shores of Rhett lake, and the bird in several marshes in California and Oregon.

TROGLODYTES BEWICKII.

Bewick's Wren.

Not uncommon in bushes and among fallen logs between Fort Reading and the Columbia. The "fallen timber" of the Oregon spruce forest districts, covered with the huge interlocked trunks of fallen trees, is a favorite habitat of this wren.

TROGLODYTES OBSOLETUS.

The Rock Wren.

This wren we found inhabiting piles of broken trap rock on the shores of the Klamath lakes, and on the Des Chutes river.

SIALIA OCCIDENTALIS.

The Western Blue-bird.

This interesting bird, one of the most striking of the many representative species which the eastern naturalist finds at the west, is nearly as abundant on the Pacific coast as the common blue-bird (*S. Wilsonii*) is in the valley of the Mississippi. It fills a corresponding place in the western fauna, and in all its habits is the counterpart of its eastern relative. The note and plumage are, however, slightly different, and yet so like, that, when camping on the Des Chutes, for months without a word from friends or home, I used to watch the blue-birds with peculiar interest as they came with characteristic familiarity about our camp ; when all was quiet, dropping down from a hanging branch within ten feet of us, to pick up the crumbs scattered about the camp-fire, in all their movements and their soothing note recalling vividly the scenes of other years and distant lands.

CINCLUS AMERICANUS.

The American Dipper.

This singular little bird I found only in the rapid and shallow streams in the Cascade mountains. It was always flitting along in the bed of the stream, from time to time plunging into the water and disappearing, but soon reappearing across or up or down the stream, skipping from stone to stone, constantly in motion, jerking its tail and turning its body with much the manners of the wrens, occasionally uttering a short and sharp chirp.

The only specimen I obtained was killed September 12, and in my notes I find the following memorandum relating to it: * * * * * * "Female. Length $7\frac{11}{12}$. Alar extent, $11\frac{3}{4}$. Iris, brown · pupil, black."

TURDUS MIGRATORIUS.

The Robin.

The robin is, apparently, nowhere on the Pacific coast so abundant as in the eastern States, but is generally distributed over all the region west of the Rocky mountains. While traversing the Sacramento valley we saw none of these birds, meeting with the first only when we had been some weeks out, on Canoe creek, a tributary of Pit river. Subsequently we saw them frequently and most abundantly in the Willamette valley, near the Columbia.

TURDUS NÆVIUS.

Oregon Robin.

This robin-like bird we found associated in flocks, and having much the habits of *T. migratorius,* in the Cascade mountains, and on the hills bordering the Willamette valley, in Oregon, in October, 1855.

ICTERIA LONGICAUDA?

The Yellow-breasted Chat.

This pretty bird is found rather abundantly in the Sacramento valley, about San Francisco, and south of that city, in California, where it remains through the winter. In summer it ranges to the Columbia, and northward.

TYRANNULA SAYA.

Say's Fly Catcher.

Not uncommon throughout California and Oregon.

TYRANNULA NIGRICANS.

Black Fly Catcher.

Common in northern California. Specimens were also obtained in the Umpqua valley, Oregon.

TYRANNULA CINERASCENS.

Common about San Francisco, California, where it is probably frequently mistaken for *T. crinita.*

BOMBYCILLA CAROLINENSIS.

The Cedar Bird.

We saw the cedar bird on only one or two occasions, in small numbers, in the pine forests of Oregon.

PTILIOGONYS TOWNSENDII.

This bird, like Maximilian's jay, we found only in the Des Chutes basin, though there it is very abundant.

It does not inhabit dense forests, nor prairies entirely destitute of trees, but chooses surfaces covered with a scattered growth of pine and cedar. We first met with it in the cañon of Mpto-ly-as river, at the base of Mount Jefferson.

As we picked our way with infinite difficulty down the side of this gorge, my attention was attracted by the delightful song of, to me, a new bird, of which a few were sitting in the pines and cedars which, by a precarious tenure, held a footing on the craggy face of the cliff.

The song, so clear, full, and melodious, seemed that of a *Mimus;* of the bird I could not see enough to judge of its affinities. The next day we followed down the river in the bottom of the cañon ; all day the deep gorge was filled with a chorus of sweet sounds from hundreds and thousands of these birds, which, from their monotonous color, and their habit of sitting on the branch of a tree projecting into the void above the stream, or hanging from some beetling crag, and flying out in narrow circles after insects, precisely in the manner of the fly-catchers I was disposed to associate with them.

Two days afterward, in the cañon of Psuc-see-que creek, of which the terraced banks were sparsely set with low trees of the western cedar, (J. occidentalis,) I found these birds numerous, and had every opportunity of hearing and seeing them, watching them for hours while feeding and singing, and procuring specimens of both male and female. With the first dawn of day they began their songs, and at sunrise the valley was perfectly vocal with their notes. Never, anywhere, have I heard a more delightful chorus of bird music. Their song is not greatly varied, but all the notes are particularly clear and sweet, and the strain of pure, gushing melody is as spontaneous and inspiring as that of the song sparrow. At this time, September 30, these birds were feeding on the berries of the cedar ; they were very shy, and could only be obtained by lying concealed in the vicinity of the trees which they frequented. I could detect no difference in the plumage of the sexes.

CORVUS CACALOTL.

The Raven.

The raven was a constant feature of the scenery in all parts of the country which we traversed. Even on the most sterile and inhospitable portions of the central desert, where heaven withholds her genial showers, and earth refuses every tribute to beauty or comfort, where stern and unrelenting sterility reigns supreme, and barren sands and rough and ragged rocks, bleached and burnt in the eternal blaze of a cloudless sun, sear the eye-ball, here, perched on some blasted pine, the presiding genius of the surrounding desolation, the raven always sat, and as we defiled past, over the trackless waste, gave us the malediction of his discordant croak.

CORVUS AMERICANUS.

The Common Crow.

Very abundant in the valley of the Sacramento ; less common in the highlands and wooded districts of California ; in the Klamath basin we did not see it, but it appeared again with the oaks on the Des Chutes river. There is, of course, no necessary connection between the distribution of the crows and the oaks, except that both prefer a country to a certain degree open and fertile; the association extends so far that we did not see crows except where some species of oak grew in greater or less abundance, the region of the pine forests, as well as that of the sage plains, being without them.

CORVUS OSSIFRAGUS.

The Fish Crow.

The fish crow I saw on the Willamette, Columbia, the coast, and about the bays of California, feeding upon dead fishes and mollusks.

PICICORVUS COLUMBIANUS.

Clarke's Crow.

This singular bird, the representative of the European nutcracker, (*Nucifraga caryocatactes*,) was rather common along a large portion of our route, and I was able to procure good specimens and study its habits at leisure. It is strictly confined to the highlands and mountains, never, where we saw it, descending to a lower altitude than about 4,000 feet. On the other hand, while crossing the Cascade mountains, at the line of perpetual snow, 7,000 feet above the sea level, I have seen this bird with Lewis and Clark's woodpecker, (*M. torquatus*,) flying over the snow covered peaks 3,000 feet above us. We first met with it in the spur of the Sierra Nevada, near Lassen's butte, and found it constantly, when in high and timbered regions, from there to the Columbia.

The habits of this bird are a compound, of about equal parts each, of those of the jays and woodpeckers. Its cry is particularly harsh and disagreeable, something like that of Steller's jay, but louder and more discordant. It has all the curiosity and all the shrewdness of jays or crows, and, from its shyness, is a difficult bird to shoot; indeed, I was never able to approach within shooting distance of one of them, but obtained my specimens by concealing myself, and waiting for them to "come round." Its flight resembles that of a woodpecker, and, perhaps from caution, it almost invariably alights on a dry tree. Even when going to the living tree, which furnishes it with its food, it always flys into another, a dry one, if one is near, first reconnoiters, and if the coast is clear begins to feed; but with the first movement of an intruder, without a note of any kind, it puts a safe distance between itself and its enemy.

The food of the nutcracker at the season when we visited its haunts was exclusively the seed of the yellow pine, (*P. ponderosa*,) in dislodging which from the cones containing it it displays great dexterity. Steller's jay and Maximilian's jay (*Gymnokitta cyanocephala*) were at the same time feeding on the same seeds, but not so exclusively.

GYMNOKITTA CYANOCEPHALA.

Prince Maximilian's Jay.

This jay, for a jay it is for all common purposes, and such I called it when we first found it, is limited, in the region traversed by our party, to the basin of the Des Chutes, in Oregon. The fauna and flora of this district, as well as all its climatic and geographic conditions, connect it with the central desert of the continent, a region lying along the

Rocky mountains on either side, and characterized by an arid climate and sterile soil, by plains covered with artemisia and ridges of trap rock, on which grow the western cedar (*Juniperus occidentalis*) and the yellow pine (*P. brachyptera.*) The black-tailed deer, (*C. macrotis,*) the badger, (*T. labradoria,*) Townsend's hare, the little *Lagomys,* and striped spermophile are its most characteristic quadrupeds, and the sage hen, Townsend's Ptilogonys, and Prince Maximilian's jay some of its peculiar birds.

We first noticed this bird when in depot camp, in the southern part of the Des Chutes basin, latitude 44° 12′, in the month of September.

Early every morning flocks of from twenty-five to thirty individuals of Maximilian's jay came across, with the usual straggling flight of jays, chattering as they flew to the trees on a hill near camp, then, from tree to tree, they made their way to the stream to drink. Their note, when flying or feeding, was a frequently repeated *ca, ca, cā,* sometimes, when made by a straggler separated from mate or flock, rather loud and harsh, but usually soft and agreeable; when disturbed, their cry was harsher. They were very shy, and only to be shot by lying in wait and firing as they passed. Subsequently, on the banks of Psuc-see-que creek, fifty miles further north, I had an opportunity of seeing them feeding, and was able to watch them carefully and at my leisure. They were then feeding on the berries of the cedar, (*J. occidentalis,*) and in their habits and cries closely resembled the jays. A specimen previously killed had the œsophagus filled with the seeds of the yellow pine. From this I should infer that, like the jays, they are omnivorous. I could discern no difference between the male and female.

PICA HUDSONICA.

The Black-billed Magpie.

We saw none of these birds in California, though the other species was abundant; but first met with it on the banks of Mpto-ly-as river, a tributary of the Des Chutes, about one hundred miles south of the Columbia. Subsequently we saw them, occasionally, on the Columbia, but nowhere in great numbers. If my own observations were my only guide, I should say that it was less gregarious in habit than *P. Nuttalii,* for all the birds of this species which we noticed were solitary or in pairs, while the yellow-billed magpie is often seen in flocks of several hundreds.

Nearer the coast, the black-billed magpie ranges much lower than we saw it, coming into California and occupying, over a limited area, the same territory with the other species.

In the interior basin, to the eastward of the Sierra Nevada and Cascade mountains, we saw no magpie of either species. Like the crows, they shun so sterile a region, and we found them again, with the crows, on our northward march, when we came into a more productive district. This species seemed to me more shy than the other magpie of the west. Like all the corvidae, however, the magpies are shy and wary, or impudent and familiar, as the fit takes them, or perhaps as their necessities or fancies govern them.

PICA NUTTALLI.

The Yellow-billed Magpie.

This beautiful bird inhabits the valleys of California in great numbers, but, probably, never extends its range northward as far as the Oregon line, at least I could not learn that it had ever been seen so far north; and the other species (*P. hudsonica*) seems there entirely to replace it.

The flocks of magpies sometimes seen in California are very large, containing hundreds of individuals. Their habits and manners betray distinctly their affinity to the crows as well as to the jays. All vociferous, petulant, mischievous, social, omnivorous, the unlettered observer groups these genera into one family from their habits, their flight, their attitudes, and their cries, as satisfactorily as the closet naturalist associates similarities of anatomical structure.

The American magpies resemble the European to a remarkable degree; and I recognized the magpie of California as a magpie, from his long tail and peculiar flight and cry, when too distant to distinguish his colors or form.

CYANOCITTA STELLERI.

Steller's Jay.

Steller's jay is, in size, form, and habits, the western representative of the blue jay (*C. cristata*) of the eastern States. Of a much deeper blue, and without the elegant variety of color which renders the blue jay one of the very handsomest of American birds, still, by the intensity of its tint, its more conspicuous crest, its bold, defiant air, and its excessively harsh and disagreeable cry, it challenges and secures attention and a certain amount of admiration.

It is almost exclusively confined to the hilly and mountainous districts, choosing in preference those covered with forests of pine. At certain seasons its food consists almost entirely of the seeds of the pine, particularly of *P. brachyptera*, which I have often seen them extracting from the cones, and with which the œsophagus of those we killed was usually filled.

This bird ranges at least as far north as the British line, and from the coast to the Rocky mountains. I brought in specimens from southern and northern California, Oregon, and Puget's Sound, the latter presented me by Lieutenant Trowbridge, United States army.

CYANOCITTA CALIFORNICA.

California Jay.

This is the first species of the genus which one sees on entering California by the way of San Francisco, and is the only jay known to many of the inhabitants of the valleys and open country. It occupies a lower altitude and a lower latitude than any other jay which we found in the region traversed by us.

The favorite haunts of the California jay are the trees and thickets bordering the streams in the valleys. As we ascended among the evergreen forests of the higher grounds, and passed northeasterly from the Sacramento valley, this bird left us, and long before reaching the line of Oregon we had lost sight of it entirely; nor did we find it again till our return to California months afterward.

The California jay has all the sprightliness and restlessness of the family, but is less noisy and its note is more agreeable than that of Steller's jay, (*C. Stellerii,*) which replaces it at the north.

PERISOREUS CANADENSIS.

The Canada Jay.

The Canada jay, or "whiskey jack," as he is familiarly called, descends much further to the southward on the Pacific side of the Rocky mountains than in the valley of the Mississippi. In California, we found them at the upper end of the Sacramento valley, in latitude 40°; while, in the eastern States, they rarely pass the line of 44°. This is the more surprising, as the climate still further magnifies the discrepancy, the isothermal line at Fort Reading, California, passing south of Cincinnati, Ohio. It is probable, however, that climate and temperature do not so much affect the range of this species as the presence or absence of the coniferous forests which form its favorite habitat.

As we progressed towards the Columbia, the Canada jay became more common, but always appeared to us as rather a shy bird, exhibiting none of the familiarity and impudence which have been ascribed to it, probably for the reason that our visit to that country was not in the winter, when they are made bold by hunger. I was informed that on the Columbia, when the ground is covered with snow, these birds become very fearless, obtrusive, and sometimes troublesome, through their depredations on the stores of provisions.

QUISCALUS PURPUREUS.

Common Blackbird.

Not uncommon in the vicinity of San Francisco, California.

SCOLECOPHAGUS MEXICANUS.

Blackbird.

Common in California and Oregon. I saw large flocks of them at Fort Vancouver, W. T., in the last of October. They were flying from field to field, and gathering into the large spruces about the fort, in the manner of all the blackbirds when on the eve of migration.

AGELAIUS XANTHOCEPHALUS.

Yellow-headed Blackbird.

Not uncommon in the Sacramento valley, especially during the fall and winter. We found them nesting, or, rather, with young—for the period of incubation had passed—at Pit river, and immense flocks of them swarmed in the rushes bordering the Klamath lakes.

AGELAIUS GUBERNATOR.

Red-wing Blackbird.

Very common about San Francisco and in the Sacramento valley; associated with *A. tricolor.*

AGELAIUS TRICOLOR.

Red and White-winged Blackbird.

Common in California, in the Klamath basin, and Oregon.

STURNELLA NEGLECTA.

Meadow Lark.

Meadow larks are more numerous in the Sacramento valley than in any portion of the eastern States, and are supposed by the residents to be identical with the common eastern species, (*S.*

ludoviciana,) and they do indeed strongly resemble it in markings and habit. I have even seen prepared specimens of *Sturnella* from the Sacramento valley ticketed *S. ludoviciana* by ornithologists. I am, however, strongly persuaded that among the myriads of larks which we saw, and the dozens we shot in California and Oregon, not one was identical with the eastern species. Though the plumage is very like, and all the movements, attitudes and habits are similar, I regard the whole as a beautiful example of a *representative* species. Any one who has passed his years of boyhood in intimate companionship with the birds in the meadow, the orchard, and the forest, learns to recognize the notes of each familiar one as readily as he recognizes the voices of his family friends. Such an one, though he may be momentarily deceived by a familar look, will never fail to detect the voice of a stranger. I am certain I never heard the note of *S. ludoviciana* in California. There is probably still another species in California.

ICTERUS BULLOCKII.

Bullock's Oriole.

Common in the Sacramento valley, particularly in the trees bordering streams, and on river bottoms in summer.

CHRYSOMITRIS TRISTIS.

The Yellow Bird.

This pretty bird and sweet songster was a constant source of pleasure, and, with its familiar form and note, a solace of exile in the interior of California and Oregon, far from the haunts of men, when almost everything beside was new and strange. We found it quite common to the Columbia.

CHRYSOMITRIS PSALTRIA.

Western Goldfinch.

Common in the valleys of California.

LOXIA AMERICANA.

Cross-bill.

The little cross-bill is a constant feature of the pine forests of Oregon and northern California. Often the silence and solitude of an entire day's march through the sombre monotony of the forests of yellow pine were relieved only by the low but cheerful chirp of flocks of these birds. Around the rare and widely separated watering places at morning and evening they would gather in considerable numbers to drink.

I procured specimens of both sexes at the very source of the main branch of the Willamette river, in the Cascade mountains.

ZONOTRICHIA LEUCOPHRYS.

The White-crowned Finch.

This finch I found very abundant on the bush-covered sand hills about San Francisco; in November, and more rarely during the summer, in northern California and Oregon. The plumage and especially the note of the western bird seem to identify it with the white-crowned sparrow of the eastern States.

ZONOTRICHIA AUROCAPILLA.

The Yellow-crowned Finch.

Abundant about San Francisco in winter.

ZONOTRICHIA GRAMINEA.

The Bay-winged Finch.

Common in the Sacramento valley, California.

SPIZELLA BREWERI.

Common in the Sacramento valley.

SPIZELLA SOCIALIS.

The Chipping Sparrow.

We saw this familiar sparrow occasionally in the Sacramento valley.

STRUTHUS OREGONUS.

The Western Snow Bird.

This bird we found very common in northern California and Oregon in summer, and about San Francisco in winter. In plumage and habits it so closely resembles its eastern representative as to lead me, for a long time, to consider them identical. The lonely valleys of the Cascade mountains contain large numbers of this little bird, having apparently the same habits as the eastern species.

CARPODACUS PURPUREUS.

The Purple Finch.

Common throughout California and Oregon.

CARPODACUS FRONTALIS.

Purple House Finch.

Common in the valleys of California.

OTOCORIS ALPESTRIS.

Sky Lark.

Very abundant in all the open country of California and Oregon. On the prairies of the Sacramento valley and of the Des Chutes basin, the shore larks, which rise before the traveller at every step and fill the air with their cheerful chirpings, recall the sky lark which so abounds on the moors and plains of Europe, and, by their numbers and their ceaseless twitter, give life to scenes as monotonous as the prairies of the west.

GUIRACA CŒRULEA.

The Blue Grosbeck.

This pretty and musical little bird we found only on Pit river, in northern California.

PIPILO OREGONA.

The Ground Robin.

This bird, so like the eastern "towhee bunting," we saw very frequently after leaving the Sacramento valley. It seemed to become more abundant as we progressed toward the Columbia, and on the upper Des Chutes, and on the slopes of the Cascades it was as common as the *P. erythrophthalmus* in the wood lots at home. In its habits it resembles its eastern representative as closely as in its plumage.

PIPILO FUSCA.

The Cañon Finch.

Very common in the Sacramento valley, where it frequents the banks of streams and river bottoms, scratching about in the leaves under the bushes, as our other ground finches delight to do. This habit, as well as its long tail and jerking flight from one clump of bushes to the centre of another, indicated to me its affinities, though the bird was a stranger to me, and was almost entirely silent.

On the shores of upper Klamath lake, upon one occasion I saw what I supposed to be another species of *Pipilo*, but could not secure a specimen. In my notes of August 15th I made the entry: "Saw finch, size and habits of towhee bunting; ground color, lilac, with bars of white on wings and tail; very shy; did not hear its note."

PICUS HARRISII.

Harris' Woodpecker.

Not uncommon in the wooded districts of northern California and Oregon.

PICUS NUTTALLII.

Nuttall's Woodpecker.

Common in California.

PICUS GAIRDNERII.

Gairdner's Woodpecker.

Very common in northern California and Oregon.

PICUS WILLIAMSONII.

Williamson's Woodpecker.

The only specimen which I saw of this new bird I killed in the pine forest bordering upper Klamath lake on the east. Its habits are apparently very similar to those of *P. Harrisii* and *P. Gairdnerii,* which inhabit the same region. The individual procured, when first seen, was creeping up the trunk of a large yellow pine, (*P. brachyptera,*) searching for insects in the bark. Its cry was very like that of *P. Harrisii.* When shot, though killed, he retained his hold of the bark of the branch on which he sat, as woodpeckers so often do, and I was compelled to dislodge him with the contents of my second barrel, by which he was somewhat mutilated.

MELANERPES FORMICIVORUS.

Woodpecker.

This beautiful bird, the rival and representative of the red-headed woodpecker, (*M. erythrocephalus*,) is an inseparable element of the scenery in the Sacramento valley.

While we were encamping under the wide-spreading oaks of that region I had a very good opportunity to study their habits, as they would come into the trees in the shade of which I was lying. They are not shy, and frequently came round in considerable numbers. Their manners are the very counterpart of those of the eastern "red-head," and their rattling cry is not unlike his. Like the "red-head," I have seen two or three of them amuse themselves by playing hide and seek around some trunk or branch, and, like the "red-head," too, they delight to sit on the end of a dry limb and fly off in circles for the insects which come near them. This bird is called "*carpentero*" by the Mexican and Spanish Californians, and is well known by the residents as the bird which pierces the bark of oaks and pines with holes, in which he inserts acorns, thus storing them up for future use. The holes are nicely adjusted to the size of the acorn, which, when driven in by the energetic blows of the "carpentero," can with difficulty be extracted.

The bark of the western yellow pine (*P. brachyptera*, Eng.) is particularly thick and cork-like, and is divided into plates of from four to eight inches in breadth, with smooth surfaces. Into these plates the carpentero sometimes inserts acorns in such numbers that all the trunk of the tree has the appearance of being thickly studded with wooden pegs.

The squirrels find these stores of acorns extremely convenient, and they become the occasion of unending battles between the carpentero and themselves.

The range of the species extends to the Columbia, and perhaps above, to the westward of the Cascade range, though more common in California than in Oregon. In the Des Chutes basin we did not see it, and in the Cascade mountains it is replaced by *M. torquatus* and *M. albolarvatus*.

MELANERPES TORQUATUS.

Lewis' Woodpecker.

This elegant and interesting bird, so unlike in the region it occupies, and in its retiring habits, the preceding species, seems to choose, as its favorite haunts, the evergreen forests which partially cover and conceal the ragged and rocky declivities of the Cascade and Rocky mountains.

I saw it first near Lassen's Butte in northern California, flying high in the air, when its flapping wings and its seemingly jet black color, led me to think it a crow diminished in size by distance. Soon, however, its flight brought it towards the sun, and by the reflected light, I saw that its color was of a deep and resplendent green, and recognized the bird. Subsequently we noticed them in the mountains all the way to the Columbia. Though often seen at a low elevation, it is evidently alpine in its preferences, for we found them most abundantly near the line of perpetual snow, and when crossing the mountain passes at the snow line have seen them flying far above us. While in the Cascade mountains, in September, I, one day, saw twenty or more, the greater part of them young birds, contending, half in sport and half in earnest, with a flock of robins (*T. migratorus*) for the possession of a clump of mountain ash, now covered with its crimson berries, on which they were feeding. From time to time several would meet on one of the high spruce "stubs" which stood near, and apparently, have rare fun dodging each other around it; in this and in their generic rattling note indicating their relationship to the "Red-head" of the east.

They are always shy birds, and difficult to shoot; yet elsewhere they may be less so, for, in the previously unexplored region of California and Oregon which we traversed, the birds were all much more shy and difficult of approach than those of districts populated by white men. In its fly-catching habits, this species closely imitates the Californian and eastern members of the genus.

MELANERPES ALBOLARVATUS.

White-headed Woodpecker.

This species we found only in the Cascade mountains of Oregon, where it is, apparently, not common.

COLAPTES MEXICANUS.

Red-shafted Flicker.

The Red-shafted Flicker is a rather common bird in all parts of California and Oregon which we visited. Many of its habits are identical with those of the Golden Flicker (*C. auratus.*) Like that species, he is often seen hopping along on the ground and seeking his food there, and the note, which has given to the eastern species the provincial name of "Wake up," is closely imitated by his western representative. The Red-shafted Flicker is, however, much the shyer bird.

APTERNUS ARCTICUS.

Three-toed Woodpecker

This Woodpecker we found only in the Cascade mountains, within a hundred miles of the Columbia.

GEOCOCCYX VIATICUS.

Road Runner. Paisaño.

This singular bird, which is quite common in southern California and Mexico, we found as far north as Fort Reading, at the upper end of the Sacramento Valley. It is there limited to the hilly districts, and frequents the chapparal of "*Manzanita,*" *Arbutus laurifolia*, and "Grease wood," (*Ceanothus cuneifolius,*) which, with scattered trees of the long-acorned oak and the nut pine, (*Q. longiglandis* and *P. Sabineana,*) form the vegetation of the district. The piles and ledges of trap rock give shelter to great numbers of lizards, and these appear to compose the greater part of the subsistence of the "racer," as it is called, its swiftness of foot being proverbial there, as in all localities where the bird is known.

The *Geococcyx* is found throughout the whole range of hills bordering the Sacramento valley on the east, becoming more abundant towards the south. It is frequently brought into the San Francisco market and is reported very good eating.

?? COCCYZUS ERYTHROPHTHALMUS.

The Black-billed Cuckoo.

While encamped at Fort Reading, California, in July, 1855, I frequently saw and heard the "rain crow," in the trees bordering Cow creek. I supposed it to be this species, and made an entry to that effect in my note book; but I had then nothing to do with the collections in natural history, and did not secure a specimen.

COLUMBA FASCIATA.

The Band-tailed Pigeon.

This beautiful pigeon, of the size and much the habits of the domestic pigeon, I observed at several points on our route. At McCumber's, N. E. of Fort Reading, the first was seen and killed by Dr. Sterling. There they are not rare, and, during the season of acorns, subsist on those of the scrub oak, which abounds in that vicinity. On the Columbia they were in pairs, and near the Dalles might readily be mistaken for domestic "doves."

ECTOPISTES CAROLINENSIS.

The Turtle Dove.

The turtle dove is very abundant in all parts of California and Oregon which we visited.

CALLIPEPLA CALIFORNICA.

The California Quail.

This beautiful bird is now so widely and so well known that little can be said of it which will be new to naturalists. In California it is called the "valley quail," to distinguish it from *C. picta*, which, inhabiting the hills and highlands, has received the name of "mountain quail."

The place filled in the fauna of the west by the California quail corresponds with that of the quail or partridge of the eastern States, (*Ortyx virginiana.*) It inhabits the prairies and the grain fields of the cultivated districts, and frequents the thickets which border the streams, usually in covies of from a dozen to an hundred individuals, except during the breeding season, when it is found only in pairs. Like the eastern quail, the cock bird is very fond of sitting on some stump or log projecting above the grass and weeds which conceal his mate and nest or brood, and, especially in the early morning, uttering his peculiar cry, (whistle it can hardly be called,) which represents in a Californian scene the "bob-white," that, so clear and full, yet soft, so suggestive of rural pleasures, form one of the most delightful accompaniments of the pleasant harvest time in the eastern States.

The note of the Californian quail is rather harsh and disagreeable than otherwise, and somewhat resembles that of some of the woodpeckers. It may be represented by the syllables kŭck-kŭck-kŭck-kā—kŭck-kŭck-kŭck-kā—the first three notes being rapidly repeated, the last prolonged with a falling inflection.

As a game bird the Californian quail is inferior to the eastern one, though, perhaps, of equal excellence for the table. It does not lie as well to the dog, and does not afford as good sport. It also takes a tree more readily than our quail. It is found in all the valleys of California and Oregon, both those of the interior and those which open on the coast. It is not found in the deep forests, nor in the mountains at any considerable elevation, nor in the interior basin, where water and vegetation are scarce. Of the many specimens obtained, some were killed in different parts of the Sacramento valley, at Fort Jones, and in the Willamette valley, near the Columbia. There is no appreciable difference between these specimens.

These birds make no elaborate nests, but lay a large number of eggs on the ground, and generally hatch in June. They are susceptible of domestication, and would be a pretty ornament for parks and lawns in the Atlantic States, where they would probably thrive.

CALLIPEPLA PICTA.

The Mountain Quail.

This elegant bird, so similar to and yet so unlike the partridge of Europe, is nowhere so common as to make it a valueless prize to the sportsman or naturalist. It occurs sparingly throughout the entire length of California and Oregon to, and perhaps across, the Columbia, having much the range, in a general way, of the "valley quail," (*C. californica*,) though everywhere a rarer bird, and always confined to the hills or mountains, while the species just mentioned, as its name implies, inhabits the valleys or low hills.

The habits of this bird are similar to those of the other species of the genus, but it is less gregarious and more shy. It is usually found in the chapparal, where it is put up with difficulty, choosing to gain safety by running on the ground rather than by flight.

On the first of August, at the base of Lassen's butte, I found a solitary hen, with a brood of very young chicks. The brood scattered like young partridges, uttered a piping note like that of young chickens, and, when all was still again, were recalled to the mother by a *cluck*, much like the cluck of the common hen. Until we reached the plains of Pit river we frequently saw small covies and broods of these partridges, in which the young were about half grown. In the Klamath lake basin we did not observe them, most of that country being too flat and bare. We found them again in the hills bordering the Willamette valley, and they extend from the Columbia almost uninterruptedly, but no where abundantly, through the Siskiyou, Calapooya, and Trinity mountains to California. They are favorite pets with the lonely miners, by whom they are kept in confinement, and are frequently so much admired for their trim figures, elegant plumage, and chivalrous bearing, as to command a high price. Their flesh is white and excellent, and quite equal to that of any of the family.

TETRAO OBSCURUS.

The Dusky Grouse.

The dusky grouse among American species is only second in size to the "sage hen," *T. urophasianus*. The cock is decidedly the handsomest of all American grouse, and the flesh is white, and equal to that of the ruffed grouse or the American partridge, (*O. virginiana.*)

This bird inhabits the evergreen forests exclusively, and is found not uncommonly in the Sierra Nevada, in California, and in the wooded districts of the country lying between the Sacramento valley and the Columbia.

In the Cascade mountains we found it associated with the ruffed grouse, which it resembles in habit more than any other species. When on the ground they lie very close, flying up from your very feet as you approach them, and, when flushed, always take to a tree; while sitting in the tree you may fire as many times as is necessary to hit the bird before you can dislodge it. In the spring, the male, seated motionless on a branch of pine or fir where it issues from the trunk, makes a booming call, which, by a remarkable ventriloquial power, serves rather to mislead than direct the sportsman, and unless experienced in shooting this kind of grouse, he will be likely to spend much time, with nothing to show for it, in a vain search for the bird.

TETRAO UMBELLUS.

Ruffed Grouse.

This bird we did not see within the limits of California, in the lake basin, nor in that of the Des Chutes river, but in the wooded portions of the Cascade mountains and in the Willamette valley it was very abundant, and was killed in considerable numbers by the different members of our party.

The only difference which I noticed between the specimens obtained there and those found east of the Mississippi was in color, the Oregon specimens being generally darker.

The habits of the bird are, apparently, everywhere the same. Their excellence for the table is proverbial; but from their habit of living in wooded districts they are sometimes with difficulty put up, and are usually shot on the ground—affording less exciting and legitimate sport than species which are only killed on the wing.

TETRAO PHASIANELLUS.

The Sharp-tailed Grouse.

The sharp-tailed grouse is found associated with the "prairie chicken" (*T. cupido*) on the prairies bordering the Mississippi and Missouri, and is frequently confounded with that bird by the "pot hunters," who annually destroy immense numbers of both species. It is, however, easily distinguishable by its lighter plumage, speckled breast, and smaller size, and is always the least abundant of the two species when they exist together. The range of the sharp-tailed grouse extends much further westward than that of the prairie chicken, the latter species being limited to the valley of the Mississippi, while the former is found as far west and south as the valleys of California.

Coming north from San Francisco, we first found it on a beautiful prairie near Canoe creek, about fifty miles northeast of Fort Reading; subsequently, after passing the mountain chain which forms the upper cañon of Pit river, we came into a level, grass-covered plain, through which the willow-bordered river flows in a sinuous course like a brook through a meadow. On this plain were great numbers of birds of various kinds, and so many of the sharp-tailed grouse, that, for two or three days, they afforded us fine sport and an abundance of excellent food. We found them again about the Klamath lakes, and in the Des Chutes basin quite down to the Dalles.

The flesh of this species is much like that of the "prairie hen," and, though not equal to that of the dusky or ruffed grouse, was always regarded as an acceptable addition to our bill of fare.

The bird lies close, and when flushed flies off, uttering a constantly repeated kuck, kuck, kuck, with a steady flight and considerable swiftness. It is, however, tender and easily killed, No. 4, and even No. 6, shot being, if properly directed, sure to bring them down when within moderate range. The young birds, being fat and heavy, as they fall on the grassy prairie scatter their feathers about as though torn quite in pieces, giving gratifying evidence of their fitness for the table.

TETRAO UROPHASIANUS.

Sage Cock.

This is the largest of American grouse, the male sometimes weighing from five to six pounds. It is, when in full plumage, rather a handsome bird, at least decidedly better looking than any figure yet given of it. The female is smaller than the male, and of a monotonous sober brown; but the male, brown above, is handsomely marked with black and white on the neck, breast, and wings, and has a distinctive character in the spaces of bare, orange-colored skin which occupy the sides of the neck. These spaces are usually concealed by the feathers, but are susceptible of inflation to a great size, and, when strutting in parade before the females, the neck is puffed out like that of the pouter pigeon.

This bird does not inhabit the valleys of California, but belongs to the fauna of the interior basin, or, more probably, to the Rocky mountain fauna—that of the dry, desert country lying on both flanks of the Rocky mountain chain. We first met with it high up on Pit river, at the point where we left it and crossed over to the lakes. Coming into camp at evening, I had been attracted by a white, chalk-like bluff, some two miles to the right of our trail, which I visited and examined. Near it was a warm spring, which came out of the hill-side, and, spreading over the prairie, kept a few acres green and fresh, strongly contrasting with the universal brown of the landscape. In this little oasis I found some, to me, new flowers, many reptiles, and a considerable number of sharp-tailed grouse, of which I killed several; the whole presenting attractions sufficiently strong—as we were to remain encamped one day—to take me over there early next morning. I had filled my plant case with flowers, had obtained frogs and snakes and chalky, infusorial earth enough to load down the boy who accompanied me, and had enjoyed a fine morning's sport, dropping as many grouse on the prairies as we could conveniently carry. Following up the little stream toward the spring on the-hill side, a dry, treeless surface with patches of "sage bushes," (*artemisia tridentata,*) I was suddenly startled by a great flutter and rush, and a dark bird, that appeared to me as large as a turkey, rose from the ground near me, and, uttering a hoarse *hĕk, hĕk,* flew off with an irregular, but remarkably well sustained flight.

I was just then stooping to drink from the little stream, and quite unprepared for game of any kind, least of all for such a bird, evidently a grouse, but so big and black, so far exceeding all reasonable dimensions, that I did not think of shooting him, but stood with open eyes, and, doubtless, open mouth, eagerly watching his flight to mark him down. But stop he did not, so long as I could see him, now flapping, now sailing, he kept on his course till he disappeared behind a hill a mile away.

I was, of course, greatly chagrined by his escape, but, knowing that given one grouse it is usually not difficult to find another, I commenced looking about for the mate of the one I had lost. My search was not a long one; almost immediately she rose from under a sage bush with a noise like a whirlwind, not to fly a mile before stopping to look around, as the cock had done, but, by a fortunate shot, falling helpless to the ground. No deer stalker ever felt more triumphant enthusiasm while standing over the prostrate body of a buck, or fisherman when the silvery sides of a salmon sparkled in his landing net, than I felt as I picked up this great, and to me unknown, bird. I afterward ranged the hill-sides for hours, with more or less success, waging a war on these birds, which I found to be quite abundant, but very strong winged and difficult to kill. I repeatedly flushed them not more than ten yards from me, and, as they rose, poured my whole charge right and left into them, knocking out feathers, perhaps, but not killing the bird, which, in defiance of all my hopes and expectations, would carry off my shot to such a distance that I could not follow him, even did I know he would never rise again. Here, as elsewhere, I found these birds confined to the vicinity of the "sage bushes," from under which they are usually sprung.

A few days later, on the shores of Wright and Rhett lakes, we found them very abundant, and killed all we cared to. A very fine male which I killed there was passed by nearly the whole party within thirty feet in open ground. I noticed him as soon, perhaps, as he saw us, and waited to watch his movements. As the train approached he sank down on the ground, depressing his head, and lying as motionless as a stick or root, which he greatly resembled. After the party had passed, I moved toward him, when he depressed his head till it rested on the ground, and evidently made himself as small as possible. He did not move till I had approached to within fifteen feet of him, when he arose and I shot him. He was in fine plumage, and weighed over five pounds. We continued to meet with the sage hen, whenever we crossed sage plains, till we reached the Columbia.

To the westward of the Cascade Range this bird probably does not exist, as all its habits and preferences seem to fit it for the occupancy of the sterile and anhydrous region of the central desert. Its flesh is dark and, particularly in old birds, highly flavored with wormwood, which to most persons is no proof of excellence. The young bird, if parboiled and stewed, is very good; but, as a whole, this is inferior for the table to any other species of American grouse.

GALLINULA GALEATA.

Gallinule.

I saw this bird but on one occasion, at San Francisco, and that in the month of November.

FULICA AMERICANA.

The Coot.

Abundant in all parts of Oregon and California, where it is a constant resident.

RALLUS ELEGANS.

King Rail.

Very common in the marshes bordering San Francisco and San Pablo bays, in California. At Petaluma they are very numerous, and called "mud hens." During the game season they are always to be found in the California market.

RALLUS VIRGINIANUS.

Virginia Rail.

This little rail is common along the smaller streams throughout California and Oregon.

We saw it first at Vacaville, a few miles above Benicia, and subsequently in many localities northward. I also received a specimen from Lieutenant Trowbridge, U. S. A., killed at Cape Flattery, Washington Territory.

CHARADRIUS VOCIFERUS.

Killdeer.

The killdeer plover is everywhere common throughout California and Oregon. Scarcely a day passed on our march in which we did not see them.

CHARADRIUS VIRGINIACUS.

The Golden Plover.

Perhaps less common than in the eastern States, but not rare in California and Oregon.

GRUS CANADENSI .

The Brown Crane.

This, the only species of crane which we saw at the west, is quite common, at different seasons, in nearly all parts of California and the Pacific territories. In the autumn and winter it is abundant on the prairies of California, and is always for sale in the markets of San Francisco, where it is highly esteemed as an article of food. In August, we frequently saw them about the Klamath lakes, and early in September, while in the Cascade mountains, in Oregon, the cranes were a constant feature of the scenery of the beautiful but lonely mountain meadows in which we camped.

We found them always exceedingly shy and difficult of approach, but not unfrequently the files of their tall forms stretching above the prairie grass, or their discordant and far-sounding screams suggested the presence of the human inhabitants of the region, whose territory was now, for the first time, invaded by the white man.

The cranes nest in these alpine meadows, and retreat to the milder climate of the valleys of California on the approach of winter. In Oregon they begin to move southward in October.

ARDEA HERODIAS.

Great Blue Crane.

This bird is more common in California than in any portion of the eastern States with which I am familiar. On San Pablo bay, in the Straits of Carquines, and along up the Sacramento one is rarely out of sight of them, and not unfrequently half a dozen or more are seen together, either sitting on the low trees or watching in the shoal water for their food. On Pit river, in the lake basin, on the Des Chutes, Willamette, and Columbia, we found them abundant, but nowhere so numerous as in the Sacramento valley.

Specimens were given me by Lieutenant Trowbridge, U. S. A., collected at Cape Flattery, and I have seen them from still further north. All agree closely in plumage with the eastern bird, and its habits are everywhere the same.

ARDEA OCCIDENTALIS.

The White Heron.

We saw the white egret in several different localities on our route, but most abundantly on San Pablo bay, where we killed several, and where, sitting so white and motionless at intervals along the shore, they give a peculiar character to the landscape.

They were found by us on the Columbia, and they range still further northward.

ARDEA MINOR.

The American Bittern.

The bittern, like the blue heron, is common throughout California and Oregon. On upper Pit river we saw large numbers of them.

ARDEA EXILIS.

Least Bittern.

This little heron we found rather common along the Sacramento, but not northward of the Sacramento valley.

TOTANUS FLAVIPES.

The Yellow Shanks Tatler.

This bird we saw occasionally in California and Oregon. At Rhett lake and Klamath marsh, which last is half marsh, half lake, and the resort of incredible numbers of water fowl, we found the yellow shanks abundant.

TOTANUS MELANOLEUCUS.

The Tell-Tale.

Not uncommon in the vicinity of San Francisco and on the Columbia.

TRINGA ALPINA.

The Dunlin.

Common about San Francisco and on the Columbia.

TRINGA SEMIPALMATA.

Semipalmated Sandpiper.

Common about San Francisco, California.

PHALAROPUS FULICARIUS.

We saw this species in small flocks, sometimes thirty or forty miles from land, off the coast of California, in November and December, 1855.

PHALAROPUS HYPERBOREUS.

I found this interesting bird evidently spending the summer on the upper branches of the Des Chutes river, in the Cascade mountains, in Oregon. At the time of our visit to that region the period of nesting had long passed, and the broods were living together till such time as their annual migration should commence.

I was particularly interested by the sprightly, sportive habits of these birds, and by the elegance of their movements on the water. Sometimes, as I sat quietly on the banks of the river, a little company of these neatly dressed phalaropes would float by, quite careless of the fact that they were borne rapidly down by the current, and wholly occupied in their sports, circling about each other with the ease and grace of skaters on ice, or swallows in the air. When alarmed they flew swiftly up the stream, uttering a *peet, peet,* much after the manner of the sandpipers.

NUMENIUS LONGIROSTRIS.

Curlew.

The curlew is quite abundant in the vicinity of San Francisco and throughout the Sacramento valley during the autumn and winter. In the summer and before the commencement of the rainy season comparatively few of them are found there. On our march through the Sacramento valley and northward we did not meet with it until we came down into the plains bordering Pit river above the upper cañon; here we found them in immense numbers, and they formed a valuable addition to our bill of fare. This prairie is entirely covered with water during the wet season, as is proven by the myriads of aquatic shells (*Planorbis*, *Physa*, *&c.*) scattered over the ground in the grass; and as it does not dry up so completely as the other vallies, the curlews apparently pass the summer there. Around the Klamath lakes and others of that group they were abundant in August, and we found them associated with the geese and other water birds which were congregated in countless numbers on the lowlands bordering the Columbia in October.

HIMANTOPUS N RICOLLIS.

The Black-necked Stilt.

We found this bird in large numbers on the shores of Rhett lake, on the line between California and Oregon. This lake, one of a group of which upper Klamath lake is the largest, is exceedingly shallow, and nearly half its surface is occupied by patches of "*tule*" (bull-rush,) which has given it the name by which it is sometimes called "Tule lake." These wide surfaces of shoal water and low islands, densely covered with rushes, afford most convenient retreats for a large number of swimming and wading birds, which nest and pass the summer there. Ducks, geese, herons, plovers, and sandpipers were very numerous, but the most conspicuous of all were the stilts, both for their numbers and their vociferous cries. When alarmed by the approach of our party and the firing of guns, they flew about in the greatest confusion, their long legs trailing behind them, and keeping up a loud and incessant scolding. I obtained a fine pair of these birds, male and female, which with several other desirable specimens procured at that time were subsequently lost.

