



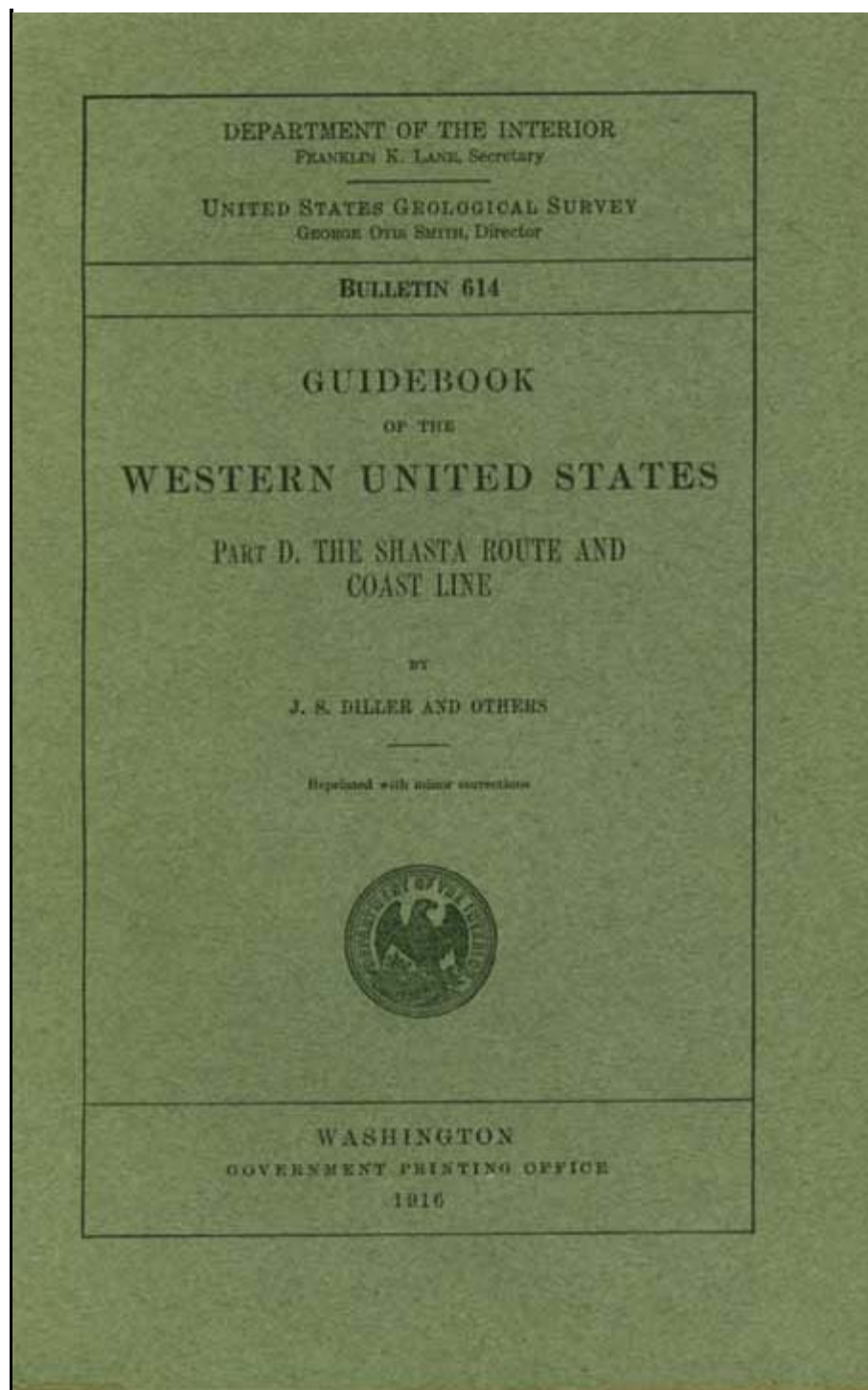
Geological Survey Bulletin 614

Guidebook of the Western United
States: Part D. The Shasta Route and
Coast Line

GUIDEBOOK OF THE WESTERN UNITED STATES

PART D. THE SHASTA ROUTE AND COAST LINE

**By
J. S. Diller and others**



GEOLOGICAL SURVEY BULLETIN 614

1916

[TABLE OF CONTENTS](#)



Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

TABLE OF CONTENTS

[Cover](#)

[Principal Divisions of Geologic Time](#)

[Preface](#)

[Introduction](#)

[Itinerary](#)

[References cited](#)

[Glossary of Geologic Terms](#)

[Index of Railroad Stations](#)

ILLUSTRATIONS

ROUTE MAP.

For the convenience of the traveler the sheets of the route map are so folded and placed that he can unfold them one by one and keep each one in view while he is reading the text relating to it. A reference in parentheses is given in the text at each point where anew sheet should he unfolded.

SHEET

- [1. Seattle to Kiro, Wash](#)
- [2. Chambers Prairie to Castle Rock, Wash](#)
- [3. Ostrander, Wash., to Clackamas, Oreg](#)
- [4. Clackamas to Tangent, Oreg](#)
- [5. Shedd to Drain, Oreg](#)
- [6. Yoncalla to West Fork, Oreg](#)
- [7. Reuben, Oreg., to Zuleka, Cal](#)
- [8. Hornbrook to Sims, Cal](#)
- [9. Gibson to Blunt, Cal](#)
- [10. Red Bluff to Delevan, Cal](#)
- [11. Maxwell to Yolo, Cal](#)
- [12. Yolo to Port Costa, Cal](#)

- 13. Port Costa to San Francisco, Cal
- [1A.](#) Los Angeles to Moorpark, Cal
- [2A.](#) Somis to Naples, Cal
- [3A.](#) Capitan to Oceano, Cal
- [4A.](#) Grover to Wunpost, Cal
- [5A.](#) San Ardo to Del Monte Junction, Cal
- [6A.](#) Watsonville Junction to San Mateo, Cal

PLATES.

PLATE

- [I.](#) Relief map of the country traversed by the Shasta Route and Coast Line
- [II.](#) A Washington forest
- [III.](#) Snoqualmie Falls, Wash
- [IV.](#) A, Mount Rainier, Wash., from Spanaway Lake; B, Paradise Park, on south slope of Mount Rainier
- [V.](#) Ocean spray (*Sericotheca discolor*), a common flower in Washington
- [VI.](#) A, Smelt fishery on Cowlitz River near Kelso, Wash.; B, Seining salmon on Columbia River
- [VII.](#) View up Columbia River from Columbia Highway at Chanticleer Inn, about 20 miles east of Portland, Oreg
- [VIII.](#) Oneonta Gorge, Columbia River near Oneonta, Oreg
- [IX.](#) Latourelle Falls, Columbia River near Latourelle, Oreg
- [X.](#) A, Trunks of trees of a submerged forest, Columbia River, above Cascade Locks, Oreg.; B, Cigar-shaped raft of logs for ocean travel.
- [XI.](#) A, Mount Hood from Portland, Oreg.; B, Willamette Falls, Oregon City, Oreg
- [XII.](#) Willamette Valley near Newburg, northwest of Hubbard, Oreg
- [XIII.](#) Shale inclosed in diabase near Roseburg, Oreg
- [XIV.](#) Hydraulic placer mining in Grants Pass region, Oreg
- [XV.](#) A, Table Rock, at entrance to Rogue River valley, Oreg.; B, Oregon Caves, southwest of Grants Pass, Oreg
- [XVI.](#) Pear and apple orchards in Rogue River valley, Oreg
- [XVII.](#) A, Mount Mazama restored; B, Wizard Island, Crater Lake, Oreg.
- [XVIII.](#) Southeast rim of Crater Lake, Oreg., from Wizard Island
- [XIX.](#) Summit of the Cascade Range

[XX](#). A, Sugar Loaf, near west base of Mount Shasta, Cal.; B, Moss Brae Falls, near Shasta Springs, Cal

[XXI](#). Mount Shasta, from Sisson Cal

[XXII](#). Eruption of Lassen Peak, Cal., at 12.30 p.m. August 22, 1914

[XXIII](#). New crater of Lassen Peak, Cal., after 25 eruptions within the old crater, August 17, 1914

[XXIV](#). A, Sinks of Suisun Flats, Cal.; B, View along shore of San Pablo Bay near Oleum, Cal

[XXV](#). A, La Brea wing of the Museum of History, Science, and Art at Los Angeles, Cal.; B, Fossil bones in asphalt deposit of Rancho La Brea, near Los Angeles, Cal

[XXVI](#). Summerland oil field, Cal

[XXVII](#). Sculptured cliffs along Coast Line near Santa Barbara, Cal

[XXVIII](#). Lighthouse at Point Conception, Cal

[XXIX](#). A, Alluvial flat and terrace of Salinas River near Bradley, Cal.; B, San Carlos Church, Monterey, Cal

[XXX](#). The Pinnacles, 12 miles northeast of Soledad, Cal

[XXXI](#). Big trees (*Sequoia sempervirens*) at Santa Cruz, Cal

[XXXII](#). Santa Clara Valley near Gilroy, Cal

[XXXIII](#). A, The arches, Stanford University, Cal.; B, Furrow a mile north west of Olema, Cal., made by movement that caused the earth quake of April, 1906

FIGURES.

FIGURE

- [1](#). Map of North America showing the area covered by the Pleistocene ice sheet at its maximum extension and the three main centers of ice accumulation
- [2](#). Generalized section of White River valley at Kent, Wash
- [3](#). Section of bluff 2 miles north of station at Tacoma, Wash
- [4](#). Section of deep cut of Northern Pacific Railway across Portland Peninsula, between Vancouver, Wash., and Portland, Oreg
- [5](#). East-west section of Willamette Valley at Portland, Oreg
- [6](#). Section of east bluff at Oregon City, Oreg
- [7](#). Generalized section of Umpqua River valley in Coast Range, Oreg.
- [8](#). Sketch of a ginkgo leaf from the Jurassic beds of Oregon
- [9](#). Section of Rogue River valley near Phoenix, Oreg
- [10](#). Tree zones of Mount Shasta, Cal
- [11](#). Section of canyon of Sacramento River just below Delta, Cal
- [12](#). Earthquake effects at Skinner's ranch, near Olema, Cal
- [13](#). Map showing the oil fields of California.
- [14](#). Generalized cross section from the Pacific Ocean to Rincon Mountain, Cal
- [15](#). Section from Palo Alto, Cal., to the summit of the Santa Cruz Range.

DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

<<< [Previous](#)

<<< [Contents](#) >>>

[Next](#) >>>

bul/613/contents.htm
Last Updated: 28-Nov-2006



Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

PRINCIPAL DIVISIONS OF GEOLOGIC TIME ^a

[A glossary of geologic terms is given on pp. [133-36](#).]

Era.	Period.	Epoch.	Characteristic life.	Duration according to various estimates.
<i>Millions of years.</i>				
Cenozoic (recent life).	Quaternary.	Recent. Pleistocene (Great Ice Age).	"Age of man." Animals and plants of modern types.	1 to 5.
	Tertiary.	Pliocene. Miocene. Oligocene. Eocene.	"Age of mammals." Possible first appearance of man. Rise and development of highest orders of plants.	
Mesozoic (intermediate life).	Cretaceous.	(b)	"Age of reptiles." Rise and culmination of huge land reptiles (dinosaurs), of shellfish with complexly partitioned coiled shells (ammonites), and of great flying reptiles. First appearance (in Jurassic) of birds and mammals; of cycads, an order of palmlike plants (in Triassic), and of angiospermous plants, among which are palms and hardwood trees (in Cretaceous).	4 to 10.
	Jurassic.	(b)		
	Triassic.	(b)		
	Carboniferous.	Permian.	"Age of amphibians." Dominance of club mosses (lycopods) and plants of horsetail and fern types. Primitive flowering plants and earliest cone-bearing trees. Beginnings of backboneed land animals (land vertebrates). Insects. Animals with nautilus-like coiled shells (ammonites) and sharks abundant.	
		Pennsylvanian.		
		Mississippian.		
	Devonian.	(b)	"Age of fishes." Shellfish (mollusks) also abundant. Rise of amphibians and land plants.	