The Stilt is found as far north as the Columbia, and is not uncommon in the valleys of California.

RECURVIROSTRA OCCIDENTALIS.

The Western Avoset.

Common on the marshes about the principal bays and water courses of California during fall and winter. It is then brought into the San Francisco market in considerable numbers and sold as an article of food. How great are its excellencies in this line I did not learn.

In the spring it migrates to the northward, nesting almost exclusively above the Columbia.

This species resembles in appearance, as well as in habits and cry, the *R. Americana* of the Atlantic coast, and still more than that species is like the avoset of Europe.

LIMOSA FEDOA.

Godwit.

Very common about San Francisco in the winter, and is always to be found in the market. It is also common on the Columbia near its mouth, and I received a specimen from Lieutenant Trowbridge, U. S. A., killed at Cape Flattery, W. T.

SCOLOPAX WILSONI.

Wilson's Snipe.

Wilson's snipe is shot in considerable numbers about San Francisco, and is constantly in the market during the autumn and winter. We saw them on the shores of Klamath lake, and at various points along our line of march.

SCOLOPAX GRISEA.

Red-breasted Snipe.

This species, though less common than the last, is found occasionally in California and Oregon.

CYGNUS BUCCINATOR.

Trumpeter Swan.

The trumpeter swan visits California and Oregon with its congeners, the ducks and geese, in their annual migrations, but, compared with the myriads of other water birds which congregate at that season in the bays and rivers of the west, it is always rare. Before we left the Columbia, early in November, the swans had begun to arrive from the north, and frequently while at Fort Vancouver their trumpeting call drew our attention to the long converging lines of these magnificent birds, so large and so snowy white, as they came from their northern nesting places, and, screaming their delight at the appearance of the broad expanse of water, perhaps their winter home, descended into the Columbia.

CYGNUS AMERICANUS.

Common Swan.

This bird, considerably smaller than the last, is perhaps more common at the west. In California swans are much less common than on the Columbia, where, during the winter season at least, they are exceedingly abundant.

BERNICLA CANADENSIS.

The Canada Goose.

The Canada goose, with several other species, becomes incalculably numerous in the valleys of California during the wet season. Some approach to this abundance of wild fowl is annually witnessed by the inhabitants of the prairie region of the valley of the Mississippi; but any exhibition of the kind which takes place in Illinois or Iowa is far surpassed by that of the

Sacramento and San Joaquin valleys. With the first October rain vegetation begins to spring over all these prairies, and the geese and ducks now come in. Flock after flock in increasing numbers they come, until their flights rival those of the passenger pigeon, and the heavens are always marked by their characteristic triangles, and the air filled with their cries.

The ducks descend to the bays, streams, and lakes, and almost cover the smaller bodies of water, while the geese settle on the prairie and feed upon the fallen grain of the oat, or the first tender sprigs of the springing grass, which now begins to tinge the landscape with green.

The Canada goose is two or three weeks later in its arrival than the smaller species with which it is associated, and is always outnumbered by them.

The market men of San Francisco have a fancy that the "honkers" of the west are considerably larger than those of the eastern States; but I suspect this is a mistake, probably occasioned by the great difference of size between the Canada goose and the white-fronted snow goose, &c., which are so abundant at the same time. I remarked no difference in size or markings between the geese of this species in San Francisco and those I had seen on the great lakes.

In August we found Canada geese in the marshes about the Klamath lakes and on some of the small lakes in the Cascade mountains. They evidently breed in these localities.

BERNICLA HUTCHINSII.

Hutchins' Goose.

This is the smallest and most abundant of all the geese which I saw in California. It bears a striking resemblance to the Canada goose, of which it seems a miniature copy. I do not remember to have seen any which exhibited a white ring around the neck as distinctly as in Cassin's figure of *Bernicla leucopareia,* and I can hardly suppose that the western goose, which has been called Hutchins', is, in fact, *B leucopareia,* nor that, if distinct, this is a common bird in California.

ANSER HYPERBOREUS.

The Snow Goose.

This bird, so rare in the eastern States, is exceedingly abundant in California during the winter. As far as my own observation extended, it was not, however, the most common species, its relative abundance being less than that of either *A. Hutchinsii* or *A. erythropus,* Hutchins' goose being the most abundant of all. I was much interested while on the prairies frequented by the geese in noticing the perfect harmony of intercourse which seemed to exist among the smaller species. They intermingled freely while feeding, and, when alarmed, rose without separation; and I have often seen a triangle flying steadily high over my head composed of individuals of three species, each plainly distinguishable by its plumage, but each holding its place in the geometrical figure as though it was composed of entirely homogeneous material, perhaps an equal number of the darker species, with three, four, or more pure, snow-white geese flying together somewhere in the converging lines.

ANSER ERYTHROPUS.

White-fronted Goose.

This goose, called "speckled belly" in the San Francisco market, is abundant during the winter in all the valleys of California. Like the greater part of the water fowl which arrive and depart with them, they migrate northward early in the spring, and pass the summer far above the Columbia, many of them spending the short season on the shores of the Arctic sea. With the approach of cold weather, they return toward the south, their numbers augmented by all the young of the season. They travel by stages, stopping, from time to time, in such places as afford them food, and remaining at these resting places till admonished by the frosts of the necessity of another movement. A large number remain in the valleys of Oregon during the winter, but by far the greater part pass on toward the valleys of California, where winter is almost unknown. They begin to appear in California early in October, but most of them arrive in November and December.

The present species is most highly esteemed of all the geese which come into the San Francisco market, good ones being worth from 75 cents to $1 per pair, while Hutchins' geese are worth but 50 cents per pair. These prices, where the expenses of living are so great, indicate their abundance.

The speckling of the under surface is a constant character in this species, though liable to considerable variation in degree. Among many hundreds which I examined, a few only were uniformly brown below.

ANAS BOSCHAS.

The Mallard.

Very common in all parts of the west visited by us. We found them breeding in many different localities in the interior, and on the mountain streams and lakes.

MARECA AMERICANA.

The American Widgeon or Baldpate.

Common in California, and on the Columbia and Willamette, in Oregon.

ANAS STREPERA.

The Gadwall or Grey Duck.

The gadwall is, apparently, not common in California, but I saw it occasionally in San Francisco in November and December.

DAFILA ACUTA.

The Pin-tail.

Common in California and Oregon in winter.

QUERQUEDULA CAROLINENSIS.

The Green-winged Teal.

This beautiful duck, the rival of the more gorgeous wood duck, is, like the mallard, universally diffused over the Pacific provinces. We found them breeding in the interior in summer, and congregated in great numbers, with other water fowl, on the Columbia and about San Francisco in winter.

AIX SPONSA.

The Wood Duck.

Common throughout California, Oregon, and Washington. There, as everywhere, when found, the handsomest of the family.

PTEROCYANEA DISCORS.

The Common Blue-winged Teal.

Common throughout California and Oregon.

PTEROCYANEA CŒRULEATA.

The Western Blue-winged Teal.

This elegant duck I did not see in northern California nor Oregon, and suspect it to be always rare north of San Francisco. It is very common, however, south of that point, at Monterey, San Diego, &c., and ranges to Chile, S. A.

RYNCHASPIS CLYPEATA.

The Shoveler.

The shoveler is not uncommon in winter about San Francisco, where we frequently shot them.

FULIGULA MARILOIDES.

The Scaup Duck.

Common about San Francisco and on the Columbia.

AYTHYA VALISNERIANA.

The Canvas-back Duck.

The canvas-back is generally distributed and well known throughout California and the Territories of Oregon and Washington ; and there, as in the eastern States, is the most highly prized for the table of all water birds. In the autumn and winter they congregate in large numbers with other ducks on the bays and rivers of California. At such times the San Francisco market is well supplied with them, and they command a price of from one dollar to one dollar and fifty cents the pair.

During the summer we found them more numerous than any other ducks in the lakes and streams of the Cascade mountains. In those solitudes they nest and rear their young, as we frequently saw the broods of young there, though the period of incubation had passed. They were common in the marshes bordering the Columbia in November, when, with geese and other ducks, they begin to retreat southward before the approaching winter. The number of canvas-backs which we saw while duck-shooting in the bays of San Francisco and San Pablo was astonishing.

The specimens which I obtained there seemed not to differ appreciably from those of the Atlantic coast ; and even if it should be true, as some would have us believe, that the bird is there inferior in flavor to those of Chesapeake bay and the New Jersey marshes, I can testify that the western canvass-backs are quite eatable.

AYTHYA ERYTHROCEPHALA.

The Red-head.

This duck, like the canvas-back, is common in the San Francisco market, and, as everywhere else, is often sold and eaten *as* canvas-back. It is, however, an excellent bird for the table, and the cheat is not so bad after all, especially as very few of those who eat them could tell the difference by the flavor, unless the two species were brought to the table together.

CLANGULA AMERICANA.

The Golden Eye.

Common in California and Oregon.

CLANGULA ALBEOLA.

The Buffle Head.

This pretty little duck, a kind of small edition of the golden eye, is very common about San Francisco, and is, perhaps, most familiar of all the ducks found there. It dives with great facility, and is not always readily killed when on the water. Like the golden eye, it is much more certainly secured by a shot while on the wing.

HARELDA GLACIALIS.

The Long-tailed Duck.

This Arctic species descends into California only during the severest cold of winter, and then only in inconsiderable numbers. It is rarely seen at San Francisco, but is common in winter at the mouth of the Columbia and on Puget's Sound.

OIDEMIA PERSPICILLATA.

The Surf Duck.

This sea duck is common about San Francisco, along the coast, and on the lower Columbia.

OIDEMIA FUSCA.

The Velvet Duck.

Common on the coast of California and Oregon.

OIDEMIA AMERICAN .

Scoter Duck.

Very abundant about San Francisco in winter.

The three preceding species of marine ducks, though more abundant during the winter than any other water fowl, are never brought into market, being considered too fishy and strong to be eaten even by the Chinese.

MERGUS CUCULLATUS.

The Hooded Mergauser.

Not uncommon in the vicinity of San Francisco; I did not see it elsewhere, but it is said to occur generally on the western coast.

MERGUS SERRATOR.

The Red-breasted Mergauser.

Abundant about San Francisco in winter. It is also common on the Columbia during part of the year. I frequently saw these birds in the markets, but suspect no one eats them but the Chinamen.

LARUS EBURNEUS??

While in depot camp, on the Des Chutes river, 150 miles south of the Dalles of the Columbia, a beautiful white gull, which I supposed to have been of this species, was killed by Lieut. Crook, United States army, and brought to me. The specimen was afterward unfortunately lost, but my notes and recollections satisfy me that this was the bird. We were, at that time, two hundred miles from the ocean, and not nearer than about one hundred miles to any considerable body of water, the nearest being the Klamath lakes.

LARUS BONAPARTII??

Bonaparte's gull was not common in the coast of California during my visit, though their range is said to extend to the Columbia. On my return, in December, I noticed numbers of them in the bay of Panama, where they were fishing with the pelicans and often stealing from them.

LARUS CALIFORNICUS??

This gull seems to occupy, in its migrations, the entire western coast of North America. At the mouth of the Columbia, October, 1855, I observed them "sponging" their subsistence from the pelicans; and in November, in the bay of San Francisco, I again saw them similarly occupied. Compared with the associated species, these birds are generally rare.

LARUS GLAUCESCENS?

This gull is not very common in those parts of California and Oregon of which I had opportunities of studying the water birds. A few of them followed the steamer in the passage from the Columbia to San Francisco, and subsequently from San Francisco southward. They are, apparently, nowhere as abundant as the western herring gull, (*L. occidentalis.*)

LARUS HEERMANNI.

This pretty gull inhabits the bays and rivers of California quite generally, but nowhere in great abundance. We saw them at the junction of Feather river and the Sacramento more abundantly than elsewhere. On a rocky island, at the entrance of San Pablo bay, I shot one of these birds, in the dark plumage, and he fell on the rocks apparently dead; in a few minutes he manifested signs of life, and I took special pains to go to him and kill him as I thought very dead; half an hour after I was slightly surprised to see him take wing and fly off as smartly as ever, his intellect, however, was evidently disturbed, for he mounted as directly upward as possible, and as long as I could see him he was still ascending, going up till lost in the distance.

LARUS OCCIDENTALIS?

This is almost the only gull about the wharves of San Francisco, and is there incredibly abundant, sometimes almost filling the air and covering the water among the shipping. It has very much the appearance of its eastern representative, and is equally familiar, gluttonous, and noisy.

The shores of the bays of San Francisco and San Pablo are sometimes for many rods whitened with these birds, either seeking their food along the water's edge when the tide is out, or, when it is full, sitting lazily in groups, apparently waiting for the ebb.

It is found following up the course of the Sacramento for a hundred miles or more, and along the coast extends its range to the mouth of the Columbia and above. It is abundant at the Farallones, where it breeds, and we saw what I supposed to be the same species, but apparently smaller and the colors all brighter, down the coast to Acapulco and below, following the steamer in numbers especially large off the island of San Marguerita, being there accompanied by the ring-billed gull (*L. zonorhyncus?*) and the short-tailed albatross (*D. brachyurus.*)

DROMEDEA NIGRIPES.

Black-Footed Albatross.

This albatross, of which I obtained a young specimen, agreeing in every respect with Audubon's description of *D. nigripes*, is abundant along the entire Pacific coast, from the mouth of the Columbia to Cape St. Lucas. How far to the north it ranges I am unable to say, but it is found, at least, as far up the coast as the Russian possessions. It may also descend lower than the entrance of the Gulf of California, but in going up the coast we first noticed them at about that latitude, and, coming down, we had more or fewer of these birds in sight all the way from Astoria to San Francisco, and subsequently from San Francisco southward, till we passed Cape St. Lucas, when they gradually left us, and we saw them no more. A marked change in the temperature takes place in passing this point, usually requiring a change in the clothing of the passengers on the steamers, so that it is probable this is the natural southern limit of the range of this species in that sea.

TACHYPETES AQUILUS.

The Frigate Pelican.

These birds are quite common off the coast of California. While on the steamer we frequently saw them floating about, high in the air, their wings entirely motionless and seeming as though sustained by their own specific gravity. If, however, the busy throng of gulls, so carefully sweeping the sea for fish or carcass far below, were called together by the discovery of anything of that kind, as swift as an arrow from a bow the frigate pelican would shoot down into their midst to share the spoil.

I had no opportunity of testing the stories told of the piratical attacks of this bird upon the defenceless gulls, as I never saw one descend near the ship.

PHAETON AETHEREUS??

The Tropic Bird.

The tropic bird is not uncommon from lower California to Panama. Its pure white color, its fluttering flight, like that of a butterfly, and its long, streamer-like tail feathers will serve to point it out to the traveller.

CARBO PENECILLATUS.

Green Cormorant.

Of this splendid species a fine specimen was presented to us by Dr. Ayres, of San Francisco He obtained it at the Farallone islands, from which he returned on the day of our arrival in the city.

We did not find it anywhere along the coast, (though doubtless it visits the shore,) and it is evident that its favorite habitat is the rocky islands which lie scattered along, at greater or less distances from the main land of California, and of which the Farallones are the most conspicuous group.

Subsequently, on our return voyage from San Francisco to Panama, when several days out, a number of large, green cormorants, apparently of this species, at different times attempted to come on board. They would fly round and round the steamer, and when arrived in front of the bow would turn and fly directly aboard, hovering over the heads of the passengers who covered the decks, seeking a vacant spot on which to alight. Several times they perched upon the rigging, and, ultimately, one in desperation, flew directly in among the crowd of passengers standing on the bow of the boat, I ran forward to secure the specimen, when I saw him disappear over the side, where he was knocked by a brute—*not* one of the beef cattle. He went under the wheel, and, greatly to my regret, was killed, and I could not secure him. What can be the impulse which leads these birds to forget all their natural fear of man, and in spite of the smoke, the motion of the walking beam, and of the steamer, and the cries of the passengers, to persist in throwing themselves into their midst it is difficult to imagine. It may be hunger, for we were far from land, or it may be fatigue from long flight—a flight which they were only willing to terminate by rest on some solid foundation. Whatever the cause, the fact is of frequent occurrence, as I learn from the officers of the ship.

CARBO TOWNSENDII?

While collecting birds in the vicinity of San Francisco, I heard that, in San Pablò bay, a white-breasted cormorant was to be found in great numbers. As I had no knowledge of a bird answering to their description I resolved to go and secure specimens. I therefore chartered the good ship "Maid of the Mist," Duncan, master, of five tons burden, and getting aboard the necessary stores for the voyage, set sail for that unknown sea. Many were the ludicrous incidents, hardships, and vexations of that eventful trip. Among its experiences were a night spent in the fog of the straits, and another, a beautiful Saturday night, which came down upon us so calm and still as if deserted by the "fickle Maid of the Mist." We held a council in an open boat, in the geographical centre of San Pablo bay; after hours hard pulling, guided by the stars, we reached the ancient capital of the western empire, Vallejo. Though a large part of the spoils of that chase were lost through the vandalism of our skipper, who would throw overboard what was not good to eat; still I saved from the general ruin a sufficient number of the so-called "white-breasted cormorant." These cormorants were all of one species, and innumerable. I noticed a considerable variation in the amount of white on the breast, in some it was entirely wanting, while in others it was very conspicuous, as they sat on the rocks or flew over our heads.

I saw great numbers of the same species near Astoria, at the mouth of the Columbia.

I detected nothing peculiar in their habits.

SULA BASSANA.

The Gannet.

While making the passage from San Francisco to Panama more or less of these birds were in sight from the steamer nearly every day of our voyage. They range from California to the isthmus.

SULA FUSCA.

The Booby.

The boobies are still more common than the gannets off the coast of California. On our outward voyage, with their characteristic stupidity, several of them came on board, apparently with no better motive than to gratify their curiosity, and when on the deck had no power to rise again.

PELECANUS FUSCUS.

Brown Pelican.

The brown pelican is very abundant on all parts of the Pacific coast which I visited. In the bay of Panama they are particularly numerous. At Acapulco a few may always be seen, while at the Golden Gate and the mouth of the Columbia their numbers are surprisingly great, and their goblin figures, flitting about, all head and wings, are inseparably connected with my remembrances of those localities.

This pelican is exclusively confined to the seacoast, and is never found, at least so far as my own experience goes, on the inland waters. On the contrary, the white pelican is almost as exclusively confined to the interior, and to bodies of fresh water.

About San Francisco, both outside of the Gate and on the bay, when near or on the water, one is scarcely ever out of sight of the brown pelican ; yet I never saw the white pelican while residing there. It was only on going up into the interior, on Suisun bay and the Sacramento river, that we found the white species entirely replacing the brown.

On San Pablo bay the two species meet and mingle.

At the Golden Gate the habits of the brown pelican may be studied quite at one's leisure. Like many other aquatic birds, at nightfall they seek the broad expanse of the open sea, where they may float in safety and sleep rocked by the gentle swell of the ocean. Near the shore they would be exposed to the attacks of various foes ; the turbulence of the breakers is, probably, not invocative of sleep, and, strange as it may seem, birds, as well as ships, unless ensconced in some snug harbor, are safer in a storm with a good offing. In every severe storm occurring upon the western coast more or less pelicans, ducks, and grebes are thrown wrecked and drowned upon the shore. This will be less wondered at than that fishes, the natural inhabitants of the watery element, should in great numbers share the fate of the birds.

After passing the night at sea, in the grey dawn of the morning the pelicans begin to move, trailing in long lines, just above the surface of the water, toward the shore, where they find their food. While shooting in the vicinity of San Francisco I passed several nights on the water in a little schooner which we had chartered for the purpose. As the day began to dawn, and the mist slowly to lift from the surface of the water, the birds which had flown seaward the evening before began to return. The long lines of uncouth and ghostly pelicans, dimly seen through the fog, slowly flapping their huge bat-like wings in funereal rank and silence, losing themselves again in the fog, formed a vision peculiarly spectral and unreal.

The habits of the brown pelicans of the Pacific coast agree closely with those of the pelicans inhabiting the Gulf of Mexico, described by Audubon. Their mode of fishing is the same. When flying along, perhaps twenty feet above the water, from time to time, with a spiral gyration, they plunge, sometimes quite beneath the surface, after their finny food, and almost invariably with success.

Like the pelicans of the Atlantic, those of the west are compelled to fish for the gulls, too idle to supply their wants by their own efforts, at least while they have so patient and efficient friends as the pelicans, from whom they can sponge their living. At the mouth of the Columbia the pelicans which I saw fishing were always attended each by one or more small gulls, (*L. Belcheri.*) These gulls followed the pelican in its flight, and settled at its head when it made a successful plunge, snatching up any fish that might fall from its capacious gular sack. I did not notice that the pelican ever displayed the least resentment of the officious attentions of these little depredators. When, in December, we entered the bay of Panama, the brown pelicans were paying tribute to the black-headed gulls, the same which, according to Audubon, follow the pelicans in the Mexican Gulf.

A large number of the individuals of *P. fuscus*, which I saw on the western coast, were young birds in brown dress, and I was able to obtain specimens exhibiting three phases of plumage: 1st, ashy brown above and white below; 2d, ashy brown above and whitish brown below; 3d, head and neck all pure white, except a slight tinge of yellow in the cheeks; back and base of neck silvery gray, feathers white at centre, ashy on their margins. Of the many thousands which I saw, none exhibited the phase of plumage given by Audubon as that of the mature bird, viz: neck, half dark brown and half yellowish white, the colors occupying longitudinal divisions. I had Audubon's works in San Francisco, and examined the pelicans with particular reference to his descriptions, and I was so confident that no such bird as his mature *P. fuscus* was to be found in that locality, that I was disposed to regard the brown pelican of the Pacific as distinct from that of the Atlantic.

It is perhaps not generally known that the fishes on which the pelican subsists are usually of very small size, large numbers of them being taken at every plunge. In the pelicans which I shot about San Francisco, I found in some cases the stomach distended with a quart or more of little fishes, from one to four inches in length; and it was rare that I found any remains of large individuals.

The pelican has in its greatest development the apparatus which gives buoyancy to many swimming birds. I allude to the system of sub-cutaneous air cells. In the brown pelican the skin is separated from the muscles over a large part of the surface, by an interval of half an inch or more, wholly occupied by a series of membranous air vessels.

PELECANUS TRACHYRHYNCHUS??

The White Pelican.

The white pelican, though generally distributed over the country west of the Rocky mountains, is far outnumbered by the brown species. Their habitats are, however, quite distinct, and they do not often come in competition in the pursuit of their aquatic food.

The white pelican is rarely or never seen at San Francisco, at Astoria, or at any other place on the coast where the brown are so abundant; but as one leaves the coast, penetrating the interior, on all the large rivers and inland lakes he will be sure to find it, though never in great numbers. It seems to occupy the inland lakes and rivers quite across the continent, and is evidently a fresh water bird; while the brown species is as exclusively confined to the vicinity of salt water. While encamped on Klamath lake we several times saw flying over the tule marshes which border it a large white pelican, of which the wings seemed almost entirely black. It might have been the present species, but appeared to be distinct.

COLYMBUS GLACIALIS.

Loon.

The loon inhabits all the waters of California and Oregon. The mountain lakes of the Cascade range we generally found occupied by one or more of these birds. Sometimes a single one, the only living thing visible, sailing slowly around over the surface, and from time to time raising its wailing cry, seemed the very embodiment of solitude.

When encamped beside one of these lonely lakes the silence of the night was frequently broken by the quavering cry of the loon, which came to us echoed from forest or mountain with an effect indescribably touching and sad.

PODICEPS OCCIDENTALIS.

Western Grebe.

I obtained specimens of this beautiful grebe on San Pablo bay, California, in November. On the lakes of the interior we saw nothing of it. It is probably nearly confined to the immediate vicinity of the coast. It occurs at the mouth of the Columbia.

PODICEPS ———?

Exceedingly abundant about San Francisco, and extending up the streams far into the interior. It is also common on the Columbia and the interior lakes of Oregon. This and the next species are sometimes brought into the markets of San Francisco, but are so "fishy" as to be uneatable.

PODICEPS CALIFORNICUS.

Common in the bays and streams of California and Oregon.

URIA TROILE.

The Foolish Guillemot.

This guillemot is exceedingly abundant along the coast of California, particularly in the rocky islands which lie in the Pacific, near the coast. At the Farallones they exist in great numbers, exhibiting the same tendency to congregate at the breeding season, and the same stupidity or devotion to their duties which has elsewhere earned them the name they bear. In the absence of domestic fowls in California, the demand for eggs in San Francisco has been almost entirely supplied from these islands, and a trade amounting to many thousands of dollars a year is kept up in eggs alone. The greater part of these eggs are those of the foolish guillemot.

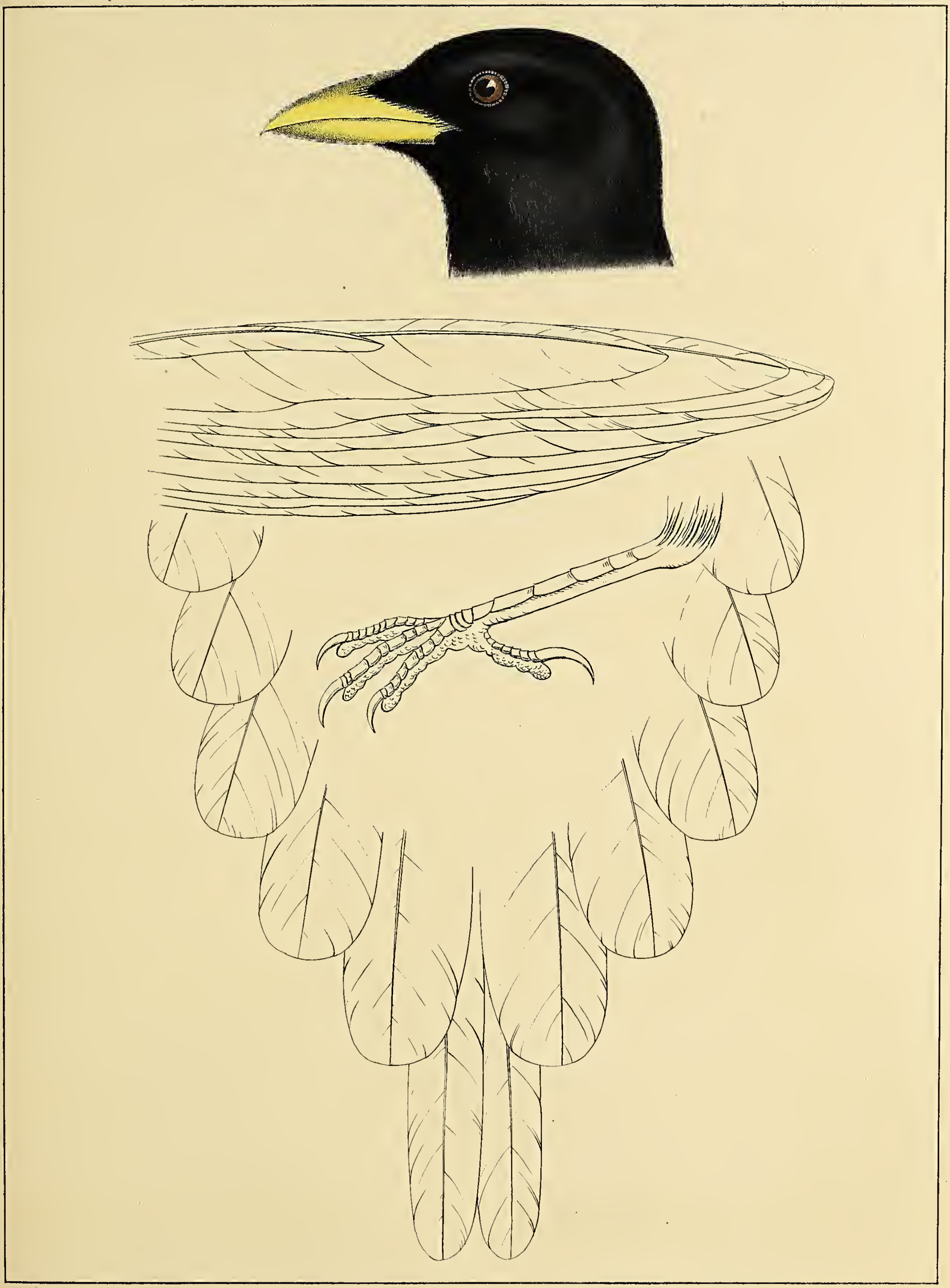
URIA ———?

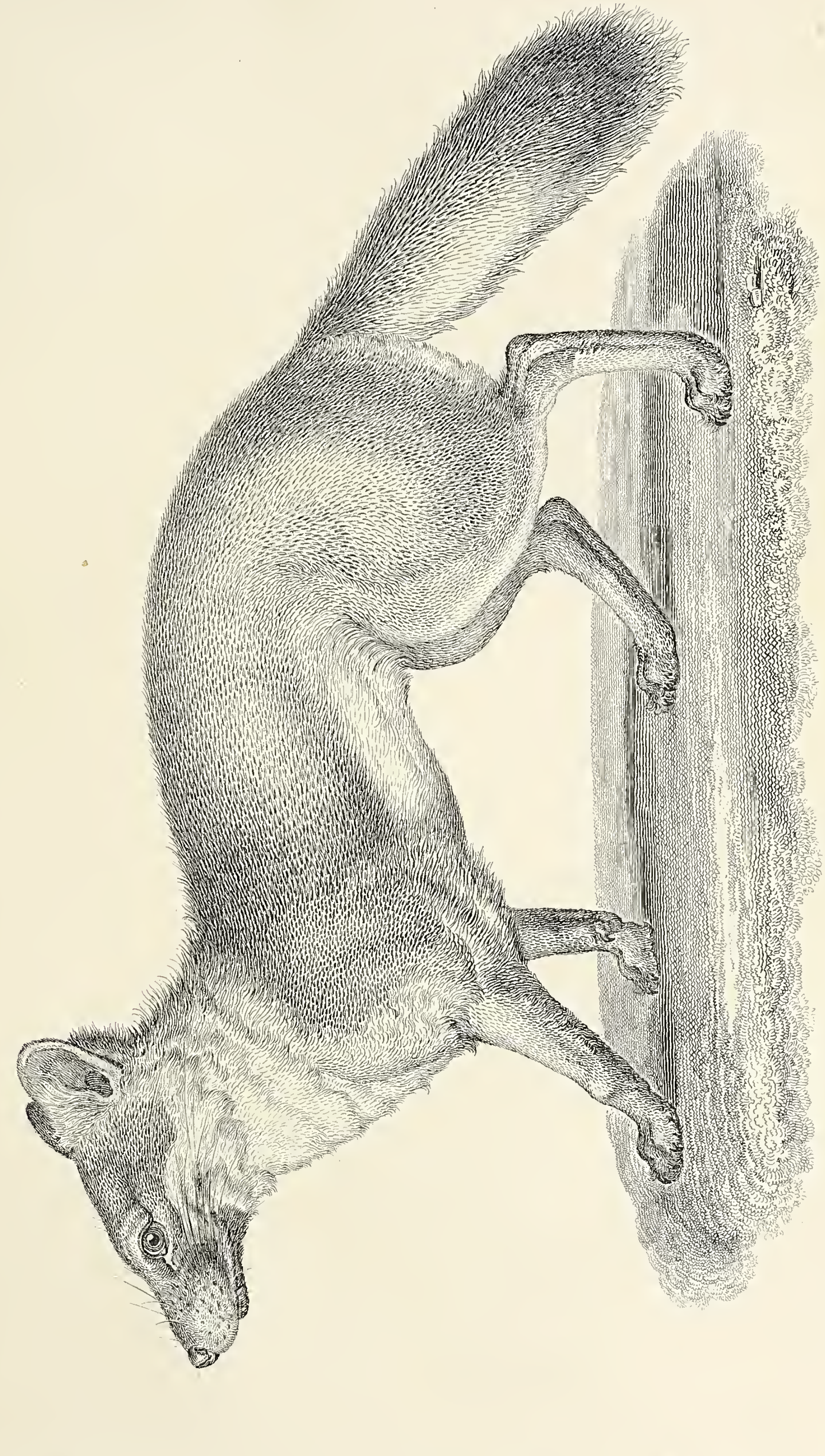
This small guillemot is not uncommon on the California coast.

MORMON CIRRHATUS.

Puffin.

I saw this bird only on two or three occasions in California. It is confined to the coast, and chooses in preference the rocky islands off shore. At the Farallones it is abundant, still more so along the coast northward.





J.H.Richard del. R.Metzeroth sc.

Fig. 1

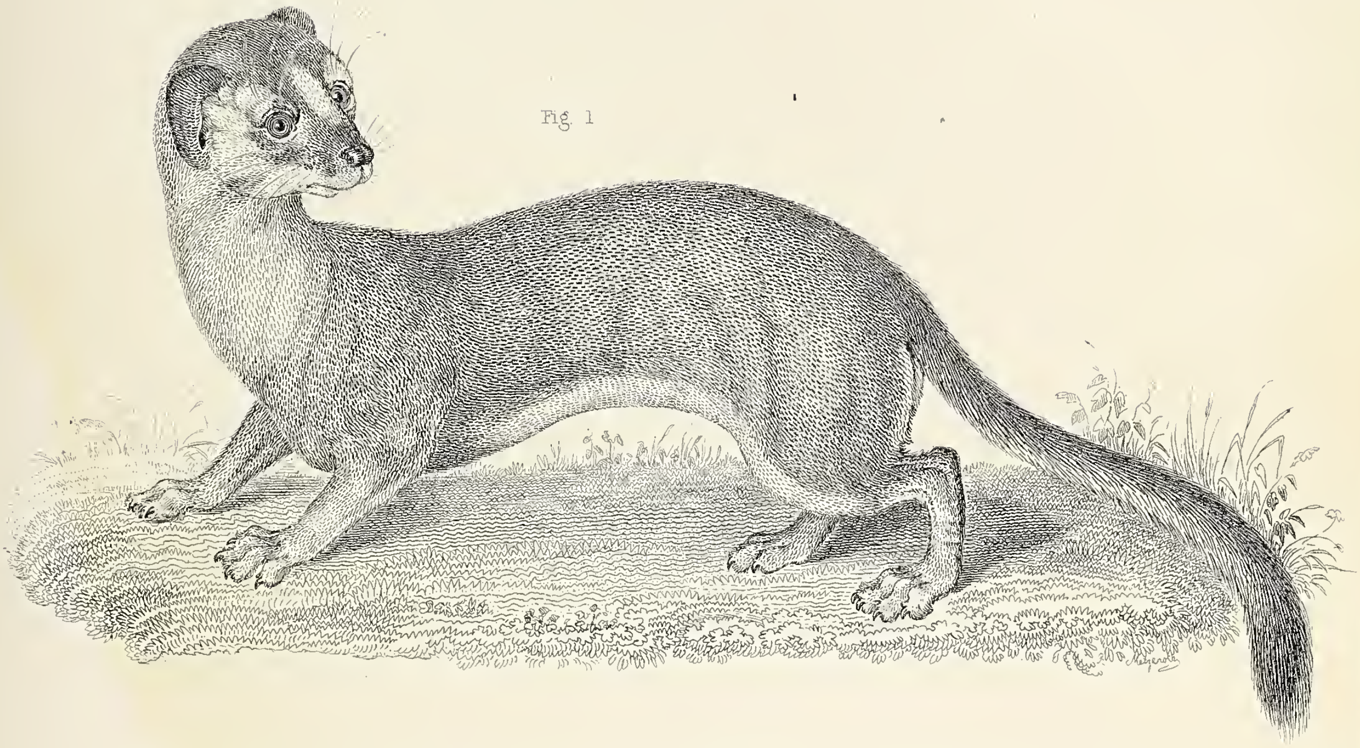
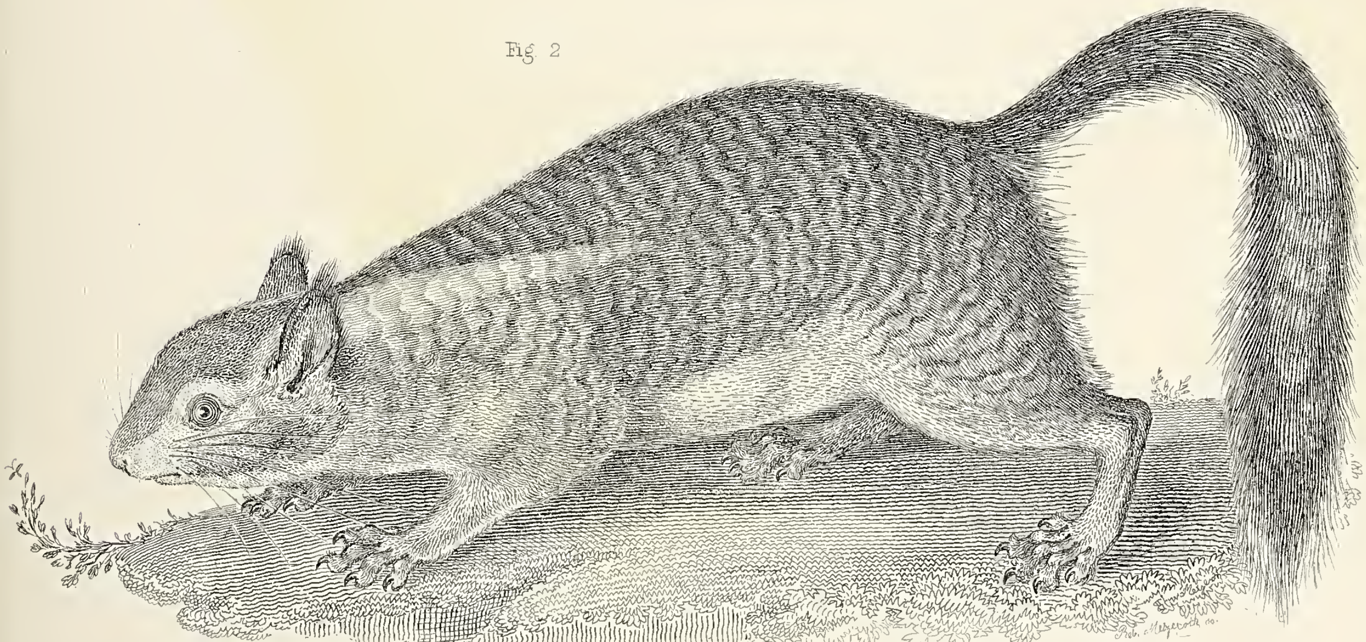


Fig. 2



J. H. Richard del. R. Metzeroth sc.

J. H. Richard del. F. M

No. 3.

REPORT UPON THE LAND SHELLS COLLECTED ON THE SURVEY.

BY W. G. BINNEY,

MEMBER OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

The terrestrial mollusks of the Pacific region of the United States are entirely distinct from those of any portion of the Union east of the Rocky mountains. No species has, as yet, been detected on both sides of this insurmountable barrier. The types, also, are quite different. Instead of the fragile, horn colored shell of our western States, the shells are large, solid, and endowed with the rich coloring of the tropical species. Our knowledge of them is still very imperfect. Future research will probably bring to light many new species and interesting facts relating to their habits and their geographical distribution.

The helices of California and Oregon are characterized by a very peculiar indentation and granulation of their surface, and often by the presence of a broad, revolving band on the body whorl. This latter peculiarity exists in one-half of the species hitherto observed.

None of the shells brought by this expedition are new to science. I have, however, given full descriptions of all, as those that have been published are very brief, and some have not been noticed by American authors.

The measurements are given in millimetres, the French system being the most convenient and the one generally adopted by European naturalists.

No. 1. HELIX FIDELIS, Gray.

Testa subconica, solida, alba, castanea aut nigra, striata, et lineis volventibus induta; spira elevata; anfr. 7 regulariter accrescentes, fasciâ nigrâ aut castaneâ cincti; sutura impressa; subtus convexa, lævigata, nigra, profunde umbilicata; apertura depresso-rotundata, intus fasciata; columella callo levi induta; labrum album aut fuscum, ad umbilicum reflexiusculum.

SYNONYMS AND REFERENCES.

Helix fidelis, Gray, Proc. Zool. Soc. p. 67, anno July, 1834.
Chemnitz, ed. 2, p. 321, t. LVII, f. 12–13.
Pfeiffer, Monog. Hel. Viv. I, p. 338—Ib. III, p. 229.
Reeve, Con. Icon. No. 657.
Helix nuttalliana, Lea, Am. Phil. Soc. VI, 88; pl. xxiii, f. 74, anno December, 1834.
Binney, Boston Journ. Nat. Hist. III, 369; pl. xii.
Terrestrial Mollusks, II, 159, III; pl. xviii.
Dekay, Nat. Hist. New York, p. 46.

DESCRIPTION.

Animal.—Color, dull ochre, slaty towards the tail. Coarsely granular upon the neck; but from a line running from the dorsal line, where it issues from the shell to the mouth, the granules diminish, and are succeeded by coarse, undulating, interrupted ridges, radiating in every direction from the aperture, and terminating in a line nearly marginal; edge simple.

Shell.—Subconic, with seven slightly rounded whorls, regularly and gradually diminishing in breadth from the base towards the apex; apex obtuse, suture distinctly impressed. Below, flattened, convex, with a deep umbilicus, about one-eighth the smaller diameter of the shell. Aperture ovate, regularly rounded. Lip thickened, white, red, or lilac colored, reflected only below, in some individuals entirely concealing the umbilicus. Columella with a light callus. Epidermis shining, covered with numerous fine, revolving lines. Striæ of increase distinct, but very slightly elevated.

There are several varieties of coloring. The base is uniformly dark, but varies from chestnut color to jet black. Upon the body whorl is a broad revolving black band, enclosed above and below by one of lighter color, white or chestnut. These bands are obsolete in the three whorls nearest the apex. The upper surface is white, light chestnut, or dark brown, in some individuals relieved by irregular patches of black. On some specimens there are faint tracings of intermediate bands, while some are entirely destitute of any bands.

Greatest diameter, 36; lesser, 31; altitude, 19 millimetres.

Geographical distribution.—Collected by Dr. J. S. Newberry, at Portland, Oregon Territory. It has not been found, except in the vicinity of Fort Vancouver, by others, but seems rather a common species in that region.

Remarks.—This is the largest and finest of the helices of the Pacific coast. It may at once be recognized by its large size and shining, variegated surface, on which the revolving black line contrasts so strongly with the lighter color of the epidermis.

No. 2. HELIX INFUMATA, Gould.

Testa depressa, biconvexa, carinata, lenticularis; nigra, apice rufa; anfr. 6–7 rugis incrementalibus et punctis numerosis minutis tumidis asperati; sutura impressa; apertura depressa, obliqua, intus lilacina; perist. lilacinum, incrassatum, subtus reflexiusculum, umbilicum profundum fere tegens.

REFERENCE.

Helix infumata, GOULD, Proc. Boston S. N. H. V, p. 127, anno February, 1855.

DESCRIPTION.

Animal.—Not hitherto observed.

Shell.—Subconic, the upper and lower surfaces equally convex, separated by a decided, though obtuse, carina, which gives the shell a lens-like shape. Epidermis uniformly black, excepting on the four upper whorls, which are light red. Suture distinctly impressed; whorls, 6, with coarse wrinkles of growth, crossed by fine, almost imperceptible revolving lines, and roughened by small elevated points or tubercles. Below, these points are much more numerous and crowded, the revolving striæ obsolete, and incremental wrinkles much less developed. Umbilicus small in proportion to the size of the shell, being only one-fifth the lesser diameter, and almost entirely concealed by the reflected lip. Aperture ovate, flattened, with a slight angle at the carina. Lip thickened, reflected only at its junction with the body whorl, near the umbilicus. There is a slight deposition of callus on the columella. Throat and lip lilac colored.

Greatest diameter, 37 ; lesser, 32 ; altitude, 18 millimetres.

Geographical distribution.—Found by Dr. Newberry, on the hills near San Francisco, California. Has not, as yet, been detected in any other locality.

Remarks.—In general appearance it is most nearly allied to *H. fidelis*, Gray. It has not, however, the revolving bands, and is at once recognized by its lenticular shape. From all the other described species of the western coast it is readily known by the peculiar protuberances which crowd the epidermis. Dr. Gould compares it in general form to *H. plicata*, Born. It must be a rare species. But one mature specimen was brought, which is the only one I have ever seen, with the exception of a single shell in the collection of Mr. Thomas Bland, of New York.

No. 3. HELIX OERUGINOSA, Gould.

Var. β.

Testa globosa, solida, maximè elevata; castanea, maculis irregularibus olivaceis longitudinalibus et fasciâ rufâ volvente variegata; anfr. 7 convexi, indentati, et minutissimĕ granulati, spira conica, elevata ; sutura impressa ; subtus inflata ; apertura depresso-rotundata, intus fasciata ; labrum album, ad umbilicum profundum et fere tectum, reflexiusculum.

SYNONYMS AND REFERENCES.

Helix æruginosa, Gould, Proc. Boston, S. N. H. V., p. 127, anno Febr., 1855.

DESCRIPTION.

Animal not yet observed.

Shell.—Heavy, subglobose, conic, with a very elevated spire. Whorls seven, rounded, the last quite ventricose, with a narrow black revolving line, which becomes concealed by the sutures of the upper whorls ; suture well defined, impressed. Below subglobose, aperture ovate, with a white thickened lip, reflected only at the deep umbilicus, which it nearly conceals. Columella with a light callus, epidermis yellowish, broken by irregular, zigzag, rufous blotches, running parallel to the incremental wrinkles. Surface smooth, unbroken by the striæ of increase, which are not prominent, and indented as in *H. Townsendiana*. There are also microscopic granulations.

Greatest diameter, 32 ; lesser, 27 ; altitude, 19 millimetres.

Geographical distribution.—Found by Dr. J. S. Newberry north of San Francisco. Has not, as yet, been detected in other localities.

Remarks.—The typical specimen, from which Dr. Gould drew his description, has the general form and appearance of *H. Townsendiana*, Lea, from Oregon. That shell, however, is destitute of the minute granulations and black revolving band, and rufous blotches.

The variety found by Dr. Newberry might, at first sight, be considered another species. It is as globular and conical as the extreme form of *H. major* of the southern States. Upon careful examination, however, it is found to agree with *æruginosa* in all its characteristics.

No. 4. HELIX DUPETITHOUARSI, Deshayes.

Testa orbiculato-conoidea, lævigata nitens, subindentata, et lineis volventibus obscuris notata; colore castanea, fasciis duabus albis zonam nigram aut rufam includentibus induta; anfr. 7–8 convexiusculi; sutura impressa; umbilicus profundus, partem quintam diametris minoris æquans; apertura rotundata, intus castanea, trifasciata; labrum album, incrassatum, reflexiusculum, umbilicum aliquantum occultans.

SYNONYMS AND REFERENCES.

Helix Dupetithouarsi, Deshayes, Revue Zoologique, p. 360, anno Dec. 1839.
" Guerin. Mag. de Zool. 1841, pl. xxx.
" in Fer. Hist. I, p. 169, pl. xcvii, f. 8–10.
Chemnitz, ed. 2, p. 328, t. viii, f. 6, 7.
Pfeiffer, Monog. Hel. Viv. I, 338.—Ib. III, 229.
Reeve, Con. Icon. 659.
Helix oregonensis, Lea, Am. Phil. Soc. VI, p. 100, t. xxiii, f. 85, anno 1839.
Pfeiffer, Monog. Hel. Viv. I, 428.—Ib. III, 272.

DESCRIPTION.

Animal.—Not hitherto observed.

Shell.—Subglobose, depressed; spire more or less elevated, sometimes quite flat; whorls seven, rounded in some instances, crossed by minute revolving lines. Suture moderately impressed; aperture ovate; lip white and thickened, reflected at its connexion with the large and deep umbilicus, which it partially conceals. On the columella there is a slight deposition of callus. Epidermis smooth and shining, in some individuals marked lightly in parts by the peculiar indentations characteristic of the California helices. Color variable, generally of an uniform dark chestnut or light fawn, with a broad black band on the body whorl, enclosed above and below by white bands of equal breadth, which are concealed in the suture of the upper whorls.

Greatest diameter, 25; lesser, 20; altitude, 13 millimetres.

Geographical distribution.—Found by Dr. Newberry at San Francisco and Benicia, in California, and on the shores of Klamath lake, in Oregon Territory. It seems to be one of the commonest and most widely distributed species of the Pacific region.

Remarks.—This shell is readily distinguished from others of the same habitat by its very smooth and shining epidermis, unusually free from any granulations or indentations. The indentations, when present, cross the incremental wrinkles of the surface at regular intervals, giving the appearance of broad, revolving lines. It is a beautiful and very distinct species.

There can be no doubt but that the figure and description of *H. oregonensis*, Lea, were drawn from an immature specimen of this shell. Although they appeared in the same year as those of M. Deshayes, the latter have, of course, the priority, being made from the mature shell.

NOTE.

No 4 has not been completed in time for publication with the rest of this Report. It will appear in a subsequent volume.

INDEX TO ZOOLOGICAL REPORT.

APPENDICES.

APPENDIX A.

ASTRONOMICAL OBSERVATIONS WITH SEXTANT.

I. *Observations on the route of the main party from Benicia to the point where the command separated, near the Three Sisters, Oregon Territory.*

CAMP 7—JULY 15, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Altair	9	31	33.5	88	46	30
	9	33	48.0	89	22	00
	9	34	50.0	89	42	30
	9	36	09.0	90	08	00
	9	37	26.5	90	34	20
	9	38	46.0	91	00	30
	9	39	56.5	91	23	20
Arcturus	9	16	07.0	100	47	50
	9	18	20.0	100	02	10
	9	20	13.5	99	17	00
	9	21	27.5	98	51	20
	9	22	52.0	98	18	10
	9	24	17.0	97	46	10
	9	25	28.0	97	20	30
Polaris	9	00	32.5	77	46	20
	9	02	40.5	77	46	30
	9	04	43.0	77	46	50
	9	07	05.5	77	48	10
	9	08	27.5	77	49	20
	9	10	07.5	77	50	20
	9	12	15.0	77	52	10

Index error —1° 06′ 35″. Barometer 29.8 in. Thermometer 69°.

CAMP 11—JULY 19, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
a Cygni	8	57	23.5	97	10	30
	8	59	47.0	98	01	10
	9	01	41.0	98	41	00
	9	02	59.0	99	08	20
	9	04	14.5	99	34	50
	9	05	25.5	100	00	00
Arcturus	9	08	52.0	96	49	10
	9	10	41.0	96	09	30
	9	12	04.0	95	37	10
	9	13	30.0	95	06	00
	9	14	43.0	94	39	30
	9	16	18.0	94	03	20

CAMP 11—JULY 19, 1855—Continued.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris	9	22	03.5	79	00	50
	9	24	36.5	79	01	10
	9	27	52.0	79	05	30
	9	29	08.0	79	04	50
	9	30	38.0	79	06	10
	9	32	23.5	79	08	20
	9	33	24.5	79	08	50
	9	34	50.5	79	09	20
	9	36	56.5	79	09	40
	9	38	33.0	79	12	10

Index error —2′ 15″. Barometer 29.7 in. Thermometer 78°.

FORT READING—JULY 22, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
a Cygni	9	46	14.0	118	32	50
	9	47	55.5	119	09	20
	9	49	48.5	119	48	30
	9	51	05.5	120	15	50
	9	52	32.5	120	46	50
	9	54	17.5	121	23	50
Arcturus	9	57	55.0	73	58	40
	10	00	11.5	73	05	40
	10	02	37.0	72	11	30
	10	04	28.5	71	28	20
	10	06	11.0	70	49	50
	10	07	55.5	70	10	00
Polaris	9	21	35.0	79	44	20
	9	23	00.0	79	44	40
	9	26	38.5	79	47	50
	9	29	06.0	79	49	30
	9	31	27.0	79	51	10
	9	32	59.5	79	53	00

Index error — 2′ 15″. Barometer, 29.6 in. Thermometer, 85°.

APPENDIX A—Continued.

FORT READING—JULY 23, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Sun's lower limb.......	10	04	23.5	114	00	00
	10	04	54.0	114	10	00
	10	05	25.0	114	20	00
	10	05	56.0	114	30	00
	10	06	25.0	114	40	00
	10	06	56.0	114	50	00
	10	07	26.0	115	00	00
	10	07	56.5	115	10	00
	10	08	27.0	115	20	00
	10	08	56.5	115	30	00
	10	09	27.0	115	40	00
	10	09	57.5	115	50	00
	10	10	30.0	116	00	00
Sun's lower limb.......	1	59	18.0	116	00	00
	1	59	48.0	115	50	00
	2	00	17.5	115	40	00
	2	00	49.5	115	30	00
	2	01	20.5	115	20	00
	2	01	50.5	115	10	00
	2	02	21.0	115	00	00
	2	02	53.5	114	50	00
	2	03	22.5	114	40	00
	2	03	52.5	114	30	00
	2	04	24.0	114	20	00
	2	04	53.0	114	10	00
	2	05	24.0	114	00	00
α Serpentarii..........	9	14	57.0	124	19	40
	9	16	46.0	124	21	10
	9	19	46.5	124	24	30
	9	21	37.0	124	23	40
	9	22	50.0	124	23	20
	9	24	36.5	124	23	10
	9	26	36.0	124	23	00
	9	28	33.0	124	19	40
	9	29	57.0	124	18	10
Polaris...............	9	42	05.5	80	00	50
	9	43	54.5	80	02	10
	9	45	44.0	80	03	50
	9	47	56.5	80	04	10
	9	49	32.0	80	05	50

Index error — 2′ 15″. Barometer, 29.6 in. Thermometer, 83°

CAMP 13—JULY 29, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni..............	8	29	20.0	102	02	40
	8	31	58.5	102	57	20
	8	33	11.0	103	22	30
	8	34	18.5	103	46	30
	8	35	21.5	104	07	20
	8	36	25.0	104	30	20
Arcturus.............	8	38	41.5	92	32	30
	8	40	25.0	91	53	30
	8	41	43.5	91	24	30
	8	43	14.0	90	51	50
	8	44	25.5	90	24	10
	8	45	45.0	89	55	50
α Serpentarii..........	8	50	51.5	124	15	10

CAMP 13—JULY 29, 1855—Continued.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Serpentarii..........	8	52	56.0	124	17	00
	8	55	21.0	124	17	50
	8	57	18.0	124	17	20
	8	58	48.5	124	17	10
	9	00	06.5	124	16	30
	9	01	48.0	124	14	10
	9	03	10.0	124	12	20
	9	05	25.5	124	08	20
Polaris...............	9	23	28.0	80	12	40
	9	26	03.5	80	15	10
	9	27	42.0	80	16	00
	9	29	49.0	80	17	20
	9	31	02.5	80	18	40
	9	32	45.0	80	20	00

Index error —1′ 50″. Barometer, 26.0 in. Thermometer, 57°.

CAMP 15—JULY 30, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni..............	8	41	18.0	107	53	00
	8	43	20.0	108	37	30
	8	45	02.5	109	12	40
	8	47	16.0	110	00	10
	8	48	52.0	110	33	10
	8	50	27.5	111	07	00
Arcturus.............	9	20	56.0	74	53	20
	9	22	20.0	74	21	20
	9	23	29.0	73	55	20
	9	24	32.0	73	31	10
	9	27	20.0	72	26	30
Polaris...............	9	09	37.0	80	11	00
	9	11	12.0	80	12	20
	9	12	11.0	80	12	50
	9	13	44.5	80	14	10
	9	15	02.0	80	15	10
	9	16	17.5	80	16	00

Index error —1′ 50″. Barometer, 24.9 in. Thermometer, 57°.

CAMP 17—AUGUST 1, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni..............	8	14	24.0	101	34	00
	8	16	19.0	102	15	20
	8	17	46.5	102	34	50
	8	19	53.0	103	28	50
	8	21	41.5	104	05	40
	8	23	14.0	104	38	30
Arcturus.............	8	26	25.0	92	07	40
	8	28	12.5	91	29	20
	8	30	26.0	90	39	10
	8	32	39.0	89	49	50
	8	34	28.0	89	11	00
	8	35	38.0	88	44	00

APPENDIX A—Continued.

CAMP 17—AUGUST 1, 1855—Continued.

Observer—Lieut. R. S. WILLIAMSON, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.	Observed double altitudes.
	h. m. s.	*d. m. s.*
Polaris	8 52 02.0	80 25 20
	8 53 16.0	80 27 10
	8 54 45.0	80 28 00
	8 56 15.5	80 29 10
	8 57 36.0	80 29 40
	8 58 41.0	80 31 30

Index error —1′ 50″. Barometer 26.1 in. Thermometer 56°.

CAMP 18—AUGUST 2, 1855.

Observer—Lieut. R. S. WILLIAMSON, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.	Observed double altitudes.
	h. m. s.	*d. m. s.*
a Cygni	8 17 52.5	104 05 40
	8 19 36.5	104 42 40
	8 21 06.5	105 14 10
	8 22 14.0	105 36 50
	8 23 27.0	106 01 50
	8 24 53.0	106 31 30
Arcturus	8 06 06.0	98 11 00
	8 07 51.5	97 33 40
	8 09 41.0	96 54 40
	8 11 03.0	96 24 10
	8 12 44.5	95 48 10
	8 15 03.0	94 57 40
Polaris	8 50 56.5	80 45 20
	8 52 33.5	80 46 40?
	8 53 38.5	80 46 40?
	8 55 04.5	80 48 10
	8 56 31.5	80 49 40
	8 57 59.5	80 51 10
a Serpentarii	8 31 24.5	123 28 30
	8 36 03.5	123 33 10
	8 37 30.0	123 34 00
	8 39 06.5	123 34 30
	8 40 31.0	123 34 30
	8 41 45.5	123 35 00
	8 42 49.0	123 34 00
	8 43 55.0	123 33 10
	8 45 04.5	123 31 00
	8 46 22.0	123 29 50
	8 47 37.5	123 27 10

Index error —1′ 50″. Barometer 26.8 in. Thermometer 64°.

CAMP 18—AUGUST 3, 1855.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.	Observed double altitudes.
	h. m. s.	*d. m. s.*
Sun's lower limb	9 19 56.0	96 00 00
	9 20 25.5	96 10 00
	9 20 53.5	96 20 00
	9 21 23.0	96 30 00
	9 21 51.0	96 40 00

CAMP 18—AUGUST 3, 1855—Continued.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.	Observed double altitudes.
	h. m. s.	*d. m. s.*
Sun's lower limb	9 22 19.0	96 50 00
	9 22 49.5	97 00 00
	9 23 16.5	97 10 00
	9 23 47.0	97 20 00
	9 24 15.5	97 30 00
	9 24 44.5	97 40 00
	9 25 12.5	97 50 00
	9 25 39.5	98 00 00
Sun's lower limb	2 37 39.0	98 00 00
	2 38 07.5	97 50 00
	2 38 38.5	97 40 00
	2 39 05.5	97 30 00
	2 39 35.0	97 20 00
	2 40 03.5	97 10 00
	2 40 30.0	97 00 00
	2 41 00.0	96 50 00
	2 41 28.5	96 40 00
	2 41 58.0	96 30 00
	2 42 25.0	96 20 00
	2 42 56.0	96 10 00
	2 43 23.0	96 00 00
Sun's lower limb	11 53 55.0	132 40 00
	11 54 54.0	132 40 45
	11 56 31.0	132 43 55
	11 58 05.0	132 44 30
	11 59 00.0	132 44 55
	12 04 37.0	132 44 55
	12 05 57.0	132 44 15
	12 07 34.5	132 42 30
	12 09 22.5	132 40 00
a Cygni	9 17 56.0	126 39 00
	9 20 18.5	127 30 00
	9 22 13.0	128 10 20
	9 24 17.5	128 55 40
	9 26 21.5	129 39 40
	9 29 02.5	130 35 20
Arcturus	8 58 09.0	77 37 30
	9 03 27.0	75 35 00
	9 06 45.5	74 22 20
	9 09 31.5	73 29 10
	9 10 54.5	72 47 50
	9 12 29.0	72 12 20
a Serpentarii	8 29 45.0	123 40 00
	8 32 58.5	123 40 20
	8 34 54.0	123 42 30
	8 38 16.0	123 41 20
	8 40 43.0	123 38 35
	8 43 39.5	123 37 30
Polaris	9 38 29.0	81 28 50
	9 41 38.5	81 31 00
	9 44 00.5	81 33 00
	9 46 23.0	81 34 45
	9 48 45.5	81 37 40
	9 51 52.5	81 39 55

Index error — 7′ 10″. Barometer, 26.8 in. Thermometer, 60°.

APPENDIX A—Continued.

CAMP 19—AUGUST 4, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris	8	25	19.0	80	47	30
	8	26	12.5	80	47	40
	8	27	09.5	80	48	10
	8	27	52.0	80	48	20
	8	29	31.0	80	49	20
	8	30	40.0	80	50	50
	8	31	20.0	80	51	10
	8	32	04.0	80	51	00
	8	32	44.5	80	51	20
	8	33	39.0	80	51	20
	8	34	29.5	80	52	10

Index error — 7′ 00″. Barometer, 27.3 in. Thermometer, 76°.

CAMP 20—AUGUST 5, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni	8	39	30.5	115	57	50
	8	41	30.5	116	39	20
	8	43	30.5	117	21	30
	8	45	00.0	117	52	20
	8	46	12.0	118	19	00
	8	47	32.5	118	47	00
	8	48	58.5	119	17	50
Arcturus	8	01	41.0	95	33	50
	8	03	42.0	94	47	10
	8	05	27.5	94	09	50
	8	07	56.0	93	16	20
	8	09	26.0	92	42	50
	8	12	18.0	91	41	00
	8	14	16.0	90	57	30
α Serpentarii	8	19	41.5	123	22	10
	8	21	16.5	123	24	40
	8	23	41.5	123	25	20
	8	24	53.0	123	27	40
	8	25	55.5	123	27	30
	8	26	57.5	123	27	40
	8	28	12.0	123	27	00
	8	29	16.5	123	26	30
	8	30	46.5	123	26	20
	8	31	58.5	123	25	10
	8	33	08.5	123	23	50
	8	35	15.5	123	22	00
Polaris	8	56	37.0	81	15	30
	8	57	58.0	81	17	10
	8	59	29.5	81	17	50
	9	00	43.0	81	18	40
	9	02	00.0	81	19	20
	9	03	24.0	81	21	00

Index error — 6′ 30″. Barometer, 26.7 in. Thermometer, 64°.5.

CAMP 21—AUGUST 6, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni	8	10	02.0	107	12	30
	8	11	27.0	107	41	00
	8	12	21.0	108	00	40
	8	13	22.5	108	21	30
	8	14	26.5	108	44	00
	8	15	17.0	109	02	10
Arcturus	8	35	05.0	81	32	20
	8	36	42.5	80	55	50
	8	38	55.5	80	05	40
	8	40	24.0	79	33	20
	8	41	41.0	79	05	00
	8	42	52.5	78	37	30
α Serpentarii	8	17	41.5	123	30	30
	8	18	41.5	123	30	50
	8	19	36.5	123	31	30
	8	20	43.0	123	32	40
	8	21	30.5	123	33	00
	8	22	20.5	123	34	20
	8	23	10.5	123	34	20
	8	24	16.5	123	34	00
	8	25	54.0	123	33	20
	8	26	48.0	123	33	20
	8	28	31.0	123	32	30
	8	29	21.5	123	30	30
	8	30	09.0	123	29	00
Polaris	8	48	22.5	81	05	50
	8	49	31.5	81	06	40
	8	50	34.5	81	07	30
	8	51	30.0	81	08	30
	8	52	33.0	81	09	10
	8	53	18.0	81	09	50

Index error — 6′ 30″. Barometer, 26.7 in. Thermometer, 69°.

CAMP 22—AUGUST 7, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni	8	28	30.0	115	14	00
	8	29	42.0	115	39	40
	8	32	11.0	116	50	30
	8	33	12.5	116	52	50
	8	34	33.5	117	21	10
	8	36	12.5	117	55	20
Arcturus	8	03	19.0	91	43	00
	8	04	22.0	91	29	00
	8	05	27.5	90	54	00
	8	06	40.0	90	27	50
	8	07	56.5	89	59	50
	8	09	31.0	89	25	40
α Serpentarii	8	12	43.5	123	21	10
	8	13	51.5	123	21	20
	8	14	51.5	123	22	50
	8	15	45.5	123	23	30
	8	17	09.0	123	23	30
	8	18	05.0	123	24	00
	8	18	58.5	123	25	00
	8	20	07.5	123	24	40
	8	20	53.5	123	24	30

APPENDIX A—Continued.

CAMP 22—AUGUST 7, 1855—Continued.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Serpentarii..........	8	21	54.0	123	23	30
	8	22	53.0	123	22	50
	8	24	21.0	123	22	10
	8	25	37.0	123	20	50
Polaris................	8	40	48.0	81	12	50
	8	42	37.5	81	14	40
	8	43	41.0	81	15	20
	8	44	39.0	81	16	50
	8	45	23.0	81	17	10
	8	46	18.0	81	17	30
	8	47	15.5	81	18	40
	8	48	32.0	81	19	20
	8	49	39.5	81	19	50
	8	50	59.5	81	20	20

Index error — 6′ 30″. Barometer, 26.0 in. Thermometer, 64°.

CAMP 23—AUGUST 8, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni...............	8	24	52.5	115	27	20
	8	26	24.5	115	57	10
	8	28	18.0	116	38	10
	8	29	24.5	117	00	30
	8	30	38.5	117	25	40
	8	31	43.5	117	49	40
Arcturus..............	7	57	35.5	92	20	00
	7	59	24.5	91	49	40
	8	00	41.5	91	12	00
	8	01	56.5	90	44	50
	8	03	25.0	90	12	40
	8	04	29.5	89	49	20
α Serpentarii..........	8	10	31.0	122	49	00
	8	11	34.0	122	50	10
	8	13	13.5	122	51	00
	8	14	33.0	122	51	10
	8	15	49.0	122	51	30
	8	16	56.5	122	51	20
	8	17	58.0	122	51	00
	8	18	57.0	122	50	00
	8	20	23.5	122	49	20
	8	21	29.5	122	49	10
Polaris................	8	39	02.0	81	47	20
	8	40	25.0	81	48	30
	8	41	20.0	81	49	20
	8	42	07.5	81	50	00
	8	43	03.5	81	50	10
	8	44	18.0	81	51	40
	8	46	14.5	81	53	00
	8	47	24.5	81	54	00

Index error —6′ 30″. Barometer, 25.9 in. Thermometer, 72°.

CAMP 23—AUGUST 9, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Sun's lower limb.......	9	11	19.0	91	00	00
	9	11	48.0	91	10	00
	9	12	13.5	91	20	00
	9	12	44.5	91	30	00
	9	13	13.5	91	40	00
	9	13	43.0	91	50	00
	9	14	10.5	92	00	00
	9	14	39.5	92	10	00
	9	15	10.0	92	20	00
	9	15	39.5	92	30	00
	9	16	06.0	92	40	00
	9	16	36.0	92	50	00
	9	17	07.0	93	00	00
Sun's lower limb.......	2	43	20.0	93	00	00
	2	43	50.5	92	50	00
	2	44	18.0	92	40	00
	2	44	47.0	92	30	00
	2	45	17.0	92	20	00
	2	45	46.5	92	10	00
	2	46	16.5	92	00	00
	2	46	47.0	91	50	00
	2	47	14.0	91	40	00
	2	47	42.0	91	30	00
	2	48	10.0	91	20	00
	2	48	37.5	91	10	00
	2	49	08.5	91	00	00
Sun's lower limb.......	11	55	02.0	128	42	20
	11	56	01.5	128	43	20
	11	57	27.0	128	44	20
	11	58	21.5	128	44	55
	11	59	06.0	128	45	10
	11	59	54.5	128	45	20
	12	01	00.5	128	45	15
	12	02	07.0	128	45	10
	12	03	40.0	128	44	30
	12	04	58.0	128	42	55
	12	05	58.0	128	41	50

Index error —6′ 30″. Barometer, 25.8 in. Thermometer, 71°.5.

CAMP 24—AUGUST 10, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni...............	8	45	20.5	123	56	40
	8	46	25.0	124	19	50
	8	48	29.5	125	03	20
	8	49	59.0	125	35	30
	8	51	02.0	125	58	00
	8	52	10.0	126	22	10
Arcturus..............	8	36	38.0	76	33	50
	8	38	04.5	76	02	10
	8	39	10.5	75	37	10
	8	40	15.0	75	13	30
	8	41	44.0	74	40	20
		42	40.5	74	19	20
Polaris................	8	26	25.5	81	57	40
	8	27	35.5	81	58	30
	8	28	19.5	81	59	50

APPENDIX A—Continued.

CAMP 24—AUGUST 10, 1855—Continued.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer. h.	m.	s.	Observed double altitudes. d.	m.	s.
Polaris	8	29	15.0	82	00	30
	8	30	04.0	82	01	00
	8	30	42.0	82	01	20
	8	31	23.5	82	02	00
	8	31	57.0	82	02	00
	8	32	45.0	82	02	40
	8	33	52.5	82	03	30

Index error — 6′ 30″. Barometer, 25.1 in. Thermometer, 78°.

CAMP 25—AUGUST 11, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

	h.	m.	s	d.	m.	s.
Polaris	8	52	40.5	83	04	30
	8	55	24.0	83	05	50
	8	58	28.0	83	08	10
	8	59	31.5	83	09	00
	9	00	41.5	83	09	40
	9	02	02.5	83	10	30
	9	04	06.5	83	12	30
	9	05	31.0	83	13	10
	9	06	22.0	83	13	30
	9	07	09.5	83	14	40

Index error — 6′ 30″. Barometer, 25.4 in. Thermometer, 64°.5.

CAMP 27, A—AUGUST 13, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

	h.	m.	s.	d.	m.	s.
α Cygni	8	46	52.0	125	42	40
	8	50	27.5	126	59	00
	8	53	08.5	127	54	30
	8	55	26.0	128	45	40
	8	57	40.5	129	30	00
	8	59	46.0	130	16	10
Arcturus	9	03	17.0	65	49	20
	9	04	49.0	65	16	00
	9	05	51.0	64	54	20
	9	07	37.0	64	14	00
	9	08	43.0	63	47	40
	9	09	55.0	63	25	00
Polaris	9	14	25.5	83	58	50
	9	17	07.0	84	00	00
	9	18	12.5	84	02	00
	9	20	19.5	84	02	50
	9	22	25.5	84	04	30
	9	24	43.5	84	06	30
	9	25	50.5	84	10	00
	9	28	34.0	84	10	50
Altair	10	09	45.0	112	34	30
	10	11	43.0	112	38	20
	10	13	55.5	112	42	50
	10	15	48.0	112	48	50

CAMP 27, A—AUGUST 13, 1855—Continued.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer. h.	m.	s.	Observed double altitudes. d.	m.	s.
Altair	10	19	32.0	112	49	50
	10	21	35.0	112	49	50
	10	23	12.0	112	50	00
	10	25	02.5	112	51	50
	10	26	55.5	112	52	00
	10	29	55.0	112	50	00
	10	31	13.5	112	48	40
	10	32	59.0	112	47	30
	10	34	41.0	112	44	10
	10	36	17.0	112	40	00
	10	37	45.5	112	38	10
	10	39	17.5	112	31	50
	10	40	40.0	112	30	00

Index error — 6′ 30″. Barometer, 26.0 in. Thermometer, 57°.5.

CAMP 28—AUGUST 15, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

	h.	m.	s.	d.	m.	s.
α Cygni	8	48	38.0	128	58	20
	8	52	03.0	130	12	50
	8	53	31.5	130	40	00
	8	55	12.5	131	18	50
	8	56	42.5	131	47	30
	8	58	59.5	132	37	40
Arcturus	8	32	17.0	74	32	40
	8	34	11.0	73	50	00
	8	37	27.5	72	38	40
	8	39	38.5	71	50	00
	8	41	31.5	71	06	30
	8	43	57.0	70	16	20
Polaris	9	40	23.5	84	42	50
	9	42	51.5	84	43	30
	9	45	25.5	84	46	40
	9	46	48.5	84	47	00
	9	48	25.0	84	47	40
	9	50	05.0	84	48	30
Altair	10	04	50.5	112	20	00
	10	06	19.5	112	22	50
	10	08	17.5	112	27	00
	10	10	02.0	112	30	00
	10	11	38.5	112	30	30
	10	12	48.0	112	31	00
	10	16	46.5	112	32	30
	10	17	59.5	112	33	20
	10	19	36.0	112	33	30
	10	21	17.5	112	32	50
	10	22	54.5	112	31	20
	10	25	26.5	112	28	00
	10	27	08.5	112	26	10
	10	28	23.0	112	22	40
	10	31	01.5	112	16	40

Index error — 6′ 30″. Barometer, 25.9 in. Thermometer, 62°.5.

APPENDIX A—Continued.

CAMP 28—AUGUST 16, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer. h.	m.	s.	Observed double altitudes. d.	m.	s.
Sun's lower limb	9	42	26.0	93	00	00
	9	42	57.5	93	10	00
	9	43	30.0	93	20	00
	9	43	58.5	93	30	00
	9	44	30.5	93	40	00
	9	45	03.0	93	50	00
	9	45	35.0	94	00	00
	9	46	05.0	94	10	00
	9	46	38.5	94	20	00
	9	47	10.0	94	30	00
	9	47	40.5	94	40	00
	9	48	12.0	94	50	00
	9	48	44.0	95	00	00
Sun's lower limb	2	38	35.0	95	00	00
	2	39	08.5	94	50	00
	2	39	40.0	94	40	00
	2	40	12.0	94	30	00
	2	40	44.0	94	20	00
	2	41	14.0	94	10	00
	2	41	47.5	94	00	00
	2	42	17.0	93	50	00
	2	42	49.5	93	40	00
	2	43	21.0	93	30	00
	2	43	51.5	93	20	00
	2	44	24.0	93	10	00
	2	44	55.5	93	00	00
Sun's lower limb	12	06	28.5	122	27	30
	12	07	12.5	122	29	50
	12	08	23.0	122	30	50
	12	09	02.0	122	30	50
	12	09	34.5	122	31	10
	12	10	17.5	122	31	50
	12	10	54.0	122	32	20
	12	11	37.5	122	32	50
	12	12	19.0	122	33	10
	12	12	52.5	122	32	50
	12	13	34.0	122	32	30
	12	14	52.5	122	31	50
	12	15	33.5	122	31	30
	12	16	23.5	122	31	00
	12	17	27.5	122	30	20
	12	18	12.5	122	30	00
a Cygni	8	25	33.0	128	56	00
	8	27	18.0	129	25	20
	8	28	37.5	130	05	30
	8	29	53.5	130	34	50
	8	31	05.0	131	01	00
	8	32	13.0	131	25	40
Arcturus	8	12	35.5	80	18	50
	8	15	24.5	79	15	00
	8	16	44.5	78	47	30
	8	19	29.0	77	46	30
	8	20	57.5	77	14	20
	8	22	19.0	76	47	40
Polaris	8	37	25.5	83	57	10
	8	39	32.0	83	58	50
	8	41	24.0	84	00	00
	8	42	54.5	84	01	30
	8	43	57.0	84	02	20
	8	45	17.5	84	04	00

Index error — 6′ 30″. Barometer, 26.0 in. Thermometer, 67°.0.

2 AA

CAMP 30—AUGUST 19, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer. h.	m.	s.	Observed double altitudes. d.	m.	s.
a Cygni	8	12	22.0	121	46	30
	8	13	53.0	122	19	30
	8	15	17.0	122	46	40
	8	16	22.0	123	11	00
	8	17	37.5	123	36	30
	8	19	13.0	124	11	00
Arcturus	8	03	09.0	79	30	20
	8	04	49.5	78	53	10
	8	06	02.5	78	26	20
	8	07	02.0	78	05	20
	8	08	38.0	77	29	50
	8	09	51.0	77	04	10
Polaris	8	24	43.0	84	22	40
	8	25	47.5	84	24	10
	8	27	02.0	84	25	40
	8	28	10.5	84	25	40
	8	29	22.0	84	27	10
	8	30	11.0	84	28	00
	8	31	03.0	84	28	50
	8	31	51.5	84	29	10
	8	32	51.5	84	30	00
	8	33	48.5	84	30	40

Index error — 6′ 30″. Barometer, 25.9 in. Thermometer, 54°.5.

CAMP 31—AUGUST 20, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
a Cygni	8	15	46.5	124	26	10
	8	17	13.0	124	56	40
	8	18	37.5	125	26	10
	8	20	04.0	125	57	10
	8	21	14.5	126	21	10
	8	22	28.5	126	46	00
Arcturus	7	58	46.0	79	38	10
	8	00	15.5	79	06	20
	8	01	46.0	78	32	30
	8	02	31.0	78	13	00
	8	03	44.5	77	50	10
	8	04	48.0	77	27	30
Polaris	8	38	46.0	85	05	00
	8	41	00.5	85	05	10
	8	42	50.5	85	07	20
	8	47	42.5	85	10	30
	8	48	56.0	85	12	10
	8	50	15.0	85	13	40
	8	51	41.0	85	14	50
	8	52	54.0	85	15	10
	8	54	09.0	85	16	50
	8	55	06.0	85	17	50
	8	56	05.0	85	18	30
	8	57	04.0	85	19	20

Index error — 6′ 30″. Barometer, 25.6 in. Thermometer, 58°.5.

APPENDIX A—Continued.

CAMP 34—AUGUST 23, 1855.

Observer—Lieut. R. S. WILLIAMSON, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer. h.	m.	s.	Observed double altitudes. d.	m.	s.
α Cygni	8	15	44.0	126	53	00
	8	17	17.5	127	24	50
	8	18	14.5	127	45	00
	8	19	22.5	128	09	10
	8	20	19.5	128	29	50
	8	21	22.0	128	51	00
Arcturus	8	25	50.5	67	17	40
	8	27	08.0	66	48	30
	8	28	12.5	66	15	30
	8	29	33.5	65	55	40
	8	30	35.5	65	32	50
	8	31	26.0	65	13	30
Polaris	8	36	14.0	85	30	40
	8	37	12.5	85	31	50
	8	38	16.5	85	32	30
	8	39	03.0	85	33	30
	8	39	39.5	85	34	00
	8	40	28.5	85	34	30
	8	41	11.5	85	35	00
	8	42	21.0	85	35	30
	8	43	10.5	85	36	00
	8	44	54.5	85	37	00

Index error — 6′ 00″. Barometer, 25.6 in. Thermometer, 65°.

CAMP 36—AUGUST 25, 1855.

Observer—Lieut. R. S. WILLIAMSON, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
α Cygni	8	19	22.0	128	42	40
	8	20	53.5	129	25	20
	8	22	04.5	129	40	50
	8	23	13.5	130	05	30
	8	25	07.0	130	45	20
	8	26	40.0	131	17	00
Arcturus	8	06	43.5	73	49	10
	8	08	11.5	73	16	50
	8	09	14.5	72	54	10
	8	10	37.5	72	20	20
	8	11	59.0	71	54	20
	8	12	55.0	71	34	30
Polaris	8	35	10.5	86	31	50
	8	36	06.5	86	32	30
	8	37	18.5	86	33	20
	8	40	16.0	86	35	20
	8	41	16.5	86	36	00
	8	42	06.0	86	37	00
	8	43	04.0	86	38	00
	8	44	03.0	86	38	50
	8	46	17.5	86	40	20
	8	47	25.5	86	41	10

Index error — 6′ 00″. Barometer, 25.6 in. Thermometer, 55°.

CAMP 37—AUGUST 27, 1855.

Observer—Lieut. H. L. ABBOT, *U. S. Top Engineers.*

Object observed.	Time of observ'n by chronometer. h.	m.	s.	Observed double altitudes. d.	m.	s.
Sun's lower limb	9	11	50.5	73	00	00
	9	12	22.5	73	10	00
	9	12	53.5	73	20	00
	9	13	24.5	73	30	00
	9	13	51.5	73	40	00
	9	14	23.5	73	50	00
	9	14	54.5	74	00	00
	9	15	22.0	74	10	00
	9	15	55.5	74	20	00
	9	16	25.0	74	30	00
	9	16	53.5	74	40	00
	9	17	26.5	74	50	00
	9	17	58.5	75	00	00
Sun's lower limb	3	29	33.0	75	00	00
	3	30	05.0	74	50	00
	3	30	35.5	74	40	00
	3	31	05.5	74	30	00
	3	31	36.5	74	20	00
	3	32	09.5	74	10	00
	3	32	38.5	74	00	00
	3	33	09.0	73	50	00
	3	33	41.5	73	40	00
	3	34	10.5	73	30	00
	3	34	40.0	73	20	00
	3	35	12.0	73	10	00
	3	35	42.0	73	00	00
Sun's upper limb	12	17	15.0	113	26	10
	12	19	05.5	113	27	30
	12	19	52.0	113	28	00
	12	20	38.0	113	28	20
	12	21	40.0	113	28	40
	12	22	44.0	113	28	50
	12	23	17.0	113	29	10
	12	24	05.0	113	29	40
	12	25	00.5	113	29	50
	12	25	53.0	113	29	30
	12	26	51.0	113	28	40
	12	27	43.0	113	28	10
	12	28	10.0	113	27	50
	12	28	39.5	113	27	10
	12	29	07.0	113	26	40
	12	29	46.0	113	25	50

Index error — 6′ 15″. Barometer, 25.9 in. Thermometer, 55°.

CAMP 37—AUGUST 28, 1855.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
Sun's lower limb	12	21	46.5	111	43	40
	12	22	45.5	111	45	20
	12	23	24.5	111	44	00
	12	24	06.0	111	43	20
	12	25	03.0	111	43	30
	12	26	08.8	111	42	50

Index error — 6′ 40″. Barometer, 25.9 in. Thermometer, 75°.

APPENDIX A—Continued.

CAMP 38 A—AUGUST 29, 1855.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Arcturus	8	38	10.0	56	40	00
	8	39	25.5	56	13	30
	8	43	39.0	56	41	10
	8	44	43.0	54	18	30
	8	45	39.0	53	57	30
	8	46	46.5	53	34	50
Polaris	9	04	51.0	87	34	20
	9	06	12.5	87	36	00
	9	07	12.0	87	37	20
	9	08	24.5	87	38	10
	9	09	26.0	87	38	40
	9	10	39.0	87	39	10
	9	12	47.0	87	40	00
	9	14	31.0	87	41	50
	9	15	35.5	87	42	30
	9	16	29.5	87	43	40
	9	17	31.0	87	44	50
	9	18	39.5	87	45	40
	9	19	40.0	87	46	40

Index error — 6′ 45″. Barometer, 25.7 in. Thermometer, 42°.

CAMP 38 A—AUGUST , 1855.

Observer—Lieut. H L. ABBOT, *U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
Sun's lower limb	8	27	59.0	57	00	00
	8	28	24.5	57	10	00
	8	28	52.5	57	20	00
	8	29	22.5	57	30	00
	8	29	52.0	57	40	00
	8	30	20.5	57	50	00
	8	30	49.0	58	00	00
	8	31	18.5	58	10	00
	8	31	45.5	58	20	00
	8	32	15.0	58	30	00
	8	32	44.5	58	40	00
	8	33	12.5	58	50	00
	8	33	42.5	59	00	00
Sun's lower limb	4	11	09.0	59	00	00
	4	11	36.5	58	50	00
	4	12	06.5	58	40	00
	4	12	32.0	58	30	00
	4	13	00.0	58	20	00
	4	13	29.0	58	10	00
	4	13	59.0	58	00	00
	4	14	29.0	57	50	00
	4	14	58.0	57	40	00
	4	15	25.5	57	30	00
	4	15	54.0	57	20	00
	4	16	25.0	57	10	00
	4	16	53.5	57	00	00
Sun's lower limb	12	17	23.0	110	14	20
	12	18	15.0	110	15	10
	12	19	02.5	110	15	50
	12	20	56.0	110	16	10
	12	21	42.5	110	16	20
	12	22	33.5	110	16	30
	12	23	21.0	110	16	50
	12	25	08.5	110	16	30

CAMP 38 A—AUGUST 30, 1855—Continued.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Sun's lower limb	12	25	59.5	110	16	10
	12	26	31.5	110	15	30
	12	27	31.5	110	15	00
	12	28	13.5	110	14	30
α Cygni	8	04	39.0	130	40	30
	8	06	03.5	131	10	40
	8	07	51.5	131	49	10
	8	09	14.5	132	19	10
	8	10	17.0	132	42	30
	8	11	18.0	133	02	30
Arcturus	8	16	19.5	63	08	50
	8	17	52.0	62	33	20
	8	18	52.0	62	12	00
	8	19	53.5	61	47	30
	8	20	52.5	61	27	30
	8	21	45.5	61	11	10
Polaris	8	24	57.5	87	06	30
	8	26	34.0	87	07	00
	8	29	32.5	87	10	00
	8	30	47.5	87	11	00
	8	32	26.5	87	11	50
	8	33	41.0	87	12	50
	8	34	57.0	87	13	20
	8	36	20.5	87	14	00
	8	37	26.5	87	14	40
	8	38	33.5	87	15	50
	8	39	51.5	87	17	00
	8	41	14.5	87	18	20
	8	43	01.5	87	19	50
	8	44	16.5	87	21	10
Altair	9	22	20.5	109	39	50
	9	23	22.5	109	42	10
	9	24	22.5	109	43	10
	9	25	20.5	109	44	00
	9	26	52.0	109	46	00
	9	29	14.5	109	47	20
	9	30	07.5	109	47	30
	9	31	14.5	109	47	50
	9	32	08.0	109	47	50
	9	33	05.0	109	47	30
	9	34	10.0	109	46	00
	9	35	15.5	109	45	50
	9	36	19.5	109	44	00

Index error — 6′ 45″. Barometer, 25.8 in. Thermometer, 35°.

CAMP 38 A—SEPTEMBER 1, 1855.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s*
Sun's lower limb	9	11	29.5	64	00	00
	9	12	00.5	64	10	00
	9	12	28.5	64	20	00
	9	12	59.0	64	30	00
	9	12	29.0	64	40	00
	9	13	59.0	64	50	00
	9	14	29.0	65	00	00
	9	14	58.5	65	10	00
	9	15	27.5	65	20	00
	9	15	58.5	65	30	00

APPENDIX A—Continued.

CAMP 38 A—SEPTEMBER 1, 1855—Continued.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Sun's lower limb.......	9	16	28.5	65	40	00
	9	16	58.5	65	50	00
	9	17	27.5	66	00	00
Sun's lower limb.......	4	06	48.5	66	00	00
	4	07	15.0	65	50	00
	4	08	16.5	65	30	00
	4	08	45.0	65	20	00
	4	09	15.0	65	10	00
	4	09	42.5	65	00	00
	4	10	14.5	64	50	00
	4	10	44.5	64	40	00
	4	11	14.5	64	30	00
	4	11	44.5	64	20	00
	4	12	14.5	64	10	00
	4	12	44.5	64	00	00
Sun's lower limb	12	33	22.5	108	36	30
	12	34	16.0	108	38	00
	12	35	04.0	108	38	30
	12	36	46.5	108	39	50
	12	37	22.0	108	41	30
	12	39	57.5	108	42	00
	12	41	47.0	108	42	20
	12	42	29.0	108	42	30
	12	43	04.5	108	42	00
	12	43	36.5	108	42	00
	12	46	46.0	108	41	00
	12	48	35.5	108	39	30
	12	49	38.0	108	38	40
	12	50	14.5	108	37	30
	12	51	16.5	108	36	20

Index error 0. Barometer 25.9 in. Thermometer 78°.