Paleozoic (old life).	Silurian.	(b)	Shell-forming sea animals dominant, especially those related to the nautilus (cephalopods). Rise and culmination of the marine animals sometimes known as sea lilies (crinoids) and of giant scorpion-like crustaceans (eurypterids). Rise of fishes and of reef-building corals.	17 to 25.
	Ordovician.	(b)	Shell-forming sea animals especially cephalopods and mollusk-like brachiopods, abundant. Culmination of the buglike marine crustaceans known as trilobites. First trace of insect life.	
	Cambrian.	(b)	Trilobites and brachiopods most characteristic animals. Seaweeds (algae) abundant. No trace of land animals found.	
Proterozoic (primordial life).	Algonkian.	(b)	First life that has left distinct record. Crustaceans, brachiopods, and seaweeds.	50+.
	Archean.	Crystalline rocks.	No fossils found.	

*a*The geologic record consists of sedimentary beds—beds deposited in water. Over large areas long periods of uplift and erosion intervened between periods of deposition. Every such interruption in deposition in any area produces there what geologists term an unconformity. Many of the time divisions shown above are separated by such unconformities—that is, the dividing lines in the table represent local or widespread uplifts or depressions of the earth's surface.

*b*Epoch names omitted; in less common use than those given.

[<<< Previous](#)
[<<< Contents >>>](#)
[Next >>>](#)



Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

PREFACE

By GEORGE OTIS SMITH.

The United States of America comprise an area so vast in extent and so diverse in natural features as well as in characters due to human agency that the American citizen who knows thoroughly his own country must have traveled widely and observed wisely. To "know America first" is a patriotic obligation, but to meet this obligation the railroad traveler needs to have his eyes directed toward the more important or essential things within his field of vision and then to have much that he sees explained by what is unseen in the swift passage of the train. Indeed, many things that attract his attention are inexplicable except as the story of the past is available to enable him to interpret the present. Herein lie the value and the charm of history, whether human or geologic.

The present stimulus given to travel in the home country will encourage many thousands of Americans to study geography at first hand. To make this study most profitable the traveler needs a handbook that will answer the questions that come to his mind so readily along the way. Furthermore, the aim of such a guide should be to stimulate the eye in the selection of the essentials in the scene that so rapidly unfolds itself in the crossing of the continent. In recognition of the opportunity afforded in 1915 to render service of this kind to an unusually large number of American citizens as well as to visitors from other countries, the United States Geological Survey has prepared a series of guidebooks¹ covering four of the older railroad routes west of the Mississippi.

¹Guidebook of the western United States: Part A, The Northern Pacific Route, with a side trip to Yellowstone Park (Bulletin 611); Part B, The Overland Route, with a side trip to Yellowstone Park (Bulletin 612); Part C, The Santa Fe Route, with a side trip to Grand Canyon of the Colorado (Bulletin 613); Part D, The Shasta Route and Coast Line (Bulletin 614).

These books are educational in purpose, but the method adopted is to entertain the traveler by making more interesting what he sees from the car window. The plan of the series is to present authoritative information that may enable the reader to realize adequately the scenic and material resources of the region he is traversing, to comprehend correctly the basis of its development, and above all to appreciate keenly the real value of the country he looks out upon, not as so many square miles of territory represented on the map in a railroad folder by meaningless spaces, but rather as land—real estate, if you please—varying widely in present appearance because differing largely in its history and characterized by even greater variation in values because possessing diversified natural resources. One region may be such as to afford a livelihood for only a pastoral people; another may present opportunity for intensive agriculture; still another may contain hidden stores of mineral wealth that may attract large

industrial development; and taken together these varied resources afford the promise of long-continued prosperity for this or that State.

Items of interest in civic development or references to significant epochs in the record of discovery and settlement may be interspersed with explanations of mountain and valley or statements of geologic history. In a broad way, the story of the West is a unit, and every chapter should be told in order to meet fully the needs of the tourist who aims to understand all that he sees. To such a traveler-reader this series of guidebooks is addressed.

To this interpretation of our own country the United States Geological Survey brings the accumulated data of decades of pioneering investigation, and the present contribution is only one type of return to the public which has supported this scientific work under the Federal Government.

In preparing the description of the country traversed by the Shasta Route and Coast Line all the geographic and geologic information already published as well as other unpublished material in the possession of the Geological Survey has been utilized, but to supplement this material Mr. Diller made a field examination of the entire route in 1914. Information has been furnished by Dr. F. M. Anderson, Dr. J. C. Branner, Dr. J. Harlan Bretz, Prof. E. S. Burgess, Mr. J. S. Daggett, Mrs. L. P. Diller, Mr. Harold Hannibal, Mr. O. H. Hershey, Prof. A. C. Lawson, Prof. G. D. Louderback, Prof. J. P. Smith, Prof. C. F. Tolman, jr., and Prof. C. E. Weaver, as well as by others to whom credit is given in the text. Railroad officials and other citizens have also generously given their aid, and other members of the Survey have freely cooperated in the work.

For the purpose of furnishing the traveler with a graphic presentation of each part of his route the accompanying maps, 19 sheets in all, have been prepared with a degree of accuracy probably never before attained in a guidebook, and their arrangement has been planned to meet the convenience of the reader. The special topographic surveys necessary to complete the topographic map of the route were made by B. A. Jenkins and J. E. Blackburn.

[<<< Previous](#)

[<<< Contents >>>](#)

[Next >>>](#)



Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

GUIDEBOOK OF THE WESTERN UNITED STATES.

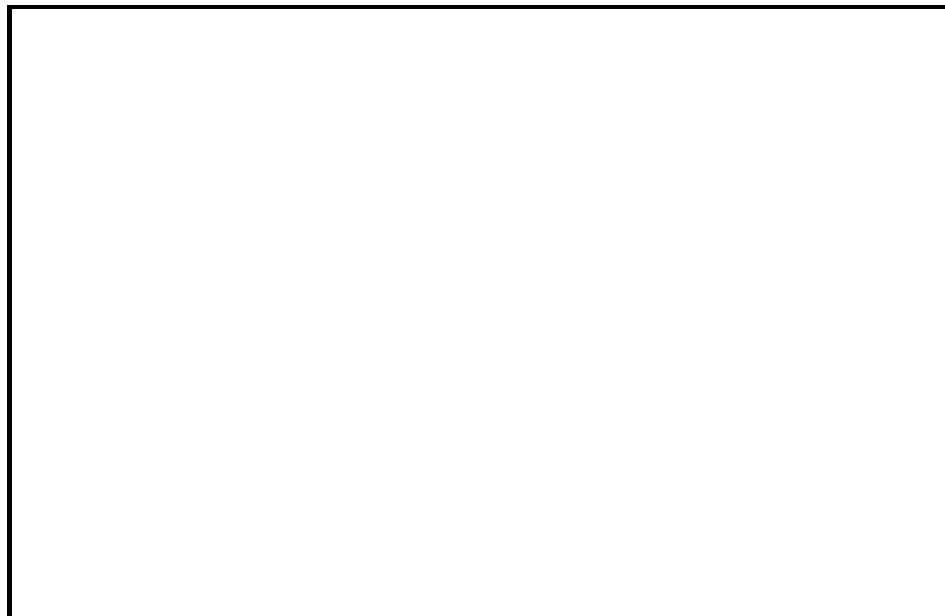
PART D. THE SHASTA ROUTE AND COAST LINE.

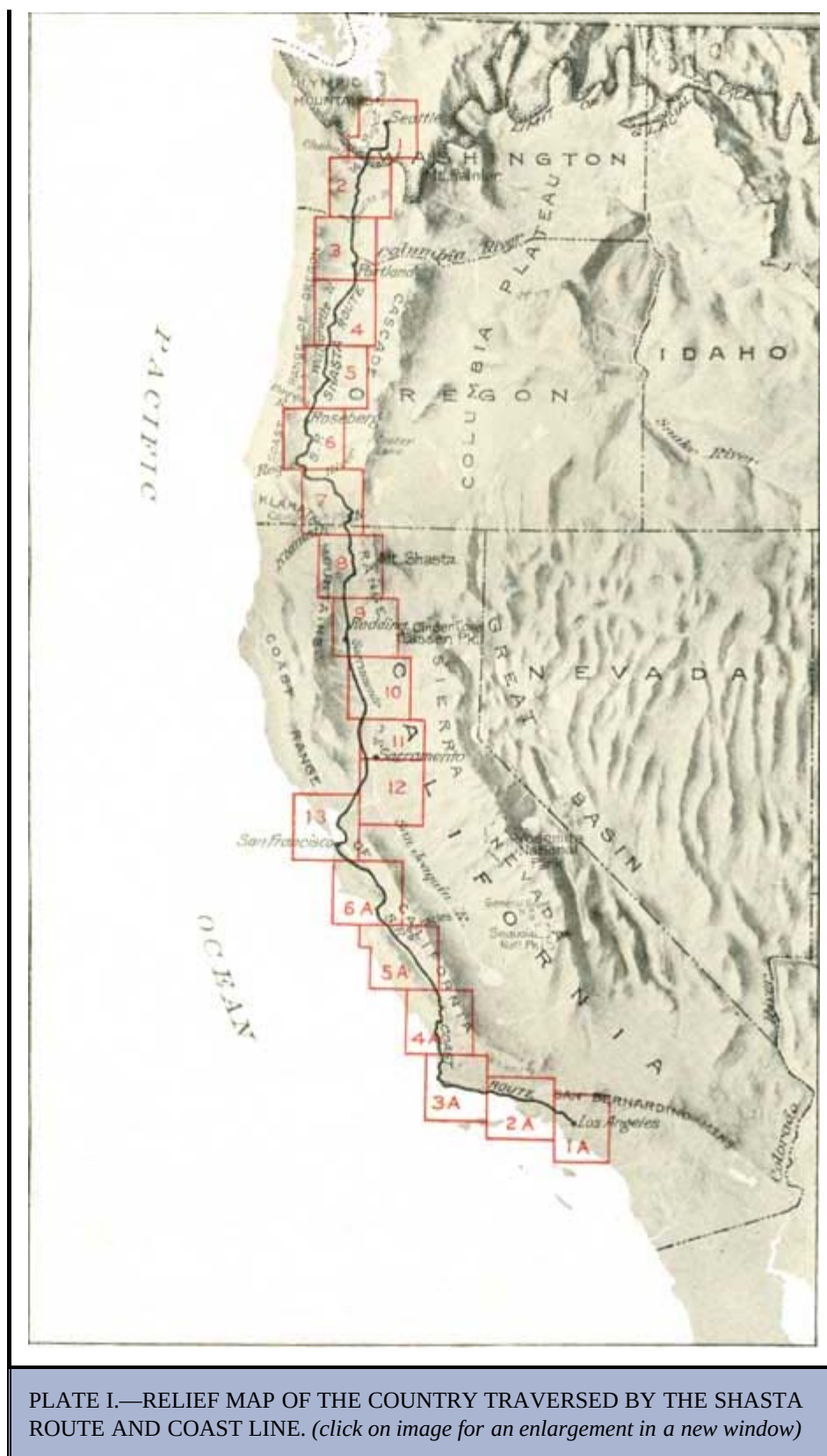
By J. S. DILLER and others.