CAMP 39 A—SEPTEMBER 2, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni..............	8	07	57.5	129	11	30
	8	09	49.5	129	48	40
	8	10	46.5	130	07	30
	8	11	42.0	130	28	40
	8	12	55.5	130	53	30
	8	13	39.0	131	10	00

CAMP 39 A—SEPTEMBER 2, 1855—Continued.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m*	*s.*	*d.*	*m.*	*s.*
Arcturus.............	8	16	47.5	65	34	10
	8	17	56.5	65	09	00
	8	18	46.0	64	50	30
	8	19	33.0	64	33	30
	8	20	34.5	64	12	10
	8	21	15.5	63	57	10
Polaris................	8	26	28.0	87	17	20
	8	28	26.0	87	19	50
	8	29	25.0	87	21	10
	8	30	22.0	87	21	40
	8	31	33.5	87	22	50
	8	32	28.5	87	23	10
	8	33	59.5	87	24	40
	8	38	41.0	87	26	50
	8	39	42.5	87	27	20
	8	40	42.0	87	28	20
	8	43	06.5	87	30	00

Index error 0. Barometer 25.9 in. Thermometer 44°.

CAMP 40—SEPTEMBER 5, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Sun's lower limb.......	11	54	44.4	104	36	40
	11	55	08.4	104	36	50
	11	55	34.0	104	37	00
	11	56	12.4	104	37	10
	11	56	46.0	104	37	30
	11	57	14.8	104	37	30
	11	57	41.2	104	37	50
	11	58	16.8	104	37	30
	11	59	20.8	104	37	10
	12	00	09.2	104	37	10
	12	00	52.4	104	37	20
	12	01	45.6	104	37	30
	12	02	29.2	104	37	00

Index error 0. Barometer, 25.8 in. Thermometer, 59°.

APPENDIX A—Continued.

II. *Observations on the routes of detached parties, in charge of Lieut. R. S. Williamson, U. S. Topographical Engineers.*

CAMP A—AUGUST 13, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni	8	13	16.4	116	19	00
	8	14	37.2	116	48	20
	8	16	00.0	117	16	50
	8	17	32.0	117	49	00
	8	19	00.0	118	19	20
	8	20	18.4	118	47	10
Arcturus	8	02	36.8	85	15	10
	8	04	33.2	84	32	30
	8	05	32.8	84	11	00
	8	06	21.2	83	52	50
	8	07	21.2	83	30	40
	8	08	14.4	83	10	50
Polaris	8	24	48.8	82	46	40
	8	26	36.0	82	48	40
	8	28	30.0	82	49	10
	8	29	56.0	82	50	00
	8	31	09.6	82	51	00
	8	33	05.6	82	53	10

Index error — 0′ 30″. Barometer, 26.0 in. Thermometer, 80°.

CAMP B—AUGUST 14, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni	8	16	46.4	118	42	20
	8	19	38.4	119	41	40
	8	21	00.0	120	10	30
	8	22	29.2	120	41	00
	8	23	38.0	121	06	40
	8	25	16.4	121	41	20
Arcturus	8	06	32.0	82	42	30
	8	08	10.0	82	07	30
	8	09	11.0	81	44	40
	8	10	25.6	81	16	50
	8	11	26.4	80	53	50
	8	12	46.0	80	25	40
Polaris	8	35	33.2	83	29	00
	8	36	36.0	83	30	40
	8	38	00.8	83	31	20
	8	39	06.0	83	32	30
	8	40	24.0	83	33	00
	8	41	40.0	83	33	40

Index error — 0′ 30″. Barometer, 26.2 in. Thermometer, 58°.

CAMP D—AUGUST 16, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Cygni	8	27	37.2	125	51	30
	8	28	54.0	126	17	20
	8	30	24.8	126	49	30
	8	31	38.8	127	15	10
	8	32	44.8	127	39	00
	8	33	57.6	128	04	00
Arcturus	8	15	54.8	75	48	50
	8	18	02.8	75	01	30
	8	18	56.4	74	41	30
	8	20	08.0	74	14	50
	8	21	24.0	73	43	10
	8	23	12.4	73	07	00
Polaris	8	38	44.4	83	50	30
	8	40	29.2	83	52	10
	8	41	37.6	83	53	40
	8	43	00.8	83	54	00
	8	44	10.0	83	55	10
	8	45	31.2	83	55	10
	8	46	29.2	83	56	30
	8	47	37.6	83	57	00
	8	48	54.0	83	59	00
	8	50	01.6	84	00	00

Index error — 0′ 30″. Barometer, 26.0 in. Thermometer, 81°.

CAMP M—SEPTEMBER 8, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris	7	40	57.2	88	18	50
	7	42	02.4	88	19	00
	7	42	57.2	88	20	40
	7	43	47.2	88	21	20
	7	44	39.6	88	21	40
	7	45	53.2	88	23	00
	7	46	36.4	88	23	10
	7	47	18.8	88	24	10
	7	48	13.2	88	24	50
	7	49	40.4	88	24	40
	7	50	40.0	88	25	40
	7	51	16.0	88	26	40
	7	52	09.2	88	27	00
	7	52	56.0	88	27	20
	7	53	37.2	88	28	10
Altair	8	35	56.0	108	34	50
	8	36	46.4	108	35	00
	8	37	27.2	108	35	40
	8	38	08.4	108	36	30
	8	39	02.4	108	37	10
	8	40	09.2	108	37	20

APPENDIX A—Continued.

CAMP M—SEPTEMBER 8, 1855—Continued.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
Altair	8	41	55.6	108	37	00
	8	42	23.2	108	38	10
	8	43	26.0	108	38	00
	8	44	14.0	108	37	50
	8	44	59.6	108	37	30
	8	46	24.0	108	36	50
	8	47	23.2	108	36	00
	8	48	40.0	108	34	30

Index error — 4′ 50″. Barometer, 24.7 in. Thermometer, 43°.5.

CAMP M—SEPTEMBER 9, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
Sun's lower limb	11	54	00.0	101	43	50
	11	54	35.2	101	44	10
	11	55	10.8	101	44	20
	11	55	54.8	101	44	40
	11	56	30.0	101	44	50
	11	57	04.0	101	45	00
	11	57	32.8	101	45	00
	11	58	08.0	101	44	50
	11	59	35.2	101	44	50
	12	00	07.2	101	44	50
	12	00	53.2	101	44	40
	12	01	27.2	101	44	30
	12	01	58.4	101	44	20
	12	02	29.6	101	44	10
	12	02	59.2	101	43	40

Index error — 5′ 20″. Barometer, 24.7 in. Thermometer, 57°.5.

CAMP 40—SEPTEMBER 11, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
Sun's lower limb	11	53	10.0	100	09	40
	11	53	49.6	100	10	00
	11	54	27.2	100	10	10
	11	54	57.2	100	10	40
	11	55	25.2	100	10	50
	11	55	51.6	100	11	00
	11	56	19.6	100	11	00
	11	56	46.4	100	11	00
	11	57	18.0	100	11	00
	11	57	45.2	100	10	50
	11	58	14.0	100	10	40
	11	58	41.2	100	10	30
	11	59	06.4	100	10	30
	11	59	30.0	100	10	20
	11	59	54.8	100	10	20
	12	00	23.2	100	10	10
	12	00	46.8	100	10	00
	12	01	10.8	100	09	40
Polaris	8	06	54.4	88	51	30
	8	08	32.0	88	52	00
	8	09	44.4	88	52	40

CAMP 40—SEPTEMBER 11, 1855—Continued.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	m.	s.	d.	m.	s.
Polaris	8	10	36.4	88	53	40
	8	11	18.0	88	54	10
	8	12	20.8	88	55	10
	8	13	07.2	88	55	10
	8	13	48.8	88	56	10
	8	14	32.0	88	56	20
	8	15	16.8	88	57	10
Altair	8	17	00.8	108	31	20
	8	18	03.2	108	33	00
	8	18	49.6	108	33	10
	8	19	40.4	108	33	30
	8	20	21.6	108	33	40
	8	20	54.6	108	33	40
	8	22	12.0	108	34	00
	8	22	52.0	108	34	00
	8	23	40.0	108	34	10
	8	24	26.0	108	33	50
	8	25	19.2	108	33	30
	8	26	42.4	108	32	00
	8	29	01.6	108	30	00

Index error — 5′ 38″. Barometer, 25.6 in. Thermometer, 40°.5.

CAMP 40—SEPTEMBER 12, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
α Coronæ Borealis	7	40	46.0	87	31	00
	7	42	19.2	86	56	10
	7	43	53.2	86	22	50
	7	45	26.0	85	49	20
	7	46	19.6	85	31	10
	7	47	10.4	85	10	50
Polaris	8	33	53.2	88	50	40
	8	35	10.0	88	51	00
	8	36	09.2	88	52	20
	8	36	54.4	88	52	30
	8	37	40.8	88	53	10
	8	38	46.0	88	54	10
	8	39	29.2	88	54	40
	8	40	37.2	88	55	50
	8	41	23.6	88	56	10
	8	42	12.8	88	56	50
Altair	8	12	45.6	108	53	10
	8	14	04.0	108	54	40
	8	15	10.8	108	55	50
	8	16	01.6	108	56	00
	8	16	46.0	108	55	40
	8	18	24.8	108	56	00
	8	19	12.0	108	56	20
	8	20	28.0	108	55	40
	8	21	42.4	108	55	40
	8	22	41.6	108	55	30
	8	23	43.2	108	54	30
	8	25	30.0	108	53	10

Index error — 5′ 40″. Barometer, 24.1 in. Thermometer, 44°.5.

APPENDIX A—Continued.

CAMP S—SEPTEMBER 19, 1855

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	m.	s.	d.	m.	s.
Polaris	8	11	59.2	89	23	20
	8	13	54.4	89	24	40
	8	15	01.2	89	25	00
	8	16	00.4	89	26	10
	8	17	23.2	89	27	10
	8	18	52.4	89	27	40
	8	20	40.0	89	28	50
	8	22	07.2	89	30	10
	8	23	27.6	89	31	20
	8	25	02.8	89	31	30
Altair	7	42	13.6	108	22	40
	7	43	16.0	108	23	50
	7	44	08.0	108	24	40
	7	45	06.8	108	25	40
	7	46	09.2	108	26	20
	7	47	03.6	108	27	10
	7	48	08.8	108	28	10
	7	49	23.6	108	28	20
	7	50	27.6	108	28	40
	7	51	28.8	108	28	40
	7	52	31.2	108	27	40
	7	53	52.8	108	27	50
	7	55	02.0	108	25	50
	7	56	03.2	108	26	20
	7	56	50.0	108	25	10
	7	57	45.2	108	24	50
	7	58	46.0	108	23	50
	7	59	28.8	108	22	40

Index error —5′ 20″. Barometer, 26.9 in. Thermometer, 54°.

CAMP S—SEPTEMBER 20, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
Sun's lower limb	11	50	20.0	93	07	40
	11	51	10.4	93	08	20
	11	51	42.4	93	08	30
	11	52	28.4	93	09	00
	11	53	22.0	93	09	00
	11	54	04.4	93	09	00
	11	54	28.0	93	09	00
	11	55	03.2	93	09	00
	11	55	31.6	93	09	00
	11	56	07.2	93	09	00
	11	56	40.4	93	08	40
	11	57	25.2	93	08	30
	11	58	14.0	93	08	20
	11	58	43.2	93	07	40
Polaris	7	19	56.0	88	47	00
	7	21	44.8	88	48	10
	7	23	08.8	88	49	00
	7	24	27.2	88	50	20
	7	25	32.4	88	51	20
	7	26	39.6	88	52	00
	7	27	50.8	88	53	10
	7	28	44.8	88	54	00
	7	29	34.8	88	54	40
	7	30	23.6	88	55	00
	7	31	14.0	88	55	40
	7	32	41.6	88	56	30

CAMP S—SEPTEMBER 20, 1855—Continued.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	m.	s.	d	m.	s.
Altair	7	39	44.8	108	24	30
	7	40	42.0	108	25	50
	7	41	32.8	108	26	00
	7	42	43.6	108	26	30
	7	43	31.2	108	27	00
	7	44	48.0	108	27	30
	7	45	27.6	108	28	00
	7	46	23.2	108	28	10
	7	47	25.6	108	28	00
	7	48	36.0	108	28	00
	7	49	42.0	108	27	10
	7	50	27.2	108	27	00
	7	51	24.4	108	26	40
	7	52	23.6	108	26	20
	7	53	10.4	108	25	20
	7	54	11.2	108	24	20

Index error — 5′ 40″. Barometer, 26.9 in. Thermometer, 54°.

CAMP S—SEPTEMBER 21, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
Sun's lower limb	11	49	38.8	92	21	30
	11	50	12.4	92	21	50
	11	50	42.8	92	22	00
	11	51	30.0	92	22	20
	11	52	15.2	92	22	40
	11	52	53.2	92	22	40
	11	53	24.8	92	22	40
	11	54	30.8	92	22	40
	11	55	17.2	92	22	30
	11	56	08.0	92	22	10
	11	56	52.8	92	22	10
	11	57	24.8	92	21	40
	11	58	08.8	92	21	40
	11	58	49.6	92	21	30
Polaris	7	19	18.8	88	50	10
	7	20	22.0	88	50	30
	7	21	24.0	88	51	20
	7	22	07.2	88	51	40
	7	23	09.6	88	52	20
	7	24	12.0	88	53	10
	7	25	02.8	88	53	30
	7	26	09.6	88	54	30
	7	27	05.2	88	55	10
	7	28	03.2	88	56	00
	7	29	30.0	88	57	10
	7	30	26.8	88	58	00
	7	31	19.2	88	59	30
	7	32	25.6	88	59	50
	7	33	38.8	89	00	40
	7	34	40.0	89	01	10
	7	35	40.0	89	02	00
	7	36	27.6	89	03	20
	7	37	11.2	89	03	30
	7	38	02.8	89	04	00
Altair	7	39	21.6	108	27	10
	7	40	13.2	108	27	20
	7	41	07.2	108	27	30
	7	41	49.2	108	28	00
	7	42	35.2	108	27	20

APPENDIX A—Contiuued.

CAMP S—SEPTEMBER 21, 1855—Continued.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers*

Objeet observed.	Time of observ'n by wateh.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Altair................	7	43	56.4	108	28	00
	7	45	20.0	108	27	00
	7	46	06.0	108	27	00
	7	48	14.0	108	26	30
	7	48	58.8	108	25	50
	7	49	46.0	108	25	00
	7	50	46.8	108	24	00
	7	51	34.4	108	22	50
	7	52	20.0	108	22	20
	7	53	19.2	108	20	50
	7	54	00.0	108	19	00

Index error — 5′ 00″. Barometer, 26.9 in. Thermometer, 54°.

CAMP S—SEPTEMBER 22, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Sun's lower limb	11	46	42.4	91	33	00
	11	47	16.0	91	32	25
	11	48	00.0	91	34	00
	11	48	41.6	91	34	40
	11	49	10.4	91	35	00
	11	49	45.2	91	35	10
	11	50	22.4	91	35	20
	11	50	53.2	91	35	40
	11	51	29.6	91	36	00
	11	52	45.6	91	36	00
	11	53	27.6	91	36	10
	11	54	04.4	91	36	10
	11	54	32.4	91	36	00
	11	55	06.4	91	36	00
	11	55	39.6	91	35	50
	11	56	18.8	91	35	40
	11	57	08.8	91	35	10
	11	58	58.8	91	34	15
	11	59	39.6	91	33	40
	12	00	11.2	91	33	00
Polaris...............	7	19	13.6	88	52	10
	7	20	58.4	88	53	10
	7	21	59.2	88	54	30
	7	22	54.4	88	55	20
	7	23	43.6	88	55	40
	7	24	38.0	88	56	20
	7	25	40.8	88	57	30
	7	26	50.4	88	58	50
	7	30	21.2	89	00	00
	7	31	46.4	89	02	00
	7	47	44.0	89	14	10
	7	49	19.6	89	15	50
	7	50	41.6	89	16	20
	7	51	30.0	89	17	00
	7	52	20.0	89	17	30
	7	52	59.6	89	17	50
	7	54	02.0	89	18	30
	7	54	52.8	89	19	00
	7	55	34.4	89	19	30
	7	56	15.2	89	20	30
Altair................	7	33	42.0	108	25	00
	7	35	08.0	108	26	40
	7	35	48.8	108	27	30
	7	36	34.4	108	27	40

CAMP S—SEPTEMBER 22, 1855—Continued.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Objeet observed.	Time of observ'n by wateh.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Altair................	7	37	22.4	108	28	10
	7	38	17.2	108	28	10
	7	39	08.4	108	28	00
	7	39	59.6	108	28	30
	7	40	45.2	108	27	50
	7	41	30.4	108	27	20
	7	42	20.0	108	27	20
	7	43	24.0	108	26	40
	7	44	28.4	108	25	50
	7	45	14.4	108	25	00

Index error — 4′ 30″. Barometer, 26.9 in. Thermometer, 54°.

CAMP 42 W—SEPTEMBER 26, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris...............	6	42	38.8	87	23	50
	6	44	08.4	87	24	50
	6	45	34.4	87	26	10
	6	46	20.0	87	26	40
	6	47	37.2	87	27	10
	6	48	38.0	87	28	10
	6	49	40.8	87	28	30
	6	50	22.8	87	29	20
	6	51	13.2	87	29	50
	6	52	03.2	87	31	10
Altair................	7	18	10.0	109	37	10
	7	18	59.6	109	38	00
	7	20	14.8	109	39	10
	7	21	06.0	109	39	30
	7	22	04.0	109	40	20
	7	22	55.2	109	40	10
	7	24	00.0	109	40	50
	7	24	40.4	109	40	30
	7	25	30.8	109	40	40
	7	26	16.8	109	40	50
	7	27	08.0	109	40	20
	7	27	50.4	109	39	30
	7	28	48.4	109	39	00
	7	29	57.2	109	37	30

Index error — 5′ 00.″ Barometer, 25.6 in. Thermometer, 46°.5.

CAMP 44 W—SEPTEMBER 28, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris...............	6	44	39.6	87	02	00
	6	45	56.0	87	03	00
	6	47	01.2	87	02	20
	6	48	49.6	87	03	50
	6	50	02.4	87	05	10
	6	51	18.8	87	06	00
	6	51	56.0	87	07	00
	6	52	35.2	87	07	00
	6	53	18.0	87	07	30
	6	54	16.0	87	08	00

APPENDIX A—Continued.

CAMP 44 W—SEPTEMBER 28, 1855—Continued.

Observer—Lieut. R. S Williamson, *U. S. Top Engineers*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Altair	7	13	01.6	110	07	30
	7	13	40.1	110	09	00
	7	14	40.4	110	08	50
	7	15	10.0	110	08	50
	7	16	00.6	110	08	30
	7	16	41.9	110	09	20
	7	17	50.7	110	09	30
	7	18	31.5	110	09	20
	7	19	31.2	110	09	10
	7	20	31.1	110	08	40
	7	21	11.2	110	08	20
	7	22	00.8	110	07	50
	7	22	41.3	110	07	30

Index error, — 4′ 40.″ Barometer, 25.4 in. Thermometer, 49°.

CAMP 45 W—SEPTEMBER 30, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris	7	26	16.0	88	12	40
	7	27	26.0	88	13	20
	7	28	11.6	88	14	00
	7	28	55.2	88	14	20
	7	29	42.8	88	14	00
	7	30	38.0	88	15	10
	7	32	04.4	88	16	00
	7	33	31.2	88	17	30
	7	34	18.8	88	17	40
	7	35	12.0	88	18	50
	7	36	13.2	88	19	50
Altair	7	07	48.0	109	33	30
	7	08	21.4	109	34	10
	7	09	03.2	109	34	50
	7	09	48.4	109	35	20
	7	10	24.8	109	35	40
	7	11	11.6	109	35	30
	7	11	49.2	109	35	30
	7	12	25.6	109	35	30
	7	13	02.0	109	35	40
	7	13	50.0	109	35	40
	7	14	33.6	109	35	40
	7	15	30.0	109	35	10
	7	16	06.8	109	34	30
	7	16	40.8	109	33	40

Index error, — 5′ 30″. Barometer, 28.9 in. Thermometer, 56°.

CAMP 48 W—OCTOBER 2, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
Sun's upper limb	9	19	31.2	62	40	00
	9	20	07.6	62	50	00
	9	20	50.8	63	00	00
	9	21	26.0	63	10	00
	9	22	02.0	63	20	00
	9	22	42.0	63	30	60

CAMP 48 W—OCTOBER 2, 1855—Continued.

Observer—Lieut. R. S. Williamson, *U S. Top. Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Sun's upper limb	9	23	20.8	63	40	00
	9	23	59.6	63	50	00
	9	24	37.6	64	00	00
	9	25	16.8	64	10	00
	9	25	56.0	64	20	00
	9	26	35.2	64	30	00
	9	27	14.4	64	40	00
Sun's upper limb	2	29	12.4	63	20	00
	2	29	50.8	63	10	00
	2	30	28.8	63	00	00
	2	31	05.2	62	50	00
	2	31	44.0	62	40	00
Polaris	7	29	04.4	88	40	20
	7	30	08.0	88	41	00
	7	30	51.2	88	41	30
	7	31	38.0	88	42	00
	7	32	21.2	88	42	40
	7	33	02.0	88	43	20
	7	33	42.8	88	43	40
	7	34	30.0	88	44	10
	7	35	21.2	88	44	50
	7	36	12.4	88	45	20
Altair	7	01	51.6	109	14	40
	7	02	58.4	109	14	50
	7	03	40.8	109	15	00
	7	04	32.8	109	15	00
	7	05	13.6	109	15	00
	7	05	56.8	109	14	50
	7	06	32.4	109	14	50
	7	07	14.8	109	14	30
	7	08	07.2	109	14	10
	7	08	43.2	109	13	30
	7	09	26.4	109	13	00
	7	10	23.6	109	12	50
	7	11	34.8	109	11	30
	7	12	28.4	109	10	30

Index error, — 5′ 0″. Barometer, 29.1 in. Thermometer, 59°.5.

CAMP 48 W—OCTOBER 3, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris	7	10	44.8	88	29	40
	7	12	08.0	88	30	10
	7	13	34.4	88	32	00
	7	14	37.2	88	32	30
	7	16	05.2	88	33	10
	7	17	05.2	88	34	30
	7	18	00.0	88	35	00
	7	18	53.6	88	35	40
	7	19	52.0	88	36	30
	7	20	48.0	88	36	30
	7	21	32.8	88	37	30
	7	22	15.2	88	38	00
Altair	6	56	44.0	109	13	10
	6	57	36.0	109	14	00
	6	58	21.2	109	14	10
	6	59	06.8	109	14	20
	6	59	50.8	109	14	50

APPENDIX A—Continued.

CAMP 48 W—OCTOBER 3, 1855—Continued.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Altair	7	00	35.2	109	14	40
	7	01	18.8	109	14	30
	7	01	59.6	109	14	30
	7	02	45.2	109	14	30
	7	03	22.0	109	14	40
	7	04	00.8	109	14	00
	7	04	32.8	109	13	30
	7	05	22.4	109	13	10

Index error, — 5′ 00″. Barometer, 29.1 in. Thermometer, 56°.

CAMP 49 W—OCTOBER 4, 1855.

Observer—Lieut. R. S. Williamson—*U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris	7	11	24.0	88	56	20
	7	12	36.0	88	58	00
	7	13	21.6	88	58	10
	7	14	10.0	88	58	20
	7	15	39.2	89	00	20
	7	17	48.4	89	01	20
	7	19	30.4	89	02	30
	7	20	30.0	89	03	30
	7	21	32.4	89	04	30
	7	22	41.2	89	05	10
Altair	6	52	45.2	108	48	20
	6	53	30.8	108	49	00
	6	54	26.0	108	49	20
	6	55	07.6	108	50	10
	6	56	25.6	108	50	40
	6	57	26.0	108	51	10
	6	58	14.8	108	51	20
	6	59	00.0	108	51	20
	6	59	48.8	108	51	20
	7	00	46.8	108	51	00
	7	02	38.4	108	49	50
	7	03	23.2	108	48	40

Index error, —5′ 00″. Barometer, 29.4 in. Thermometer, 66°.5.

CAMP 50 W—OCTOBER 5, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris	7	05	45.6	89	28	10
	7	06	42.4	89	28	30
	7	07	59.2	89	29	10
	7	09	01.2	89	30	10
	7	10	09.2	89	31	20
	7	11	29.6	89	32	00

CAMP 50 W—OCTOBER 5, 1855—Continued.

Observer—Lieut R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris	7	12	18.4	89	32	40
	7	13	28.0	89	33	40
	7	14	26.0	89	34	20
	7	15	34.8	89	35	00
Altair	6	49	22.4	108	16	20
	6	50	10.8	108	17	20
	6	51	01.6	108	17	00
	6	51	52.8	108	17	50
	6	52	42.8	108	18	10
	6	53	26.0	108	17	50
	6	54	02.0	108	18	10
	6	54	38.0	108	17	50
	6	55	32.4	108	18	00
	6	56	58.0	108	18	00
	6	57	48.0	108	17	20
	6	58	31.2	108	16	40
	6	59	10.4	108	16	10

Index error, — 5′00″. Barometer, 29.6 in. Thermometer, 57°.

CAMP 51 W—OCTOBER 6, 1855.

Observer—Lieut. R. S. Williamson, *U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris	6	59	33.2	90	09	40
	7	00	59.6	90	11	00
	7	01	53.2	90	11	30
	7	02	50.0	90	12	30
	7	03	46.4	90	12	50
	7	04	58.8	90	14	10
	7	06	09.2	90	14	50
	7	06	53.2	90	15	20
	7	07	48.4	90	16	00
	7	08	52.4	90	17	00
Altair	6	43	15.2	107	33	00
	6	44	33.2	107	34	10
	6	45	26.0	107	34	30
	6	46	11.2	107	34	30
	6	46	52.4	107	34	40
	6	47	42.0	107	34	50
	6	48	28.0	107	35	00
	6	49	03.6	107	35	10
	6	50	08.2	107	35	10
	6	50	58.8	107	35	20
	6	51	58.8	107	35	00
	6	53	09.6	107	34	50
	6	54	00.4	107	34	30
	6	55	04.4	107	33	00
	6	55	44.8	107	33	00

Index error, — 5′ 00″. Barometer, 29.7 in. Thermometer, 50°.5.

APPENDIX A—Continued.

III. *Observations on the routes of detached parties, in charge of Lieut. H. L. Abbot, U. S. Topographical Engineers.*

CAMP 40 A—SEPTEMBER 7, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.	Observed double altitudes.
	h. m. s.	d. m. s.
α Cygni	7 29 33.5	138 33 00
	7 31 55.0	139 22 10
	7 33 20.0	139 50 00
	7 34 20.0	140 11 30
	7 35 21.0	140 33 30
	7 36 13.5	140 50 50
Arcturus	7 39 24.0	51 43 30
	7 41 19.5	51 02 50
	7 42 42.0	50 31 30
	7 43 49.5	50 10 00
	7 44 59.5	49 43 50
	7 46 33.0	49 12 10
Polaris	7 57 47.5	89 37 10
	7 59 26.0	89 38 50
	8 01 08.0	89 40 40
	8 02 41.0	89 44 20
	8 03 57.0	89 46 10
	8 05 26.0	89 49 20
	8 06 40.0	89 50 00
	8 08 31.0	89 52 10
	8 09 33.0	89 54 00
	8 10 44.0	89 55 50

Index error, 0. Barometer, 28.0 in. Thermometer, 70°.0.

CAMP 41 A—SEPTEMBER 8, 1855.

Observer—Lieut. H L. Abbot, *U. S. Top. Engineers.*

	h. m. s.	d. m. s.
Jupiter	8 35 29.5	49 21 40
	8 37 25.0	49 44 20
	8 39 01.0	50 03 10
	8 40 37.5	50 18 50
	8 41 56.0	50 33 40
	8 42 08.0	50 46 30
Arcturus	7 59 33.0	46 50 10
	8 01 30.5	46 06 50
	8 04 24.0	45 07 30
	8 05 53.5	44 35 20
	8 08 19.0	43 44 20
Polaris	8 14 51.0	90 52 10
	8 16 19.0	90 53 50
	8 17 37.5	90 55 20
	8 21 37.5	91 01 10
	8 24 11.5	91 06 20
	8 25 26.0	91 09 30
	8 27 02.5	91 10 20
	8 28 37.0	91 12 50
	8 30 50.0	91 15 40
	8 32 57.0	91 18 30

Index error, 0. Barometer, 27.1 in. Thermometer, 55°.0.

CAMP 42 A—SEPTEMBER 9, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.	Observed double altitudes.
	h. m. s.	d. m. s.
α Cygni	7 19 16.0	138 46 10
	7 21 47.5	139 38 30
	7 23 26.5	140 13 20
	7 24 37.5	140 38 30
	7 25 56.5	141 06 30
	7 26 53.5	141 25 20
Arcturus	7 31 11.0	55 11 20
	7 32 18.0	54 47 20
	7 33 37.0	54 19 50
	7 34 48.0	53 55 40
	7 35 47.5	53 32 50
	7 36 50.0	53 12 20
Polaris	7 41 53.5	90 25 10
	7 43 02.5	90 26 40
	7 44 32.5	90 28 40
	7 47 30.5	90 29 50
	7 48 27.0	90 30 40
	7 50 31.5	90 32 10
	7 52 14.0	90 33 50
	7 54 05.5	90 35 10
	7 55 23.0	90 35 50
	7 56 45.0	90 36 50

Index error, + 1′ 50″. Barometer, 28.8 in. Thermometer, 50°.5.

CAMP 44 A—SEPTEMBER 15, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers*

	h. m. s.	d. m. s.
Jupiter	8 33 16.0	53 02 40
	8 34 27.0	53 13 40
	8 35 05.0	53 26 40
	8 37 16.5	53 37 20
	8 38 38.0	53 48 00
	8 39 47.5	53 58 10
Arcturus	7 35 34.0	55 00 00
	7 37 35.5	54 18 50
	7 38 58.0	53 49 50
	7 40 05.0	53 27 00
	7 41 27.0	52 56 40
	7 43 04.5	52 23 30
Polaris	8 08 05.5	91 45 00
	8 09 32.5	91 46 40
	8 10 49.5	91 47 40
	8 12 25.5	91 49 30
	8 16 10.0	91 50 40
	8 17 24.0	91 53 30
	8 19 33.5	91 55 10
	8 23 35.0	91 58 00
	8 28 41.0	92 00 40
	8 29 56.5	92 01 30

Index error, 0. Barometer, 29.6 in. Thermometer, 52°.0.

APPENDIX A—Continued.

CAMP 46 A, (same as 42 A)—SEPTEMBER 20, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	m.	s.	d.	m.	s.
Jupiter	7	33	18.5	49	44	50
	7	34	54.0	50	02	30
	7	36	34.0	50	21	10
	7	37	43.0	50	32	30
	7	38	59.0	50	45	30
	7	40	08.0	50	57	00
Arcturus	7	01	56.5	45	06	30
	7	03	18.5	44	16	30
	7	04	24.0	43	53	10
	7	05	21.0	43	32	50
	7	06	26.0	43	10	40
	7	07	21.5	42	51	00
Polaris	7	13	42.0	90	18	50
	7	15	23.5	90	20	10
	7	16	51.0	90	21	00
	7	18	25.0	90	22	00
	7	19	33.5	90	24	00
	7	20	55.0	90	24	40
	7	21	41.0	90	25	50
	7	24	31.5	90	28	10
	7	25	58.0	90	28	50
	7	27	10.0	90	29	40

Index error, + 2′ 30″. Barometer, 27.1 in. Thermometer, 43°.5.

CAMP 47 A—SEPTEMBER 21, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
Jupiter	7	37	22.5	51	42	40
	7	38	50.5	51	57	50
	7	40	03.5	52	10	10
	7	41	03.0	52	20	20
	7	42	05.5	52	30	30
	7	43	18.0	52	41	50
Polaris	7	11	45.5	89	51	30
	7	13	21.5	89	53	20
	7	14	23.5	89	55	20
	7	16	54.0	89	56	30
	7	19	38.0	89	58	20
	7	21	13.5	89	59	30
	7	22	56.0	90	01	30
	7	24	22.5	90	02	30
	7	25	51.0	90	03	00
	7	27	21.5	90	04	40

Index error, + 1′ 00″. Barometer, 28.5 in. Thermometer, 49°.0.

CAMP 48 A, (same as 40 A)—SEPTEMBER 22, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
Jupiter	7	48	54.0	54	28	10
	7	50	20.0	54	45	10
	7	52	21.0	54	49	20
	7	53	45.0	55	11	46

CAMP 48 A, (same as 40 A)—SEPT. 22, 1855—Continued.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by watch.			Observed double altitudes.		
	h.	m.	s.	d.	m.	s.
Polaris	7	25	23.0	89	43	50
	7	27	12.5	89	46	20
	7	28	10.5	89	48	20
	7	31	17.0	89	50	30
	7	33	34.0	89	51	30
	7	35	11.0	89	53	50
	7	36	11.0	89	54	20
	7	37	28.0	89	55	10
	7	38	37.0	89	56	10
	7	40	09.0	89	57	00

Index error, + 1′ 20″. Barometer, 28.0 in. Thermometer, 40°.

CAMP 51 A—SEPTEMBER 26, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	m.	s.	d.	m.	s.
η Pegasi	8	20	37.5	112	18	20
	8	23	00.0	113	07	40
	8	24	32.0	113	40	30
	8	26	12.0	114	15	20
	8	28	11.0	114	56	40
	8	29	50.5	115	30	40
γ Bootis	8	05	56.0	64	33	50
	8	07	26.0	64	01	10
	8	08	13.0	63	45	20
	8	09	17.5	63	23	30
Polaris	8	37	21.0	90	00	20
	8	38	43.0	90	01	30
	8	39	56.0	90	02	10
	8	41	30.5	90	04	30
	8	43	05.0	90	06	20
	8	44	40.5	90	06	40
	8	45	54.0	90	06	50
	8	47	08.0	90	07	40
	8	48	43.0	90	09	10
	8	50	39.0	90	10	50
	8	51	45.0	90	11	10
	8	53	02.0	90	11	50
	8	54	18.0	90	12	40

Index error, + 1′ 20″. Barometer, 25.5 in. Thermometer, 51°.5.

CAMP 52 A—SEPTEMBER 27, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
η Pegasi	8	33	16.5	118	00	40
	8	35	04.5	118	38	10
	8	36	13.0	119	00	40
	8	37	39.5	119	29	20
	8	39	14.5	120	02	30
	8	41	0.00	120	38	20

APPENDIX A—Continued.

CAMP 52 A—SEPTEMBER 27, 1855—Continued.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m*	*s.*
Polaris................	8	08	29.5	89	43	10
	8	10	11.0	89	44	20
	8	11	20.0	89	45	30
	8	12	11.5	89	46	20
	8	13	07.5	89	46	40
	8	14	42.5	89	48	10
	8	16	21.0	89	49	10
	8	17	47.5	89	50	30
	8	18	43.0	89	51	30
	8	19	44.5	89	52	00

Index error, + 1′ 20″. Barometer, 25.5 in. Thermometer, 49°.

CAMP 53 A—SEPTEMBER 28, 1855.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
η Pegasi..............	8	05	06.5	110	02	50
	8	07	46.0	110	36	10
	8	08	50.5	110	57	20
	8	10	11.5	111	26	30
	8	11	45.0	111	59	10
	8	12	50.5	112	21	50
α Cor. Borealis........	7	33	13.5	81	21	10
	7	35	08.0	80	40	30
	7	36	34.0	80	10	30
	7	37	37.5	79	48	20
	7	38	36.5	79	26	00
	7	39	48.5	78	59	40
Polaris................	7	42	58.5	89	38	50
	7	44	40.5	89	39	30
	7	46	20.0	89	40	20
	7	47	10.0	89	41	10
	7	48	04.0	89	41	50
	7	49	58.0	89	43	10
	7	51	23.0	89	44	20
	7	52	45.5	89	45	00
	7	53	52.5	89	46	10
	7	55	06.5	89	47	20

Index error, + 1′ 20″. Barometer, 27.7 in. Thermometer, 41°.5.

CAMP 54 A, (same as 41 A)—SEPTEMBER 29, 1855.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
η Pegasi..............	9	02	10.0	130	22	30
	9	03	52.0	130	55	40
	9	05	08.5	131	16	30
	9	09	05.5	132	30	20
	9	11	06.0	133	06	20
	9	12	27.0	133	30	10
Polaris................	8	41	54.0	90	27	20
	8	44	02.5	90	29	30
	8	45	03.5	90	30	00
	8	47	40.0	90	31	30
	8	48	54.0	90	32	10
	8	49	47.5	90	32	50

CAMP 54 A, (same as 41 A)—SEPT. 29, 1853—Continued.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m*	*s.*	*d.*	*m.*	*s.*
Polaris................	8	50	46.0	90	33	40
	8	51	34.5	90	34	30
	8	52	24.5	90	35	20
	8	53	10.5	90	35	50

Index error, + 1′ 20″. Barometer, 27.7 in. Ther., 41°.5.

CAMP 55 A, (same as 42 A)—OCTOBER 2, 1855.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
Sun's lower limb.......	9	43	44.5	58	00	00
	9	44	23.5	58	10	00
	9	45	02.0	58	20	00
	9	45	41.5	58	30	00
	9	46	18.0	58	40	00
	9	46	56.5	58	50	00
	9	47	33.5	59	00	0
	9	48	12.5	59	10	00
	9	48	52.5	59	20	00
	9	49	30.0	59	30	00
	9	51	08.5	59	40	00
	9	50	47.0	59	50	00
	9	51	25.0	60	00	00
Sun's lower limb.......	3	03	44.0	60	00	00
	3	04	23.5	59	50	00
	3	05	05.0	59	40	00
	3	05	42.0	59	30	00
	3	06	20.0	59	20	00
	3	06	59.0	59	10	00
	3	07	37.5	59	00	00
	3	08	13.5	58	50	00
	3	08	52.0	58	40	00
	3	09	31.5	58	30	00
	3	10	08.5	58	20	00
	3	10	47.0	58	10	00
	3	11	25.5	58	00	00

Index error, — 0′ 30″.

CAMP 57 A—OCTOBER 5, 1855.

Observer—Lieut. H. L. ABBOT, *U. S. Top. Engineers.*

Object observed.	*h.*	*m.*	*s.*	*d.*	*m.*	*s.*
η Pegasi..............	7	56	51.0	116	24	50
	7	58	54.0	117	06	50
	8	00	43.5	117	44	20
	8	02	16.0	118	14	30
	8	03	39.5	118	42	30
	8	05	28.0	119	21	10
Polaris................	8	13	45.5	91	10	20
	8	15	40.0	91	11	00
	8	16	55.0	91	12	00
	8	17	49.0	91	12	30
	8	18	58.0	91	12	50
	8	22	25.0	91	15	50
	8	23	57.5	91	17	20
	8	25	14.0	91	18	40
	8	26	29.5	91	19	20
	8	27	56.0	91	20	00
	8	29	13.0	91	20	50

Index error, — 0′ 30″. Barometer, 27.3 in. Ther., 46°.

APPENDIX A—Continued.

CAMP 58 A—OCTOBER 6, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
η Pegasi	8	23	55.5	126	26	50
	8	25	35.5	126	59	30
	8	26	52.5	127	22	40
	8	27	58.0	127	44	20
	8	29	14.0	128	08	20
	8	30	45.5	128	37	10
α Cor. Borealis	8	13	36.0	57	25	40
	8	14	48.0	57	15	30
	8	16	50.0	56	21	40
	8	17	46.5	56	01	50
	8	18	36.5	55	46	40
	8	19	49.0	55	22	10
Polaris	8	34	12.5	91	35	40
	8	36	01.0	91	37	40
	8	37	30.5	91	38	20
	8	41	27.0	91	41	00
	8	42	44.5	91	42	10
	8	43	53.0	91	43	10
	8	45	12.0	91	43	40
	8	46	16.0	91	44	20
	8	47	16.5	91	44	50
	8	48	27.0	91	45	40

Index error, + 0′ 50″. Barometer, 26.5 in. Thermometer, 39°.

CAMP 59 A—OCTOBER 7, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
η Pegasi	8	51	09.5	135	35	30
	8	52	53.5	136	06	30
	8	54	16.5	137	27	50
	8	56	26.0	137	02	40
	8	57	41.0	137	25	50
	8	59	24.5	137	50	00
	9	01	06.0	138	20	10
Polaris	8	10	17.5	91	28	20
	8	11	43.5	91	29	20
	8	12	45.0	91	30	10
	8	13	55.0	91	31	10
	8	14	50.0	91	32	00
	8	18	51.0	91	34	40
	8	20	01.0	91	35	10
	8	21	17.0	91	36	20
	8	22	09.0	91	37	00

Index error, + 0′ 50″. Barometer, 26.5 in. Thermometer, 39°.

CAMP 60 A—OCTOBER 8, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris	8	06	22.5	91	27	40
	8	07	29.0	91	28	10
	8	08	53.0	91	30	10
	8	09	48.0	91	30	30
	8	10	40.5	91	31	00

CAMP 60 A—OCTOBER 8, 1855—Continued.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
Polaris	8	11	31.0	91	31	30
	8	12	28.0	91	32	00
	8	13	15.0	91	32	20
	8	14	12.0	91	33	10
	8	15	30.0	91	34	30
Altair	7	05	12.5	106	31	50
	7	06	51.5	106	35	00
	7	07	41.5	106	35	00
	7	08	30.5	106	35	20
	7	09	20.5	106	35	30
	7	10	08.5	106	36	30
	7	11	50.5	106	36	50
	7	13	34.0	106	37	30
	7	15	56.5	106	38	50
	7	16	40.5	106	38	00
	7	17	33.5	106	38	30
	7	18	49.5	106	37	20
	7	21	03.5	106	36	20
	7	21	51.5	106	35	40
	7	23	01.5	106	32	40
	7	24	50.5	106	31	20

Index error, + 0′ 50″. Barometer, 28.9 in. Thermometer, 43°.

CAMP 62 A—OCTOBER 12, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
η Pegasi	8	06	31.0	128	00	10
	8	07	36.5	128	20	10
	8	09	10.0	128	49	50
	8	10	09.0	129	07	00
	8	11	23.5	129	29	40
	8	12	45.0	129	54	50
Polaris	8	16	43.5	91	51	20
	8	18	43.5	91	52	40
	8	20	12.5	91	53	40
	8	21	15.5	91	54	50
	8	23	14.0	91	56	20
	8	25	07.5	91	57	20
	8	26	35.5	91	58	40
	8	27	51.0	91	59	40
	8	29	51.0	92	00	30
	8	31	05.0	92	01	10

Index error, + 1′ 20″. Barometer, 25.3 in. Thermometer, 44°.

CAMP 64 A—OCTOBER 14, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

	h.	*m.*	*s.*	*d.*	*m.*	*s.*
η Pegasi	7	53	05.5	125	48	00
	7	54	44.0	126	19	50
	7	56	06.5	126	46	10
	7	57	23.0	127	10	20
	7	58	55.0	127	27	30
	8	00	19.0	128	02	10

APPENDIX A—Continued.

CAMP 64 A—OCTOBER 14, 1855—Continued.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

bject observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	m.	s.	d.	m.	s.
α Cor. Borealis	8	02	53.0	49	36	10
	8	04	41.0	48	59	40
	8	05	44.0	48	38	30
	8	06	41.0	48	18	20
	8	07	59.0	47	53	10
	8	09	28.0	47	22	00
Polaris	7	17	13.0	91	23	50
	7	18	10.5	91	25	00
	7	19	33.5	91	25	50
	7	24	24.0	91	29	10
	7	25	49.5	91	30	30
	7	27	16.0	91	31	30
	7	28	04.5	91	32	40
	7	28	55.5	91	33	10
	7	30	04.0	91	33	50
	7	31	43.5	91	35	00

Index error, — 0′ 50″. Barometer, 29.5 in. Thermometer, 41°.5.