INTRODUCTION

From Alaska to Lower California the western coast of North America is bordered by a belt of mountains which is from 100 to 200 miles wide. This belt as a whole has been named the Pacific System. It separates the Pacific Ocean on the west from an interior plateau region, which also stretches from Alaska to Mexico. This plateau is of varied character but, as is well illustrated by the State of Nevada, much of it is arid and is seamed with mountain ranges.

Attention need be directed here only to that part of the Pacific System which lies chiefly in the States of Washington, Oregon, and California, a section 1,300 miles in length. (See Pl. I.) Within these three States the Pacific System embraces a number of distinct mountain ranges from which project some of the loftiest peaks on the continent. It includes also broad valleys that are in part close to sea level. Consequently it is a region of strong contrasts in altitude and of wide diversity of scenery and climate. Before the snow disappears each summer from the crest of the Sierra Nevada the burning sun in the interior valley of California has yellowed the grain and has tinted the fruit in orchard and vineyard. Throughout the year the snow cap of Mount Rainier is in full sight from the fertile valleys of Washington, where winter severity is unknown.





For its entire extent, from Alaska to Lower California, the Pacific System may in general be divided lengthwise into three parts—two long lines of mountain ranges and an intervening belt of valleys that may be called the Pacific valley belt. The northernmost member of this belt that need be considered here is the valley of Puget Sound. A low divide separates the sound from Cowlitz Valley, the next member of the belt to the south. Cowlitz Valley drains southward to the Columbia and is succeeded on the south by Willamette (wil-lam'et) Valley, whose waters flow northward into the Columbia. Willamette Valley extends southward for

about 120 miles, or about halfway across the State of Oregon. Between its head and the north end of the Great Valley of California, the next member of the Pacific valley belt, there is a tract of generally mountainous country, where, for 200 miles, the threefold longitudinal division of the Pacific System into two ranges and an intervening belt of valleys is less evident than it is elsewhere. South of this interrupting mass of mountains, which is dominated by Mount Shasta, the Great Valley of California stretches for more than 400 miles, having a width in general of 40 to 50 miles. Its northern part, known as the Sacramento Valley, drains southward, and its southern part, known as the San Joaquin Valley, drains northward, Sacramento and San Joaquin rivers both flowing into San Francisco Bay. The south end of the San Joaquin Valley is separated by the transverse Tehachapi Mountains from the Mohave Desert. This in turn is separated by the San Bernardino range from the Salton Basin, which is nothing more than the former upper part of the Gulf of California, the sea having been excluded by the great mass of sediment dumped into the gulf by Colorado River. By some the Mohave Desert and the Gulf of California are regarded as parts of the Pacific valley belt. By others, however, notwithstanding the general alignment of these features with the Great Valley of California, they are regarded as parts of the plateau region that lies east of the Pacific System of mountains.

As the Pacific valley belt separates in general two parallel ranges of mountains, so these ranges in turn may be subdivided into mountain groups that are sufficiently distinct in form or structure to have received individual names.

At the north end of the western hue, between Puget Sound and the ocean, stand the Olympic Mountains, which attain a height of 8,000 feet. Very little is known of their structure or of the rocks that compose them.

South of the Olympic Mountains, stretching along the coast of Washington and Oregon for 350 miles, is a comparatively low range which, to distinguish it from the similarly situated range in California, may be called the Oregon Coast Range. This consists chiefly of rather soft sandstones carrying fossil shells from which it has been determined that the sands were deposited in the sea during early and middle Tertiary time. Lavas associated with these rocks show that volcanoes were active in this region in early Tertiary time. These rocks are no longer in the original horizontal position in which they were deposited but have been crumpled by pressure. Moreover, in some places they have been traversed by long cracks or fissures, and the rocks on one side of a crack have been shoved past the rocks on the other side. The geologist would describe these effects briefly by saying that the beds have been folded, fractured, and faulted.

South of the Oregon Coast Range, partly in Oregon but chiefly in California, are the Klamath Mountains. They are composed of rocks that are older and more complicated in structure than those of the Oregon Coast Range and are closely related in materials and in structure to the Sierra Nevada. The Klamath Mountains extend south-southeastward into California for 150 miles and overlap to the east for 80 miles the north end of the California Coast Ranges.

The California Coast Ranges extend southward for more than 600 miles to the vicinity of Point Conception, where the coast turns sharply eastward along the Santa Barbara Channel. They consist of rocks of great variety of character and of widely different geologic ages. Their structure also is exceedingly complex. The most abundant rocks were formed in the Tertiary, Cretaceous, and perhaps Jurassic periods. Most of these rocks were deposited as sediments on a sea bottom, but associated with the rocks so formed are in places layers of lava or masses of igneous rock, which were forced in molten condition into the sedimentary rocks. All have been folded and faulted at several periods. Finally erosion, or the action of moving water, in the form of rain, streams, and waves, aided by the crumbling effect of weather, carved out the hills as they now appear. The resulting forms reveal to one skilled in

their interpretation some indication of the complexity of the underlying rock structure.

At their south end the Coast Ranges meet another set of ranges, which have a more easterly trend than the Coast Ranges proper and do not fall readily into the general threefold division of the Pacific System of mountains that is so clearly recognizable farther north. The suggestion has been made that these mountains should be distinguished from the Coast Ranges, with which they have commonly been included, by designating them the Sierras de los Angeles, from the city of Los Angeles. Well-known individual ranges classed in this group are the Santa Ynez, San Gabriel, and San Bernardino.

Along the east side of the Pacific valley belt stretch two great ranges—the Cascade Range on the north and the Sierra Nevada on the south. The Cascade Range begins a few miles north of the boundary between Washington and British Columbia and continues southward for 650 miles to the vicinity of Mount Shasta in California. It has a foundation of granite and of sedimentary rocks, such as sandstone and shale, ranging in age from Carboniferous to Miocene. Some of the sedimentary rocks and some associated igneous rocks have been changed by heat and pressure into crystalline laminated rocks known as schists. From Mount Rainier southward the rocks just mentioned are buried to an increasing extent under lavas which probably flowed from many vents at different times. The volcanic cones, such as Shasta, Hood, and Rainier, which form striking features of the Cascades, represent a comparatively late stage of volcanic activity and have been piled up on a preexisting mountain range.

The Sierra Nevada which continues southward the general line of the Cascade Range, is of somewhat different structure and history. It is a great inclined block 350 miles long and 80 miles wide, with a gentle slope to the west and an abrupt descent on the east to the deserts of Nevada. This abrupt descent marks a line of faults, east of which the desert country has gone down and west of which, to some extent, the Sierra Nevada has gone up. The Sierra Nevada consists of a great irregular mass of granite which in early Cretaceous time was intruded in a molten condition into sedimentary and older igneous rocks, both of which sets of rocks, in consequence of the heat and squeezing which accompanied this intrusion, were changed in part to schists and slates. After the range had been deeply worn down by erosion, floods of lava were poured over the surface in Tertiary time and the range was tilted up to its present general form. That form, however, has been much modified in detail by comparatively recent erosion and by the canyon cutting of the present streams.

South of the Dominion of Canada three rivers, the Columbia, the Klamath, and the Pit, flow across the Pacific System from the interior plateaus to the ocean. Other large streams, such as the Willamette, in Oregon, and the Sacramento and San Joaquin, in California, flow northward or southward for many miles in one or another of the longitudinal depressions of the Pacific valley belt before turning westward across the western line of mountains to reach the Pacific.

The valley belt is the great agricultural region of the Pacific coast, and in Washington and Oregon, owing partly to its accessibility to ocean-going ships by way of Puget Sound and the Columbia, it contains most of the population. In California, however, the broad fields, orchards, and vineyards traversed by the Sacramento and San Joaquin are rivaled by the many smaller but fertile valleys of the Coast Ranges. The superb harbor of San Francisco sufficiently accounts for the situation of the metropolis; and the rapid growth of Los Angeles, the second city in the State, is due to a combination of shipping advantages with highly profitable kinds of agriculture and extensive resources in petroleum

NOTE.—For the convenience of the traveler the sheets of the route map in this book are so arranged that he can unfold them one by one and keep in view the one to which the text he is reading relates. A reference is made in the

text to each sheet at the place where it should be so unfolded, and the areas covered by the sheets are shown on Plate I. A list of these sheets and of the other illustrations, showing where each one is placed in the book, is given on pages [137-138](#). A glossary of geologic terms is given on pages [133-136](#) and an index of stations on pages [139-142](#).

[<<< Previous](#)

[<<< Contents >>>](#)

[Next >>>](#)

bul/614/intro.htm
Last Updated: 8-Jan-2007



Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

ITINERARY

SHASTA ROUTE.

SEATTLE TO SAN FRANCISCO.

Washington. On May 11, 1792, Capt. Robert Gray, of Boston, anchored in the great river that he named Columbia, in honor of his ship, and laid the foundation of our subsequent claim to the region which it drains. The Hudson's Bay Co., whose agents early visited the extreme Northwest, discouraged settlers, but at Tumwater, near Olympia, at the head of Puget Sound, a permanent American settlement was established in 1845. Marcus Whitman and other missionaries settled near the site of Walla Walls in 1836, but in 1847 Whitman and his wife were killed by the Indians and the station was broken up. Conflicting claims between the United States and Great Britain were adjusted by a treaty July 17, 1846, which fixed the forty-ninth parallel as the international boundary. Oregon, as all this wild country was then called, became a Territory on August 14, 1848, and on March 2, 1853, the part of it north of Columbia River was separated as the Territory of Washington, which was admitted as a State February 22, 1889. The State of Washington has an area of 69,127 square miles and in 1910 had a population of 1,141,990.

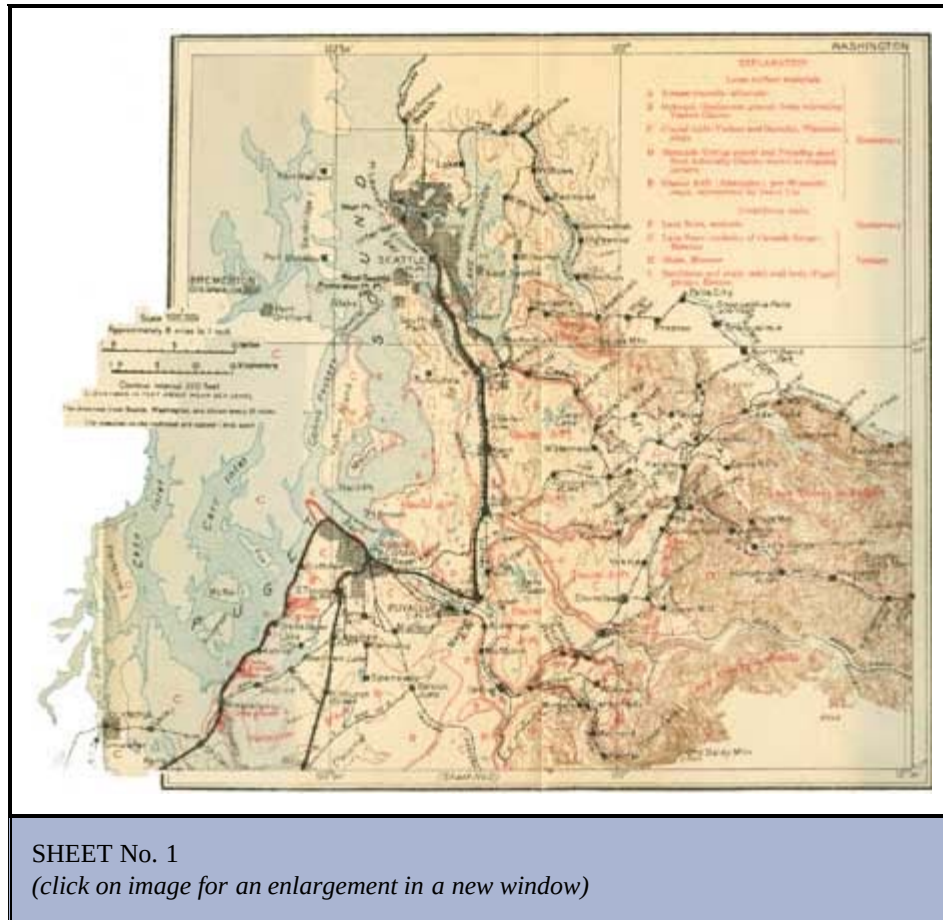
The superb forests of Washington, illustrated in Plate II, are the basis of its chief industries. Within it are 10 national forests, a national park, and a national monument, which together cover more than one-fourth of the State.



PLATE II.—A WASHINGTON FOREST. The trees are chiefly red fir, but a cedar

stands at the extreme left. Photograph by Curtis, Seattle.

Coal is the principal mineral resource of Washington. In the production of this fuel the State holds first rank on the Pacific coast, the output in 1913 having been 3,877,891 tons, valued at \$9,243,137. Wheat, grown chiefly in the eastern part of the State, is the principal agricultural product. Oats and barley are next in importance. Western Washington, which has a moister climate than the eastern part, produces large crops of hay. The fruit industry is developing rapidly, apples in particular finding good markets in the eastern cities and abroad. The waters of the State are full of fish, and the salmon industry is large. The high mountains and heavy rainfall insure abundant water power, which will no doubt be increasingly utilized.



Seattle.

Elevation 20 feet.

Population 237,194.¹

Seattle (see sheet 1, p. 20), the metropolis of Washington, the commercial center of the Puget Sound country, and the gateway to Alaska, stands on a neck of land between Elliott Bay (an eastern arm of Admiralty Bay, Puget Sound) and the fresh-water Lake Washington, about 86 miles by steamer and 957 miles by railroad north of San Francisco. Seattle was founded in 1852 and named after a Duwamish Indian chief. A fire that destroyed almost the whole of the business quarter in 1889 and the financial depression of 1893 retarded for a time the growth of the city, but the discovery of gold in the Klondike region in 1897 gave it a new impulse, as it became the shipping point for the new gold fields. It is the western terminus of three railroads and has direct connections with several others. Its population has nearly trebled in 10 years, and it is now one of the largest and most progressive cities of the Pacific Northwest.

¹The figures given for population throughout this book are those of the United

States Census for 1910. For places that are not incorporated the census figures represent the population of the election precinct, township, or other similar unit; such figures are in this book marked with an asterisk (*)

The city is built on a series of terraces, the commercial quarter standing near sea level and the better residential part occupying a terrace about 500 feet above the sea. From this part of the city there are fine views not only of the Olympic Mountains and Puget Sound, to the west, but also of Lake Washington and Mount Rainier, to the east. The city has an excellent salt-water harbor, which is being connected by a ship canal with Lake Washington, where vessels may go into fresh water to free their hulls of weeds and barnacles.

The principal exports are coal, timber, hops, and fish. Seattle is the chief point of entry from the Alaskan gold fields, and large quantities of gold dust are brought to the United States assay offices here.

The hills in the lower part of the city have been leveled off by a method used in hydraulic mining; in other words, they have been literally washed away by powerful jets of water. (See Pl. XIV, p. 48.) This method of grading was feasible because the city is built on unconsolidated drift left by a glacier that once occupied the basin of Puget Sound, as described below by W. C. Alden.²

²Thousands of years ago, during what is variously termed the Great Ice Age, the glacial period, or the Pleistocene epoch, the northern part of the North American Continent was covered by vast sheets of ice similar to the great ice cap which now covers most of Greenland. (See fig. 1.) Although at times the ice may have coalesced in one vast sheet stretching from the Atlantic to the Pacific and from the Arctic regions southward about to the line of Missouri and Ohio rivers, yet there were three distinct centers of accumulation and spreading. One of these centers was on Labrador Peninsula, one west of Hudson Bay, and one, called the Cordilleran, in the mountains of western Canada. There were also several distinct periods of ice accumulation, each followed by a warmer interval thousands of years in duration, during which the ice is believed to have largely or wholly melted away. There is evidence of at least four of these distinct stages of glaciation, and the last of these is known as the Wisconsin stage.





At a time which probably corresponds to the Wisconsin stage of glaciation east of the Rocky Mountains the mountains of Washington were largely covered with ice, and a lobe of the Cordilleran ice sheet extended southward from British Columbia into the Puget Sound basin. (See Pl. I.) The name Vashon, from the large island between Seattle and Tacoma, has been applied by geologists to this ice lobe, the last of the Puget Sound glaciers, and to the deposits formed in connection with it. This glacier is believed to have attained a thickness of about 2,500 feet. The ice filled the depressions now occupied by the sound, spread over the elevated plains between the valleys, and extended from the foot of the Olympic Mountains on the west to the base of the Cascade Range on the east. On the south it reached to and covered much of the plains south of Olympia. The ice of this glacier was probably coalescent on the east with that descending the slopes and valleys of the Cascades, to which the name Osceola glacier has been applied by geologists.

These glaciers, on melting, left deposits of clay, sand, gravel, and boulders (the Vashon and Osceola drift) on the elevated tracts between and around the troughs of the sound, but the deep depressions were unfilled, so that after the ice melted they were occupied by marine waters.

This later drift lies upon stratified sands and gravels (called the Douty gravel, Puyallup sand, and Orting gravel) deposited by waters from the melting of earlier glaciers. Buried in these deposits are beds of lignite, formed from vegetation that grew upon the sands and gravels. These older sands and gravels are in places much weathered and eroded; they were evidently exposed during a long interglacial stage before they were overridden and covered by the deposits of the Vashon and Osceola glaciers.

Beneath all these deposits lies a layer of stiff blue clay, mostly stratified but in places showing no bedding and crowded with subangular stones and large boulders. This deposit. (known to geologists as the Admiralty till) is supposed to have been formed at a still earlier stage of glaciation, when the Puget Sound basin was occupied by a lobe of the Cordilleran ice sheet, as it was later by another lobe at the Vashon substage. Some phenomena suggest that glaciers occupied the basin still earlier.

One view as to the origin of the deep troughs composing Puget Sound may be stated briefly as follows: The Admiralty ice sheet occupied and overflowed deep valleys which had been cut when the land stood higher. When this ice melted the hilly tracts between the valleys were uncovered first, and the washing in of sand and gravel leveled these up into what are now the elevated intervalley plains. The final melting of the tongues of ice left the troughs to be occupied by marine water. Later came the ice of the Vashon glacier, and this, on melting, again left the main depressions unfilled.

According to another view the disappearance of the Admiralty glacier left the clay, sand, and gravel spread in a continuous sheet over the Puget Sound basin, burying, in large part, the older valleys and ridges. Afterward the land rose about 1,000 feet and streams cut deep valleys in these soft deposits. Then the basin was depressed about to its present level and the ice of the Vashon and Osceola glaciers filled the valleys and overtopped the intervening tracts, and, on melting, left the area thinly mantled with drift and the depressions unfilled.

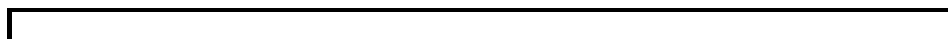
As the main outlet of the Puget Sound basin is to the north, icedammed freshwater lakes were for a time held in the troughs at each stage of advance of the ice front. When the outlet was at last opened the troughs were filled with marine water, which finally reached the level at which we now find it.

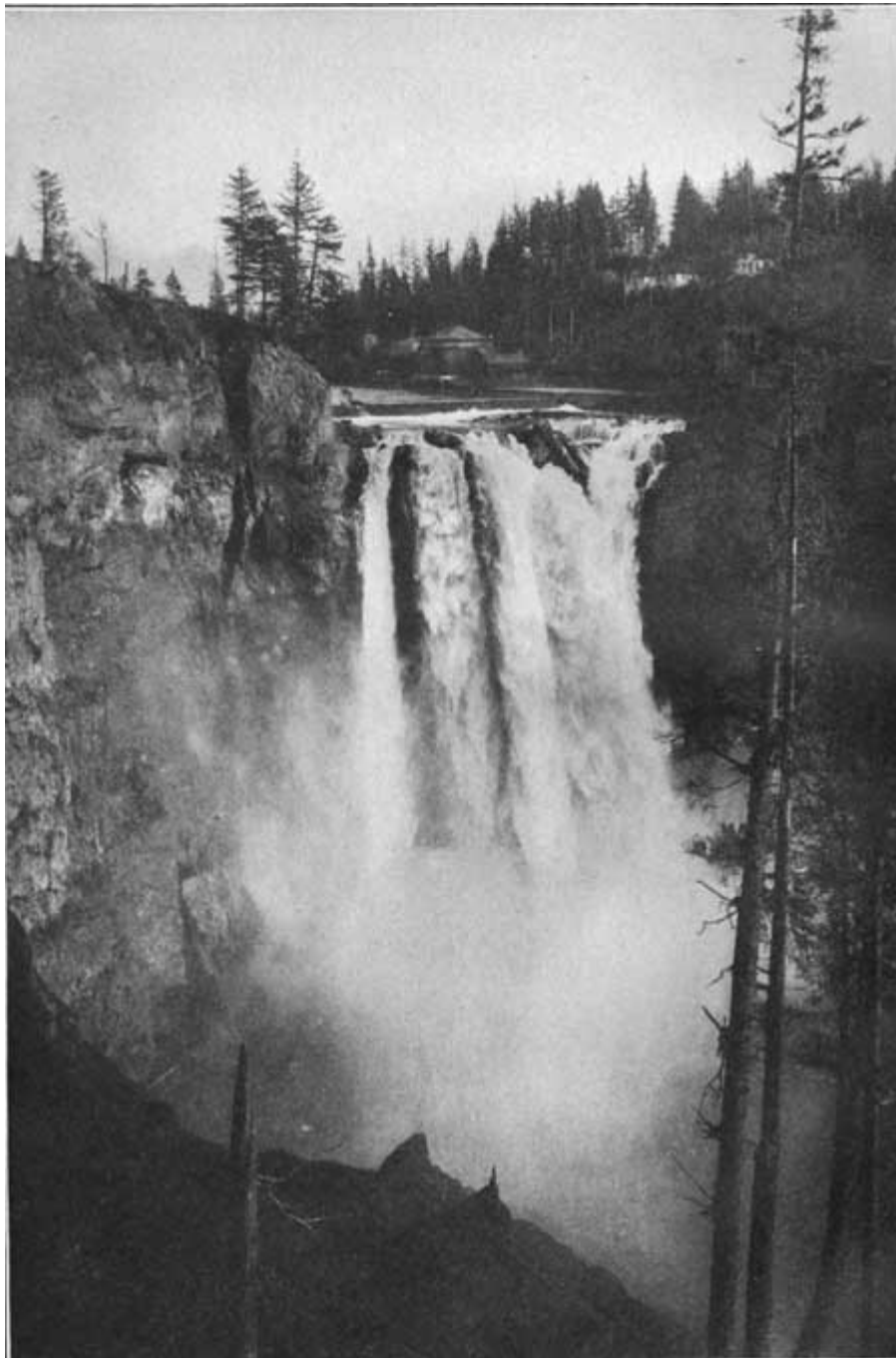
Marine shells found at various levels up to 290 feet above tidewater show that since the disappearance of the glacier of the Vashon substage the basin has been further depressed and submerged and then reelevated.

Excursions from Seattle.