CAMP 64 A—OCTOBER 16, 1855

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

	h.	m.	s.	d.	m.	s.
Sun's lower limb	9	48	51.5	50	00	00
	9	49	31.0	50	10	00
	9	50	13.5	50	20	00
	9	50	53.5	50	30	00
	9	51	36.5	50	40	00
	9	52	17.5	50	50	00
	9	53	01.0	51	00	00
	9	53	40.5	51	10	00
	9	54	22.0	51	20	00
	9	55	05.0	51	30	00
	9	55	47.0	51	40	00
	9	56	30.0	51	50	00
	9	57	10.0	52	00	00
Sun's lower limb	2	55	52.0	52	00	00
	2	56	35.0	51	50	00
	2	57	18.0	51	40	00
	2	58	00.0	51	30	00
	2	58	44.0	51	20	00
	2	59	24.0	51	10	00
	3	00	06.0	51	00	00
	3	00	49.0	50	50	00
	3	01	30.0	50	40	00
	3	02	11.5	50	30	00
	3	02	52.5	50	20	00
	3	03	33.0	50	10	00
	3	04	15.0	50	00	00

Index error, — 0′ 50″.

CAMP 68 A—OCTOBER 24, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

	h.	m.	s.	d.	m.	s.
α Cor. Borealis	7	06	08.0	56	24	10
	7	08	03.0	55	43	40
	7	09	26.5	55	14	50
	7	10	46.5	54	46	50
	7	11	47.0	54	26	10
	7	12	49.5	54	03	40

CAMP 68 A—OCTOBER 24, 1855—Continued.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	m.	s.	d.	m.	s.
Polaris	7	36	13.5	91	03	20
	7	38	16.5	91	05	00
	7	39	35.5	91	06	20
	7	41	15.0	91	07	20
	7	43	44.0	91	08	10
	7	45	06.0	91	09	50
	7	46	25.5	91	11	10
	7	47	52.5	91	12	10
	7	49	08.0	91	13	10
	7	50	00.5	91	13	50

Index error, — 6′ 00″. Barometer, 30.0 in. Thermometer, 45°.

CAMP 69 A—OCTOBER 25, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

	h.	m.	s.	d.	m	s.
α Lyræ	8	20	45.0	105	25	00
	8	22	24.0	104	50	40
	8	23	28.0	104	29	20
	8	26	31.0	103	23	40
	8	27	45.5	102	50	20
	8	29	51.5	102	33	00
Polaris	8	32	58.0	90	49	10
	8	37	13.0	90	52	40
	8	38	32.0	90	53	00
	8	39	56.5	90	53	10
	8	41	06.5	90	54	20
	8	42	53.0	90	54	50
	8	43	48.0	90	55	20
	8	44	42.0	90	56	00
	8	45	50.0	90	56	30
	8	46	55.0	90	57	10

Index error, — 5′ 20″. Barometer, 29.9 in. Thermometer, 50°.5.

CAMP 70 A—OCTOBER 26, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

	h.	m.	s.	d.	m.	s.
η Pegasi	6	50	05.0	120	54	50
	6	52	31.0	121	45	20
	6	53	49.5	122	11	00
	6	54	40.0	122	30	00
	6	55	23.5	122	43	30
	6	56	27.0	123	05	30
α Cor. Borealis	6	59	37.0	55	17	20
	7	01	14.0	54	40	30
	7	02	22.5	54	18	20
	7	03	41.0	53	51	10
	7	05	09.0	53	19	50
	7	06	33.0	52	50	40
Polaris	7	10	53.5	89	19	40
	7	12	18.0	89	20	40
	7	13	02.5	89	21	20
	7	13	48.5	89	21	50
	7	14	38.0	89	22	20

APPENDIX A—Continued.

CAMP 70 A—OCTOBER 26, 1855—Continued.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer. h.	m.	s.	Observed double altitudes. d.	m.	s.
Polaris	7	15	20.0	89	22	50
	7	16	19.0	89	23	20
	7	17	03.5	89	24	10
	7	18	01.5	89	25	00
	7	19	06.5	89	25	40
Jupiter	7	57	23.0	61	51	10
	7	58	03.5	61	52	10
	7	58	51.0	61	52	20
	7	59	44.5	61	52	40
	8	00	44.0	61	53	20
	8	01	39.5	61	54	40
	8	02	44.0	61	55	00
	8	03	46.5	61	55	20
	8	04	33.5	61	55	20
	8	05	34.0	61	55	00
	8	07	51.5	61	54	50
	8	09	06.0	61	54	50
	8	10	02.0	61	54	10
	8	10	52.0	61	53	40
	8	11	46.0	61	53	20
	8	12	42.0	61	52	40
	8	13	26.0	61	52	00
	8	14	19.5	61	51	10

Index error, + 0′ 50″. Barometer, 29.6 in. Thermometer, 38°.5.

CAMP 71 A—OCTOBER 27, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
η Pegasi	7	24	38.5	133	50	50
	7	26	01.5	134	17	20
	7	27	16.5	134	41	50
	7	28	26.0	135	04	10
	7	29	25.0	135	22	30
	7	30	24.5	135	41	20
α Lyræ	7	34	03.5	118	42	10
	7	35	05.0	118	20	30
	7	36	07.5	117	58	20
	7	37	05.0	117	35	50
	7	38	01.0	117	16	20
	7	38	49.0	116	58	40
Polaris	7	41	10.0	89	09	30
	7	42	21.5	89	10	10
	7	43	00.5	89	10	50
	7	43	50.0	89	11	10
	7	44	34.0	89	11	40
	7	45	08.0	89	12	10
	7	45	42.5	89	12	50
	7	46	20.5	89	13	10
	7	47	12.5	89	13	30
	7	48	03.5	89	14	00
Jupiter	7	54	06.0	62	27	10
	7	54	56.5	62	28	00
	7	55	46.5	62	28	40
	7	56	30.5	62	29	30
	7	57	15.5	62	29	50
	7	58	06.0	62	29	50
	7	58	58.5	62	30	00
	7	59	42.5	62	30	20
	8	00	26.5	62	30	20

CAMP 71 A—OCTOBER 27, 1855—Continued.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer. h.	m.	s.	Observed double altitudes. d.	m.	s.
Jupiter	8	01	27.5	62	30	10
	8	02	06.0	62	30	00
	8	03	42.5	62	29	50
	8	04	31.0	62	29	40
	8	05	14.0	62	29	30
	8	08	14.0	62	28	40
	8	09	06.5	62	28	20
	8	10	03.0	62	27	10

Index error, + 0′ 50″. Barometer, 29.3 in. Thermometer, 45°.5.

CAMP 73 A—OCTOBER 30, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
η Pegasi	6	40	28.0	123	15	30
	6	41	36.0	123	39	30
	6	42	43.5	124	02	00
	6	43	59.0	124	28	00
	6	45	05.5	124	51	10
	6	46	05.5	125	11	00
α Lyræ	7	07	35.5	124	14	20
	7	09	14.0	123	38	50
	7	10	25.5	123	12	20
	7	11	15.5	122	54	40
	7	11	58.5	122	38	30
	7	13	09.5	122	12	40
Polaris	6	50	42.0	87	44	00
	6	52	16.0	87	45	30
	6	53	27.5	87	46	30
	6	54	14.0	87	47	00
	6	55	42.0	87	48	50
	6	56	24.5	87	49	10
	6	58	43.5	87	50	20
	7	00	05.5	87	51	20
	7	01	25.5	87	52	10
	7	02	24.0	87	52	50
	7	03	14.0	87	53	40

Index error, + 1′ 20″. Barometer, 29.7 in. Thermometer, 45°.

CAMP 74 A—OCTOBER 31, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	h.	m.	s.	d.	m.	s.
α Lyræ	8	02	02.0	102	52	00
	8	04	29.0	102	00	00
	8	05	48.0	101	31	30
	8	06	31.5	101	14	40
	8	07	42.0	100	49	50
	8	08	28.5	100	32	30
	8	10	08.0	99	58	00
	8	10	55.0	99	42	20
	8	11	56.0	99	19	30

APPENDIX A—Continued.

CAMP 74 A—OCTOBER 31, 1855—Continued.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.	Observed double altitudes.
	h. m. s.	d. m. s.
Polaris	8 17 59.0	88 00 00
	8 19 54.5	88 01 20
	8 20 39.5	88 02 00
	8 21 52.0	88 02 30
	8 22 58.0	88 03 00
	8 24 02.5	88 03 30
	8 26 13.0	88 04 10
	8 27 27.0	88 04 50
	8 28 17.0	88 05 30
	8 29 35.0	88 06 10
Jupiter	7 38 34.5	64 13 50
	7 39 33.0	64 14 10
	7 40 10.5	64 14 40
	7 41 23.5	64 15 20
	7 42 14.0	64 16 20
	7 43 02.0	64 16 30
	7 43 59.0	64 17 20
	7 44 46.0	64 17 30
	7 45 31.5	64 18 10
	7 46 18.5	64 18 10
	7 48 08.5	64 17 50
	7 49 01.0	64 17 30
	7 49 54.0	64 17 30
	7 50 55.5	64 17 20
	7 52 15.0	64 16 30
	7 53 54.0	64 15 30
	7 54 50.0	64 14 30
	7 55 45.0	64 13 50

Index error, + 1′ 20″. Barometer, 29.4 in. Thermometer, 41°.

CAMP 76 A—NOVEMBER 2, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.	Observed double altitudes.
	h. m. s.	d. m. s.
η Pegasi	7 05 46.5	136 25 30
	7 07 27.5	136 56 00
	7 08 59.0	137 26 30
	7 10 09.5	137 48 10
	7 11 43.5	138 19 20
	7 13 05.0	139 46 30
α Lyræ	7 15 02.5	93 01 20
	7 16 01.0	92 40 10
	7 16 58.0	92 21 20
	7 17 46.0	92 03 50
	7 18 45.0	91 42 40
	7 20 02.0	91 14 20
Polaris	7 24 01.0	86 43 10
	7 25 04.0	86 43 40
	7 26 04.5	86 44 20
	7 26 53.0	86 45 00
	7 27 54.0	86 45 40
	7 28 43.0	86 46 00
	7 29 34.5	86 47 20
	7 31 17.0	86 48 40

CAMP 76 A—NOVEMBER 2, 1855—Continued.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.	Observed double altitudes.
	h. m. s.	d. m. s.
Jupiter	7 38 44.5	65 10 20
	7 39 49.0	65 10 30
	7 40 38.0	65 10 40
	7 41 30.0	65 10 50
	7 42 24.5	65 10 30
	7 44 15.5	65 09 30
	7 45 06.0	65 09 00

Index error, + 1′ 20″. Barometer, 28.8 in. Thermometer, 44°.

CAMP 77 A—NOVEMBER 4, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.	Observed double altitudes.
	h. m. s.	d. m. s.
η Pegasi	6 44 15.0	132 33 00
	6 45 27.5	132 59 10
	6 46 46.5	133 24 40
	6 48 08.5	133 51 00
	6 49 37.0	134 20 40
	6 51 04.5	134 49 50
α Lyræ	6 27 19.5	131 00 00
	6 28 09.5	130 42 00
	6 28 58.0	130 22 50
	6 29 51.0	130 03 30
	6 30 37.0	129 46 40
	6 31 31.0	129 27 10
Polaris	6 57 36.0	86 22 20
	6 59 02.0	86 22 40
	6 59 44.5	86 23 10
	7 00 30.5	86 23 30
	7 01 16.0	86 23 50
	7 02 01.0	86 24 30
	7 02 46.0	86 24 50
	7 03 26.5	86 25 20
	7 04 03.5	86 26 00
	7 04 53.0	86 26 20
Jupiter	7 21 39.5	65 21 20
	7 22 44.5	65 22 10
	7 23 32.5	65 22 50
	7 24 34.5	65 23 40
	7 25 22.0	65 24 00
	7 26 12.0	65 24 40
	7 27 23.5	65 25 00
	7 28 19.0	65 25 30
	7 29 07.5	65 25 50
	7 29 57.5	65 25 50
	7 30 42.0	65 25 40
	7 31 33.0	65 25 30
	7 32 28.5	65 25 20
	7 33 28.5	65 25 00
	7 34 22.5	65 24 30
	7 35 46.5	65 23 30

Index error, + 1′ 20″. Barometer, 28.7 in. Thermometer, 43°.5.

APPENDIX A—Continued.

CAMP 81 A—NOVEMBER 10, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Lyræ	7	17	26.0	103	11	20
	7	18	19.5	102	51	00
	7	19	00.0	102	37	10
	7	19	49.5	102	18	50
	7	21	04.0	101	51	30
	7	22	10.5	101	27	40
Polaris...............	7	24	22.5	85	14	00
	7	25	14.5	85	14	30
	7	26	34.5	85	15	20
	7	27	15.5	85	15	30
	7	28	05.5	85	16	00
	7	29	00.0	85	16	20

Index error, + 1′ 20″. Barometer, 27.0 in. Thermometer, 35°.

CAMP 85 A—NOVEMBER 14, 1855.

Observer—Lieut. H. L. Abbot, *U. S. Top. Engineers.*

Object observed.	Time of observ'n by chronometer.			Observed double altitudes.		
	h.	*m.*	*s.*	*d.*	*m.*	*s.*
α Lyræ	7	51	38.5	83	50	00
	7	52	52.0	83	23	50
	7	53	45.5	83	04	20
	7	54	34.0	82	47	30
	7	55	42.5	82	22	40
	7	56	34.5	82	04	30
Polaris	8	18	17.5	83	48	20
	8	19	21.5	83	48	30
	8	20	24.0	83	48	50
	8	21	08.0	83	49	10
	8	21	52.0	83	49	40
	8	22	37.0	83	50	00
	8	23	52.0	83	50	20
	8	24	41.5	83	50	30
	8	25	32.5	83	50	50
	8	27	37.0	83	51	10

Index error, + 0′ 30″. Barometer, 28.9 in. Thermometer, 43°.

APPENDIX B.

COMPARISON OF CHRONOMETERS.

Date.	No. of camp.	Locality.	No. of chronom.	Reading of chron's, mean solar time.			Difference.			Chronom'r slow of mean solar time.		
				h.	m.	s.	h.	m.	s.	h.	m.	s.
1855. July 15	7	Feather river	1980	5	56	30. 0				0	03	23. 20
			1888	5	58	08. 0	0	01	38. 0			
			1980	5	57	50. 0						
			1155	5	59	23. 0	0	01	33. 0			
			1980	5	59	10. 0						
			213	6	01	08. 5	0	01	58. 5			
July 19	11	Antelope creek	1980	5	56	10. 0				0	01	19 67
			1888	5	58	08. 5	0	01	58. 5			
			1980	5	57	10. 0						
			1155	5	59	07. 0	0	01	57. 0			
			1980	5	58	00. 0						
			213	6	00	21. 5	0	02	21. 5			
July 23	------	Fort Reading	1980	6	13	10. 0				0	01	13. 07
			1888	6	15	29. 0	0	02	19. 0			
			1980	6	14	25 0						
			1155	6	16	44. 0	0	02	19. 0			
			1980	6	16	00. 0						
			213	6	18	47. 0	0	02	47. 0			
July 29	13	Asbury's rancho	1980	5	55	40. 0				0	03	20. 92
			1888	5	58	30. 5	0	02	50. 5			
			1980	5	56	50. 0						
			1155	5	59	40. 0	0	02	50. 0			
			1980	5	57	45. 0						
			213	6	01	09. 5	0	03	24. 5			
July 30	14	McCumber's flat	1980	6	04	00. 0				0	04	13. 57
			1888	6	06	56. 0	0	02	56. 0			
			1980	6	04	30. 0						
			1155	6	07	23 0	0	02	53. 0			
			1980	6	05	00. 0						
			213	6	08	28. 0	0	03	28. 0			
August 1	16	Canoe creek	1980	6	02	35. 0				0	04	37. 90
			1888	6	05	44. 0	0	03	09. 0			
			1980	6	03	20. 0						
			1155	6	06	23. 0	0	03	03. 0			
			1980	6	04	00. 0						
			213	6	07	34. 0	0	03	34 0			

NOTE.—Although the chronometers were carefully compared on every day during the survey, it has been considered unnecessary to transmit any results not used for the determination of longitude.

APPENDIX C.

LIST OF CAMPS, WITH DISTANCES, ALTITUDES, LATITUDES AND LONGITUDES WHEN ASTRONOMICALLY DETERMINED, ETC.

I. *Route of the main party from Benicia to the point where the command separated near the Three Sisters, Oregon Territory.*

Camp.	Locality.	Air-line distance from preceding camp.	Altitude above mean tide at Benicia.	Latitude.	Longitude.	Remarks.
			Feet.	° ′ ″	° ′ ″	
1	Near Benicia		101			From camp 1 to camp 13, inclusive, the route lay through a fertile and settled region, where supplies of all kinds could be easily obtained.
2	Near Cordelia	10.5	69			
3	Near Vacaville	10.6	304			
4	Cache creek	27.7	295			
5	Near Nicholas	15.6	289			
6	Yuba river, opposite Marysville.	16.4	281			
7	Feather river	5.5	252	39 11 37.3	121 34 44.1	
8	Near Hamilton	15.8	260			
9	Chico creek	22.0	308			
10	Deer creek	19.2	363			
11	Antelope creek	17.7	420	40 10 31.8	122 07 20.9	
12	Liver creek	13.0				
	Fort Reading	8.4	518	40 28 57.2	122 10 50.0	
13	Asbury's rancho	18.1	2985			
14	McCumber's flat	9.2	4187	40 31 43.8	121 39 27.0	Wood, water, & grass, abundant.
15	Lost creek	12.7	5337	40 34 37.3	121 25 43.7	Do. do.
16	Canoe creek	11.6	4271			Do. do.
17	Near Canoe creek	4.8	3860	40 45 13.9	121 20 13.2	Do. do.
18	Junction of large branch with Canoe creek.	8.8	3271	40 53 54.8		Do. do.
19	Pit river	4.2	2784			Do. do.
20	Near mouth of Fall river	7.4	3304	41 00 20.8		Do. do.
21	Lower end of upper cañon of Pit river.	10.0	3346	40 57 00.3		Water and wood abundant; grass scarce.
22	Upper end of upper cañon of Pit river.	6.7	4103	41 01 46.2		Wood, water, & grass, abundant.
23	Leave Pit river	18.5	4212	41 17 51.4		Do. do.
24	On small creek	10.4	4876	41 27 06.7		Do. do.

APPENDIX C—Continued.

Camp.	Locality.	Air-line distance from preceding camp.	Altitude above mean tide at Benicia.	Latitude.	Longitude.	Remarks.
			Feet.	° ′ ″	° ′ ″	
25	Wright lake	25.5	4470	41 48 54.5	----	Water and grass plentiful; wood very scarce.
26	Lost river, near Natural Bridge.	21.4	4014	----	----	Good supply of water; no wood, and very little grass.
27 A	Leave Lost river	13.0	4036	42 07 56.5	----	Good supply of wood, water, and grass.
28	Upper Klamath lake	12.6	4180	42 17 10.2	----	Do. do.
29	Upper Klamath lake	6.8	4131	----	----	Do. do.
30	Klamath river	9.8	4196	42 31 31.4	----	Do. do.
31	Klamath river	16.3	4437	42 45 27.1	----	Do. do.
32	Klamath marsh	15.0	4487	----	----	Wood and water abundant; grass scarce.
33	Klamath marsh	8.8	4512	----	----	Plentiful supply of wood, water, and grass.
34	Klamath marsh	10.1	4526	----	----	Do. do.
35	Water hole	17.6	4864	----	----	Abundance of wood; no grass, and very little water.
36	Des Chutes river	18.2	4411	43 27 45.5	----	Abundance of wood, water, and grass.
37	Des Chutes river	16.2	4165	43 39 08.4	----	Do. do.
38 A	Des Chutes river	3.1	4129	43 40 34.1	----	Do. do.
39 A	Rafted Des Chutes river	13.8	4038	43 52 36.8	----	Do, do.
J	On small branch	14.0	3784	----	----	Do. do.
40	Near forks of Indian trail	19.4	4343	44 14 59.9	----	Do. do.

APPENDIX C—Continued.

II. *Routes of detached parties in charge of Lieut. R. S. Williamson, U. S. Top. Engineers.*

Camp.	Locality.	Air-line distance from preceding camp.	Altitude above mean tide at Benicia.	Latitude.	Remarks.
			Feet.	° ′ ″	
26	Lost river, near Natural Bridge	--------	4014	--------------	Left main party at this camp.
A	Fork of Yreka and Oregon trail	14. 6	--------	41 51 27. 5	
B	Klamath river, near Oregon trail	24. 5	3733	42 07 48. 7	
C	On Lower Klamath lake	8. 6	--------	--------------	
D	Outlet of Upper Klamath lake	7. 5	--------	--------------	
37	Des Chutes river	--------	4165	43 39 08. 4	Left main party at this camp.
E	Main branch of Des Chutes river	5. 1	4247	--------------	Grass scarce; wood and water abundant.
F	North fork of main branch of Des Chutes river.	11. 0	4311	--------------	Excellent wood, water, and grass.
G	Meadow	7. 0	4673	--------------	Wood, water, and grass abundant.
H	Near "Three Sisters"	18. 5	6054	--------------	Grass scarce; good wood and water.
I	Why-chus creek	12. 7	--------	--------------	Excellent wood, water, and grass.
J	On branch of Des Chutes river	15. 7	3784	--------------	Do. do.
40	Near forks of Indian trail	--------	4343	44 14 59. 9	Started from this camp.
K	Mountain lakes	11. 4	4711	--------------	Wood and water abundant; grass scarce.
L	Water hole	8. 5	2949	--------------	No grass; water bad; in forest.
M	Whortleberry camp	6. 6	5493	44 13 46. 6	Good wood, water, and grass.
40	Second time at same camp	13. 3	4343	44 14 59. 9	
N	Near "Three Sisters"	13. 3	6102	44 03 48. 8	Do. do.
O	Small branch	13. 0	4627	--------------	Grass poor; water scarce; wood plentiful.
P	Small meadow	10. 1	5237	--------------	Good grass and wood; water bad.
Q	Small creek	15. 0	4882	--------------	Wood, water, and grass abundant.
R	Small lake	12. 0	--------	--------------	Grass scarce; wood and water plentiful.
S	Why-chus creek	15. 1	3125	44 17 52. 8	Abundance of wood, water, and grass.
40 W	Leave Why-chus creek	14. 8	5422	--------------	Wood and water abundant; grass scarce.
41 W	Same as camp G	17. 0	4673	--------------	
42 W	Des Chutes river	14. 1	4412	43 41 54. 4	Grass poor; wood and water abundant.
43 W	Near Des Chutes river	11. 1	4339	--------------	Excellent wood, water, and grass.
44 W	Headwaters of Des Chutes river	18. 1	4592	43 27 22. 1	Do. do.
45 W	Middle fork	19. 0	2355	--------------	Do do.
46 W	------do	20. 0	1154	43 44 29. 1	Do. do.
47 W	------do	18. 1	671	--------------	Grass very scarce; wood & water abundant.
48 W	First settlement	1 9	738	43 55 13. 7	Remainder of the route traversed a settled country, where supplies of all kinds could be easily obtained.
49 W	Spore's ferry of McKenzie's fork	20. 3	512	44 07 09. 0	
50 W	Calapooya creek	18. 7	440	44 23 22. 0	
51 W	North fork of Santiam river	25. 4	448	44 44 54. 0	
52 W	Near Butte creek	25. 4	339	--------------	
53 W	Ridge above Oregon City	19. 2	266	--------------	
54 W	Opposite Fort Vancouver	17. 4	105	--------------	

APPENDIX C—Continued.

III. *Routes of detached parties in charge of Lieut. H. L. Abbot, U. S. Top. Engineers.*

Camp.	Locality.	Air-line distance from preceding camp.	Altitude above mean tide at Benicia.	Latitude.	Longitude.	Remarks.
			Feet.	° ′ ″	° ′ ″	
40	Near forks of Indian trail		4343	44 14 59.9		Abundance of wood, water, and grass.
40 A	Mpto-ly-as river	27.0	1907	44 36 22.7		Good water and wood; grass scarce.
41 A	Psuc-see-que creek	7.5	1964	44 41 27.7		Do. do.
42 A	Nee-nee springs	23.0	2829	45 01 09.2		Abundant supply of wood, water, and grass.
43 A	Tysch creek	16.9	1153	45 16 17.7		Wood and water plentiful; grass rather scarce.
44 A	Fort Dalles	23.7		45 35 19.5		
45 A	Same as 43 A	23.7	1153	45 16 17.7		
46 A	Same as 42 A	16.9	2829	45 01 09.2		
47 A	Chit-tike creek	17.5	1479	44 45 52.8		Wood and water abundant; grass coarse and scarce.
48 A	Same as 40 A	13.4	1907	44 36 22.7		
49 A	Same as Camp S	21.5	3125	44 17 52.8		
50 A	Que-y-ee brook	8.0	3270			Excellent wood, water, and grass.
51 A	Mount meadow	12.6	4508	44 34 34.1		Wood and grass abundant; water by digging.
52 A	Near Mount Jefferson	1.0	2673	44 34 47.7		Wood, water, and grass abundant.
53 A	Castle rock	7.5	2407	44 40 02.7		Wood and water abundant; grass very scarce.
54 A	Same as 41 A	11.5	1964	44 41 27.7		
55 A	Same as 47 A	5.7	1479	44 45 52.8		
56 A	Same as 42 A	17.6	2829	45 01 09.2		
57 A	Wit-la-wit springs	10.6	2601	45 03 51.1		Wood abundant; water and grass scarce.
58 A	Cranberry meadow	9.5	3145	45 09 10.8		Wood and water abundant; grass plentiful, but coarse.
59 A	Wat-tum-pa lake	7.2	3604	45 11 37.9		Grass coarse; wood and water plentiful.
60 A	Ty-ty-pa lake	2.6	4433	45 11 00.3		Excellent wood, water, and grass.
61 A	On ridge	6.4	4297			Fine wood; no grass, and very little water.
62 A	Whortleberry camp	4.4	4334	45 14 41.6		Grass scarce; water abundant; in forest.
63 A	Among logs	13.4	1574			In forest; no water or grass.
64 A	Currin's rancho	8.4	532	45 18 41.3		Supplies of all kinds abundant.

APPENDIX C—Continued.

Camp.	Locality.	Air-line distance from preceding camp.	Altitude above mean tide at Benicia.	Latitude.	Longitude.	Remarks.
			Feet.	° ′ ″	° ′ ″	
65 A	Oregon City	13.0	149	....	....	The remainder of the route traversed fertile and settled valleys.
66 A	Pudding river	15.9	170	....	....	
67 A	Salem City	20.0	382	44 56 51.9	122 53 43	Latitude and longitude of Salem from observations made under the direction of the surveyor general of the Territory.
68 A	Lackimute river	15.0	192	44 46 13.8	....	
69 A	Long Tom creek	29.5	251	44 20 41.3	....	
70 A	Eugene City	23.3	536	44 02 44.1	....	
71 A	Near head of coast, fork of Willamette.	19.0	821	43 46 08.8	....	
72 A	Near Long's hills	17.0	530	....	....	
73 A	Winchester	19.2	308	43 17 41.3	....	
74 A	Cañonville	25.5	516	42 55 36.9	....	
75 A	Six Bit House, Wolf creek	15.5	1151	....	....	
76 A	Harris' rancho	13.2	1187	42 31 12.6	....	
77 A	Fort Lane	20.6	1202	42 25 56.0	....	
78 A	Near head of Stewart creek.	25.4	2195	....	....	
79 A	Dewitt's ferry, Klamath river.	18.0	2193	....	....	
80 A	Yreka	13.0	2586	....	....	
81 A	Fort Jones	13.0	2887	41 35 42.4	....	
82 A	Head of Scott's valley	17.4	3457	....	....	
83 A	In Trinity valley	18.4	2513	....	....	
84 A	Clear creek	20.4	1608	....	....	
85 A	Shasta	14.5	985	40 36 30.7	....	
	Fort Reading	15.0	518	40 28 57.2	122 10 50	

APPENDIX D.

BAROMETRICAL AND THERMOMETRICAL OBSERVATIONS, WITH DATA FOR CONSTRUCTING PROFILES OF THE TRAVELLED ROUTES.

I. *Route of the main party from Benicia to the point where the command separated, near the Three Sisters, Oregon Territory.*

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
July 9	Camp 1, near Benicia	6 a. m.	1060	29.891	69.0	68.0	29.937	......	......	......	......	For explanation of the column headed "Corrected reading of barometer," see Chapter VI of the General Report.
9	do	9 a. m.	1060	29.994	78.0	79.0	29.932	......	......	......	......	
9	do	9 a. m.	1061	29.954	79.0	79.0	29.939	......	......	......	......	
9	do	9 a. m.	1068	29.968	79.0	79.0	29.944	......	......	......	......	
9	do	9 a. m.	1089	29.956	78.0	79.0	29.958	......	......	......	......	
9	do	12 m.	1060	29.972	85.0	81.0	29.933	......	......	......	......	
9	do	12 m.	1061	29.976	85.0	81.0	29.937	......	......	......	......	
9	do	12 m.	1068	29.982	85.0	81.0	29.934	......	......	......	......	
9	do	12 m.	1089	29.960	85.0	81.0	29.936	......	......	......	......	
9	do	3 p. m.	1060	29.941	88.0	82.0	29.931	......	......	......	......	
9	do	3 p. m.	1061	29.944	88.0	82.0	29.934	......	......	......	......	
9	do	3 p. m.	1068	29.951	88.0	82.0	29.932	......	......	......	......	
9	do	3 p. m.	1089	29.930	86.0	82.0	29.940	......	......	......	......	
9	do	6 p. m.	1060	29.938	86.0	72.0	29.930	......	......	......	......	
9	do	6 p. m.	1061	29.942	86.0	72.0	29.934	......	......	......	......	
9	do	6 p. m.	1068	29.944	86.0	72.0	29.925	......	......	......	......	
9	do	6 p. m.	1089	29.926	86.0	72.0	29.933	......	......	......	......	
9	do	9 p. m.	1060	29.958	62.0	59.0	29.937	......	......	......	......	
9	do	9 p. m.	1061	29.954	62.0	59.0	29.933	......	......	......	......	
9	do	9 p. m.	1068	29.984	62.0	59.0	29.954	......	......	......	......	
9	do	9 p. m.	1089	29.960	62.0	59.0	29.954	......	......	......	......	
10	do	6 a. m.	1060	30.026	59.0	58.0	29.915	......	......	......	......	
10	do	6 a. m.	1061	30.024	59.0	58.0	29.913	......	......	......	......	
10	do	6 a. m.	1068	30.032	59.0	58.0	29.912	......	......	......	......	
10	do	6 a. m.	1089	30.014	59.0	58.0	29.918	......	......	......	......	
10	do	9 a. m.	1060	30.074	67.5	65.5	29.940	......	......	......	......	
10	do	9 a. m.	1061	30.072	69.0	65.5	29.933	......	......	......	......	
10	do	9 a. m.	1068	30.081	68.0	65.5	29.936	......	......	......	......	
10	do	9 a. m.	1089	30.058	68.0	65.5	29.937	29.934	101	......	2.8	
10	Camp 2, near Cordelia	6 p. m.	1060	30.025	84.0	79.0	29.988	......	......	......	......	
10	do	9 p. m.	1060	29.996	68.0	66.0	29.985	......	......	......	......	
11	do	6 a. m.	1060	29.990	64.0	61.0	29.974	29.982	69	12.2	15.0	
11	Camp 3, near Vacaville	6 p. m.	1060	29.850	97.0	96.0	29.749	......	......	......	......	
11	do	9 p. m.	1060	29.810	75.0	68.0	29.744	......	......	......	......	
12	do	6 a. m.	1060	29.821	69.0	67.0	29.745	29.746	304	11.2	26.2	
12	Camp 4, Cache creek.	9 p. m.	1060	29.847	92.0	89.0	29.746	......	......	......	......	
13	do	6 a. m.	1060	29.772	54.0	52.0	29.740	29.743	295	27.2	53.4	
13	Camp 5, near Nicholas	9 p. m.	1060	29.673	70.0	68.0	29.748	......	......	......	......	

APPENDIX D—Continued.

Date.		Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.					Inches.			Inches.	Inches.	Feet.	Miles.	Miles.	
July	14	Camp 5, near Nicholas	6 a. m.	1060	29.775	57.0	56.0	29.746	29.747	289	23.0	76.4	
	14	Camp 6, Yuba river, opposite Marysville	6 p. m.	1060	29.706	86.0	81.0	29.766					
	14	do	9 p. m.	1060	29.698	73.0	70.0	29.753					
	15	do	6 a. m.	1060	29.750	59.0	57.0	29.752	29.757	281	17.6	94.0	
	15	Camp 7, Feather river	3 p. m.	1060	29.800	85.0	83.0	29.781					
	15	do	6 p. m.	1060	29.769	82.0	80.0	29.784					
	15	do	9 p. m.	1060	29.779	70.0	68.0	29.796					
	16	do	6 a. m.	1060	29.838	60.0	59.0	29.798	29.790	252	5.8	99.8	
	16	Camp 8, near Hamilton	6 p. m.	1060	29.800	90.0	87.0	29.788					
	16	do	9 p. m.	1060	29.802	78.0	76.0	29.780					
	17	do	6 a. m.	1060	29.877	65.0	62.0	29.780	29.783	260	15.4	115.2	
	17	Camp 9, Chico creek	6 p. m.	1060	29.770	92.0	89.0	29.736					
	17	do	9 p. m.	1060	29.739	75.0	71.0	29.724					
	18	do	6 a. m.	1060	29.790	66.0	64.0	29.733	29.731	308	22.3	137.5	
	18	Camp 10, Deer creek	6 p. m.	1060	29.730	86.0	83.0	29.676					
	18	do	9 p. m.	1060	29.731	82.0	79.0	29.668					
	19	do	6 a. m.	1060	29.776	66.0	64.0	29.677	29.674	363	19.7	157.2	
	19	Camp 11, Antelope creek	6 p. m.	1060	29.682	89.0	87.0	29.617					
	19	do	9 p. m.	1060	29.689	81.0	75.0	29.616					
	20	do	6 a. m.	1060	29.746	67.0	66.0	29.611	29.615	420	19.1	176.3	
	22	Fort Reading	6 a. m.	1060	29.647	71.0	70.0						
	22	do	6 a. m.	1061	29.639	71.0	70.0						
	22	do	6 a. m.	1068	29.655	71.0	70.0						
	22	do	6 a. m.	1089	29.626	71.0	70.0						
	22	do	7 a. m.	1060	29.647	74.0	73.0						
	22	do	7 a. m.	1061	29.644	74.0	73.0						
	22	do	7 a. m.	1068	29.659	74.0	73.0						
	22	do	7 a. m.	1089	29.631	74.0	73.0						
	22	do	8 a. m.	1060	29.644	76.0	74.0						
	22	do	8 a. m.	1061	29.643	76.0	74.0						
	22	do	8 a. m.	1068	29.657	76.0	74.0						
	22	do	8 a. m.	1089	29.630	76.0	74.0						
	22	do	9 a. m.	1060	29.632	80.0	81.0						
	22	do	9 a. m.	1061	29.636	80.0	81.0						
	22	do	9 a. m.	1068	29.640	80.0	81.0						
	22	do	9 a. m.	1089	29.615	80.0	81.0						
	22	do	10 a. m.	1060	29.620	86.0	84.0						
	22	do	10 a. m.	1061	29.623	86.0	84.0						
	22	do	10 a. m.	1068	29.629	86.0	84.0						
	22	do	10 a. m.	1089	29.611	86.0	84.0						
	22	do	11 a. m.	1060	29.613	91.0	89.0						
	22	do	11 a. m.	1061	29.617	91.0	89.0						
	22	do	11 a. m.	1068	29.619	91.0	89.0						
	22	do	11 a. m.	1089	29.606	91.0	89.0						
	22	do	12 m.	1060	29.609	93.0	94.0						
	22	do	12 m.	1061	29.610	93.0	94.0						
	22	do	12 m.	1068	29.612	93.0	94.0						
	22	do	12 m.	1089	29.594	93.0	94.0						
	22	do	1 p. m.	1060	29.596	96.0	100.0						
	22	do	1 p. m.	1061	29.594	96.0	100.0						
	22	do	1 p. m.	1068	29.600	96.0	100.0						
	22	do	1 p. m.	1089	29.576	96.0	100.0						
	22	do	2 p. m.	1060	29.577	98.0	97.0						
	22	do	2 p. m.	1061	29.575	98.0	97.0						
	22	do	2 p. m.	1068	29.582	98.0	97.0						
	22	do	2 p. m.	1089	29.572	98.0	97.0						
	22	do	3 p. m.	1060	29.567	99.0	97.0						

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				Inches.			Inches.	Inches.	Feet.	Miles.	Miles.	
July 22	Fort Reading	3 p. m.	1061	29.566	99.0	97.0						
22	do	3 p. m.	1068	29.574	99.0	97.0						
22	do	3 p. m.	1089	29.556	99.0	97.0						
22	do	4 p. m.	1060	29.560	98.5	96.0						
22	do	4 p. m.	1061	29.560	98.5	96.0						
22	do	4 p. m.	1068	29.568	98.5	96.0						
22	do	4 p. m.	1089	29.546	98.5	96.0						
22	do	5 p. m.	1060	29.551	98.0	95.0						
22	do	5 p. m.	1061	29.551	98.0	95.0						
22	do	5 p. m.	1068	29.556	98.0	95.0						
22	do	5 p. m.	1089	29.536	98.0	95.0						
22	do	6 p. m.	1060	29.544	96.0	93.0						
22	do	6 p. m.	1061	29.543	96.0	93.0						
22	do	6 p. m.	1068	29.550	96.0	93.0						
22	do	6 p. m.	1089	29.530	96.0	93 0						
22	do	7 p. m.	1060	29.547	93.0	88.0						
22	do	7 p. m.	1061	29.552	93.0	88.0						
22	do	7 p. m.	1068	29.558	93.0	88.0						
22	do	7 p. m.	1089	29.532	93.0	88.0						
22	do	8 p. m.	1060	29.547	90.0	85.0						
22	do	8 p. m.	1061	29.558	90.0	85.0						
22	do	8 p. m.	1068	29.562	90.0	85.0						
22	do	8 p. m.	1089	29.536	90.0	85.0						
22	do	9 p. m.	1060	29.564	88.0	83.0						
22	do	9 p. m.	1061	29.568	88.0	83.0						
22	do	9 p. m.	1068	29.578	88.0	83.0						
22	do	9 p. m.	1089	29.552	88.0	83.0						
23	do	6 a. m.	1060	29.642	72.5	69.5						
23	do	6 a. m.	1061	29.642	72.5	69.5						
23	do	6 a. m.	1068	29.651	72.5	69.5						
23	do	6 a. m.	1089	29.631	72.5	69.5						
23	do	7 a. m.	1060	29.655	73.0	71.0						
23	do	7 a. m.	1061	29.654	73.0	71.0						
23	do	7 a. m.	1068	29.662	73.0	71.0						
23	do	7 a. m.	1089	29.637	73.0	71.0						
23	do	8 a. m.	1060	29.662	76.0	74.0						
23	do	8 a. m.	1061	29.658	76.0	74.0						
23	do	8 a. m.	1068	29.668	76.0	74.0						
23	do	8 a. m.	1089	29.648	76.0	74.0						
23	do	9 a. m.	1060	29.668	80.0	79.0						
23	do	9 a. m.	1061	29.667	80.0	79.0						
23	do	9 a. m.	1068	29.677	80.0	79.0						
23	do	9 a. m.	1089	29.651	80.0	79.0						
23	do	10.15 a. m.	1060	29.677	86.0	83.0						
23	do	10.15 a. m	1061	29.658	86.0	83.0						
23	do	10.15 a. m.	1068	29.680	86.0	83.0						
23	do	10.15 a. m.	1089	29.658	86.0	83.0						
23	do	11.15 a. m.	1060	29.678	90.0	88.0						
23	do	11.15 a. m.	1061	29.678	90.0	88.0						
23	do	11.15 a. m.	1068	29.682	90.0	88.0						
23	do	11.15 a. m.	1089	29.660	90.0	88.0						
23	do	12 m.	1060	29.675	92.5	94.0						
23	do	12 m.	1061	29.678	92.5	94.0						
23	do	12 m.	1068	29.680	92.5	94.0						
23	do	12 m.	1089	29.662	92.5	94.0						
23	do	1 p. m.	1060	29.671	94.0	94.0						
23	do	1 p. m.	1061	29.676	94.0	94.0						
23	do	1 p. m.	1068	29.676	94.0	94.0						

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
July 23	Fort Reading	1 p. m.	1089	29.662	94.0	94.0						
23	......do	2 p. m.	1060	29.661	95.5	95.5						
23	......do	2 p. m.	1061	29.662	95.5	95.5						
23	......do	2 p. m.	1068	29 668	95.5	95.5						
23	......do	2 p. m.	1089	29.654	95.5	95.5						
23	......do	3 p. m.	1060	29.641	96.0	95.0						
23	......do	3 p. m.	1061	29 639	96.0	95.0						
23	......do	3 p. m.	1068	29.651	96.0	95.0						
23	......do	3 p. m.	1089	29.631	96.0	95.0						
23	......do	4 p. m.	1060	29.626	96.5	95.0						
23	......do	4 p. m.	1061	29.626	96.5	95 0						
23	......do	4 p. m.	1068	29.637	96.5	95.0						
23	......do	4 p. m.	1089	29.616	96.5	95.0						
23	......do	5 p. m.	1060	29.617	96.0	94.0						
23	......do	5 p. m.	1061	29.618	96.0	94.0						
23	......do	5 p. m.	1068	29.627	96.0	94.0						
23	......do	5 p. m.	1089	29.608	96.0	94.0						
23	......do	6 p. m.	1060	29.615	95.0	92.0						
23	......do	6 p. m.	1061	29.615	95.0	92 0						
23	......do	6 p. m.	1068	29.624	95.0	92.0						
23	......do	6 p. m.	1089	29.604	95.0	92.0						
23	......do	7 p. m.	1060	29.622	91.5	86.5						
23	......do	7 p. m.	1061	29.628	91.5	86.5						
23	......do	7 p. m.	1068	29.633	91.5	86.5						
23	......do	7 p. m.	1089	29.611	91.5	86.5						
23	......do	8 p. m.	1060	29.626	87.0	84.0						
23	......do	8 p. m.	1061	29.634	87.0	84.0						
23	......do	8 p. m.	1068	29.639	87.0	84.0						
23	......do	8 p. m.	1089	29.616	87.0	84.0						
23	......do	9 p. m.	1060	29.638	85.0	82.0						
23	......do	9 p. m.	1061	29.642	85.0	82.0						
23	......do	9 p. m.	1068	29.648	85.0	82.0						
23	......do	9 p. m.	1089	29.631	85.0	82.0						
24	......do	6 a. m.	1060	29.670	66.5	65.0						
24	......do	6 a. m.	1061	29.682	66.5	65.0						
24	......do	6 a. m.	1068	29.688	66.5	65.0						
24	......do	6 a. m.	1089	29 664	66.5	65.0						
24	......do	7 a. m.	1060	29.689	70.0	69.5						
24	......do	7 a. m.	1061	29.688	70.0	69 5						
24	......do	7 a. m.	1068	29.698	70.0	69.5						
24	......do	7 a. m.	1089	29.678	70.0	69.5						
24	......do	8 a. m.	1060	29.698	73.5	73.0						
24	......do	8 a. m.	1061	29.695	73.5	73.0						
24	......do	8 a. m.	1068	29.704	73.5	73.0						
24	......do	8 a. m.	1089	29.680	73.5	73.0						
24	......do	9 a. m.	1060	29.691	78.0	78.0						
24	......do	9 a. m.	1061	29.688	78.0	78.0						
24	......do	9 a. m.	1068	29.697	78.0	78.0						
24	......do	9 a. m.	1089	29.674	78.0	78.0						
24	......do	10 a. m.	1060	29.689	83.0	83.0						
24	......do	10 a. m.	1061	29.689	83.0	83.0						
24	......do	10 a. m.	1068	29.696	83.0	83.0						
24	......do	10 a. m.	1089	29.676	83.0	83.0						
24	......do	11 a. m.	1060	29.676	88.5	89.0						
24	......do	11 a. m.	1061	29.674	88.5	89.0						
24	......do	11 a. m.	1068	29.679	88.5	89.0						
24	......do	11 a. m.	1089	29.657	88.5	89.0						
24	......do	12 m.	1060	29.662	93.0	94.5						