Lake Washington, a beautiful sheet of water near the eastern border of Seattle, is about 20 miles long and 2 to 5 miles wide and is entirely surrounded by glacial drift. Small steamers that ply to and fro on the lake afford fine views of the Cascade Range.

Snoqualmie Falls (Pl. III) is 270 feet high and more than 50 feet wide and is well worth seeing. It may be reached by the Northern Pacific line by way of Woodinville, a trip of 54 miles, or by ferry across Lake Washington to Kirkland and thence by automobile, a route that, for small parties, is generally preferable. At the falls Snoqualmie River plunges over a great mass of lava underlain by fossiliferous sediments of the Eocene coal-bearing formation.





PART III.—SNOQUALMIE FALLS, WASH. Height, 268 feet. Falls go over a bluff of ancient lava underlain by sandstone and shale of Eocene age. Photograph by Curtis, Seattle.

In the immediate vicinity of Squak Mountain and Sammamish Lake there are a number of large channels cut and then abandoned by streams from the former glaciers. They may be reached by either of the routes just mentioned but are best seen southeast of Redmond, where Snoqualmie River once entered Sammamish Lake.

The United States navy yard and huge dry dock at Bremerton, about 20 miles from Seattle, are easily reached by steamer across the Sound. A trip to Hood Canal affords a close view of the densely forested Olympic Mountains. The scenic center of this range is Crescent Lake, reached from Seattle by steamer to Port Angeles, on the Strait of Juan de Fuca, and thence by stage. West of Port Townsend lighthouse, which is passed on this trip, is a bold bluff, 175

feet in height, of stratified glacial sand. Tertiary beds (rich in fossils at Clallam Bay) are well exposed on the southern shore of the Strait of Juan de Fuca. Crescent Lake contains ten varieties of trout, of which two are unknown elsewhere. Mount Olympus, 12 miles away, may be reached from this point with pack outfit. The mountain is a complex mass of metamorphic sandstone, shale, radiolarian chert, glaucophane schist, and greenstone cut by peridotite serpentine, a series of rocks closely resembling what is known as the Franciscan group of the California Coast Ranges.

Between Seattle and Portland trains are operated by the Northern Pacific Railway, Southern Pacific Co., Oregon-Washington Railroad & Navigation Co., Chicago, Milwaukee & St. Paul Railway, and Great Northern Railway, the tracks of all these lines being near together. The Shasta Route trains run over the Oregon-Washington and Chicago, Milwaukee & St. Paul tracks from Seattle to Tacoma, and over the Northern Pacific from Tacoma to Portland.

On leaving Seattle the train first traverses made land, built out into Puget Sound by washing glacial gravels through flumes from the adjacent hills. A turn to the left,¹ 2.3 miles from Seattle, brings into view a bluff of whitish shales and sandstones. These rocks are exposed for only a short distance at this place, but a mile farther south they reappear in a more prominent bluff just north of Georgetown.

¹Unless clearly otherwise intended, the words right and left as used in this bulletin refer to the sides of the railway track as they appear to a traveler facing the engine in going from Seattle to San Francisco.

Georgetown (Argo).
 Elevation 20 feet.
 Seattle 3 miles.

These rocks, which were once sediments on a sea bottom, contain abundant fossil sea shells that indicate Tertiary (middle Oligocene) age. The exposure of the beds at this place is due to their having been arched up from their originally horizontal attitude. This arch, or anticline, as geologists term it, may be traced, as shown on the map, from Bainbridge Island southeastward to and beyond Lake Washington.

Some greenish rocks that form a bluff on the left are composed largely of fragments of volcanic material. These beds are fossiliferous near the wagon-road bridge at Steels Crossing. They belong to the principal coal-bearing formation of Washington, presently to be described, and are associated with lavas. At Steels Crossing the railroad enters the coal field of western Washington, the largest in the State. The productive portions of the field, however, are miles away, northeast and southeast of this point, about Newcastle and Issaquah, Black Diamond and Franklin, Wilkeson and Carbonado. The field contains many coal beds, three or four of which have been mined, in places to a depth of 2,000 feet. The coal ranges from low-grade subbituminous to anthracite but is mainly subbituminous and bituminous. Coking coals occur at a number of localities and are worked in the Wilkeson region. They are the only coals coked commercially on the Pacific coast.

The fossil plants that are associated with the coal and that represent the vegetation from which the coal was formed contrast strongly with the plants of this region to-day. In the present forest conifers are dominant in size and number, but in the forests of the Eocene coal period conifers were few and palms and deciduous trees were abundant. No palms now grow wild within a thousand miles of the Puget Sound region, so the climate here during the coal period must have been very unlike that of to-day. The coal-bearing rocks crop out at intervals along the western base of the Cascade Range from the international boundary on the north to the Columbia on the south.

Black River Junction.

Elevation 39 feet.

Population 519.*

Seattle 10 miles.

The railroad crosses Black River, the outlet of Lake Washington, at Black River Junction, from which branch lines lead to the Newcastle, Renton, and Black Diamond coal fields. The mine at Renton is only 2 miles to the east (left) of Black River Junction. Two beds are mined here. The thicker one is 2 feet 8-1/2 inches thick and inclines or dips southeastward at an angle of 12°. The

coal is subbituminous.

From Seattle to Tacoma the railway follows a broad valley in glacial drift which forms the bluffs on both sides. This valley, which is continuous from Duwamish River to the Puyallup, was left by the melting of the ancient glacier as one of the intricate series of depressions now occupied in part by Puget Sound. It was later partly filled with silt, sand, and gravel by the mountain streams. White River, which enters the valley on a low deposit of gravel and sand which it has itself built up south of Auburn, separates on this sloping deposit, or alluvial cone, into two streams. One, which retains the name White River, flows northward into the Duwamish, and the other, called Stuck River, turns to the south and joins the Puyallup. This division of a stream on the sloping surface of its own deposits tells the story of a long period of successive floods carrying heavy loads of gravel and sand into this old depression. The later floods have spread over the valley the fine silt to which its remarkable fertility is due. A generalized section of the valley is shown in figure 2.

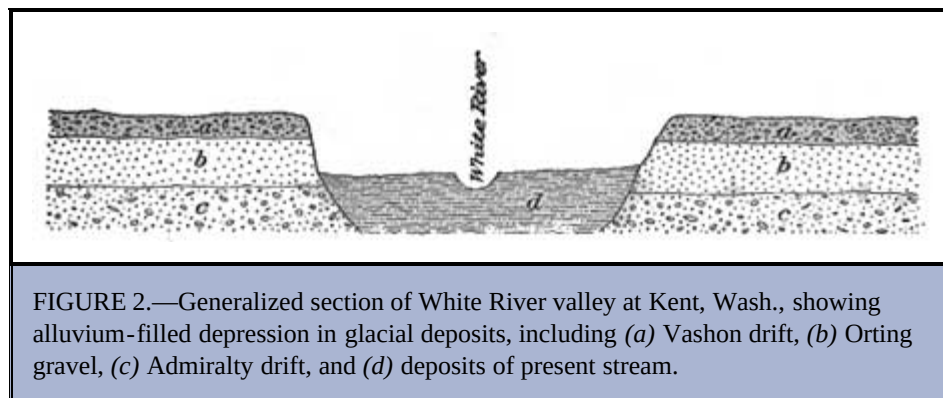


FIGURE 2.—Generalized section of White River valley at Kent, Wash., showing alluvium-filled depression in glacial deposits, including (a) Vashon drift, (b) Orting gravel, (c) Admiralty drift, and (d) deposits of present stream.

Kent.

Elevation 40 feet.

Population 1,908.

Seattle 17 miles.

The dominant industry in the vicinity of Kent is dairying, and herds of Holstein cattle may be seen in the fields. There are condensed-milk factories at Kent and Auburn, and the two have a combined average daily output of about 96,000 cans, or 25 carloads. The red-berried elder (*Sambucus callicarpa*), a showy shrub in June, is likely to attract the traveler's attention along this part of the route. On the left, a mile away, is the bluff of the great gravel pit of the Northern Pacific Railway, which shows the structure of the ancient delta of Green River. Near the pit are the Northern Pacific transfer yards, containing 37 miles of track.

Auburn.

Elevation 74 feet.

Population 957.

Seattle 22 miles.

On the (left) side of the valley, 3 miles northeast of Sumner, is the power plant of the Puget Sound Light & Traction Co., where water drawn from Lake Tapps, on the upland a few miles to the southeast, develops 80,000 horsepower.

Sumner.

Elevation 70 feet.

Population 892.

Seattle 29 miles.

As Sumner is approached a yeast factory can be seen on the left. On the right, near the station, is the gravel pit of the Chicago, Milwaukee & St. Paul Railway, which shows the general composition of the gravel cliffs inclosing the valley.

The Sumner and Puyallup country, once noted for its hops, is now better known for its fresh and canned fruit, especially raspberries and blackberries. Here the Cuthbert red raspberry reaches perfection and is grown in enormous quantities. The Puyallup & Sumner Fruit Growers' Association consisting of 1,400 growers, has its own refrigerating plant and in 1913 shipped 600 cars of fresh fruit to the eastern markets.

North Puyallup.
Seattle 31 miles.

Puyallup is the home of Ezra Meeker, a pioneer who in 1852 with an ox team crossed the plains and mountains to Puget Sound. In 1906 he returned by the same means of conveyance from Puyallup to New York City, marking the Oregon Trail at many points by monuments. The brilliant yellow flowers of the gosmore, or cat's ear (*Hypochaeris radicata*), a near relative of the dandelion, abound by the wayside. At North Puyallup, with its berry farms, the railroad enters the Puyallup Indian Reservation and crosses the valley. As Tacoma is approached the Indian School for Trades may be seen on the left.

Tacoma.
Population 83,743.
Seattle 41 miles.

Tacoma is the western headquarters and the official tidewater terminus of the Northern Pacific Railway. It is beautifully situated on a series of terraces rising about 300 feet above the head of Commencement Bay, the southeast arm of Puget Sound, and commands fine views of the Sound, the Cascade Mountains, and the white cone of Mount Rainier (Pl. IV, A). Its industrial establishments include a lead smelter and refinery, large sawmills, furniture factories, foundries, railway shops, and flour mills. Tacoma carries on an extensive commerce in grain, lumber, coal, tea, silk, and other articles. In the courthouse is the Ferry Museum, which contains, among other things, an interesting collection of Indian baskets, domestic utensils, canoes, and implements of hunting and war.

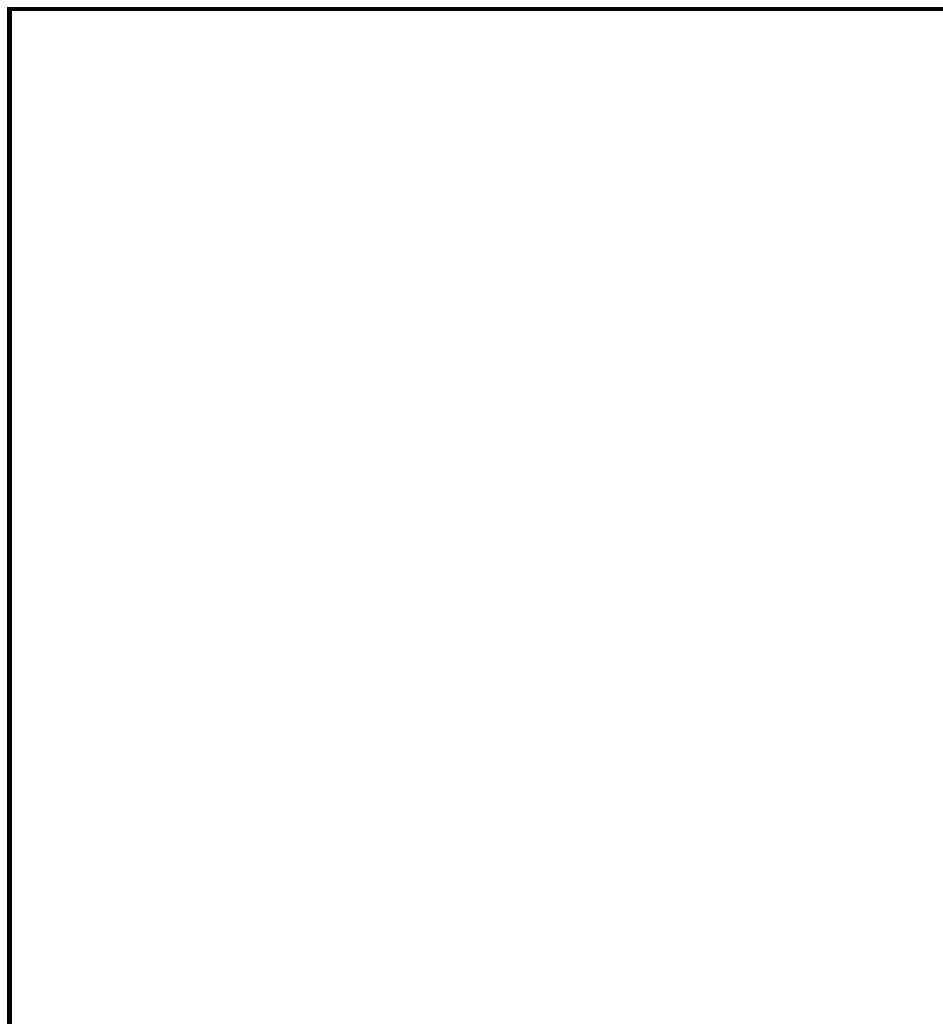




PLATE IV.—A. MOUNT RAINIER, WASH., FROM SPANAWAY LAKE. Mount Rainier is an extinct volcano 14,408 feet in height. It is a huge pile of lava (chiefly andesite) resting on a plateau of Tertiary and older rocks. Photograph copyrighted by Barnes, Parkland, Wash.

B. PARADISE PARK, ON SOUTH SLOPE OF MOUNT RAINIER. Elevation, 5,500 feet. The rock at the right at the summit is Gibraltar. Beyond the forest is the Nisqually Glacier, at the head of Nisqually River. Photograph by Curtis & Miller, Seattle.

Tacoma is a subport of entry (Port Townsend is the official port) and is second only to San Francisco in the volume of its foreign trade. It has an excellent harbor and 25 miles of water front, and from it transoceanic steamship lines run to Japan and China, to the Philippines and Hawaii, and to London and Glasgow.

Capt. George Vancouver visited the site of Tacoma in 1792, and Lieut. Charles Wilkes

surveyed it on his exploring expedition in 1841. Gen. Morton Matthew McCarver founded the present city in 1868. It was at first called Commencement City, but fortunately the name was later changed to Tacoma, an Indian word meaning "big snow mountain" and referring to Mount Rainier.

Excursions from Tacoma.

The principal excursions from Tacoma go to Mount Rainier, which is reached either from the northwest by way of the Wilkeson coal field or from the south by way of Longmire Springs and Paradise Park.

The great naturalist John Muir has justly termed the mountain parks "fountains of life." Appreciation of the beautiful in nature should become more and more an American characteristic, and in these days of national stock taking we do well to inventory as part of the nation's wealth its resources in wild scenery.

The Mount Rainier National Park is unique in possessing the wildest of mountain scenery almost at the gates of two large cities. Less than half a day's travel by rail and stage from Tacoma brings the visitor to the hotel at Longmire Springs, well within the park, and the perfectly graded Government road enables him to reach the lower end of the Nisqually Glacier. Just beyond is Paradise Park, where a tent hotel affords accommodations amid beautiful surroundings at the starting point for the ascent of the mountain.

Mount Rainier is the noblest of the peaks that overlook our Pacific coast. It attains an elevation of 14,408 feet and is the highest peak of the Cascade Range. Like Fujiyama in Japan and Shishaldin in Alaska, it rises majestically with the graceful lines that proclaim its volcanic origin. Its base is set in the green of the wonderful Puget Sound forest, and its snowy cone merges into the clouds, to which it appears to belong rather than to the earth. From this cone a score of radiating glaciers, the largest in the United States, extend down the gashed slopes into the forest below, where they give rise to rushing, roaring rivers of milk-white water. Over 25 years ago James Bryce, later British ambassador to this country, and Karl von Zittel, the well-known German geologist, visited Mount Rainier, and in a report expressed the hope that this peak might be reserved as a national park. It is gratifying to Americans to know that these experienced and discriminating travelers said that they had seen nothing "more beautiful in Switzerland or Tyrol, in Norway, or in the Pyrenees than the Carbon River glaciers and the great Puyallup glaciers."

In Paradise Park (Pl. IV, B), or in some other sylvan retreat on the lower slopes of Mount Rainier, whoever is weary of the city may find true recreation. All about are bright flowers, which throughout the summer follow the retreating snowbanks in a succession of gardens wherein nature displays a profusion of bloom alongside of ice and snow. Below are the forests, dark and almost silent, except where their stillness is broken by the raucous cry of the Clark crow or where some stream roars over the boulders or splashes musically among the ferns. Above all looms the peak, clad in eternal snow.

The volcanic cone of Mount Rainier has been built up by lava erupted through past ages. Although it is practically extinct, its crater still gives forth steam and sulphurous fumes. The form of the cone has been modified by the destructive work of glaciers, which have cut deep grooves into the mountain sides, and of avalanches, whose occasional thunder testifies to the continued attack of atmospheric agencies.

Mountain goats, marmots, and ptarmigan constitute the fauna of the mountain.

To avoid some heavy grades the Northern Pacific Co., by tunneling Point Defiance and continuing thence by way of Steilacoom, has recently built a new line from Tacoma to Tenino, commonly known as "the loop," thus enabling the traveler to enjoy some coast

scenery. This line is 6 miles longer than the old line, but the easier grades offset the difference in distance. From Tacoma the new line follows the shore northwestward for 4 miles, past the flour and saw mills to the lead smelter, affording a good view of Commencement Bay and of the harbor of Tacoma on the right. In the bluffs on the left rudely stratified cross-bedded sand and gravel (Puyallup substage) rest at several points on evenly stratified clays and fine sands with local pockets of gravel and boulders of the earlier (Admiralty) stage of glaciation. The first good example is on the left, 2 miles from the Tacoma union station, where an arch of the clay beds brings them plainly into view, as shown in figure 3.

Four miles from Tacoma, near the smelter tunnel, on the left, is a deep clay pit exposing the same formations in the same relative position, but just beyond, at the entrance of the main tunnel, there are on both sides of the cut beds of well-stratified clay and fine sand with patches of gravel lapping up over irregularly stratified and cross-bedded sand and gravel. The tunnel is 4,400 feet in length and 275 feet in greatest depth. In excavating it no hard rocks were cut, but a large tooth, probably of a mastodon, and traces of coaly material were found in sand associated with gravel.

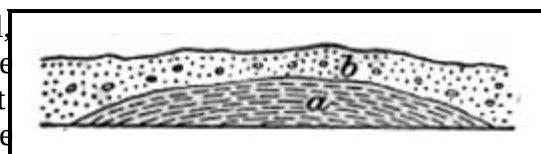


FIGURE 3.—Section of bluff 2 miles north of station at Tacoma, Wash., showing (a) an arch of finely stratified sand and clay of the Admiralty glacial drift, overlain by (b) irregularly stratified gravel and sand of the Puyallup substage.

From the west portal the run along the shore for 15 miles affords splendid views of the Narrows and the Olympic Range beyond. Puget Sound has 1,750 miles of shore line, with shelving beach, precipitous cliffs, and dense forests, affording some of the most beautiful inland water views in America. The seepage of much water in many places along a line about 120 feet above low tide marks the contact of stratified clays and overlying gravel and causes the railway much trouble from slides.

As Steilacoom is approached the traveler's attention is likely to be attracted by the pits on the left, from which large quantities of gravel are loaded on scows for shipment to Tacoma and Seattle. The loading is done by an application of the hydraulic method, first devised in placer mining. The gravels as exposed in the pits show distinctly the double set of bedding planes characteristic of delta deposits, namely, a series of beds that dip rather steeply in the direction of the river's flow (foreset beds), overlain by a series of nearly horizontal layers (topset beds). The delta was built out into Lake Russell while the Puget Sound glacier was melting.

Steilacoom.

Population 430.

Seattle 60 miles.

Steilacoom is one of the oldest settlements in the western part of the State. A monument placed here in 1908 marks the site of the first Protestant church building erected north of the Columbia. It was built in 1853. Scotch broom (*Genista scoparia*), which has been introduced into this region, flourishes about Steilacoom, and its bright yellow blossoms form a pleasing feature of the landscape.

Ketron.

Seattle 62 miles.

Beyond Ketron the water view widens. The horizontally stratified sands and gravels that have been the prevalent material along the railway for miles are well developed and within view on Ketron and Anderson islands. The dark-spotted rock used to protect the railroad embankment from the southwest storms of winter comes from the vicinity of Bremerton and contains a few fossil shells. Porpoises, seals, and even whales may occasionally be seen in this part of the Sound. A whale stranded near Steilacoom in 1912. At the mouth of Sequelitcher Creek are the wharf and power house of the Dupont powder works, which are just out of sight on

the left. The foreset bedding of the old delta gravels is well shown for 3-1/2 miles along this portion of the route. These gravels are succeeded abruptly at 22.1 miles from Tacoma by well-exposed stratified clays (Admiralty) overlain by stratified gravels.

Nisqually.

Population 497.*

Seattle 68 miles.

At the mouth of Nisqually River a strip of the present delta nearly a mile wide is alternately covered and left bare by the tides. Three miles up the river valley is Nisqually station, where the main line is crossed by the Grays Harbor branch of the Northern Pacific, leading to Olympia, the State capital, and beyond to the coast. From Olympia another branch runs through Tumwater, the oldest American settlement in Washington, which marked the end of the Oregon Trail.

Near Nisqually station there is a small terminal moraine left by the receding front of the Puget Sound glacier. South of Nisqually River are delta gravels which were deposited by a former stream on the great outwash plains left by the melting glacier. These gravels are well exposed in the railway cut. Near the Nisqually are obtained some of the best forest views on the route. Almost all the lands of the Seattle-Tacoma region except the cultivated river valleys are still forested. The dominant forest tree is the red fir, which covers fully 90 per cent of the heavily timbered area, in places with a stand so dense that the sun can scarcely penetrate to the soil. In a narrow strip along the coast the dominant species is the Sitka or tideland spruce. In the bottom lands, mainly river valleys, the conspicuous trees or shrubs are the red cedar, giant cedar, white fir, large-leaved maple, Oregon ash, cottonwood, western dogwood, vine maple, crab apple, various willows, devil's-club, and salmon berry. On the gravelly plains may be seen the only species of oak growing in the State, the black pine, and from spring until the middle of July a carpet of brilliant flowers.

<<< [Previous](#)

<<< [Contents](#) >>>

[Next](#) >>>



Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

SOME PUBLICATIONS ON WEST-COAST GEOLOGY.

ANDERSON, F. M., Cretaceous deposits of the Pacific coast: California Acad. Sci. Proc., 3d ser., vol. 2, No. 1, pp. 1-154, 1902.

ARNOLD, RALPH, Geology and oil resources of the Summerland district, Santa Barbara County, Cal.: U. S. Geol. Survey Bull. 321, 1907.