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
July 24	Fort Reading	12 m	1061	29.664	93.0	94.5						
24	do	12 m	1068	29.672	93.0	94.5						
24	do	12 m	1089	29.652	93.0	94.5						
24	do	1 p. m	1060	29.645	97.0	97.0						
24	do	1 p. m	1061	29.642	97.0	97.0						
24	do	1 p. m	1068	29.658	97.0	97.0						
24	do	1 p. m	1089	29.636	97.0	97.0						
24	do	2 p. m	1060	29.629	99.5	99.0						
24	do	2 p. m	1061	29.633	99.5	99.0						
24	do	2 p. m	1068	29.643	99.5	99.0						
24	do	2 p. m	1089	29.615	99.5	99.0						
24	do	3.30 p. m	1060	29.599	101.0	102.0						
24	do	3.30 p. m	1061	29.596	101.0	102.0						
24	do	3.30 p. m	1068	29.602	101.0	102.0						
24	do	3.30 p. m	1089	29.585	101.0	102.0						
24	do	4 p. m	1060	29.585	101.5	97.0						
24	do	4 p. m	1061	29.583	101.5	97.0						
24	do	4 p. m	1068	29.594	101.5	97.0						
24	do	4 p. m	1089	29.572	101.5	97.0						
24	do	5 p. m	1060	29.569	101.0	95.5						
24	do	5 p. m	1061	29.569	101.0	95.5						
24	do	5 p. m	1068	29.575	101.0	95.5						
24	do	5 p. m	1089	29.554	101.0	95.5						
24	do	6 p. m	1060	29.552	98.0	94.5						
24	do	6 p. m	1061	29.555	98.0	94.5						
24	do	6 p. m	1068	29.559	98.0	94.5						
24	do	6 p. m	1089	29.537	98.0	94.5						
24	do	7 p. m	1060	29.541	95.5	94.5						
24	do	7 p. m	1061	29.542	95.5	94.5						
24	do	7 p. m	1068	29.553	95.5	94.5						
24	do	7 p. m	1089	29.530	95.5	94.5						
24	do	8 p. m	1060	29.544	92.5	88.5						
24	do	8 p. m	1061	29.541	92.5	88.5						
24	do	8 p. m	1068	29.554	92.5	88.5						
24	do	8 p. m	1089	29.531	92.5	88.5						
24	do	9 p. m	1060	29.558	89.5	85.0						
24	do	9 p. m	1061	29.544	89.5	85.0						
24	do	9 p. m	1068	29.566	89.5	85.0						
24	do	9 p. m	1089	29 541	89.5	85.0						
25	do	6 a. m	1060	29.576	68.5	68.0						
25	do	6 a. m	1061	29.580	68.5	68.0						
25	do	6 a. m	1068	29.587	68.5	68.0						
25	do	6 a. m	1089	29.565	68.5	68.0						
25	do	7 a. m	1060	29.576	71.0	71.0						
25	do	7 a. m	1061	29.579	71.0	71.0						
25	do	7 a. m	1068	29.588	71.0	71.0						
25	do	7 a. m	1089	29.564	71.0	71.0						
25	do	8 a. m	1060	29.593	75.5	76.0						
25	do	8 a. m	1061	29.592	75.5	76.0						
25	do	8 a. m	1068	29.604	75.5	76.0						
25	do	8 a. m	1089	29.581	75.5	76.0						
25	do	9 a. m	1060	29.592	80.5	80.5						
25	do	9 a. m	1061	29.591	80.5	80.5						
25	do	9 a. m	1068	29.604	80.5	80.5						
25	do	9 a. m	1089	29.581	80.5	80.5						
25	do	10 a. m	1060	29.595	87.0	84.5						
25	do	10 a. m	1061	29.600	87.0	84.5						
25	do	10 a. m	1068	29.609	87.0	84.5						

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1865.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
July 25	Fort Reading	10 a. m.	1089	29 586	87.0	84.5						
25	do	11.10 a. m.	1060	29.592	92.0	90.5						
25	do	11.10 a. m.	1061	29.600	92.0	90.5						
25	do	11.10 a. m.	1068	29.607	92.0	90.5						
25	do	11.10 a. m.	1089	29.585	92.0	90.5						
25	do	12 m.	1060	29.590	94.0	94.5						
25	do	12 m.	1061	29.588	94.0	94.5						
25	do	12 m.	1068	29.600	94.0	94.5						
25	do	12 m.	1089	29.575	94.0	94.5						
25	do	1 p. m.	1060	29.585	96.5	96.0						
25	do	1 p. m.	1061	29.580	96.5	96.0						
25	do	1 p. m.	1068	29.596	96.5	96.0						
25	do	1 p. m.	1089	29.567	96.5	96.0						
25	do	2 p. m.	1060	29.564	99.0	92.5						
25	do	2 p. m.	1061	29.564	99.0	92.5						
25	do	2 p. m.	1068	29.572	99.0	92.5						
25	do	2 p. m.	1089	29.549	99.0	92.5						
25	do	3 p. m.	1060	29.554	99.5	97.0						
25	do	3 p. m.	1061	29.556	99.5	97 0						
25	do	3 p. m.	1068	29.559	99.5	97.0						
25	do	3 p. m.	1089	29.537	99.5	97.0						
25	do	4 p. m.	1060	29.540	99.0	96.0						
25	do	4 p. m.	1061	29.538	99.0	96.0						
25	do	4 p. m.	1068	29 549	99.0	96.0						
25	do	4 p. m.	1089	29.528	99.0	96.0						
25	do	5 p. m.	1060	29.520	98.0	95.5						
25	do	5 p. m.	1061	29.522	98.0	95.5						
25	do	5 p. m.	1068	29.528	98.0	95.5						
25	do	5 p. m.	1089	29.506	98.0	95.5						
25	do	6 p. m.	1060	29.515	96.5	93.0						
25	do	6 p. m.	1061	29.515	96.5	93.0						
25	do	6 p. m.	1068	29.524	96.5	93.0						
25	do	6 p. m.	1089	29.500	96.5	93.0						
25	do	7 p. m.	1060	29.514	93.0	89.0						
25	do	7 p. m.	1061	29.515	93.0	89.0						
25	do	7 p. m.	1068	29.522	93.0	89.0						
25	do	7 p. m.	1089	29.500	93.0	89.0						
25	do	8 p. m.	1060	29.514	90.0	87.0						
25	do	8 p. m.	1061	29.514	90.0	87.0						
25	do	8 p. m.	1068	29.520	90.0	87 0						
25	do	8 p. m.	1089	29.500	90.0	87.0						
25	do	9 p. m.	1060	29.528	88.0	86.0						
25	do	9 p. m.	1061	29.530	88.0	86.0						
25	do	9 p. m.	1068	29.538	88.0	86.0						
25	do	9 p. m.	1089	29.513	88.0	86.0						
26	do	6 a. m.	1060	29.579	67.0	68.0						
26	do	6 a. m.	1061	29.580	67.0	68.0						
26	do	6 a. m.	1068	29.590	67.0	68.0						
26	do	6 a. m.	1089	29.513	67.0	68.0						
26	do	7 a. m.	1060	29.593	70.5	71.0						
26	do	7 a. m.	1061	29.589	70.5	71.0						
26	do	7 a. m.	1068	29.603	70.5	71.0						
26	do	7 a. m.	1089	29.576	70.5	71.0						
26	do	9 a. m.	1060	29.616	81.0	79.0						
26	do	9 a. m.	1061	29.611	81.0	79.0						
26	do	9 a. m.	1068	29.620	81.0	79.0						
26	do	9 a. m.	1089	29.600	81.0	79.0						
26	do	10 a. m.	1060	29.626	87.0	85.0						

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
July 26	Fort Reading	10 a. m.	1061	29.620	87.0	85.0	......	......	......	......	......	
26	do	10 a. m.	1068	29.630	87.0	85.0	......	......	......	......	......	
26	do	10 a. m.	1089	29.606	87.0	85.0	......	......	......	......	......	
26	do	11 a. m.	1060	29.634	93.0	89.0	......	......	......	......	......	
26	do	11 a. m.	1061	29.634	93.0	89.0	......	......	......	......	......	
26	do	11 a. m.	1068	29.638	93.0	89.0	......	......	......	......	......	
26	do	11 a. m.	1089	29.616	93.0	89.0	......	......	......	......	......	
26	do	12 m.	1060	29.625	93.0	93.0	......	......	......	......	......	
26	do	12 m.	1061	29.622	93.0	93.0	......	......	......	......	......	
26	do	12 m.	1068	29.630	93.0	93.0	......	......	......	......	......	
26	do	12 m.	1089	29.608	93.0	93.0	......	......	......	......	......	
26	do	2 p. m.	1060	29.603	97.0	94.0	......	......	......	......	......	
26	do	2 p. m.	1061	29.608	97.0	94.0	......	......	......	......	......	
26	do	2 p. m.	1068	29.615	97.0	94.0	......	......	......	......	......	
26	do	2 p. m.	1089	29.591	97.0	94.0	......	......	......	......	......	
26	do	3 p. m.	1060	29.591	98.0	95.0	......	......	......	......	......	
26	do	3 p. m.	1061	29.588	98.0	95.0	......	......	......	......	......	
26	do	3 p. m.	1068	29.600	98.0	95.0	......	......	......	......	......	
26	do	3 p. m.	1089	29.576	98.0	95.0	......	......	......	......	......	
26	do	4 p. m.	1060	29.574	97.0	94.0	......	......	......	......	......	
26	do	4 p. m.	1061	29.572	97.0	94.0	......	......	......	......	......	
26	do	4 p. m.	1068	29.582	97.0	94.0	......	......	......	......	......	
26	do	4 p. m.	1089	29.560	97.0	94.0	......	......	......	......	......	
26	do	5 p. m.	1060	29.563	96.5	94.0	......	......	......	......	......	
26	do	5 p. m.	1061	29.563	96.5	94.0	......	......	......	......	......	
26	do	5 p. m.	1068	29.570	96.5	94.0	......	......	......	......	......	
26	do	5 p. m.	1089	29.550	96.5	94.0	......	......	......	......	......	
26	do	6 p. m.	1060	29.556	96.5	93.0	......	......	......	......	......	
26	do	6 p. m.	1061	29.560	96.5	93.0	......	......	......	......	......	
26	do	6 p. m.	1068	29.567	96.5	93.0	......	......	......	......	......	
26	do	6 p. m.	1089	29.549	96.5	93.0	......	......	......	......	......	
26	do	8 p. m.	1060	29.560	91.0	84.0	......	......	......	......	......	
26	do	8 p. m.	1061	29.560	91.0	84.0	......	......	......	......	......	
26	do	8 p. m.	1068	29.568	91.0	84.0	......	......	......	......	......	
26	do	8 p. m.	1089	29.550	91.0	84.0	......	......	......	......	......	
26	do	9 p. m.	1060	29.576	87.5	81.0	......	......	......	......	......	
26	do	9 p. m.	1061	29.576	87.5	81.0	......	......	......	......	......	
26	do	9 p. m.	1068	29.588	87.5	81.0	......	......	......	......	......	
26	do	9 p. m.	1089	29.568	87.5	81.0	......	......	......	......	......	
27	do	9.10 a. m.	1060	29.636	84.0	84.0	......	......	......	......	......	
27	do	9.10 a. m.	1061	29.636	84.0	84.0	......	......	......	......	......	
27	do	9.10 a. m.	1068	29.644	84.0	84.0	......	......	......	......	......	
27	do	9.10 a. m.	1089	29.624	84.0	84.0	......	......	......	......	......	
27	do	10 a. m.	1060	29.643	87.0	86.0	......	......	......	......	......	
27	do	10 a. m.	1061	29.640	87.0	86.0	......	......	......	......	......	
27	do	10 a. m.	1068	29.651	87.0	86.0	......	......	......	......	......	
27	do	10 a. m.	1089	29.630	87.0	86.0	......	......	......	......	......	
27	do	11 a. m.	1060	29.644	93.0	91.0	......	......	......	......	......	
27	do	11 a. m.	1061	29.643	91.0	91.0	......	......	......	......	......	
27	do	11 a. m.	1068	29.652	91.0	91.0	......	......	......	......	......	
27	do	11 a. m.	1089	29.631	91.0	91.0	......	......	......	......	......	
27	do	12 m.	1060	29.640	96.0	95.0	......	......	......	......	......	
27	do	12 m.	1061	29.640	96.0	95.0	......	......	......	......	......	
27	do	12 m.	1068	29.650	96.0	95.0	......	......	......	......	......	
27	do	12 m.	1089	29.628	96.0	95.0	......	......	......	......	......	
27	do	1 p. m.	1060	29.628	99.0	98.0	......	......	......	......	......	
27	do	1 p. m.	1061	29.629	99.0	98.0	......	......	......	......	......	
27	do	1 p. m.	1068	29.638	99.0	98.0	......	......	......	......	......	

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
July 27	Fort Reading	1 p. m.	1089	29.615	99.0	98.0						
27	do	2 p. m.	1060	29.614	101.0	98.0						
27	do	2 p. m.	1061	29.613	101.0	98.0						
27	do	2 p. m.	1068	29.623	101.0	98.0						
27	do	2 p. m.	1089	29.597	101.0	98.0						
27	do	3 p. m.	1060	29.600	102.0	98.0						
27	do	3 p. m.	1061	29.600	102.0	98.0						
27	do	3 p. m.	1068	29.613	102.0	98.0						
27	do	3 p. m.	1089	29.584	102.0	98.0						
27	do	4 p. m.	1060	29.588	101.0	97.0						
27	do	4 p. m.	1061	29.586	101.0	97.0						
27	do	4 p. m.	1068	29.600	101.0	97.0						
27	do	4 p. m.	1089	29.572	101.0	97.0						
27	do	5 p. m.	1060	29.570	100.0	96.0						
27	do	5 p. m.	1061	29.568	100.0	96.0						
27	do	5 p. m.	1068	29.581	100.0	96.0						
27	do	5 p. m.	1089	29.552	100.0	96.0						
27	do	6 p. m.	1060	29.562	98.5	96.0						
27	do	6 p. m.	1061	29.562	98 5	96.0						
27	do	6 p. m.	1089	29.551	98.5	96.0						
27	do	7 p. m.	1060	29.560	96.5	91.0						
27	do	7 p. m.	1061	29.560	96.5	91.0						
27	do	7 p. m.	1089	29.551	96.5	91.0						
27	do	8 p. m.	1060	29.555	92.5	86.0						
27	do	8 p. m.	1061	29.562	92.5	86.0						
27	do	8 p. m.	1089	29.546	92.5	86.0						
27	do	9 p. m.	1060	29.560	87.5	80.0						
27	do	9 p. m.	1061	29.560	87.5	80.0						
27	do	9 p. m.	1089	29.546	87.5	80.0			518	24.0	200.3	For explanation of altitude of Fort Reading, see Chapter VI of the General Report.
28	On plateau	0.35 p. m.	1060	29.543	97 0	98.0	29.413		716	1.2	201.5	
28	do	1.27 p. m.	1060	29.546	102.0	98.0	29.390		740	2.5	204.0	
28	Crossing of Bear creek	2.30 p. m.	1060	29.557	102.5	98.0	29.414		715	2.5	206.5	
28	Station	3.30 p. m.	1060	29.169	102.0	97.0	29.044		1,080	2.7	209.2	
28	Ogburn's rancho	6.40 p. m.	1060	27.731	85.5	83.5	27.664		2,424	9.0	218.2	
29	Camp 13, Asbury's rancho	6 a. m.	1060	27.214	62.5	62.0	27.013		2,985	2.0	220.2	
29	Shingle Town	7.45 a. m.	1060	26.603	75.5	75.0	26.409		3,665	2.6	222.8	
29	Mill creek	8.40 a. m.	1060	26.551	80.0	79.0	26.353		3,715	2.2	225.0	
29	Camp 14, McCumber's flat	12 m.	1060	26.081	83.0	81.0	25.915					
29	do	3 p. m.	1060	26.075	84.5	84.0	25.934					
29	do	6 p. m.	1060	26.045	78.0	76.0	25.912					
29	do	9 p. m.	1060	26.025	59.0	55.0	25.925					
30	do	6 a. m.	1060	26.011	53.0	50.0	25.899	25.917	4,187	5.2	230.2	
30	Deer flat	8.50 a. m.	1060	25.898	77.0	74.0	25.747		4,365	7.7	237.9	
30	Station in pass	10.05 a. m.	1060	25.445	78.5	75.0	25.308		4,852	2.6	240.5	
30	do	10.45 a. m.	1060	25.239	77.5	75.0	25.115		5,066	0.6	241.1	
30	do	11.15 a. m.	1060	25.152	80.0	77.0	25.030		5,162	0.4	241.5	
30	do	1.10 p. m.	1060	24.571	80.0	76.0	24.473		5,797	2.1	243.6	
30	Summit of Noble's pass, western chain of Sierra Nevada.	2.10 p. m.	1061	24.157	80.5	75.0	24.075		6,260	1.8	245.4	
30	Camp 15, Lost creek	6 p. m.	1061	24.891	71.0	65.0	24.836					
30	do	9 p. m.	1061	24.865	62.0	53.0	24.825					
31	do	6 a. m.	1061	24.796	49 0	45.0	24.826	24.829	5,337	2.6	248.0	
31	Hat creek	7.35 a. m.	1061	24.893	63.0	62.5	24.899		5,272	2.8	250.8	
31	Near Hat creek	8 a. m.	1061	24.939	69.0	69.0	24.935		5,283	0.8	251.6	
31	Near Canoe creek	9.20 a. m.	1061	25.407	75.5	74.0	25.406		4,799	2.8	254.4	
31	do	10.40 a. m.	1060	25.513	78.0	75.0	25.524		4,668	1.6	256.0	
31	do	0.10 p. m.	1060	25.637	84.0	78.0	25.660		4,539	2.6	258.6	
31	Camp 16, Canoe creek	3 p. m.	1060	25.729	79.0	76.0	25.792					

APPENDIX D—Continued.

Date.		Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.					*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
July	31	Camp 16, Canoe creek	6.10 p. m.	1060	25.705	70.5	69.0	25.800					
	31	do	9 p. m.	1060	25.669	56.0	56.0	25.787					
Aug.	1	do	6 a. m.	1060	25.695	42.5	41.5	25.781	25.790	4,271	2.0	260.6	
	1	Camp 17, near Canoe creek	3 p. m.	1060	26.167	85.5	83.5	26.207					
	1	do	3 p. m.	1089	26.159	85.5	83.5	26.214					
	1	do	6 p. m.	1060	26.160	80.5	77.5	26.191					
	1	do	6 p. m.	1089	26.152	80.5	77.5	26.198					
	1	do	9 p. m.	1060	26.142	57.0	55.0	26.204					
	1	do	9 p. m.	1089	26.135	57.0	55.0	26.212					
	2	do	6 a. m.	1060	26.163	48.5	47.0	26.198					
	2	do	6 a. m.	1089	26.157	48.5	47.0	26.207	26.204	3,860	6.5	267.1	
	2	Near Canoe creek	1.15 p. m.	1060	26.731	85.0	85.0	26.730		3,308	7.8	274.9	
	2	Camp 18, junction of Canoe creek and large branch	6 p. m.	1060	26.794	86.0	81.0	26.782					
	2	do	6 p. m.	1089	26.780	86.0	81.0	26.783					
	2	do	9 p. m.	1060	26.780	65.5	62.0	26.786					
	2	do	9 p. m.	1089	26.769	65.5	62.0	26.790					
	3	do	6 a. m.	1060	26.783	48.0	47.0	26.779					
	3	do	6 a. m.	1089	26.768	48.0	47.0	26.779					
	3	do	9 a. m.	1060	26.889	89.0	74.0	26.785					
	3	do	9 a. m.	1089	26.768	88.0	74.0	26.782					
	3	do	1 p. m.	1060	26.864	92.0	87.0	26.786					
	3	do	1 p. m.	1089	26.847	92.0	87.0	26.784					
	3	do	2 p. m.	1060	26.855	88.0	88.0	26.795					
	3	do	2 p. m.	1089	26.840	88.5	88.0	26.796					
	3	do	3 p. m.	1060	26.848	87.0	86.0	26.794					
	3	do	3 p. m.	1089	26.825	87.0	86.0	26.786					
	3	do	6 p. m.	1060	26.845	89.0	83.5	26.762					
	3	do	6 p. m.	1089	26.833	89.0	83.5	26.765					
	3	do	9 p. m.	1060	26.811	63.5	56.0	26.774					
	3	do	9 p. m.	1089	26.801	63.5	56.0	26.779					
	4	do	6 a. m.	1060	26.864	52.5	48.0	26.783					
	4	do	6 a. m.	1089	26.843	52.5	48.0	26.783	26.783	3,271	3.9	278.8	
	4	Station	1.40 p. m.	1089	26.930	89.0	89.0	26.840		3,259	1.5	280.3	
	4	Station	1.50 p. m.	1089	27.088	91.0	90.0	26.997		3,093	0.3	280.6	
	4	Near mouth of Canoe creek	2.30 p. m.	1060	27.247	90.5	88.0	27.144		2,867			Not used on profile.
	4	Camp 19, Pit river	7 p. m.	1060	27.293	75.5	76.0	27.181					
	4	do	9 p. m.	1060	27.280	58.0	53.0	27.194					
	5	do	6 a. m.	1060	27.302	47.0	45.0	27.234	27.203	2,784	4.2	284.8	
	5	Station on River bluff	7.50 a. m.	1089	26.758	69.0	65.0	26.599		3,433	2.4	287.2	
	5	Foot of pass, Stoneman's Ridge	8.40 a. m.	1089	26.806	76.0	74.0	26.688		3,370	1.1	288 3	
	5	Summit of pass	11.30 a. m.	1089	26.178	88.0	84.0	26.066		4,080	2.6	290.9	
	5	Foot of pass	12.09 a. m.	1089	26.646	92.0	86.0	26.531		3,581	1.0	291.9	
	5	Near upper end of cañon	11 a. m.	1060	26.389	81.0	80.0	26.269		3,795			Not used on profile.
	5	Camp 20, near mouth of Fall river	6 p. m.	1060	26.804	87.0	82.0	26.694					
	5	do	9 p. m.	1060	26.753	64.0	65.0	26.694					
	6	do	6 a. m.	1060	26.782	46.0	45.0	26.766	26.718	3,304	8.0	296.3	
	6	Camp 21, mouth of upper cañon of Pit river	6 p. m.	1060	26.689	88.0	86.0	26.683					
	6	do	9 p. m.	1060	26.679	70.5	68.0	26.695					
	7	do	6 a. m.	1060	26.710	55.5	53.5	26.696					
	7	do	6 a. m.	1089	26.676	55.5	53.5	26.696	26.692	3,346	12.6	308.9	
	7	Station	8.10 a. m.	1060	26.608	70.0	69.0	26.558		3,493	0.6	309.5	
	7	On bluff above river	9.30 a. m.	1060	26.098	75.0	74.0	26.048		4,040	2.1	311.6	
	7	Near Pit river	0.31 p. m.	1060	25.975	86.0	81.0	25.928		4,170	4.2	315.8	

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				Inches.			Inches.	Inches.	Feet.	Miles.	Miles.	
August 7	Camp 22, entrance of upper cañon	6 p. m.	1060	25.990	77.0	75.0	25.973					
7	do	6 p. m.	1089	25.957	77.0	75.0	25.984					
7	do	9 p. m.	1060	25.990	63.5	65.0	25.980					
7	do	9 p. m.	1089	25.953	63.5	65.0	25.987					
8	do	6 a. m.	1060	26.025	48.0	47.0	25.980					
8	do	6 a. m.	1089	25.981	47.5	47.0	25.981	25.981	4,103	3.0	318.8	
8	Camp 23, last on Pit river	7 p. m.	1060	25.937	76.5	75.5	25.904					
8	do	7 p. m.	1089	25.898	77.0	75.5	25.898					
8	do	9 p. m.	1060	25.940	74.0	70.0	25.893					
8	do	9 p. m.	1089	25 888	74.0	70.0	25.875					
9	do	9.25 a. m.	1060	25.958	82.0	74.0	25.921					
9	do	9.25 a. m.	1089	25.913	82.0	74.0	25.910					
9	do	12 m	1060	25.930	95.0	84.0	25.915					
9	do	12 m.	1089	25.886	95.0	84.0	25.905					
9	do	3 p. m.	1060	25.874	95.5	85.0	25.905					
9	do	3 p. m.	1089	25.825	95.0	85.0	25.891					
9	do	9 p. m.	1060	25.822	72.0	71.0	25.892					
9	do	9 p. m.	1089	25.777	72.0	71.0	25.882					
10	do	6 a. m.	1060	25.772	58.0	54.0	25.902					
10	do	6 a. m.	1089	25.731	58.0	54.0	25.895	25.899	4,212	21.6	340.4	
10	On divide	9.40 a. m.	1060	25.180	75.0	72.0	25.294		4,885	6.5	346.9	
10	Camp 24, Spring branch	12 m.	1060	25.220	80.0	79.0	25.334					
10	do	3 p. m.	1060	25.188	84.0	82.0	25.336					
10	do	3 p. m.	1089	25.135	84.0	82.0	25.331					
10	do	6 p. m.	1060	25.158	79.0	77.0	25.325					
10	do	6 p. m.	1089	25.109	79.5	77.0	25.319	25.333	4,876	3.7	350.6	
11	Station on plateau	0.29 p. m.	1060	25.508	82.0	80.0	25.657		4,472	16.8	367.4	
11	Camp 25, Wright lake	6 p. m.	1060	25.446	71.0	68.0	25.622					
11	do	9 p. m.	1060	25.456	65.0	64.0	25.618					
12	do	6 a. m.	1060	25.515	58.0	57.0	25.640	25.627	4,470	11.1	378.5	
12	Camp 26, near Natural bridge	6.30 p. m.	1089	25.906	80.5	76.0	26.026					
12	do	6.45 p. m.	1060	25.941	77.0	74 5	26.025					
12	do	8.20 p. m.	1060	25.952	60.5	65.0	26 054					
12	do	8.20 p. m.	1089	25.902	60.5	65.0	26.048					
13	do	6 a. m.	1060	26.012	45.0	48.0	26.056					
13	do	6 a. m.	1089	25.968	45.0	48.0	26.056	26.045	4,014	24.3	402.8	
13	Camp 27 A, last on Lost river	6 p. m.	1060	25.998	78.0	82.0	26.010					
13	do	11 p. m.	1060	26.002	56.0	59.0	26.036					
14	do	6 a. m.	1060	26.000	45.0	43.0	26.012	26.019	4,036	15.0	417.8	
14	On divide	10 a. m.	1060	25.906	81.0	72.0	25.906		4,154	9.7	427.5	
14	Camp 28, Upper Klamath lake, (50 feet above water)	9 p. m.	1060	25.921	66.5	66.0	25.915					
15	do	6 a. m.	1060	25.928	50.0	49.0	25.938					
15	do	9 a. m.	1060	25.980	69.0	68.0	25.933					
15	do	12 m.	1060	25.991	86.0	80.0	25.924					
15	do	3 p. m.	1060	25.982	94.5	87.0	25.921					
15	do	6 p. m.	1060	25 951	82.0	80.0	25.905					
15	do	p. m.	1060	25.948	64.5	61.0	25 916					
16	do	9 a. m.	1060	25.994	71.0	68.0	25.913					
16	do	12 m.	1060	26.005	84.0	75.0	25.931					
16	do	3 p. m.	1060	25.979	86.5	81.0	25.927					
16	do	6 p. m.	1060	25.945	76.0	74.0	25.904					
16	do	9 p. m.	1060	25.970	68.5	66.0	25.923					
17	do	6 a. m.	1060	25.960	53.0	54.0	25.933					
17	do	9 a. m.	1060	26.012	75.0	71.0	25.926					
17	do	12 m.	1060	25.999	81.0	80.0	25.927					
17	do	3 p. m.	1060	25.976	86.0	81.5	25.923					

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
Aug. 17	Camp 28, Upper Klamath lake, (50 feet above water)	6 p. m.	1060	25.938	79.5	76.5	25.918					
17	........do	8.30 p. m.	1060	25.942	70.0	67.0	25 920					
18	........do	5.40 a. m.	1060	25.929	49.0	46.5	25.917	25.922	4,180	4.2	431.7	
18	Camp 29, Upper Klamath lake	6 p. m.	1060	25.959	73.0	72.0	25.925					
18	........do	8.30 p. m.	1060	25.963	65.0	60.0	25.926					
19	........do	6 a. m.	1060	25.925	47.0	47.0	25.922	25.924	4,131	16.0	447.7	
19	Camp 30, Klamath river	3 p. m.	1060	25.972	85.0	83.0	25.955					
19	........do	6 p. m.	1060	25.952	79.0	77.0	25.943					
19	........do	8.30 p. m.	1060	25.921	54.0	55.0	25.953					
20	........do	6 a. m.	1060	25.943	37.0	35.0	25.955	25.951	4,196	11.7	459.4	
20	Camp 31, Klamath river	7 p. m.	1060	25.642	67.0	66.0	25.613					
20	........do	8.45 p. m.	1060	25.652	58.0	59.0	25.620					
21	........do	5.45 a. m.	1060	25.668	36.0	34.0	25.620	25.618	4,437	18.4	477.8	
21	Camp 32, Klamath marsh	6 p. m.	1060	25.705	80.0	77.0	25.600					
21	........do	8 p. m.	1060	25.712	67.0	69.0	25.613					
22	........do	6 a. m.	1060	25.709	41.0	39.0	25.606	25.606	4,487	24.0		Not used on profile.
22	Camp 33, Klamath marsh	6 p. m.	1060	25.713	78.0	75.0	25.571					
22	........do	8 p. m.	1060	25.716	66.0	65.0	25.581					
23	........do	5.35 a. m.	1060	25.683	43.5	41.0	25.575	25.576	4,512	17.5	487.1	
23	Camp 34, Klamath marsh	3 p. m.	1060	25.700	93.5	89.0	25.577					
23	........do	6 p. m.	1060	25.664	80.0	77.0	25.576					
23	........do	8 p. m.	1060	25.638	64.5	66.0	25.575					
24	........do	6 a. m.	1060	25.567	28.0	26.5	25.578	25.576	4.526	11.3	498.4	
24	Camp 35, water hole	2.30 p. m.	1060	25.286	87.0	84.0	25.279					
24	........do	6 p. m.	1060	25.243	71.0	70.0	25.282					
25	........do	5.20 a. m.	1060	25.176	41.0	41.0	25.274	25.278	4,864	18.5	516.9	
25	Station on divide	7 a. m.	1060	25.248	45.5	42.5	25.327		4,801	1.5	518.4	
25	Station on divide	7.50 a. m.	1060	25.318	59.0	65.0	25.369		4,755	3.5	521.9	
25	Station on divide	8.40 a. m.	1060	25.409	70.0	67.5	25.440		4,677	2.5	524.4	
25	Station on divide	9.45 a. m.	1060	25.551	75.5	70.5	25.581		4,522	3.0	527.4	
25	Station on divide	10.45 a. m.	1060	25.597	80.5	79.5	25.622		4,477	3.0	530.4	
25	Camp 36, Des Chutes river	3 p. m.	1060	25.602	83.0	78.0	25.654					
25	........do	6 p. m.	1060	25.607	74.0	73.0	25.658					
25	........do	8 p. m.	1060	25.587	56.0	54.0	25.650					
26	........do	6 a. m.	1060	25.592	27 0	23.5	25.655	25.654	4,411	5.2	535.6	
26	Near crossing of river	10.10 a. m.	1060	25.834	78.0	77.0	25.797		4,314	11.5	547.1	
26	Camp 37, Des Chutes river	6 p. m	1060	25.907	76.0	71.0	25.891					
26	........do	8.20 p. m.	1060	25.917	61.0	57.0	25.904					
26	........do	8.20 p. m.	1089	25.878	61.0	57.0	25.909					
27	........do	6 a. m.	1060	25.932	31.0	27.0	25.896					
27	........do	6 a. m.	1089	25.898	31.0	27.0	25.906					
27	........do	7 a. m.	1060	25.952	36.0	38.0	25.900					
27	........do	7 a. m.	1089	25.915	36.0	38.0	25.907					
27	........do	8 a. m.	1060	25.987	49.5	50.0	25.904					
27	........do	8 a. m.	1089	25.942	49.5	50.0	25.903					
27	........do	10 a. m.	1060	26.021	69.0	68.0	25.910					
27	........do	10 a. m.	1089	25.981	69.0	68.0	25.914					
27	........do	11 a. m.	1060	26.014	73.0	71.5	25.901					
27	........do	11 a. m.	1089	25.973	72.5	71.5	25.905					
27	........do	12 m.	1089	25.951	76.0	74.0	25.889					
27	........do	1 p. m.	1060	26.002	77.0	76.0	25.898					
27	........do	1 p. m.	1089	25.954	78.0	76.0	25.891					
27	........do	2 p. m.	1060	25.985	75.5	74.0	25.897					
27	........do	2 p. m.	1089	25.944	75.5	74.0	25.900					
27	........do	4 p. m.	1060	25.965	74.0	73.0	25.886					
27	........do	4 p. m.	1089	25.928	74.0	73.0	25.892					
27	........do	5 p. m.	1060	25.964	73.0	71.5	25.884					

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
Aug. 27	Camp 37, Des Chutes river	5 p. m.	1089	25.919	73.0	71.5	25.883					
27	do	6 p. m.	1060	25.960	67.0	66.0	25.886					
27	do	6 p. m.	1089	25.918	67.0	66.0	25.888					
27	do	7 p. m.	1060	25.954	63.0	62.0	25.883					
27	do	7 p. m.	1089	25.908	63.0	62.0	25.881					
27	do	8 p. m.	1060	25.966	58.5	58.5	25.894					
27	do	8 p. m.	1089	25.916	59.0	58.5	25.888					
27	do	9 p. m.	1060	25.952	55.0	55.0	25.887					
27	do	9 p. m.	1089	25.894	55.0	55.0	25.873					
28	do	6 a. m.	1060	25.852	32.0	30.5	25.910					
28	do	7 a. m.	1060	25.852	36.0	36.0	25.904					
28	do	8 a. m.	1060	25.864	49.5	50.5	25.905					
28	do	9 a. m.	1060	25.879	62.0	62.5	25.894					
28	do	10 a. m.	1060	25.887	72.0	72.0	25.895					
28	do	11 a. m.	1060	25.882	73.5	72.0	25.900					
28	do	12 m.	1060	25.860	75.5	74.0	25.891					
28	do	1 p. m.	1060	25.857	77.0	76.0	25.895					
28	do	2 p. m.	1060	25.836	75.0	73.0	25.896					
28	do	3 p. m.	1060	25.830	73.0	71.0	25.904					
28	do	4 p. m.	1060	25.822	71.0	69.0	25.902					
28	do	5 p. m.	1060	25.819	72.0	71.0	25.897					
28	do	7 p. m.	1060	25.797	60.0	58.0	25.893					
28	do	8 p. m.	1060	25.796	55.5	55.0	25.895					
28	do	9 p. m.	1060	25.780	49.5	50.0	25.890					
29	do	6 a. m.	1060	25.707	45.0	44.0	25.827	25.896	4,165	11.2	558.3	
29	Camp 38 A, Des Chutes river.	10 a. m.	1060	25.756	58.0	56.0	25.874					
29	do	11 a. m.	1060	25.744	57.0	55.0	25.875					
29	do	12 m.	1060	25.752	62.0	64.0	25.887					
29	do	1 p. m.	1060	25.750	64.0	62.0	25.887					
29	do	2 p. m.	1060	25.744	65.0	64.0	25.892					
29	do	3 p. m.	1060	25.746	69.0	67.0	25.890					
29	do	4 p. m.	1060	25.744	60.0	58.0	25.907					
29	do	5 p. m.	1060	25.746	54.0	52.0	25.918					
29	do	6 p. m.	1060	25.746	52.0	50.0	25.912					
29	do	7 p. m.	1060	25.740	48.0	47.0	25.906					
29	do	8 p. m.	1060	25.738	44.0	42.0	25.899					
29	do	9 p. m.	1060	25.740	43.0	41.5	25.897					
30	do	7 a. m.	1060	25.827	36.0	35.0	25.903					
30	do	8 a. m.	1060	25.840	39.0	38.0	25.909					
30	do	9 a. m.	1060	25.859	45.5	44.5	25.916					
30	do	10 a. m.	1060	25.875	54.5	54.0	25.917					
30	do	11 a. m.	1060	25.900	67.0	66.5	25.914					
30	do	12 m.	1060	25.902	71.0	70.5	25.913					
30	do	1 p. m.	1060	25.886	66.0	64.0	25.913					
30	do	2 p. m.	1060	25.870	65.0	63.5	25.910					
30	do	3 p. m.	1060	25.868	70.0	68.0	25.900					
30	do	4 p. m.	1060	25.857	66.5	64.5	25.898					
30	do	5 p. m.	1060	25.846	63.5	61.0	25.890					
30	do	6 p. m.	1060	25.841	59.0	57.0	25.885					
30	do	7 p. m.	1060	25.830	52.0	49.5	25.888					
30	do	8 p. m.	1060	25.803	41.0	41.0	25.881					
30	do	9 p. m.	1060	25.790	35.5	35.0	25.881					
31	do	6 a. m.	1060	25.781	22.0	20.0	25.913					
31	do	7 a. m.	1060	25.803	28.5	28.0	25.918					
31	do	8 a. m.	1060	25.806	32.0	30.5	25.917					
31	do	9 a. m.	1060	25.818	42.0	42.0	25.915					
31	do	10 a. m.	1060	25.837	54.0	54.0	25.917					
31	do	11 a. m.	1060	25.854	69.0	68.5	25.908					

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
Aug. 31	Camp 38 A, Des Chutes river..	12 m.......	1060	25.857	75.0	74.0	25.911	....	....	......	......	
31	........do........	1 p. m.....	1060	25.850	75.0	73.5	25.906	....	....	......	......	
31	........do........	2 p. m.....	1060	25.834	72.5	70.5	25.907	....	....	......	......	
31	........do........	3 p. m.....	1060	25.832	72.0	70.0	25.908	....	....	......	......	
31	........do........	4 p. m.....	1060	25.836	67.0	65.0	25.916	....	....	......	......	
31	........do........	5 p. m.....	1060	25.839	65.0	63.0	25.911	....	....	......	......	
31	........do........	6 p. m....	1060	25.840	59.5	57.5	25.889	....	....	......	......	
31	........do........	7 p. m.....	1060	25.838	54.0	52.0	25.907	....	....	......	......	
31	........do........	8 p. m.....	1060	25.848	52.0	50.0	25.902	....	....	......	......	
Sept. 1	........do........	6.30 a. m..	1060	25.824	29.0	28.0	25.909	....	....	......	......	
1	........do........	7 a. m.....	1060	25.829	31.0	29.5	25.908	....	....	......	......	
1	........do........	8 a. m.....	1060	25.833	38.5	38.0	25.908	....	....	......	......	
1	........do........	9 a. m.....	1060	25.835	48.5	49.0	25.900	....	....	......	......	
1	........do........	10 a. m....	1060	25.839	59.0	59.0	25.892	....	....	......	......	
1	........do........	11 a. m....	1060	25.876	76.0	75.0	25.901	....	....	......	......	
1	........do........	12 m.......	1060	25.872	79.5	77.5	25.903	....	....	......	......	
1	........do........	1 p. m.....	1060	25.846	72.0	73.0	25.906	....	....	......	......	
1	........do........	2 p. m.....	1060	25.840	75.0	74.0	25.900	....	....	......	......	
1	........do........	3 p. m.....	1060	25.836	77.0	75.0	25.896	....	....	......	......	
1	........do........	5 p. m.....	1060	25.836	67.0	65.0	25.903	....	....	......	......	
1	........do........	6 p. m.....	1060	25.836	59.0	57.0	25.907	....	....	......	......	
1	........do........	7 p. m.....	1060	25.834	54.0	53.0	25.901	....	....	......	......	
1	........do........	8 p. m.....	1060	25.842	50.0	48.0	25.897	....	....	......	......	
1	........do........	9 p. m.....	1060	25.846	46.0	45.0	25.895	....	....	......	......	
2	........do........	6 a. m.....	1060	25.866	32.0	31.0	25.896	25.906	4,129	3.3	561.6	
2	Camp 39 A, Des Chutes river..	6 p. m.....	1060	25 948	60.5	58.0	25.984	....	....	......	......	
2	........do........	7 p. m.....	1060	25.932	54.5	53.0	25.978	....	....	......	......	
2	........do........	9 p. m.....	1060	25.911	45.0	43.0	25.968	25.977	4,038	15.2	576.8	
4	Camp J, on small branch......	5.30 a. m..	1060	26.200	41.0	41.0	26.181	....	....	......	......	
4	........do........	6 a. m.....	1060	26.204	40.5	40.0	26.171	26.176	3,784	16.9	593.7	
4	Station on plateau...........	6.50 a. m..	1060	26.120	40.5	40.0	26.022	....	3,960	0.3	594.0	
4	Station on plateau...........	7.31 a. m..	1060	26.160	49.5	47.0	26.022	....	3,960	2.0	596.0	
4	Station on plateau...........	10.15 a. m.	1060	26.402	56.0	52.0	26.310	....	3,658	6.2	602.2	
4	Camp 40, near forks of Indian trail........	8.30 p. m..	1060	25.688	42.5	42.0	25.616	....	....	......	......	Not used on profile.
5	........do........	6 a. m.....	1060	25.713	32.0	29.0	25.648	....	....	......	......	
5	........do........	9 a. m.....	1060	25.746	46.5	46.0	25.656	....	....	......	......	
5	........do........	9.05 a. m..	1060	25.768	50.0	47.5	25.658	....	....	......	......	For altitude, &c., see below.
5	On bank of creek, 1.6 miles from Camp 40............	10.20 a. m.	1060	26.142	56.5	53.5	26.032	....	3,970	......	......	Not used on profile.
5	Camp 40, near forks of Indian trail........	12 m......	1060	25.768	60.5	58.0	25.673	....	....	......	......	
5	........do........	3 p. m.....	1060	25.760	61.5	58.5	25.699	....	....	......	......	
5	........do........	3 p. m.....	1089	25.732	62.0	58.5	25 701	....	....	......	......	
5	........do........	6 p. m.....	1060	25.736	52.5	50.0	25.685	....	....	......	......	
5	........do........	6 p. m.....	1089	25.700	52.5	50.0	25.684	....	....	......	......	For data from which the altitude of this camp has been determined, see also Section II of this Appendix, date Sept. 10, &c.
5	........do........	8 p. m.....	1060	25.728	51.5	47.0	25.666	....	....	......	......	
5	........do........	8 p. m.....	1089	25.693	51.5	47.0	25.666	....	....	......	......	
6	........do........	6 a. m.....	1060	25.722	34.0	31.5	25.656	....	....	......	......	
6	........do........	6 a. m.....	1089	25.674	34.0	31.5	25.663	25.679	4,343	28.7	......	

APPENDIX D—Continued.