ARNOLD, RALPH, and ANDERSON, ROBERT, Geology and oil resources of the Santa Maria oil district, Santa Barbara County, Cal.: U. S. Geol. Survey Bull. 322, 1907.

ARNOLD, RALPH, and HANNIBAL, HAROLD, The marine Tertiary stratigraphy of the north Pacific coast of America: Am. Philos. Soc. Proc., vol. 52, pp. 559-605, 1913.

BRANNER, J. C., NEWSOM, J. F., and ARNOLD, RALPH, U. S. Geol. Survey Geol. Atlas, Santa Cruz folio (No. 163), 1909.

BRETZ, J. H., Glaciation of Puget Sound: Washington Geol. Survey Bull. 8, 1913. Contains list of publications.

CONDON, THOMAS, Oregon geology, a revision of The two islands, edited by Ellen Condon McCormack, 1910.

DARTON, N. H., The structural materials of Oregon and Washington: U. S. Geol. Survey Bull. 387, 1909.

DILLER, J. S., U. S. Geol. Survey Geol. Atlas, Lassen Peak folio (No. 15), 1895.

_____ A geological reconnaissance in northwestern Oregon: U. S. Geol. Survey Seventeenth Ann. Rept., pt. 1, pp. 447-520, 1896.

_____ U. S. Geol. Survey Geol. Atlas, Roseburg folio (No. 49), 1898.

_____ U. S. Geol. Survey Geol. Atlas, Redding folio (No. 138), 1906.

_____ Geological history of Crater Lake: U. S. Dept. Interior, 1912.

_____ Mineral resources of southwestern Oregon: U. S. Geol. Survey Bull. 546, 1914.

ELDRIDGE, G. H., and ARNOLD, RALPH, The Santa Clara Valley, Puente Hills, and Los Angeles oil districts, southern California: U. S. Geol. Survey Bull. 309, 1907.

FAIRBANKS, H. W., U. S. Geol. Survey Geol. Atlas, San Luis folio (No. 101), 1904.

LANDES, HENRY, and RUDDY, C. A., Coal deposits of Washington: Washington Geol.

Survey Ann. Rept. for 1902.

LAWSWON, A. C., Report of the California State Earthquake Investigation Commission: Carnegie Inst. Washington Pub. 87, 1908.

_____ U. S. Geol. Survey Geol. Atlas, San Francisco folio (No. 193), 1914.

MATTHES, F. E., Mount Rainier and its glaciers: U. S. Dept. Interior, 1914.

Oregon Bureau of Mines and Geology, Mineral resources of Oregon, vol. 1, 1914.

OSMONT, V. C., A geological section of the Coast Ranges north of the Bay of San Francisco: California Univ. Dept. Geology Bull., vol. 4, No. 3, pp. 37-87, 1904.

RANSOME, F. L., The Great Valley of California, a criticism of the theory of isostasy: California Univ. Dept. Geology Bull., vol. 1, pp. 371-428, 1896.

RUSSELL, I. C., and SMITH, G. O., Glaciers [and rocks] of Mount Rainier: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 2, pp. 349-424, 1898.

SMITH, G. O., The coal of the Pacific coast: U. S. Geol. Survey Twenty-second Ann. Rept., Pt. 3, pp. 473-513, 1902.

SMITH, G. O., and WILLIS, BAILEY, Contributions to the geology of Washington: U. S. Geol. Survey Prof. Paper 19, 1903.

STANTON, T. W., Fauna of the Knoxville beds: U. S. Geol. Survey Bull. 133, 1896.

WEAVER, C. E., A report on the Tertiary paleontology of western Washington: Washington Geol. Survey Bull. 13, in preparation, 1914.

WILLIS, BAILEY, and SMITH, G. O., U. S. Geol. Survey Geol. Atlas, Tacoma folio (No. 54), 1899.

[<<< Previous](#)

[<<< Contents >>>](#)

[Next >>>](#)



Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

GLOSSARY OF GEOLOGIC TERMS

Alluvial fan. The outspread sloping deposit of boulders, gravel, and sand left by stream where it passes from a gorge out upon a plain.

Andesite. A lava of widespread occurrence, usually of dark-gray color and intermediate in chemical composition between rhyolite and basalt.

Anticline. An arch of bedded or layered rock suggestive in form of an overturned canoe. (See fig. 3, p. 18.) (See also Dome and Syncline.)

Badlands. A region nearly devoid of vegetation where erosion, instead of carving hills and valleys of the familiar type, has cut the land into an intricate maze of narrow ravines and sharp crests and pinnacles. Travel across such a region is almost impossible; hence the name.

Basalt. A common lava of dark color and of great fluidity when molten. Basalt is less siliceous than granite and rhyolite, and contains much more iron, calcium, and magnesium.

Bolson (pronounced bowl-sown'). A flat-floored desert valley that drains to a central evaporation pan or playa.

Bomb. See Volcanic bomb.

Breccia (pronounced bretch'a). A mass of naturally cemented angular rock fragments.

Crystalline rock. A rock composed of closely fitting mineral crystals that have formed in the rock substance as contrasted with one made up of cemented grains of sand or other material or with a volcanic glass.

Diabase. A heavy, dark intrusive rock having the same composition as basalt, but, on account of its slower cooling, a more crystalline texture. Its principal constituent minerals are feldspar, augite, and usually olivine. Olivine is easily changed by weathering, and in many diabases is no longer recognizable. Augite is a mineral containing iron and magnesium and is similar to hornblende.

Dike. A mass of igneous rock that has solidified in a wide fissure or crack in the earth's crust.

Diorite. An even-gained intrusive igneous rock consisting chiefly of the minerals feldspar, hornblende, and very commonly black mica. If the rock contains much quartz, it is called quartz diorite: Quartz diorite resembles granite and is connected with that rock by many intermediate varieties, including monzonite. The feldspar in diorite differs from that in granite in containing calcium and sodium instead of potassium. Hornblende is a green or black mineral containing iron, magnesium, calcium, and other constituents.

Dip. The slope of a rock layer expressed by the angle which the top or bottom the layer

makes with a horizontal plane. (See fig. 9, p. 51.) (See also Strike.)

Dissected. Cut by erosion into hills and valleys. Applicable especially to plains or peneplains in process of erosion after an uplift.

Dome. As applied to rock layers or beds, a short anticline, suggestive of an inverted basin.

Drift. The rock fragments—soil, gavel, and silt—carried by a glacier. Drift includes the unsorted material known as till and deposits made by streams flowing from a glacier.

Erosion. The wearing away of materials at the earth's surface by the mechanical action of running water, waves, moving ice, or winds, which use rock fragments and gains as their tools or abrasives. Erosion is aided by weathering. Weathering.)

Fault. A fracture in the earth's crust accompanied by movement of the rock on one side of the break past that on the other. If the fracture is inclined and the rock on one side appears to have slid down the slope of the fracture the fault is termed a normal fault. If, on the other hand, the rock on one side appears to have been shoved up the inclined plane of the break, the fault is termed a reverse fault. (See Pl. XXXIII, B, p. 127; fig. 12, p. 90; fig. 15, p. 128.)

Fault block. A part of the earth's crust bounded wholly or in part by faults.

Fault scarp. The cliff formed by a fault. Most fault scarps have been modified by erosion since the faulting.

Fauna. The animals that inhabited the world or a certain region at a certain time.

Fissure. A crack, break, or fracture in the earth's crust or in a mass of rock.

Flood plain. The nearly level land that borders a stream and is subject to occasional overflow. Flood plains are built up by sediment left by such overflows. (See Pl. XXIX, A, p. 119.)

Flora. The assemblage of plants growing at a given time or in a given place.

Fold. A bend in rock layers or beds. Anticlines and synclines are the common types of folds. (See fig. 15, p. 128.)

Formation. A rock layer, or a series of continuously deposited layers grouped together, regarded by the geologist as a unit for purposes of description and mapping. A formation is usually named from some place where it is exposed in its typical character. For example, Denver formation, Niobrara limestone.

Fossil. The whole or any part of an animal or plant that has been preserved in the rocks or the impression left on rock by a plant or animal. Preservation is invariably accompanied by some change in substance, and from some impressions the original substance has all been removed. (See Pl. XXV, p. 92.)

Gneiss (pronounced nice). A rock resembling granite, but with its mineral constituents so arranged as to give it a banded appearance. Most gneisses are metamorphic rocks derived from granite or other igneous rocks.

Granite. A crystalline igneous rock that has solidified slowly deep within the earth. It consists chiefly of the minerals quartz, feldspar, and one or both of the common kinds of mica, namely, black mica, or biotite, and white mica, or muscovite. The feldspar is the kind

known as orthoclase, and may be distinguished from quartz by its pale reddish tint and its property of breaking with flat shining surfaces (cleavage), for quartz breaks irregularly. The micas are easily recognized by their cleavage into thin, flexible flakes and their brilliant luster.

Horizon. In geology any distinctive plane traceable from place to place in different exposures of strata and marking the same period of geologic time. A particular horizon may be characterized by distinctive fossils.

Igneous rocks. Rocks formed by the cooling and solidification of a hot liquid material, known as magma, that has originated at unknown depths within the earth. Those that have solidified beneath the surface are known as intrusive rocks, or, if the cooling has taken place slowly at great depth, as plutonic intrusive or plutonic rocks. Those that have flowed out over the surface are known as effusive rocks, extrusive rocks, or lavas. The term volcanic rocks includes not only lavas but bombs, pumice, tuff, volcanic ash, and other fragmental materials or ejecta thrown out from volcanoes.

Lithologic. Pertaining to lithology, or the study of rocks. (See also Petrology.) Pertaining to rock character.

Lode. An ore-bearing vein (see Vein); especially a broad or complex vein.

Loess (pronounced lurse with the r obscure). A fine homogeneous silt or loam showing usually no division into layers and forming thick and extensive deposits in the Mississippi Valley and in China. It is generally regarded as in part at least a deposit of wind-blown dust.

Meander. To flow in Serpentine curves. A loop in a stream. The term comes from the Greek name of a river in Asia Minor, which has a sinuous course. Most streams in flowing across plains develop meanders.

Metamorphism. Any change in rocks effected in the earth by heat, pressure, solutions, or gases. A common cause of the metamorphism of rocks is the intrusion into them of igneous rocks. Rocks so changed are termed metamorphic.

Monzonite. An even-grained intrusive igneous rock intermediate in character between diorite and granite. It resembles granite.

Moraine. A mass of drift deposited by a glacier at its end or along its sides.

Oil pool. An area or body of sedimentary rock that yields petroleum on drilling. The oil occurs in the pores of the rock and is not a pool or pond in the ordinary sense of these words.

Outcrop. That part of a rock that appears at the surface. The appearance of a rock at the surface or its projection above the soil.

Paleontology. The study of the world's ancient life, either plant or animal, by means of fossils.

Peneplain. A region reduced almost to a plain by the long-continued normal erosion of a land surface. It should be distinguished from a plain produced by the attack of waves along a coast or the built-up flood plain of a river.

Petrography. The description of rocks, especially of igneous and metamorphic rocks studied with the aid of the microscope.

Petrology. The study of rocks, especially of igneous and metamorphic rocks.

Placer deposit. A mass of gravel, sand, or similar material resulting from the crumbling and erosion of solid rocks and containing particles or nuggets of gold, platinum, tin, or other valuable minerals derived from rocks or veins by erosion.

Playa (pronounced plah'ya). The shallow central basin of a desert plain, in which water gathers after a rain and is evaporated.

Porphyry. Any igneous rock in which certain crystal constituents are distinctly visible in contrast with the finer-grained substance of the rock.

Quartzite. A rock composed of sand grains cemented by silica into an extremely hard mass.