II. *Routes of detached parties in charge of Lieut. R. S. Williamson, U. S. Topographical Engineers.*

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
Aug. 14	On bank of Lower Klamath lake	11.45 a. m.	1089	25.937	77.0	74.0	26.113		3,953	28.0		50 feet above water; distance estimated from Camp 26.
14	Camp B, Klamath river, near crossing of Oregon trail	6 p. m.	1089	26.238	82.5	80.5	26.262					
14	do	9 p. m.	1089	26.243	58.5	58.0	26.299					
15	do	6 a. m.	1089	26.255	40.0	41.0	26.332	26.298	3,733	13.0		40 feet above water.
15	On Klamath river, near mouth of cañon	12 m	1089	26.033	85.0	82.0	26.017		4,040	12.5		15 feet above water.
28	Near Des Chutes river	10 a. m.	1089	25.815	69.0	67.0	25.874		4,166	5.6		Distance estimated from Camp 37.
28	Main branch of Des Chutes river	12 m	1089	25.837	77.5	75.0	25.909		4,128	0.3		
28	Camp E, near main branch of Des Chutes river	3 p. m.	1089	25.728	74.0	73.0	25.843					
28	do	6 p. m.	1089	25.704	64.0	63.5	25.839					
28	do	8 p. m.	1089	25.688	57.5	57.0	25.827					
29	do	6 a. m.	1089	25.604	46.5	46.5	25.765	25.818	4,247	1.7		
29	Near Des Chutes river	9.20 a. m.	1089	25.627	56.0	53.5	25.785		4,226	3.6		
29	Near north fork of Des Chutes river	2 p. m.	1089	25.628	62.0	56.0	25.813		4,195	3.3		
29	Camp F, near north fork	4.40 p. m.	1089	25.508	49.0	50.0	25.737					
29	do	6 p. m.	1089	25.493	47.0	47.0	25.715					
29	do	8 p. m.	1089	25.502	45.0	45.5	25.705					
30	do	6 a. m.	1089	25.506	38.5	37.5	25.627	25.696	4,311	11.0		
30	Near Des Chutes	9.30 a. m.	1089	25.539	53.5	49.0	25.625		4,384	2.1		
30	do	0.15 p. m.	1089	25.367	58.0	55.5	25.455		4,567	3.3		
30	Camp G, meadow	3 p. m.	1089	25.324	59.5	58.5	25.426					
30	do	6 p. m.	1089	25.300	54.0	53.0	25.401					
30	do	8 p. m.	1089	25.280	45.0	45.5	25.392					
31	do	6 a. m.	1089	25.238	29.0	29.5	25.398	25.404	4,673	2.2		See also Sept. 25, in this Section of the Appendix.
31	Lake at base of Snow peak	10.50 a. m.	1089	24.681	55.0	53.5	24.712		5,375	11.0		
31	Summit of divide, southern rim of crater	0.30 p. m.	1089	23.760	63.5	63.0	23.891		6,303	4.9		
31	Summit of divide, northern rim of crater	2.35 p. m.	1089	23.294	65.0	63.5	23.437		6,830	1.0		
31	Camp H, near Three Sisters	4 p. m.	1089	24.010	56.0	54.5	24.163					
31	do	6 p. m.	1089	24.028	51.0	49.5	24.164					
31	do	8 p. m.	1089	24.038	50.0	49.0	24.142					
Sept. 1	do	6 a. m.	1089	24.022	42.0	39.0	24.075	24.136	6,054	5.5		
1	Small creek	8.10 a. m.	1089	24 542	54.0	48.5	24.639		5,434	1.0		
1	Near forks of Indian trail	12 m	1089	25.641	61.0	60.0	25.761		4,343	7.3		
6	On ridge	9 a. m.	1060	25.010	58.5	56.0	24.903		5,199	2.5		Distance estimated from Camp 40.
6	On ridge	10.10 a. m.	1060	24.841	57.0	57.0	24.746		5,374	2.0		
6	On divide	11.18 a. m.	1060	24.144	59.0	58.0	24.058		6,154	2.2		
6	Summit of ridge	0.15 p. m.	1060	23.613	55.0	52.0	23.534		6,763	1.3		
6	Camp K, mountain lake	6.10 p. m.	1060	25.391	53.5	50.0	25.305					
6	do	8 p. m.	1060	25.376	42.0	41.5	25.305					
7	do	6 a. m.	1060	25.375	32.5	30.5	25.308	25.306	4,711	6.0		
7	On ridge	8.19 a. m.	1060	24.851	68.0	66.0	24.709		5,478	1.4		
7	On slope, near ridge	9.40 a. m.	1060	25.783	76.0	70.0	25.630		4,459	3 3		Lower limit of glacial action.
7	Near branch	2.44 p. m.	1060	27.300	77.0	76.0	27.179		2,814	5.0		

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
Sept. 8	Camp L, water hole........	6.07 a. m.	1060	27.093	46.0	45.5	27.002	....	2,949	3.0	......	
8	Camp M, whortleberry camp..	3.25 p. m..	1060	24.731	64.0	62.5	24.658	....	....	......	......	
8	........do....................	6.07 p. m..	1060	24.708	56.0	55.0	24.657	....	....	......	......	
8	........do....................	7.30 p. m..	1060	24.700	52.5	50.0	24.656	....	....	......	......	
8	........do....................	8.52 p. m..	1060	24.684	44.0	43.0	24.659	....	....	......	......	
9	........do....................	6.54 a. m..	1060	24.646	43.5	42.5	24.650	....	....	......	......	
9	........do....................	9 a. m.....	1060	24.673	52 5	52.0	24.646	....	....	......	......	
9	........do....................	11.45 a. m.	1060	24.666	59.5	58.0	24.631	....	....	......	......	
9	........do....................	0.10 p. m..	1060	24.672	58.5	57.0	24.635	....	....	......	......	
9	........do....................	3 p. m.....	1060	24.660	56.0	55.0	24.611	....	....	......	......	
9	........do....................	6.12 p. m..	1060	24.650	49.5	48.0	24.600	....	....	......	......	
9	........do....................	8 p. m.....	1060	24.639	42.0	40.5	24.606	....	....	......	......	
10	........do....................	6 a. m.....	1060	24.623	38.0	36.5	24.690	24.642	5,493	6.5	......	
10	On divide....................	10 a. m....	1060	24.956	56.0	52.0	24.921	....	5,147	1.0	......	
10	Camp 40, (second time at same camp)......................	6 p. m.....	1060	25.656	49.0	48.5	25.655	....	....	......	......	For data from which the altitude of this camp has been determined, see also Section I of this Appendix, date Sept. 5, &c.
10	........do....................	8.15 p. m..	1060	25.652	37.5	37.0	25.659	....	....	......	......	
11	........do....................	6 a. m.....	1060	25.638	27.5	26.0	25.651	....	....	......	......	
11	........do....................	9 a. m.....	1060	25.691	54.0	53.0	25.651	....	....	......	......	
11	........do....................	12 m.......	1060	25.692	66.5	66.0	25.653	....	....	......	......	
11	........do....................	3 p. m.....	1060	25.665	66.5	65.0	25.644	....	....	......	......	
11	........do....................	6 p. m.....	1060	25.622	53.0	52.5	25.628	....	....	......	......	
11	........do....................	8.38 p. m..	1060	25.605	40.5	40.5	25.633	....	....	......	......	
12	........do....................	6 a. m.....	1060	25.562	32.0	31.5	25.636	25.646	4,343	16.0	......	
12	Camp N, near Three Sisters ..	6 p. m.....	1060	24.140	54.0	53.5	24.079	....	....	......	......	
12	........do....................	9 p. m.....	1060	24.118	45.0	44.0	24.079	....	....	......	......	
13	........do....................	6 a. m.....	1060	24.100	40.0	39.0	24.083	24.080	6,102	15.0	......	
13	Summit of ridge..............	8.57 a. m..	1060	23.525	64.0	62.0	23.453	....	6,911	2.0	......	
13	On slope of hill	11.20 a. m.	1060	24.843	78.0	73.0	24.732	....	5,431	5.5	......	
13	On small branch	0.25 p. m..	1060	25.404	79.0	76.5	25.303	....	4,795	1.5	......	
13	Camp O, small branch........	6 p. m.....	1060	25.413	51.5	49.5	25.346	....	....	......	......	
13	........do....................	8 p. m.....	1060	25.398	41.0	40.0	25.352	....	....	......	......	
14	........do....................	6 a. m.....	1060	25.352	29.5	27.5	25.430	25.376	4,627	7.0	......	
14	On ridge.....................	9.20 a. m..	1060	25.003	64.0	64.0	24.860	....	5,327	6.4	......	
14	Camp P, small meadow......	3 p. m.....	1060	24.958	57.0	56.0	24.906	....	....	......	......	
14	........do....................	6.13 p. m..	1060	24.930	49.0	48.5	24.869	....	....	......	......	
14	........do....................	7.40 p. m..	1060	24.923	47.5	47.5	24.870	....	....	......	......	
15	........do....................	6 a. m.....	1060	24.826	46.5	46.0	24.866	24.878	5,237	6.5	......	
15	Camp Q, small creek.........	6.10 p. m..	1060	25.196	43.0	42.5	25.160	....	....	......	......	
15	........do....................	8.40 p. m..	1060	25.177	38.0	38.0	25.159	....	....	......	......	
16	........do....................	7.30 a. m..	1060	25.148	40.5	43.0	25.151	....	....	......	......	
16	........do....................	9 a. m.....	1060	25.163	44.5	43.0	25.159	....	....	......	......	
16	........do....................	12 m.......	1060	25.179	44.0	43.0	25.152	....	....	......	......	
16	........do....................	3 p. m.....	1060	25.194	40.0	38.5	25.162	....	....	......	......	
16	........do....................	6 p. m.....	1060	25.186	43.0	42.0	25.155	....	....	......	......	
16	........do....................	8.15 p. m..	1060	25.214	42.0	42.0	25.157	....	....	......	......	
17	........do....................	6.15 a. m..	1060	25.262	40.5	39.5	25.158	....	....	......	......	
17	........do....................	0.05 p. m..	1060	25.300	50.5	50.0	25.166	....	....	......	......	
17	........do....................	3 p. m.....	1060	25.297	49.0	47.0	25.161	....	....	......	......	
17	........do....................	6 p. m.....	1060	25.306	46.0	45.0	25.158	....	....	......	......	
17	........do....................	7.15 p. m..	1060	25.318	44.0	43.0	25.162	....	....	......	......	
18	........do....................	6 a. m.....	1060	25.354	43.5	43.0	25.158	25.160	4,882	19.9	......	
24	Camp S, Why-chus creek....	10.04 a. m.	1089	26.922	54.5	53.0	26.789	....	3,125	30.0	......	See, also, Section III of this Appendix, Sept. 25.
24	Camp 40 W, small branch	6 p. m.....	1089	24.604	37.5	37.0	24.569	....	....	......	......	
24	........do....................	8 p. m.....	1089	24.610	32.0	31.0	24.571	....	....	......	......	
25	........do....................	4 a. m.....	1089	24.619	28.0	29.0	24.578	....	....	......	......	
25	........do....................	5.50 a. m..	1089	24.631	30.0	28.0	24.569	24.572	5,422	20.0	......	
25	Camp 41 W, same as Camp G.	3 p. m.....	1089	25.453	66.0	65.0	25.350	....	....	......	......	

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected readings of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
Sept. 25	Camp 41 W, same as Camp G.	6 p. m.	1089	25.391	54.0	54.0	25.290	....	....	......	......	
25	........do	8.14 p. m.	1089	25.390	44.5	45.0	25.304	....	....	......	......	
26	........do	5 a. m.	1089	25.284	31.0	29.0	25.354	....	....	......	.....	
26	........do	6 a. m.	1089	25.276	31.0	31.0	25.348	25.329	4,673	20.0	......	See also August 30, in this Seetio of pendix.
26	Des Chutes river	11.35 a. m.	1089	25.590	69.0	68.5	25.567	....	4,460	9.0	......	
26	Camp 42 W, Des Chutes river.	6 p. m.	1089	25.638	53.5	53.0	25.594	....	....	......	......	
26	........do	7.59 p. m.	1089	25.630	47.0	46.0	25.598	....	....	......	......	
27	........do	4.25 a. m.	1089	25.557	40.0	40.0	25.601	....	....	......	......	
27	........do	5.45 a. m.	1089	25.558	40.0	40.0	25.610	25.601	4,412	9.0	......	
27	South braneh of Des Chutes river	11.52 a. m.	1089	25.650	58.0	57.0	25.608	....	4,415	10.0	......	
27	Camp 43 W, Des Chutes river.	3.25 p. m.	1089	25.616	53.0	51.5	25.563	....	....	......	......	
27	........do	6 p. m.	1089	25.621	45.0	44.5	25.532	....	....	......	......	
28	........do	4.23 a. m.	1089	25.652	28.0	28.0	25.731	....	....	......	......	
28	........do	5.45 a. m.	1089	25.662	26.0	25.5	25.733	25,640	4,339	5.0	......	
28	South braneh of Des Chutes river.	9.10 a. m.	1089	25.634	61.0	52.0	25.569	....	4,458	6.0	541.6	6 miles from Camp 36.
28	........do	11.57 a. m.	1089	25.497	69.5	68.0	25.504	....	4,532	7.0	548.6	
28	Camp 44 W, head of Des Chutes river.	6 p. m.	1089	25.439	49.5	49.0	25.392	....	....	......	......	
29	........do	5.15 a. m.	1089	25.432	25.0	24.5	25.377	....	....	......	......	
29	........do	5.58 a. m.	1089	25.439	25.5	24.5	25.375	25.381	4,592	4.0	552.6	
29	On hill	7.07 a. m.	1089	25.065	48.0	49.0	24.948	....	5,168	2.5	555.1	
29	Summit of ridge	9.05 a. m.	1089	24.790	66.0	61.0	24.642	....	5,511	4.7	559.8	
29	Divide, summit of range	10 a. m.	1089	24.708	66.5	63.0	24.567	....	5,595	2.0	561.8	
29	On deseent	12 m	1089	24.798	68.0	63.0	24.669	....	5,481	5.0	566.8	
29	In valley	1.35 p. m.	1089	26.570	72.0	64.0	26.431	....	3,566	3.7	570.5	
29	On stream	2.40 p. m.	1089	27.312	73.5	70.0	27.182	....	2,788	2.5	573.0	
29	Camp 45 W, middle fork of Willamette river	6 p. m.	1089	27.658	59.5	58.5	27.581	....	....	......	......	
29	........do	7.50 p. m.	1089	27.674	53.5	53.0	27.584	....	....	......	......	
30	........do	4.50 a. m.	1089	27.704	41.5	43.0	27.598	....	....	......	......	
30	........do	5.50 a. m.	1089	27.708	40.5	40.0	27.595	27.589	2,355	3.5	576.5	
30	Middle fork of Willamette	7.27 a. m.	1089	28.150	52.0	49.0	27.995	....	1,979	3.2	579.7	
30	........do	9.21 a. m.	1089	28.375	60.0	54.0	28.202	....	1,774	3.5	583.2	
30	........do	11.47 a. m.	1089	28.610	74.5	70.5	28.448	....	1,532	4.4	587.6	
30	........do	1.10 p. m.	1089	28.654	75.5	74.5	28.525	....	1,454	2.5	590.1	
30	Camp 46 W, middle fork	6 p. m.	1089	28.891	71.0	69.5	28.829	....	....	......	......	
30	........do	7.55 p. m.	1089	28.878	56.0	56.0	28.831	....	....	......	......	
Oet. 1	........do	6.03 a. m.	1089	28.810	44.0	43.0	28.851	28.837	1,154	9.4	599.4	
1	Middle fork	7.39 a. m.	1089	29.012	62.0	57.5	29.013	....	989	2.0	601.5	
1	........do	10.05 a. m.	1089	29.102	72.0	65.0	29.102	....	903	4.5	606.0	
1	........do	0.50 p. m.	1089	29.150	84.5	82.0	29.187	....	821	5.0	611.0	
1	Camp 47 W, middle fork	5.48 p. m.	1089	29.232	69.0	66.5	29.340	....	....	......	......	
1	........do	9.10 p. m.	1089	29.222	58.0	58.0	29.320	....	....	......	......	
2	........do	5 a. m.	1089	29.200	52.0	53.0	29.358	....	....	......	......	
2	........do	6 a. m.	1089	29.210	50.0	50.0	29.349	29.342	671	10.5	621.5	
2	Camp 48 W, first settlement.	3 p. m.	1089	29.160	82.0	84.0	29.294	....	....	......	......	
2	........do	6 p. m.	1089	29 142	68.0	67.0	29.298	....	....	......	......	
2	........do	7.48 p. m.	1089	29.136	59.5	60.0	29.289	....	....	......	......	
3	........do	6 a. m.	1089	29.163	49.5	48.5	29.302	....	....	......	......	
3	........do	9 a. m.	1089	29.180	59.5	59.0	29.267	....	....	......	......	
3	........do	11.48 a. m.	1089	29.182	71.0	69.5	29.278	....	....	......	......	
3	........do	5 p. m.	1089	29.106	72.0	71.0	29.305	....	....	......	......	
3	........do	6 p. m.	1089	29.102	62.5	62.5	29.265	....	....	......	......	
3	........do	7.30 p. m.	1089	29.090	56.0	56.0	29.240	....	....	.....	.....	
4	........do	6 a. m.	1089	29.080	43.0	42.5	29.205	29.274	738	1.5	623.0	
4	Camp 49 W, MeKenzie's fork.	6 p. m.	1089	29.400	67.5	66.0	29.499	....	....	......	......	

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				Inches.			Inches.	Inches.	Feet.	Miles.	Miles.	
Oct. 5	Camp 49 W, McKenzie's fork.	6 a. m.	1089	29.408	40.0	41.0	29.516	29.507	512	24.0	647.0	
5	Camp 50 W, Calapooya creek.	6 p. m.	1089	29.558	64.0	63.0	29.589					
5	do	7.30 p. m.	1089	29.565	57.0	57.0	29.589					
6	do	6.05 a. m.	1089	29.630	38.0	37.5	29.580	29.586	440	20.5	667.5	
6	Camp 51 W, North fork of Santiam river	6 p. m.	1089	29.680	58.0	57.5	29.573					
6	do	8 p. m.	1089	29.700	51.0	50.5	29.565					
7	do	6 a. m.	1089	29.739	41.0	41.0	29.579	29.572	448	27.0	694.5	
7	Camp 52, near Butte creek	6.20 p. m.	1089	29.827	52.0	52.0	29.679					
7	do	7.40 p. m.	1089	29.838	51.0	50.0	29.673					
8	do	6 a. m.	1089	29.800	46.0	45.5	29.714	29.689	339	25.5	720.0	
9	Camp 53 W, ridge above Oregon City	6 a. m.	1089	29.842	56.0	55.0	29.770		266	19.3	739.3	
9	Clackamas river	8.05 a. m.	1089	30.081	60.0	58.0	29.928		119	2.0	741.3	
9	Willamette river, opposite Portland city	11.18 a. m.	1089	30.133	68.0	65.0	29.984		66	11.0	752.3	
9	Camp 54 W, opposite Fort Vancouver	6.08 p. m.	1089	30.040	61.0	58.0	29.959					
10	do	7.15 a. m.	1089	30.096	50.0	50.0	30.014					
10	do	10 a. m.	1089	30.125	57.0	56.0	29.939					
10	do	0.25 p. m.	1089	30.095	62.5	62.0	29.954					
10	do	2.30 p. m.	1089	30.052	69.5	68.5	29.925					
10	do	7 p. m.	1089	29.980	59.0	58.0	29.919					
11	do	6.30 a. m.	1089	29.992	49.5	49.0	29.946					
11	do	9 a. m.	1089	30.000	55.0	55.0	29.939					
11	do	12 m.	1089	29.964	62.0	62.0	29.937					
11	do	3 p. m.	1089	29.950	63.5	63.5	29.937					
11	do	6 p. m.	1089	29.956	61.0	61.5	29.934					
12	do	8 a. m.	1089	29.974	58.0	57.5	29.932					
12	do	12 m.	1089	29.993	63.5	62.5	29.938					
12	do	3 p. m.	1089	29.983	65.0	64.0	29.958					
12	do	9 p. m.	1089	29.980	51.0	50.0	29.959					
13	do	7.30 a. m.	1089	29.886	45.0	44.5	29.950					
13	do	9 a. m.	1089	29.862	47.0	46.5	29.939					
13	do	12 m.	1089	29.795	65.0	65.0	29.938					
13	do	3 p. m.	1089	29.762	65.5	64.5	29.940					
13	do	6 p. m.	1089	29.736	58.5	58.0	29.934					
14	do	7.20 a. m.	1089	29.846	51.5	51.5	29.990					
14	do	9 a. m.	1089	29.870	55.5	55.0	29.934					
14	do	3 p. m.	1089	29.895	68.0	67.0	29.941					
14	do	6 p. m.	1089	29.900	59.5	59.0	29.934					
15	do	7.30 a. m.	1089	30.093	55.0	54.0	29.932					
15	do	9 a. m.	1089	30.122	59.5	59.5	29.935					
15	do	0.30 p. m.	1089	30.142	63.5	63.0	29.946					
15	do	3 p. m.	1089	30.137	65.5	65.0	29.935					
15	do	6 p. m.	1089	30.126	60.0	60.0	29.934					
15	do	7.30 p. m.	1089	30.130	55.0	55.0	29.928					
16	do	6.45 a. m.	1089	30.156	49.0	48.0	29.939	29.943	105	7.0	759.3	

APPENDIX D—Continued.

III. *Routes of detached parties in charge of Lieut. H. L. Abbot, U. S. Topographical Engineers.*

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
Sept. 6	Near base of Black Butte.....	12 m.......	1089	26.790	76.0	70.0	26.698	....	3,294	10.0	.....	Not used on profile; distance estimated from camp 40.
6	Camp 40 A, Mpto-ly-as cañon.	9 p. m.....	1089	28.172	56.0	54.0	28.096	....	....	......	......	On line of profile.
7	........do....................	6 a. m.....	1089	28.216	43.0	42.0	28.108	28.102	1,907	18.0	636.7	Mean height deduced from observations on Sept. 6-7, and 22-23.
7	Plateau above river	1 p. m.....	1089	27.388	89.5	84.0	27.329	....	2,660	2.6	639.3	
7	Camp 41 A, Psuc-see-que creek	6 p. m.....	1089	28.005	80.0	78.0	28.013	....	....	......	......	
7	........do....................	9 p. m.....	1089	28.038	73.0	70.0	28.016	....	....	......	....	
8	........do	6 a. m.....	1089	27.990	41.0	40.0	28.035	28.021	1,964	7.7	647.0	
8	On plateau north of creek	8 a. m.....	1089	27.481	70.0	63.0	27.475	....	2,527	1.0	648.0	
8	Near Chit-tike creek	9 a. m.....	1089	28.470	74.0	67.0	28.452	....	1,531	4.2	......	Not used on profile.
8	Wam Chuck river	12 m.......	1089	28.500	87.0	80.0	28.488	....	1,504	11.5	663.7	
8	Highest point of mountain crossed by trail	2 p. m.....	1089	26.823	82.0	76.0	26.872	....	3,095	4.0	667.7	Mean height deduced from observations on Sept. 8 and 21.
8	In small ravine	2.40 p. m..	1089	26.931	87.0	80.0	26.969	....	3,054	3.3	671.0	
8	Camp 42 A, Nee-nee springs..	6 p. m.....	1089	27.089	70.0	67.0	27.139	....	....	......	......	
8	....	9 p. m.....	1089	27.088	55.5	55.0	27.129	....	....	......	......	
9	....	6 a. m.....	1089	27.072	50.0	48.0	27.130	27.133	2,829	4.9	675.9	Mean height deduced from observations on Sept. 8-9, 20-21, and Oct. 3-5.
9	Summit Mutton mountains...	8 a. m.....	1089	26.940	68.0	58.0	26.907	....	3,087	2.7	......	
9	Tysch prairie	8.30 a. m..	1089	27.800	70.0	65.0	27.769	....	2,207	1.5	......	General level of prairie.
9	Divide between two branches of Tysch creek	12 m.......	1089	28.787	85.0	78.0	28.743	....	1,246	15.5	......	
9	Camp 43 A, Tysch creek	9 p. m.....	1089	28.777	53.0	48.0	28.746	....	....	......	......	
10	........do....................	6 a. m....	1089	28.855	33.0	31.5	28.886	28.816	1,153	0.5	......	
10	Summit of Tysch mountains..	8 a. m.....	1089	27.320	61.0	57.0	27.287	....	2,706	2.5	......	
10	In ravine, (dry)..............	10 a. m....	1089	28.225	75.0	65.0	28.173	....	1.805	6.0	......	
10	Fifteen Mile creek	11.30 a. m.	1089	28.760	80.0	69.0	28.707	....	1,286	7.0	......	
10	Eight Mile creek	1.30 a. m..	1089	29.190	83.0	73.0	29.145	....	862	5.0	......	
10	Near Five Mile creek	2.30 p. m..	1089	28.805	84.0	77.0	28.766	....	1,228	2.0	......	
15	Camp 44 A, Fort Dalles	9 p. m.....	1089	29.573	55.0	52.0	29.544	....	476	5.7	......	
17	Above Cascades, Columbia river	2.35 p. m..	1089	29.855	67.5	65.0	29.701	....	333	42.0	......	Observations to determine the descent of the Columbia river at the Cascades.
17	Foot of principal rapid	3.10 p. m..	1089	29.879	63.0	62.0	29.736	....	300	0.3	......	Do.
17	Lower landing, Cascades of Columbia river..............	5 p. m.....	1089	29.917	61.0	63.0	29.765	....	272	4.2	......	Do.
20	South fork Tysch creek	7.48 a. m..	1089	28.902	59.0	57.0	28.868	....	1,117	75.5	......	Eight-tenths of a mile south of camp 43 A.
20	Highest point of trail on Mutton mountains	1 p. m.....	1089	26.980	61.0	56.0	23.975	....	2,995	16.0	......	
20	Summit of wooded hill.......	2 p. m.....	1089	27.142	65.0	59.0	27.134	....	2,833	1.0	......	
20	Camp 46 A, same as Camp 42 A	6 p. m.....	1089	27.136	44.0	42.0	27.144	....	....	......	......	
20	........do....................	9 p. m.....	1089	27.136	43.5	43.5	27.146	....	....	......	.....	
21	........do............	6 a. m.....	1089	27.108	40.0	38.0	27.147	27.146	2,829	2.4	675.9	Mean height deduced from observations on Sept. 8-9, 20-21, and Oct. 3-5.
21	Highest point of mountain crossed by trail	10 a. m....	1089	26.978	58.0	50.0	26.941	....	3,036	8.2	667.7	Mean height deduced from observations on Sept. 8 and 21.
21	Wam Chuck river............	12 m.......	1089	28.494	74.0	69.0	28.473	....	1,503	4.0	663.7	
21	On bluff above cañon.........	1 p. m.....	1089	28.146	65.0	61.0	23.159	....	1,810	1.0	662.7	
21	Camp 47 A, Chit-tike creek...	6 p. m.....	1089	28.454	56.0	55.0	28.479	....	....	.....	.....	
21	........do....................	9 p. m.....	1089	28.476	50.0	49.0	28.490	....	....	......	......	

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
Sept. 22	Camp 47 A, Chit-tiko creek...	6 p. m.....	1089	28.470	29.0	27.0	28.480	28.483	1,479	9.4	653.3	
22	Base of cañon side...........	7 a. m.....	1089	28.377	61.0	52.0	28.355	....	1,611	1.0	652.3	
22	On side of cañon	7.30 a. m..	1089	27.693	60.0	48.0	27.676	....	2,281	0.6	651.7	
22	Summit of cañon side........	8 a. m.....	1089	27.500	58.0	52.0	27.489	....	2,468	0.8	650.9	
22	Dry ravine....................	8.30 a. m..	1089	27.831	60.0	53.0	27.817	.. ..	2,140	0.7	650.2	
22	In lateral cañon..............	9 a. m.....	1089	27.627	68.0	59.0	27.597	....	2,360	1.5	648.7	
22	On cañon side	9.30 a. m..	1089	27.811	65.0	56.0	27.790	....	2,167	0.5	......	Not used on profile.
22	Lower plateau................	10.15 a. m.	1089	27.534	63.0	59.0	27.524	....	2,433	3.2	646.0	
22	Higher plateau...............	12 m.......	1089	27.468	64.0	56.0	27.469	....	2,488	1.8	644.2	
22	Camp 48 A, same as camp 40 A.	6 p. m.....	1089	28.002	49.0	47.0	28.011	....	....	......	......	
22	........do.....................	9.30 p. m..	1089	27.980	41.0	39.0	27.956	....	....	......	......	
23	........do.....................	6 a. m.	1089	27.860	44.0	42.0	27.989	27.985	1,907	7.5	636.7	Mean height deduced from observations on September 6, 7, 22, and 23.
23	On cañon side	7 a. m.	1089	26.962	56.0	52.0	27.054	....	2,928	0.5	636.2	
23	Summit of cañon side........	7.30 a. m. .	1089	26.767	57.0	55.0	26.855	......	3,133	0.8	635.4	
23	Dry ravine....................	7.45 a. m. .	1089	27.180	62.0	59.0	27.254	....	2,722	0.9	634.5	
23	Mouth of lateral cañon.......	8 a. m.	1089	26.790	64.0	58.0	26.861	....	3,127	0.7	633.8	
23	On edge of lateral defile......	8.30 a. m. .	1089	26.473	66.0	60.0	26.540	....	3,461	2.4	631.4	
23	On bluff above dry bed	10 a. m. ...	1089	26.221	63.0	59.0	26.301	....	3,714	3.2	628.2	
23	Dry bed of torrent............	10.30 a. m.	1089	26.285	62.0	61.0	26.367	....	3,685	0.4	627.8	Mean height deduced from observations on Sept. 23 and 26.
25	Camp 49 A, same as camp S..	9 a. m.	1060	27.005	52.0	48.0	26.854	....	3,125	16.6	611.2	See also Section II of this Appendix, Sept. 24.
25	Camp 50 A, Que-y-ee brook...	6 p. m.....	1060	26.836	51.5	51.0	26.725	....	3,270	7.5	618.7	
26	Foot of ridge, east of Black Butte	8 a. m.	1060	26.705	46.0	34.0	26.726	....	3,262	0.7	619.4	
26	On ridge east of Black Butte..	9 a. m.	1060	26.622	51.0	48.0	26.632	....	3,360	0.6	620.0	
26	........do.....................	9.15 a. m. .	1060	26.615	57.0	53.0	26.611	....	3,382	0.7	620.7	
26	... .do.....................	9.30 a. m. .	1060	26.498	62.0	55.0	26.482	....	3,517	1.9	622.6	
26	........do.....................	10 a. m. ...	1060	26.334	65.0	60.0	26.310	....	3,698	2.1	624.7	
26	Summit of ridge, east of Black Butte......................	10.45 a. m.	1060	26.135	67.0	63.0	26.106	....	3,914	1.5	626.2	
26	Trail leaves dry bed of torrent.	11 a. m. ...	1060	25.836	70.0	64.0	25.798	....	3,685	1.6	627.8	Mean height deduced from observations on Sept. 23 and 26.
26	Small opening in forest	12 m.......	1060	26.285	62.0	61.0	26.267	....	3,743	6.0	.....	Not on line of profile.
26	Camp 51 A, mountain meadow	10 p. m.....	1060	25.485	53.0	50.0	25.433	....	4,508	1.6	.....	
27	On edge of Mpto-ly-as cañon..	8 a. m.	1060	25.240	52.0	47.0	25.226	....	4,865	0.4	......	
27	In cañon, near river..........	10.30 a. m.	1060	27.116	65.0	63.0	27.056	....	2,920	0.7	......	
27	Bluff west of river	11 a. m. ...	1060	26.794	66.0	58.0	26.730	....	3,256	0.3	......	
27	Near crater, in pedregal.......	3 p. m.....	1060	26.742	60.0	53.0	26.676	....	3,313	5.0	......	
27	Camp 52 A, near Mt. Jefferson	6 p. m.....	1060	27.488	50.0	48.0	27.262	....	....	......	......	
28	........do.....................	7 a. m.	1060	27.217	36.0	34.0	27.260	27.261	2,673	3.8	......	
28	Ridge north of pedregal brooks	12 m.......	1060	26.828	73.0	67.0	26.810	....	3,192	2.2	.....	
28	Summit of spur...............	0.30 p. m..	1060	26.559	73.0	62.0	26.519	....	3,497	1.2	......	
28	Edge of cañon side............	1 p. m.....	1060	26.632	70.0	63.0	26.611	....	3,400	3.0	......	
28	Camp 53 A, Castle rock.......	6 p. m.....	1060	27.679	71.0	71.0	27.565	....	....	....	......	
29	........do.....................	6 a. m.....	1060	27.680	42.0	41.0	27.565	27.565	2,407	3.5	......	
29	On rocky spur in cañon.......	8.30 a. m..	1060	27.390	68.0	63.0	27.213	....	2,748	3.5	......	Barometer broken.
Oct. 3	Camp 56 A, same as camp 42 A	12 m.	1060	27.132	79.0	76.0	27.088	....	....	......	......	
3	........do.....................	3 p. m.	1060	27.105	74.0	72.0	27.119	....	....	......	......	
3	........do.....................	6 p. m... .	1060	27.095	62.0	59.0	27.113	....	....	......	......	
3	........do.....................	9 p. m.....	1060	27.100	54.0	53.0	27.118	....	....	......	......	
4	........do.....................	6 a. m.....	1060	27.124	35.0	34.0	27.108	....	....	......	......	
4	........do.....................	9 a. m.....	1060	27.192	57.0	56.0	27.120	....	....	......	......	
4	........do........	3 p. m.....	1060	27.152	63.0	61.0	27.117	....	....	......	......	
4	........do.....................	6 p. m.....	1060	27.130	51.0	49.0	27.133	....	.. ..	......	......	
4	........do.....................	9 p. m.....	1060	27.129	46.0	45.0	27.116	....	....	......	......	

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from Benicia.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
Oct. 5	Camp 56 A, same as camp 42 A	6 a. m.	1060	27.155	37.0	35.0	27.117	27.115	2,829	46.7		Mean height deduced from observations on Sept. 8–9, 20–21, and Oct. 3–5,
5	Near ridge	11 a. m.	1060	27.266	66.0	57.0	27.295		2,662	4.7	680.6	
5	Trail enters thick forest	12 m.	1060	27.475	67.0	59.0	27.510		2,445	4.7	685.3	
5	Camp 57 A, Wil-la-wit springs.	9 p. m.	1060	27.331	47.0	45.0	27.351					
6	do	6 a. m.	1060	27.330	26.0	25.0	27.284	27.317	2,601	2.2	687.5	
6	On gently ascending slope	8.45 a. m.	1060	27.313	58.0	48.0	27.187		2,768	1.6	689.1	
6	do	9 a. m.	1060	27.200	57.0	50.0	27.077		2,879	0.6	689.7	
6	Summit of bluff	9.10 a. m.	1060	27.110	62.0	53.0	26.976		2,982	0.5	690.2	
6	Near Wan-nas-se creek	10 a. m.	1060	27.066	60.0	54.0	26.943		3,016	5.0	695.2	
6	On side of ravine	11 a. m.	1060	26.840	65.0	58.0	26.709		3,257	2.0	697.2	
6	Cranberry meadow	12 m.	1060	26.950	64.0	57.0	26.830		3,132	1.0	698.2	
6	Camp 58 A, Cranberry meadow	9 p. m.	1060	26.916	36.0	36.0	26.815					
7	do	6 a. m.	1060	26.846	25.0	22.0	26.698	26.756	3,145	0.5	698.7	
7	On branch of Tysch creek	8 a. m.	1060	27.050	50.0	44.0	26.843		3,119	1.5	700.2	
7	On side of ravine	9 a. m.	1060	26.746	58.0	52.0	26.526		3,447	1.5	701.7	
7	On side of ravine	11 a. m.	1060	26.427	70.0	63.0	26.197		3,791	3.0	704.7	
7	Foot of ridge	12 m.	1060	26.562	76.0	67.0	26.332		3,649	1.7	706.4	
7	Camp 59 A, Wat-tum-pa lake.	6 p. m.	1060	26.502	49.0	47.0	26.354					
7	do	9 p. m.	1060	26.500	42.0	38.0	26.358	36.356	3,604	1.0	707.4	
8	On ridge	10 a. m.	1060	26.219	67.0	56.0	26.094		3,922	0.8	708.2	
8	Summit of ridge	10.15 a. m.	1060	26.112	65.0	57.0	25.995		4,028	0.2	708.4	
8	Lu-ah-hum-lu-ah-hum prairie.	11 a. m.	1060	26.180	61.0	57.0	26.112		3,903	1.2	709.6	
8	Camp 60 A, Ty-ty-pa lake	9 p. m.	1060	25.954	43.0	43.0	25.992					
9	do	9 a. m.	1060	26.075	54.0	52.0	25.986					
9	do	12 m.	1060	26.078	58.0	55.0	25.995					
9	do	3 p. m.	1060	26.070	59.0	57.0	25.993					
9	do	6 p. m.	1060	26.040	44.0	42.0	25.992					
10	do	6 a. m.	1060	26.116	45.0	45.0	25.970	25.988	4,017	1.6	711.2	
10	True summit of pass	8.30 a. m.	1060	25.794	55.0	51.0	25.620		4,433	0.7	711.9	Summit of main ridge.
10	On descent	8.45 a. m.	1060	25.879	54.0	50.0	25.709		4,337	0.6	712.5	
10	On descent	9 a. m.	1060	25.922	57.0	51.0	25.746		4,297	0.3	712.8	
10	On descent	10 a. m.	1060	25.930	62.0	55.0	25.755		4,287	0.5	713.3	
10	On low ridge	10.30 a. m.	1060	25.835	62.0	57.0	25.655		4,385	0.9	714.2	
10	In prairie	11 a. m.	1060	26.000	63.0	60.0	25.834		4,202	1.1	715.3	
10	Edge of enormous precipice	11.30 a. m.	1060	25.626	68.0	58.0	25.457		4,610	0.8	716.1	
10	Summit of mountain	12 m.	1060	25.250	65.0	62.0	25.097		5,006	1.2	717.3	Extraordinary magnetic variation.
10	Camp 61 A, on ridge	6 p. m.	1060	25.778	53.0	47.0	25.740					
10	do	9 p. m.	1060	25.792	56.0	54.0	25.725	25.732	4,297	7.0	724.3	
11	Small lake, Indian "Stone House"	9 a. m.	1060	26.236	65.0	56.0	26.171		3,859	0.9	725.2	
11	Summit of precipice	10.15 a. m.	1060	25.340	63.0	58.0	25.292		4,808	2.1	727.3	
12	Camp 62 A, Whortleberry camp	10 a. m.	1060	25.670	46.0	45.0	25.670					
12	do	11 a. m.	1060	25.674	47.0	46.0	25.675					
12	do	12 m.	1060	25.670	50.0	49.0	25.673					
12	do	3 p. m.	1060	25.668	46.0	45.0	25.680					
12	do	6 p. m.	1060	25.667	44.0	42.0	25.670					
12	do	8 p. m.	1060	25.668	45.0	44.0	25.681	25.675	4,334	3.0	730.3	
13	On ridge	6.45 a. m.	1060	25.358	44.0	37.0	25.411		4,598	1.1	731.4	
13	On high mountain	7 a. m.	1060	25.200	50.0	43.0	25.242		4,781	0.7	732.1	
13	On ridge	7.40 a. m.	1060	25.323	46.0	42.0	25.387		4,624	2.0	734.1	
14	Camp 63 A, among logs	6.30 a. m.	1060	28.305	53.0	51.0	28.394		1,574	13.7	747.8	
14	Camp 64 A, Currin's rancho	9 p. m.	1060	29.529	55.0	51.0	29.496					
16	do	2 p. m.	1060	29.713	84.0	82.0	29.497					
16	do	3 p. m.	1060	29.680	81.0	75.0	29.484					
16	do	4 p. m.	1060	29.658	76.0	73.0	29.489					
16	do	6 p. m.	1060	29.588	57.0	55.0	29.472					
16	do	8 p. m.	1060	29.588	53.0	51.0	29.458	29.480	532	8.6	756.4	

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from camp opposite Vancouver.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
Oct. 22	Camp 65 A, Oregon city......	7.55 a. m..	1060	30.128	45.0	43.0	29.894	....	149	......	18.5	
22	Near Oregon city	8.55 a. m..	1060	30.155	50.0	48.0	29.907	....	138	1.5	20.0	
22	Camp 66 A, Pudding river....	6 p. m.....	1060	30.063	55.0	54.0	29.870	....	....	......	......	
22	........do....................	7 p. m....	1060	30.050	51.0	50.0	29.857	....	....	......	......	
23	........do....................	6 a. m.....	1060	29.950	38.5	38.0	29.887	29.871	170	16.5	36.5	
23	Camp 67 A, Salem	6 p. m.....	1060	29.800	58.0	57.0	29.641	....	....	......	......	
24	........do....................	6 a. m.....	1060	29.802	52.0	52.0	29.651	29.646	382	23.5	60.0	
24	Camp 68, Lackimute river....	6 p. m.....	1060	30.004	52.0	52.0	29.839	....	....	......	......	
24	........do....................	7.20 p. m..	1060	30.022	44.5	46.0	29.858	....	....	......	......	
25	........do....................	6 a. m.....	1060	30.033	34.0	34.0	29.850	29.849	192	17.0	77.0	
25	Camp 69 A, Long Tom creek.	6 p. m.....	1060	29.948	51.0	50.0	29.800	....	....	......	......	
26	........do....................	6 a. m.....	1060	29.842	35.0	36.0	29.766	29.783	251	31.5	108.5	
27	Camp 70 A, Eugene city......	6 a. m.....	1060	29.566	39.0	38.0	29.472	....	536	24.0	132.5	
27	Camp 71 A, near source of Coast fork..................	6 p. m.....	1060	29.320	52.0	51.5	29.174	....	....	......	......	
27	........do....................	8.20 p. m..	1060	29.310	44.0	47.0	29.161	....	....	......	......	
28	........do....................	6 a. m.....	1060	29.342	43.0	43.0	29.186	29.174	821	25.0	157.5	
28	Summit of Calapooya mount's.	8.23 a. m..	1060	29.304	50.0	50.0	29.108	....	868	1.5	159.0	
28	On Pass creek	10.15 a. m.	1060	29.678	56.0	53.0	29.473	....	538	4.9	163.9	
28	On Pass creek	11.58 a. m.	1060	29.802	62.0	57.0	29.619	....	403	2.9	166.8	
28	Leave Pass creek	0.57 p. m..	1060	29.850	65.0	63.0	29.676	....	350	1.4	168.2	
28	Summit of ridge	1.25 p. m..	1060	29.410	67.0	67.0	29.222	....	774	2.4	170.6	
28	Elk creek....................	1.38 p. m..	1060	29.639	68.0	67.0	29.468	....	544	0.9	171.5	
28	Camp 72 A, near Long's hills.	6 p. m	1060	29.616	54.5	54.5	29.480	....	....	......	......	
28	........do....................	8 p. m.....	1060	29.612	53.0	54.0	29.488	....	....	......	......	
29	........do....................	6 a. m.....	1060	29.476	45.5	45.0	29.490	29.486	530	5.0	176.5	
29	Summit of ridge	8.28 a. m..	1060	29.008	51.5	54.0	28.988	....	1,003	1.5	178.0	
29	Summit Long's hills.........	8.55 a. m..	1060	28.655	50.0	48.5	28.640	....	1,337	1.2	179.2	
29	On small creek	9.51 a. m..	1060	29.400	61.0	56 0	29.355	....	654	1 8	181.0	
29	Summit of ridge..............	10.18 a. m.	1060	29.187	60.5	56.0	29.151	....	848	1.4	182.4	
29	Small creek..................	10.35 a. m.	1060	29.426	59.0	58.0	29.398	....	614	3.3	185.7	
29	Summit of ridge	11.37 a. m.	1060	39.339	65.0	68.0	29.316	....	691	3.0	188.7	
30	Camp 73 A, Winchester......	2 p. m.....	1060	29.643	54.0	53.0	29.726	....	....	......	......	
30	........do....................	3 p. m.....	1060	29 644	53.5	53.0	29.731	....	....	......	......	
30	........do....................	4 p. m.....	1060	29.641	51.5	51.0	29.728	....	....	......	......	
30	........do....................	5 p. m.....	1060	29.650	49.5	48.5	29.728	....	....	......	......	
30	........do....................	6 p. m.....	1060	29.662	46.5	45 5	29.728	....	....	......	......	
30	........do....................	7 p. m.....	1060	29.667	45.5	45.0	29.712	....	....	......	......	
31	........do....................	6 a. m.....	1060	29.716	34.0	34.0	29.700	29.722	308	6.8	195.5	
31	Summit of ridge	8.15 a. m..	1060	29.651	45.0	44.0	29.579	....	441	4.9	200.4	
31	Roseburg	8.30 a. m.	1060	29.781	45.0	43.5	29.709	....	307	0.7	201.1	
31	South Umpqua river	8.45 a. m..	1060	29.809	49.0	46.5	29.726	....	305	1.4	202.5	
31	South Umpqua river	9.33 a. m..	1060	29.751	53.0	52.5	29.655	....	371	1.3	203.8	
31	Small flat....................	10.23 a. m.	1060	29.695	53.5	51.0	29.605	....	310	2.4	206.2	
31	Summit of ridge	10.44 a. m.	1060	29.084	49.5	48.0	29.011	....	976	0.5	206.7	
31	On flat, foot of ridge	11 a. m....	1060	29.572	55.0	51.0	29.489	....	526	0.8	207.5	
31	Near South Umpqua river....	11.23 a. m.	1060	29.683	57.5	50.5	29.601	....	421	1 5	209.0	
31	Myrtle Creek	1.10 p. m..	1060	29.597	61.0	57.0	29.513	....	475	2.7	211.7	
31	Crossing of South Umpqua river........................	2.42 p. m..	1060	29.563	60.0	56.0	29.533	....	485	6.9	218.6	
31	Camp 74 A, Cañonville.......	6 p. m.....	1060	29.420	43.0	44 0	29.421	....	....	......	......	
31	........do....................	7 p. m.....	1060	29.406	40.5	42.0	29.398	....	....	......	......	
Nov. 1	........do....................	6 a. m.....	1060	29.449	41.0	44.0	29.371	29.397	516	2.9	221.5	
1	Summit of pass, Umpqua cañon	9.54 a. m..	1060	28.106	49.0	44.0	27.994	....	1,963	7.0	228.5	
1	On Cow creek................	10.36 a. m.	1060	28.492	50.5	49.0	28.387	....	1,578	2.0	230.5	
1	Leave Cow creek.....	1.12 p. m..	1060	28.696	58.0	54.0	28.599	....	1,372	6.5	237.0	
1	Summit of ridge..............	1.40 p. m..	1060	28.175	57.0	52.0	28.100	....	1,858	1.0	238.0	

APPENDIX D—Continued.

Date.		Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from camp opposite Vancouver.	Remarks.
1855.					Inches.			Inches.	Inches.	Feet.	Miles.	Miles.	
Nov.	1	Camp 75 A, Six-Bit House, Wolf creek	5.05 p. m.	1060	28.750	50.0	49.0	28.716					
	2	do	6 a. m.	1060	28.820	32.5	31.5	28.720	28.718	1,151	2.3	240.3	
	2	Grave creek hills	9.40 a. m.	1060	28.442	43.5	44.0	28.307		1,658	3.0	243.3	
	2	Foot of ridge	9.47 a. m.	1060	28.600	47.5	48.5	28.455		1,514	0.3	243.6	
	2	Grave creek hills	9.55 a. m.	1060	28.444	53.0	50.5	28.285		1,680	0.2	243.8	
	2	Small branch, foot of hills	10.10 a. m.	1060	28.814	55.0	51.0	28.653		1,322	0.5	244.3	
	2	Grave creek	10.55 a. m.	1060	29.012	58.5	62.0	28 859		1,124	1.8	246.1	
	2	Grave creek hills	0.10 p. m.	1060	28.092	59.0	59.0	27.970		1,990	2.5	248.6	
	2	Flat, foot of hills	0.50 p. m.	1060	28.944	60.5	56.5	28.829		1,153	1.5	250.1	
	2	Jump off Joe creek	1.15 p. m.	1060	29.114	63.5	57 0	28.999		990	1.2	251.3	
	2	Camp 76 A, Harris's rancho	6 p. m.	1060	28.859	48.0	46.5	28.785					
	2	do	7 p. m.	1060	28.852	44.0	44.0	28.783					
	3	do	7 a. m.	1060	28.770	30.5	31.0	28.776	28.781	1,187	3.0	254.3	
	3	Summit of ridge	8.23 a. m.	1060	28.443	43.0	38.0	28.415		1,537	3.5	257.8	
	3	Small creek	9.08 a. m.	1060	29.024	47.0	43.0	28.979		999	2.6	260.4	
	3	Evans' Ferry, Rogue river	10.37 a. m.	1060	29.122	55.5	48.0	29.066		917	4.5	264.9	
	3	Camp 77 A, Fort Lane	6 p. m.	1060	28.748	43.5	42.5	28.768					
	3	do	7 p. m.	1060	28.731	40.5	40.0	28.764					
	4	do	8 a. m.	1060	28.756	45.5	44.0	28.761					
	4	do	9 a. m.	1060	28.764	49.0	46.5	28.762					
	4	do	12 m	1060	28.758	57.0	60.0	28.759					
	4	do	3 p. m.	1060	28.746	60.5	55.0	28.761					
	4	do	6.20 p. m.	1060	28.752	45.0	42.5	28.812					
	5	do	6 a. m.	1060	28.828	31.5	30.5	28.781	28.771	1,202	14.0	278.9	
	5	Camp 78 A, near head of Stewart creek	6 p. m.	1060	27.794	49.5	49.5	27.758					
	5	do	6.30 p. m.	1060	27.796	49.0	48.0	27.754					
	6	do	6 a. m.	1060	27.718	50.5	49.0	27.769	27.760	2,195	26.0	304.9	
	6	On small branch of Stewart creek	9 a. m.	1060	27.318	56.0	53.0	27.345		2,639	3.7	308.6	
	6	Summit of Siskiyou mountain	10.28 a. m.	1060	25.480	58.0	51.0	25.514		4,580	3.5	312.1	
	6	Small creek, foot of ridge	11.25 a. m.	1060	26.510	60.0	59.5	26.552		3,461	2.5	314.6	
	6	Leave small creek	11.45 a. m.	1060	26.750	63.0	59.5	26.794		3,207	1.3	315.9	
	6	Summit of ridge	11.57 a. m.	1060	26.491	63.0	59.0	26.540		3,474	0.9	316.8	
	6	Foot of ridge	0.05 p. m.	1060	26.555	62.5	61.0	26.607		3,403	0.9	317.7	
	6	In valley	0.43 p. m.	1060	26.990	65.0	65.0	27.046		2,946	3.0	320.7	
	6	Summit of ridge	1.07 p. m.	1060	26.780	64.5	61.5	26 845		3,154	0.8	321.5	
	6	Near Cottonwood creek	1.35 p. m.	1060	27.243	65.5	62.5	27.308		2,677	2.0	323.5	
	6	Near Klamath river	2.40 p. m.	1060	27.722	67.5	65.0	27.789		2,189	3.5	327.0	
	6	Camp 79 A, Klamath river	6 p. m.	1060	27.705	61.0	60.5	27.779					
	7	do	6 a. m.	1060	27.675	55.0	55.0	27.786	27.782	2,193	1.2	328.2	
	7	Near Klamath river	8.05 a. m.	1060	27.673	55.5	62.0	27.762		2,211	0.5	328.7	
	7	Camp 80 A, Yreka	6 p. m.	1060	27.290	53.0	51.5	27.350					
	8	do	6 a. m.	1060	27.262	34.5	33.0	27.352	27.351	2,586	17.0	345.7	
	8	Summit of Little Scott's mountain	10.25 a. m.	1060	25.763	51.0	52.0	25.725		4,260	6.5	352.2	
	8	Foot of ridge	0.40 p. m.	1060	27.070	57.5	57.0	27.076		2,859	6.5	358.7	
	8	Camp 81 A, Fort Jones	6 p. m.	1060	27.012	38.5	36.5	27.064					
	9	do	9 a. m.	1060	27.022	45.0	43.5	27.053					
	9	do	12 m	1060	26.980	50.5	47.5	27.041					
	9	do	3 p. m.	1060	26.950	45.0	44.0	27.055					
	9	do	6 p. m.	1060	26.950	42.0	41.0	27.029					
	10	do	7.30 a. m.	1060	27 058	35.0	34.0	27.037					
	10	do	9 a. m.	1060	27.076	35.5	33.0	27.046					
	10	do	12 m	1060	27.087	39.0	37.0	27.040					
	10	do	3 p. m.	1060	27.064	39.5	38.0	27.043					
	10	do	6 p. m.	1060	27.060	35.5	35.0	27.036					

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from camp opposite Vancouver.	Remarks.
1855.				Inches.			Inches.	Inches.	Feet.	Miles.	Miles.	
Nov. 11	Camp 81 A, Fort Jones	6 a. m.	1060	27.097	37.0	32.0	27.047	27.045	2,887	3.0	361.7	
11	Camp 82 A, head of Scott's valley	6 p. m.	1060	26.368	43.0	43.0	26.454					
12	do	6 a. m.	1060	26.368	33.0	34.5	26.516	26.485	3,457	23.0	384.7	
12	Summit of Scott's mountains.	10 a. m.	1060	24.350	33.5	37.0	24.495		5,598	4.0	388.7	
12	Texas house	0.25 p. m.	1060	26.507	50.0	48.5	26.671		3,272	6.3	395.0	
12	Camp 83 A, Trinity valley	6 p. m.	1060	27.202	40.0	41.0	27.422					
13	do	6 a. m.	1060	27.179	40.5	45.0	27.439	27.430	2,513	13.6	408.6	
13	Leave Trinity river	0.05 p. m.	1060	27.499	53.0	47.0	27.757		2,185	13.0	421.6	
13	Summit of Trinity mountain	2.15 p. m.	1060	25.519	42.0	39.0	25.839		4,151	5.4	427.0	
13	Camp 84 A, Clear creek	6 p. m.	1060	28.010	41.0	41.0	28.320					
14	do	6 a. m.	1060	28.132	29.0	29.0	28.344	28.332	1,608	5.6	432.6	
14	Leave Clear creek	1.40 p. m.	1060	28.806	62.5	57.0	28.893		1,086	15.9	448.5	
14	Summit of ridge	2.35 p. m.	1060	28.430	61.0	52.0	28.526		1,437	2.5	451.0	
14	Camp 85 A, Shasta	6 p. m.	1060	28.882	47.5	45.0	28.970					
14	do	8 p. m.	1060	28.890	44.0	42.0	28.939					
15	do	7 a. m.	1060	28.998	41.0	39.5	28.923	28.944	985	2.0	453.0	
15	Summit of ridge	8.45 a. m.	1060	28.883	50.5	48.5	28.756		1,221	1.3	454.3	
15	Foot of ridge	9.12 a. m.	1060	29.434	55.0	48.5	29.290		713	1.0	455.3	
15	Johnson's ferry, Sacramento river	10.42 a. m.	1060	29.662	61.5	57.0	29.506		510	4.7	460.0	
17	Fort Reading	9 a. m.	1060	29.750	46.5	49.5						
17	do	10 a. m.	1060	29.654	52.0	46.0						
17	do	11 a. m.	1060	29.640	55.5	55.0						
17	do	12 m	1060	29.620	59.0	54.5						
17	do	1 p. m.	1060	29.608	60.0	54.0						
17	do	2 p. m.	1060	29.587	60.5	55.0						
17	do	3 p. m.	1060	29.575	61.0	55.5						
17	do	4 p. m.	1060	29.560	61.0	53.0						
17	do	5 p. m.	1060	29.550	57.0	47.0						
17	do	6 p. m.	1060	29.549	55.0	47.0						
17	do	8 p. m.	1060	29.550	50.5	44.0						
18	do	7 a. m.	1060	29.517	40.0	36.0						
18	do	8 a. m.	1060	29.538	46.5	39.5						
18	do	10 a. m.	1060	29.548	53.5	49.0						
18	do	11 a. m.	1060	29.536	56.5	56.0						
18	do	12 m	1060	29.534	57.5	58.0						
18	do	1 p. m.	1060	29.516	60.0	59.5						
18	do	2 p. m.	1060	29.513	61.0	57.0						
18	do	3 p. m.	1060	29.508	63.0	57.0						
18	do	4 p. m.	1060	29.508	62.0	57.0						
18	do	5 p. m.	1060	29.508	60.0	51.0						
18	do	6 p. m.	1060	29.522	58.5	47.0						
18	do	7 p. m.	1060	29.538	56.0	43.0						
19	do	7 a. m.	1060	29.618	49.0	48.0						
19	do	9 a. m.	1060	29.640	56.0	53.0						
19	do	10 a. m.	1060	29.646	59.0	55.0						
19	do	11 a. m.	1060	29.632	60.0	57.0						
19	do	12 m.	1060	29.600	63.0	62.0						
19	do	1 p. m.	1060	29.584	64.5	63 5						
19	do	2 p. m.	1060	29.579	65.0	63.5						
19	do	3 p. m.	1060	29.580	65.0	62.0						
19	do	4 p. m.	1060	29.584	63.0	59.0						
19	do	5 p. m.	1060	29.588	55.5	46.0						
19	do	9 p. m.	1060	29.632	53.0	42.0						
20	do	7 a. m.	1060	29.542	40.0	29.5						
20	do	9 a. m.	1060	29.608	54.0	45.0						
20	do	10 a. m.	1060	29.606	60.5	55.0						

APPENDIX D—Continued.

Date.	Station.	Hour.	Number of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Corrected reading of barometer.	Mean of corrected readings of barometer.	Elevation above mean tide at Benicia.	Distance from preceding station.	Distance from camp opposite Vancouver.	Remarks.
1855.				*Inches.*			*Inches.*	*Inches.*	*Feet.*	*Miles.*	*Miles.*	
Nov. 20	Fort Reading	11 a. m.	1060	29.584	63.5	60.0						
20	do	12 m.	1060	29.550	65.5	63.0						
20	do	1 p. m.	1060	29.526	66.0	64.0						
20	do	3 p. m.	1060	29.482	69.0	65.0						
20	do	4 p. m.	1060	29.472	68.0	63.0						
20	do	5 p. m.	1060	29.458	63.0	55.0						
20	do	6 p. m.	1060	29.446	60.0	53.0						
20	do	8.40 p. m.	1060	29.428	51.0	38.5						
21	do	7 a. m.	1060	29.300	36.0	27.5						
21	do	8 a. m.	1060	29.291	38.0	30.5						
21	do	9 a. m.	1060	29.294	43.0	37.5						
21	do	10 a. m.	1060	29.290	54.5	46.0						
21	do	11 a. m.	1060	29.270	58.0	52.0						
21	do	12 m.	1060	29.228	61.0	53.0						
21	do	1 p. m.	1060	29.204	62.5	55.0						
21	do	2 p. m.	1060	29.188	61.0	57.5						
21	do	3 p. m.	1060	29.188	61.5	57.5						
21	do	4 p. m.	1060	29.168	61.0	54.0						
21	do	5 p. m.	1060	29.160	51.0	50.5						
21	do	6 p. m.	1060	29.165	58.0	49.0						
21	do	7 p. m.	1060	29.168	57.0	46.0						
21	do	9 p. m.	1060	29.190	52.0	41.0						
22	do	7 a. m.	1060	29.319	40.0	30.0						
22	do	8 a. m.	1060	29.345	42.5	33.0						
22	do	9 a. m.	1060	29.373	44.5	40.0						
22	do	10 a. m.	1060	29.402	54.0	45.0						
22	do	11 a. m.	1060	29.400	55.0	49.0						
22	do	12 m.	1060	29.388	58.5	52.0						
22	do	1 p. m.	1060	29.376	60.0	55.0						
22	do	2 p. m.	1060	29.364	61.5	58.0						
22	do	3 p. m.	1060	29.348	61.0	56.0						
22	do	4 p. m.	1060	29.336	59.5	52.0						
22	do	6 p. m.	1060	29.363	54.0	45.0						For explanations of alti-
22	do	7 p. m.	1060	29.372	54.0	44.0						tude of Fort Reading,
22	do	8 p. m.	1060	29.384	51.0	41.0						see Chapter VI of Gen-
22	do	9 p. m.	1060	29.395	49.0	38.0			518	10.0	470.0	eral Report.

APPENDIX D—Continued.

IV. *Barometrical observations taken at Fort Reading, California, during the operations of the parties in the field.*

Date.	BAROMETER NUMBER 1068.						ATTACHED THERMOMETER.						DETACHED THERMOMETER.					
	6 A. M.	9 A. M.	12 M.	3 P. M.	6 P. M.	9 P. M.	6 A. M.	9 A. M.	12 M.	3 P. M.	6 P. M.	9 P. M.	6 A. M.	9 A. M.	12 M.	3 P. M.	6 P. M.	9 P. M.
1855.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*												
July 28........	29.602	29.636	29.632	29.602	29.562	29.544	80	84	90	98	90	82	72	86	96.5	99.5	96	81.5
29........	29.602	29.636	29.626	29.582	29.544	29.603	81	85	94	99	94	80	72.5	87.5	97.5	102	96	82.5
30..... ..	29.630	29.655	29.636	29.607	29.523	29.564	80	83	92	96	92	78	74	85	96	97	93	87
31........	29.688	29.654	29.636	29.504	29.438	29.505	79	81	90	93	90	80	72.5	84	96	95	91	88
Aug. 1........	29.596	29.594	29.582	29.513	29.470	29.472	80	87	93	96	92	86	77	88	95	96.5	92.5	85
2........	29.546	29.514	29.562	29.530	29.502	29.513	73	87	93	96	93	86	72.5	88.5	94.5	96	93.5	84
3........	29.568	29.608	29.612	29.584	29.594	29.540	72	88	93	96	94	88	72.5	88	94	92	94	83
4........	29.642	29.641	29.686	29.578	29.612	29.604	72	83	93	96.5	93	84	72	83.5	94	96	93	82
5.... ...	29.632	29.690	29.683	29.578	29.612	29.604	73	84	93	96	93	84	73	85	93.5	96	93	82
10........	29.424	29.446	29.342	29.406	....	29.395	80	85	90	93	......	85	80	85	90.5	93.5	.....	84
11........	29.420	29.449	29.498	29.425	29.415	29.445	74	70	86.5	91	86	81	74.5	79	87	91	86	81.5
12........	29.580	....	29.580	.. ..	....	....	72.5	......	83	......	......	......	71	......	84	......	......	......
13........	29.708	....	....	....	....	....	73	......	.....	......	......	......	73	......	......	......	......	......
15........	29.684	29.694	29.688	29.660	29.630	29.616	71.5	82	90	94	80.5	77.5	72	82.5	91	94	81	78
16..	29.656	29.664	29.650	29.514	29.588	29.568	69	80	91	96	95	77	69	80	92	96	94	77
17........	29.611	29.618	29.610	29.581	29.586	29.528	69	84.5	94	100	95	78	69.5	85	94	98	95	78
18........	29.638	29.618	29.610	29.582	29.588	29.568	79	83.5	95	102	97	79	77	84	95	102	98	99
19........	29.654	29.664	29.650	29.514	29.588	29.568	78	84	96	100	94	78	78	84	96	101	94	78
20........	29.638	29.618	29.610	29.582	29.587	29.564	77	86	99	107	97	79	77	86	99	107	97	79
21........	29.684	29.694	29.688	29.660	29.630	29.616	80	89	98	100	84	76	80	89	98	100	84	76
22	29.632	29.690	29.515	29.444	29.390	29.392	78	86	94	99	80	78	78	86	94	99	80	78
23........	29.642	29.641	29.686	29.578	29.612	29.604	82	90	97	101	83	77	82	90	97	101	83	77
24........	29.536	29.525	29.519	29.472	29.494	29.512	82	90	95	100.5	95	84	82	84	93.5	102	96	84
25........	29.506	29.525	29.515	29.472	29.494	29.513	71	91	95	102	96	80	71	90	94	103	97	81
26........	29.504	29.720	29.688	29.571	29.676	29.660	70	81	93	99	80	78	70	84	93	99	80	78
27........	....	....	29.677	29.572	29.651	29.600	... ..	......	91	97	76	70	......	......	94	98	76	71
Sept. 5........	....	29.712	29.636	29.621	29.610	29.560	......	73	77.5	83	80	75	.....	73.5	78	83	80	75
6........	29.600	29.682	29.636	29.630	29.616	29.611	75	77	78	88	80	76	75	77	78	88	80	76
7........	29.680	29.671	29.636	29.650	29.610	29.611	66	78	79	87	81	74	66	78	79.5	88	81	74
8........	29.618	29.650	29.614	29.602	29.582	29.578	64	75	91	94	90	77	64	76	91.5	94	90	77
9........	29.618	29.651	29.636	29.620	29.582	29.560	63	78	90	93	88	74	63	78	90	93	88	74
10........	29.628	29.612	29.614	29.602	29.510	29.578	65	80	92	96	85	75	64	80	92	95	85	75
11........	29.600	29.650	29.636	29.602	29.502	29.500	70	84	97	98	90	78	70	84	97	98	90	78
12........	29.652	29.682	29.601	29.650	29.560	29.568	59	75	89	92	88	77	59	75	89	94	88	77
13........	29.680	29.682	29.601	29.630	29.500	29.560	64	80	90	95	87	74	64	80	90	95	87	74
14.... ...	29.600	29.682	29.636	29.638	29.616	29.611	61	78	88	91	88	76	61	78	88	92	88	76
15	29.618	29.650	29.614	29.602	29.582	29.578	63	79	90	92	80	71	64	80	90	93	80	71
16........	29.680	29.671	29.650	29.650	29.610	29.611	70	84	92	96	84	77	71	84	92	96	84	77
17........	29.688	29.610	29.600	29.560	29.600	29.512	75	83	97	98	83	71	75	83	97	98	83	71
18........	29.671	29.650	29.636	29.600	29.561	29.561	71	85	90	94	80	70	71	86	91	95	80	70
19........	29.650	29.610	29.600	29.560	29.510	29.500	58	78	84	90	79	70	58	79	85	92	79	70
20........	29.642	29.612	29.610	29.600	29.561	29.560	54	76	82	89	78	69	54	79	83	90	78	68
21........	29.631	29.600	29.610	29.500	29.510	29.500	60	80	88	92	81	70	60	80	88	93	81	70
22........	29.636	29.610	29.600	29.561	29.560	29.561	72	85	90	94	77	64	72	85	90	94	77	64
23........	29.621	29.610	29.600	29.510	29.500	29.512	70	84	88	93	79	60	70	84	88	93	79	61
24........	29.700	29.734	29.736	29.700	29.672	29.680	61	71	78	81	75	70	58	71.5	78	83	75	70

APPENDIX D—Continued.

Date.	Barometer number 1068.						Attached thermometer.						Detached thermometer.					
	6 A. M.	9 A. M.	12 M.	3 P. M.	6 P. M.	9 P. M.	6 A. M.	9 A. M.	12 M.	3 P. M.	6 P. M.	9 P. M.	6 A. M.	9 A. M.	12 M.	3 P. M.	6 P. M.	9 P. M.
1855.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*												
Sept. 25........	29.670	29.700	29.691	29.678	29.610	29.564	64	78	86	91	80	75	64	79	91	93.5	80.5	75
26........	29.672	29.650	29.671	29.636	29.600	29.568	68	79	88	92	80	75	70	79	89	92	80	75
27........	29.600	29.671	29.678	29.700	29.678	29.600	67	78	89	93	80	70	68	78	91	93.5	80	70
28........	29.588	29.622	29.612	29.592	29.600	29.651	71	75	90	83	84.5	79	71	77.5	87	91	89	79
29........	29.710	29.746	29.768	29.712	29.678	29.610	73	81	84	91	80	75	72	83	85	92	81	76
30........	29.700	29.748	29.754	29.712	29.678	29.600	70	79	86	95	81	78	71	80	87	96	80	78
Oct. 1........	29.404	29.468	29.420	29.481	29.400	29.388	75	79	90	94	81	79	75	78	91	96	83	79
2........	29.544	29.582	29.584	29.530	29.516	29.550	70	74	89	92	84	80	70	74	89	92	84	80
3........	29.482	29.488	29.482	29.420	29.389	29.380	66	77	92	97	94	83	64	77	96.5	100	98	78
4........	29.404	29.468	29.420	29.481	29.400	29.388	65	71	84	89	80	75	62	70	85	90	89	75
5........	29.500	29.581	29.583	29.532	29.534	29.500	75	80	90	94	78	60	74	83	91	96	79	64
6........	29.742	29.756	29.724	29.686	29.650	29.642	71	82	88	90	81	71	72	83	88	91	82	71
7........	29.822	29.824	29.820	29.753	29.744	29.724	62	70	82	90	80	68	61	70.5	83	91	81	70
8........	29.720	29.731	29.730	29.741	29.732	29.700	68	72	81	88	75	70	66	70	82	90	78	71
9........	29.600	29.671	29.678	29.700	29.678	29.600	67	74.5	80	84	70	68	68	75	80	85	74	68
10........	29.700	29.748	29.754	29.712	29.678	29.600	70	77	79	86	73	64	71	79	84	89	74	64
11........	29.785	29.812	29.782	29.754	29.732	29.748	65	71	78	83	79	75	68	74	79	84	79	75
12........	29.688	29.671	29.636	29.650	29.610	29.611	66	77	89	90	88	78	66	77	89	90	81	78
13........	29.652	29.682	29.601	29.650	29.560	29.568	59	65	86	88	72	69	60	68	85	89	74	68
14........	29.700	29.734	29.736	29.700	29.672	29.680	62	72	80	85	71	65	62	73	81	84	70	65
15........	29.642	29.612	29.610	29.600	29.561	29.560	54	70	85	87	70	68	54	70	86	89	71	64
16........	29.730	29.782	29.701	29.650	29.631	29.568	58	69	78	82	75	63	57	70	77	83	75	65
17........	29.633	29.650	29.634	29.576	29.566	29.550	54	74	82	85	69	64	52	75	85	88	70	66
18........	29.544	29.582	29.584	29.530	29.516	29.550	62	71.5	79.5	82	70	66.5	61.5	73	81.5	85	71	64
19........	29.610	29.644	29.656	29.628	29.634	29.667	56	62	71	74	76	72	54	61.5	71.5	76	71	68
20........	29.642	29.612	29.610	29.600	29.561	29.560	54	73	84	87	70	68	55	72	85	88	71	68
21........	29 785	29.812	29.782	29.754	29.732	29.748	63	66	77	79	76	70	55.5	67	76	80	76	66
22........	29.762	29.764	29.740	29.700	29.672	29.666	64	76	84	83	76	73	62	75	82	86.5	76	65
23........	29.742	29.773	29.764	29.750	29.700	29.714	52	64.5	84.5	84	73	69.5	52	64	85	84.5	70.5	64
24........	29.742	29.807	29.800	29.764	29.750	29.744	58	66	77	81	70	67	58	65	77.5	81	70	66
25........	29.776	29.800	29.771	29.734	29.706	29.688	65	70	77	83	78	74	......	......	......	......	......	......
26........	29.742	29.756	29.724	29.686	29.650	29.642	70	72	79	85	74	70	......	......	......	......	......	......
27........	29.720	29.731	29.730	29.741	29.732	29.700	68	70	77	84	79	64	......	......	......	......	......	......
28........	29.742	29.756	29.721	29.658	29.624	29.642	61	68	75	80	72	74	......	......	......	......	......	......
29........	29.630	29.650	29.614	29.558	29.550	29.500	54	64	69	73	72	61	48	63	69.5	78	70	60
30........	29.685	29.690	29.668	29.632	29.650	29.700	56	65.5	68	71	67	68	54	65	67	70	65	55
31........	29.700	29.794	29.763	29.732	29.720	29.750	56	62	68	72.5	64	65	55	61.5	69	73	66	60.5
Nov. 1........	29.806	29.816	29.817	29.758	29.708	29.777	45	58	70	71	68	54	......	......	......	......	......	......
2........	29.864	29.880	29.808	29.788	29.708	29.764	53	57	63	66	61	50	......	......	......	......	......	......
3........	29.785	29.808	29.782	29.754	29.732	29.748	65	71	78	83	79	75	......	......	......	......	......	......
4........	29.776	29.788	29.754	29.734	29.706	29.688	66	70	77	85	78	74	......	......	......	......	......	......
5........	29.742	29.756	29.722	29.670	29.660	29.676	52	61	71	75	70	63	......	......	......	......	......	......
6........	29.726	29.781	29.758	29.709	29.654	29.656	60	68	73	79	73	70	......	......	......	......	......	......
7........	29.633	29.660	29.640	29.611	29.605	29.656	60	62	70	69	64	61	......	......	......	......	......	......

APPENDIX E.

OBSERVATIONS FOR DETERMINING THE HORARY OSCILLATIONS OF THE BAROMETRIC COLUMN.

Data from which Table No. 1 of corrections for the horary oscillations of the barometric column has been deduced.*

Date.	6 A. M.	7 A. M.	8 A. M.	9 A. M.	10 A. M.	11 A. M.	12 M.	1 P. M.	2 P. M.	3 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	8 P. M.	9 P. M.
1855.																
July 22	29.535	29.527	29.519	29.496	29.484	29.448	29.439	29.418	29.394	29.382	29.376	29.368	29.366	29.377	29.385	29.407
July 23	29.526	29.538	29.537	29.532	29.524	29.516	29.507	29.499	29.485	29.463	29.447	29.439	29.440	29.456	29.472	29.489
July 24	29.570	29.580	29.580	29.561	29.546	29.518	29.492	29.465	29.443	†29.420	29.395	29.379	29.369	29.365	29.376	29.398
July 25	29.470	29.464	29.470	29.455	29.441	29.425	29.418	29.406	29.379	29.367	29.355	29.337	29.336	29.344	29.352	29.371
July 26	29.477	29.483	†29.483	29.478	29.472	29.464	29.445	†29.434	29.423	29.408	29.394	29.384	29.377	†29.382	29.395	29.421
July 27	†29,489	†29.495	†29.495	29.490	29.489	29.474	29.462	29.443	29.424	29.407	29.398	29.382	29 378	29.381	29.387	29.404
Hourly mean	29.511	29.514	29.514	29.502	29.492	29.474	29.460	29.444	29.425	29.408	29.394	29.381	29.378	29.384	29.395	29.415
Grand mean.	29.442	29.442	29.442	29.442	29.442	29.442	29.442	29.442	29.442	29.442	29.442	29.442	29.442	29.442	29.442	29.442
Horary cor'n	— .069	— .072	— .072	— .060	— .050	— .032	— .018	— .002	+ .017	+ .034	+ .048	+ .061	+ .064	+ .058	+ .047	+ .027

* These data consist of hourly barometric readings, taken at Fort Reading, Cal., and reduced to what they would have been, had the temperature of the mercury been 32° Fahr. Barometer used, No. 1060.

† The reading at this hour was omitted. This assumed value has been found by careful interpolation from the constructed daily curve.

Data from which Table No. 2 of corrections for the horary oscillations of the barometric column has been deduced.*

Date.	6 A. M.	7 A. M.	8 A. M.	9 A. M.	10 A. M.	11 A. M.	12 M.	1 P. M.	2 P. M.	3 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	8 P. M.	9 P. M.
1855.																
Aug. 27.....	25.926	25.935	25.938	†25.938	25.927	25.911	†25.900	25.890	25.876	†25.867	25.859	25.861	25.871	25.874	25.896	25.891
Aug. 28.....	25.844	25.835	25.816	25.802	25.787	25.779	25.751	25.746	25.729	25.728	25.724	25.719	†25.722	25.725	25.735	25.732
Aug. 30.....	25.804	25.810	25.816	25.819	25.816	25.811	25.803	25.800	25.786	25.773	25.771	25.767	25.770	25.775	25.774	25.774
Aug. 31....	25.796	25.804	25,798	25.787	25.778	25.761	25.750	25.743	25.733	25.732	25.748	25.755	25.769	25.780	25.794	†25.813
Sept. 1	25.825	25.823	25.810	25.789	25.768	25.767	25.753	25.746	25.733	25.725	†25.730	25.747	25.765	25.775	25.792	25.804
Hourly mean	25.839	25.841	25.836	25.827	25.815	25.806	25.791	25.785	25.771	25.765	25.766	25.770	25.779	25.786	25.798	25.803
Grand mean.	25.799	25.799	25.799	25.799	25.799	25.799	25.799	25.799	25.799	25.799	25.799	25.799	25.799	25.799	25.799	25.799
Horary cor'n	— .040	— .042	— .037	— .028	— .016	— .007	+ .008	+ .014	+ .028	+ .034	+ .033	+ .029	+ .020	+ .013	+ .001	— .004

* These data consist of hourly barometric readings reduced to what they would have been, had the temperature of the mercury been 32° Fahr. Those on August 27 and 28 were taken at camp 37, and the remainder at camp 38. Both these camps were near the head of Des Chutes valley, and only about three miles distant from each other. Barometer used, No. 1060.

† The reading at this hour was omitted. This assumed value has been found by careful interpolation from the constructed daily curve.

Data from which Table No. 3 of corrections for the horary oscillations of the barometric column has been deduced.*

Date.	7 A. M.	8 A. M.	9 A. M.	10 A. M.	11 A. M.	12 M.	1 P. M.	2 P. M.	3 P. M.	4 P. M.	5 P. M.	6 P. M.	7 P. M.	8 P. M.
1855.														
November 17	†29.597	†29.602	29.604	29.592	29.568	29.538	29.525	29.503	29.489	29.474	29.475	29.479	†29.485	29.492
November 18	29.487	29.491	†29.494	29.482	29.462	29.458	29.433	29.427	29.417	29.422	29.425	29.443	29.465	†29.485
November 19	29.564	†29.566	29.567	29.566	29.549	29.514	29.493	29.484	29.484	29.488	29.497	†29.512	†29.530	†29.545
Hourly mean.............	29.549	29.553	29.555	29.547	29.526	29.503	29.484	29.471	29.463	29.461	29.466	29.478	29.493	29.507
Grand mean	29.504	29.504	29.504	29.504	29.504	29.504	29.504	29.504	29.504	29.504	29.504	29.504	29.504	29.504
Horary correction.........	— .045	— .049	— .051	— .043	— .022	+ .001	+ .020	+ .033	+ .041	+ .043	+ .038	+ .026	+ .011	— .003

* These data consist of hourly barometric readings, taken at Fort Reading, Cal., and reduced to what they would have been had the temperature of the mercury been 32° Fahr. Barometer used, No. 1060.

† The reading at this hour was omitted. This assumed value has been found by careful interpolation from the constructed daily curve.

APPENDIX F.

DATA FOR CONSTRUCTING PROFILES OF THE ROUTES PROPOSED FOR A RAILROAD.

I. *Route from Benicia to Fort Vancouver, surveyed by Lieut. R. S. Williamson, U. S. Top. Engineers.*

Locality.	Distance from Benicia.	Altitude above mean tide at Benicia.	Grade per mile from preceding station.	Remarks.
	Miles.	*Feet.*	*Feet.*	
Benicia	0.0	00	....	
Depot camp	2.8	101	36	
Camp 2, near Cordelia	15.0	69	2	
Camp 3, near Vacaville	26.2	304	21	
Camp 4, Cache creek	53.4	295	0	
Camp 5, near Nicholas	76.4	289	0	
Camp 6, opposite Marysville	94.0	281	0	
Camp 7, near Feather river	99.8	252	5	
Camp 8, near Hamilton	115.2	260	0	
Camp 9, on Chico creek	137.5	308	2	
Camp 10, on Deer creek	157.2	363	3	
Camp 11, on Antelope creek	176.3	420	3	
Fort Reading	200.3	518	4	
Station	223.2	837	14	
Mouth of McCloud's river	235.0	922	7	
Station	240.2	954	6	
Station	250.7	1,078	12	
Station	255.4	1,156	17	
Station	281.9	1,730	22	
Station	289.4	2,177	60	
Camp 19, near Pit river	313.9	2,784	25	From Fort Reading to Camp 19, the line was surveyed by Lieut. E. G. Beckwith, 3d artillery, in 1854.
Station	317.4	3,370	168	
Western entrance of tunnel	319.7	3,830	200	Tunnel through Stoneman's ridge. Altitude of summit, 4,080 feet.
Eastern entrance of tunnel	320.2	3,741	178	
Station	321.0	3,581	200	
Camp 20, near mouth of Fall river	325.4	3,304	63	
Camp 21, near upper cañon	338.0	3,346	3	

APPENDIX F—Continued.

Locality.	Distance from Benicia.	Altitude above mean tide at Benicia.	Grade per mile from preceding station.	Remarks.
	Miles.	*Feet.*	*Feet.*	
Camp 22, near upper cañon	347. 9	4, 103	76	
Camp 23, last on Pit river	369. 5	4, 212	5	
Station	376. 0	4, 888	103	
Camp 24, Spring branch	379. 7	4, 876	2	
Station	396. 5	4, 472	24	
Foot of ridge	403. 1	4, 480	1	Altitude approximate.
Summit of ridge	406. 6	5, 000	150	Altitude approximate.
Camp 25, Wright lake	410. 1	4, 470	150	
Station	414. 1	4, 500	8	Altitude approximate.
Summit of bluff	420. 1	4, 250	42	Altitude approximate.
Foot of bluff	421. 1	4, 050	200	Altitude approximate.
Camp 26, near Natural Bridge	435. 4	4, 014	3	
Camp 27 A, leave Lost river	450. 4	4, 036	2	
Divide, (23 feet cut)	460. 1	4, 154	10	
Low ridge, (40 feet cut)	462. 1	4, 131	11	
Camp 29, Upper Klamath lake	476. 1	4, 131	0	
Camp 30, Klamath river	487. 8	4, 196	6	
Camp 31, Klamath river	506. 2	4, 437	13	
Camp 34, Klamath marsh	522. 8	4, 526	5	
Camp 35, Water hole	541. 3	4, 864	18	
Station	542. 8	4, 801	42	
Station	546. 3	4, 755	13	
Station	548. 8	4, 677	31	
Station	551. 8	4, 522	52	
Station	554. 8	4, 477	15	
Camp 36, Des Chutes river	560. 0	4, 411	13	
Station	566. 0	4, 458	8	
Station	573. 0	4, 532	10	
Camp 44 W, near source of Des Chutes river	577. 0	4, 592	15	
Summit of pass through Cascade mountains	585. 0	5, 595	125	
Middle fork of Willamette river	600. 0	2, 788	187	
Camp 45 W, Middle fork	603. 5	2, 355	124	
Station	606. 7	1, 979	117	
Station	610. 2	1, 774	59	
Station	614. 6	1, 532	55	
Station	617. 1	1, 454	31	
Camp 46 W, Middle fork	626. 5	1, 154	32	
Station	628. 5	989	82	
Station	633. 0	903	19	
Station	638. 0	821	16	
Camp 47 W	648. 5	671	14	
Camp 48 W, first settlement	650. 0	738	44	

APPENDIX F—Continued.

Locality.	Distance from Benicia.	Altitude above mean tide at Benicia.	Grade per mile from preceding station.	Remarks.
	Miles.	*Feet.*	*Feet.*	
Camp 49 W, McKenzie's fork	674. 0	512	9	
Camp 50 W, Calapooya creek	694. 5	440	3	
Camp 51 W, north fork of Santiam river	721. 5	448	0	
Camp 52 W, near branch of Rock creek	747. 0	339	4	
Camp 53 W, ridge above Oregon City	766. 3	266	4	
Bank of Clackamas river	768. 3	119	73	
Opposite Portland	779. 3	66	5	
Camp 54 W, opposite Fort Vancouver	786. 3	105	5	

II. *Route from Fort Vancouver to Fort Reading, surveyed by Lieut. H. L. Abbot, U. S. Top. Engineers.*

Locality.	Distance from camp opposite Vancouver.	Altitude above mean tide at Benicia.	Grade per mile from preceding station.	Remarks.
	Miles.	*Feet.*	*Feet.*	
Camp opposite Vancouver	0. 0	105	--------	
Camp 65 A, (70 feet above river)	18. 5	149	3	
Oregon City, (40 feet above river)	20. 0	138	8	
Camp 66 A, Pudding river	36. 5	170	2	
Camp 68 A, Lackimute river	77. 0	192	1	
Camp 69 A, Long Tom creek	108. 5	251	2	
Camp 70 A, Eugene City	132. 5	536	12	
Camp 71 A, near head of Coast fork	157. 5	821	11	
Summit of Pass, Calapooya mountains	159. 0	868	31	
Station	163. 9	538	67	
Leave Pass creek	166. 8	407	45	
Divide, (40 feet cut)	170. 6	774	87	
Elk creek	171. 7	544	173	
Near camp 72 A	175. 4	555	3	
Summit of Long's hills, (40 feet cut)	179. 4	1, 337	186	
Foot of Long's hills	182. 4	654	214	
Summit of ridge	185. 9	848	56	
Foot of ridge	189. 2	614	71	
Summit of ridge	192. 2	691	26	
Camp 73 A, Winchester	199. 0	308	56	
Summit of hill	203. 9	441	27	

APPENDIX F—Continued.

Locality.	Distance from camp opposite Vancouver.	Altitude above mean tide at Benicia.	Grade per mile from preceding station.	Remarks.
	Miles.	*Feet.*	*Feet.*	
Roseburg	204. 6	307	191	
South Umpqua river	206. 0	305	1	
Hill	207. 3	371	50	
South Umpqua river	221. 5	421	4	Approximate grade and distance.
Myrtle creek	224. 2	475	20	
Cross South Umpqua river	231. 1	485	1	
Camp 74 A, Cañonville	234. 0	516	11	
Summit of Umpqua cañon	241. 0	1, 963	207	
On Cow creek	243. 0	1, 578	192	
Cross and leave Cow creek	247. 5	1, 429	33	
Summit of divide	250. 5	1, 858	143	
Wolf creek, near Six Bit house	254. 5	1, 109	187	Altitude approximate.
Mouth of Wolf creek	277. 5	617	21	Distance, altitude, and grade, approximate.
Evans' ferry, Rogue river	307. 5	917	10	Distance and grade, approximate.
Camp 77 A, Fort Lane	321. 5	1, 202	20	
Camp 78 A, near head of Stewart creek	347. 5	2, 195	38	
Northern entrance of tunnel	351. 2	2, 639	120	Tunnel through Siskiyou mountains. Summit 3.5 miles from northern entrance. Altitude 4,580 feet.
Southern entrance of tunnel	357. 2	3, 461	137	
Leave small creek	358. 5	3, 306	119	
Summit of ridge	359. 4	3, 474	186	
On ridge	360. 3	3, 403	78	
Foot of ridge	363. 3	2, 995	136	
Summit of hill	364. 1	3, 154	198	
On side of hill	366. 1	2, 776	189	
Foot of mountain	369. 6	2, 189	168	
Camp 79 A, near Klamath river	370. 8	2, 193	3	
Camp 80 A, Yreka	388. 3	2, 586	22	
Near base of Shasta Butte	418. 3	3, 500	30	Altitude, distance, and grade, approximate.
Johnson's ferry, Sacramento river	498. 3	510	37	Distance and grade, approximate.
Fort Reading	508. 3	518	1	

ERRATA FOR VOLUME VI.

INTRODUCTION.

Page 13, line 26—for "Helen's" read "Helens."

PART I.

Page 29, line 7—for "46°" read "45°."
117, lines 13 and 14—for "there by the Medical Department of the Army" read "at the Presidio, near San Francisco by the United States Coast Survey."