Rhyolite. A lava, usually of light color, corresponding in chemical composition to granite. The same molten liquid that at great depth within the earth solidifies as granite would, if it flowed out on the surface, cool more quickly and crystallize less completely as rhyolite.

Schist. A rock that by subjection to heat and pressure within the earth has undergone a change in the character of the particles or minerals that compose it and has these minerals arranged in such a way that the rock splits more easily in certain directions than in others. A schist has a crystalline grain roughly similar to the grain of a piece of wood.

Sedimentary rocks. Rocks formed by the accumulation of sediment in water (aqueous deposits) or from air (eolian deposits). The sediment may consist of rock fragments or particles of various sizes (conglomerate, sandstone, shale); of the remains or products of animals or plants (certain limestones and coal); of the product of chemical action or of evaporation (salt, gypsum, etc.); or of mixtures of these materials. Some sedimentary deposits (tuffs) are composed of fragments blown from volcanoes and deposited on land or in water. A characteristic feature of sedimentary deposits is a layered structure known as bedding or stratification. Each layer is a bed or stratum. Sedimentary beds as deposited lie flat or nearly flat. (See Pl. XXVIII, p. 118.)

Shale. A rock consisting of hardened thin layers of fine mud.

Slate. A rock that by subjection to pressure within the earth has acquired the property of splitting smoothly into thin plates. The cleavage is smoother and more regular than the splitting of schist along its grain.

Stratigraphy. The branch of geologic science that deals with the order and relations of the strata of the earth's crust.

Strike. The direction along which an inclined rock layer would meet the earth's surface if that surface were level. The outcrop (which see) of a bed on a plain is coincident with its strike.

Structure. In geology the forms assumed by sedimentary beds and igneous rocks that have been moved from their original position by forces within the earth or the forms taken by intrusive masses of igneous rock in connection with effects produced mechanically on neighboring rocks by the intrusion. Folds (anticlines and synclines) and faults are the principal mechanical effects considered under structure. Schistosity and cleavage are also structural features.

Syncline. An inverted arch of bedded or layered rock suggestive in form of a canoe.

Talus (pronounced tay'lus). The mass of loose rock fragments that accumulates at the base of

a cliff or steep slope.

Terrace. A steplike bench on a hillside. Most terraces along rivers are remnants of valley bottoms formed when the land was lower or when the stream flowed at higher levels. Other terraces have been formed by waves. Some terraces have been cut in solid rock, others have been built up of sand and gravel, and still others have been partly cut and partly built up. (See Pl. XXIX, A, p. 119.)

Till. The deposit of mingled boulders, rock fragments, and soil left behind by a melting glacier or deposited about its margin.

Tuff. A rock consisting of a layer or layers of lava particles blown from a volcano. A fine tuff is often called volcanic ash and a coarse tuff breccia.

Type locality. The place at which a formation is typically displayed and from which it is named; also the place at which a fossil or other geologic feature is displayed in typical form.

Unconformity. A break in the regular succession of sedimentary rocks, indicated by the fact that one bed rests on the eroded surface of one or more beds which may have a distinctly different dip from the bed above. An unconformity may show that the beds below it have at some time been raised above the sea and have been eroded. In some places beds thousands of feet thick have been washed away before the land again became submerged and the first bed above the surface of unconformity was deposited. If beds of rock may be considered as leaves in the volume of geologic history, an unconformity marks a gap in the record.

Vein. A mass of mineral material that has been deposited in or along a fissure in the rocks. A vein differs from a dike in that the vein material was introduced gradually by deposition from solution whereas a dike was intruded in a molten condition.

Volcanic bomb. A rounded mass of lava thrown out while in a hot and pasty condition from a volcano. A bomb, like a raindrop, is rounded in its passage through the air and may be covered with a cracked crust due to quick cooling.

Volcanic cone. A mountain or hill usually of characteristic conical form, built up around a volcanic vent. The more nearly perfect cones are composed principally of lava fragments and volcanic ashes.

Volcanic glass. Lava that has cooled and solidified before it has had time to crystallize.

Volcanic neck. A plug of lava that formerly congealed in the pipe of a volcano. When the tuffs and lava flows that make up most of a volcano have been washed away by erosion the neck may remain as an isolated hill.

Volcanic rocks. Igneous rocks erupted at or near the earth's surface, including lavas, tuffs, volcanic ashes, and like material.

Weathering. The group of processes, such as the chemical action of air, and rain water and of plants and bacteria and the mechanical action of changes of temperature, whereby rocks on exposure to the weather change in character, decay, and finally crumble into soil. (See Pl. XXVII, p. 109.)

bul/614/glossary.htm
Last Updated: 8-Jan-2007



Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

INDEX OF RAILROAD STATIONS

A.

Ager, Cal
Albany, Oreg
Albany Junction, Oreg
Alcatraz, Cal
Alford, Oreg
Anderson, Cal
Anlauf, Oreg
Antelope, Cal
Antler, Cal
Arbuckle, Cal
Argo, Wash
Arguello, Cal
Aromas, Cal
Ashland, Oreg
Atascadero, Cal
Auburn, Wash
Aurora, Oreg
Azalea, Cal

B.

Barlow, Oreg
Batavia, Cal
Bay Shore, Cal
Belmont, Cal
Ben Ali, Cal
Benham, Cal
Benicia, Cal
Beresford, Cal
Berkeley, Cal
Biggs, Cal
Black River Junction, Wash
Blunt, Cal
Bradley, Cal
Bromela, Cal
Brooks, Oreg
Bucoda, Wash
Burbank, Cal
Burlingame, Cal

C.

Callender, Cal
Camarillo, Cal
Cana, Cal
Canby, Oreg
Cannon, Cal
Capitan, Cal
Carnadero, Cal
Carnes, Oreg
Carpinteria, Cal.
Carrolls, Wash
Casmalia, Cal
Castella, Cal
Castle Crag, Cal
Castle Rock, Wash
Central Mine, Cal
Central Point, Oreg
Chambers Prairie, Wash
Centralia, Wash
Chanslor, Cal
Chatsworth, Cal
Chehalis, Wash
Chemawa, Oreg
Chico, Cal
Chittenden, Cal
Chorro, Cal
Chualar, Cal
Clackamas, Oreg
Coalca, Oreg
Coburn, Cal
Cole, Cal
Colestin, Oreg
Colusa Junction, Cal
Comstock, Oreg
Concepcion, Cal
Coram, Cal
Corning, Cal
Coromar, Cal
Cottage Grove, Oreg
Cottonwood, Cal
Cow Creek, Oreg
Coyote, Cal
Creswell, Oreg
Cuesta, Cal

D.

Davis, Cal
Del Monte Junction, Cal
Delavan, Cal:

Delta, Cal
Dillard, Oreg
Divide, Oreg
Dixon, Cal
Doe Creek, Oreg
Dole, Oreg
Drain, Oreg
Drake, Cal
Dunnigan, Cal
Dunsmuir, Cal
Durham, Cal

E.

Eaglet, Cal
East Morrison Street, Oreg
Edenvale, Cal
Edgewood, Cal
Edna, Cal
Elkhorn Cal
Elmira, Cal
Elmore, Cal
Elwood, Cal
Eugene, Oreg
Evaline, Wash

F.

Fairfield, Cal.
Felida, Wash

G.

Gato, Cal
Gaviota, Cal
Gazelle, Cal
Georgetown, Wash
Gerber, Cal
Germantown, Cal
Gervais, Oreg
Gibson, Cal
Gilory, Cal
Girvan, Cal
Glendale, Oreg
Gold Hill, Oreg
Goldtree, Cal
Goleta, Cal
Gonzales, Cal
Goodyear, Cal
Goshen, Oreg
Grants Pass, Oreg

Green, Oreg
Greenwood, Cal
Grenada, Cal
Gridley, Cal
Grover, Cal
Guadalupe, Cal

H.

Halsey, Oreg
Harrisburg, Oreg
Hasson, Cal
Hercules, Cal
Hewitt, Cal
Hillhurst, Wash
Hillsdale, Cal
Honda, Cal
Hooker, Cal
Hope Ranch, Cal
Hornbrook, Cal
Hubbard, Oreg
Hugo, Oreg

I.

Irving, Oreg
Ivrea, Cal

J.

Jalama, Cal
Jefferson, Oreg
Junction City, Oreg

K.

Kalama, Wash
Kelso, Wash
Kennett, Cal
Kent, Wash
Keswick, Cal
Ketron, Wash
King City, Cal
Kirkwood, Cal
Klamathon, Cal
Knapps, Wash
Kyro, Wash.

L.

Lagol, Cal
Lakeview, Wash
Lamoine, Cal
Latham, Oreg
Leesdale, Cal
Leland, Oreg
Lento, Cal
Leona, Oreg
Leslie, Cal
Lincoln, Cal
Liveoak, Cal
Logandale Cal
Lompoc Junction, Cal
Los Angeles, Cal
Lyman, Cal

M.

Mcintosh, Wash
McKay, Cal
Madrone Cal
Malton, Cal
Marion, Oreg
Martins Bluff, Wash
Marysville, Cal
Mathews, Oreg
Maxwell, Cal
Mayfield, Cal
Medford, Oreg
Menlo Park, Cal
Merlin, Oreg
Merritt, Cal
Metz, Cal
Middle Creek, Cal
Millbrae, Cal
Millersburg, Oreg
Milwaukee, Oreg
Miramar, Cal
Montague, Cal
Montalvo, Cal
Moorpark, Cal
Morley, Cal
Motion, Cal
Mott, Cal
Mountain View, Cal
Mullen, Cal
Myrtle Creek, Oreg

N.

Nacimiento, Cal
Napavine, Wash

Naples, Cal
Narlon, Cal
Nelson, Cal
New Era, Oreg
Nichols, Oreg
Nisqually, Wash
Nord, Cal
Norman, Cal
North Puyallup, Wash

O.

Oakland Cal
Oakland, Oreg
O'Brien, Wash
Oceano, Cal
Olequa, Wash
Oregon City, Oreg
Orella, Cal
Orland, Cal
Ostrander, Wash
Oxnard, Cal

P.

Palo Alto, Cal
Paso Robles, Cal
Phoenix, Oreg
Pinole, Cal
Pismo, Cal
Pitt, Cal
Plumb, Wash
Port Costa, Cal
Portland, Oreg
Proberta, Cal

R.

Rainier, Wash
Rawson, Cal
Raymer, Cal
Red Bluff, Cal
Redding, Cal
Redwood, Cal
Reuben, Oreg
Rice Hill, Oreg
Richfield, Cal
Richmond, Cal
Richvale, Cal
Riddle, Oreg
Ridgefield, Wash

Rodeo, Cal
Rogue River, Oreg
Roseburg, Oreg
Roseville, Cal
Round Prairie, Oreg
Roy, Wash

S.

Sacate, Cal
Sacramento, Cal
Safety, Oreg
Saginaw, Oreg
St. Clair, Wash
Salem, Oreg
Salinas, Cal
San Ardo, Cal
San Bruno, Cal
San Carlos, Cal
San Francisco, Cal
San Jose, Cal
San Lucas, Cal
San Luis Obispo, Cal
San Martin, Cal
San Mateo, Cal
San Miguel, Cal
San Pablo, Cal
Santa Barbara, Cal
Santa Clara, Cal
Santa Cruz, Cal
Santa Margarita, Cal
Santa Susana, Cal
Sargent, Cal
Schumann, Cal
Seacliff, Cal
Seattle, Wash
Serrano, Cal
Shasta Springs, Cal
Shedd, Oreg
Sheridan, Cal
Simi, Cal
Sims, Cal
Siskiyou, Oreg
Sisson, Cal
Smithson, Cal
Snowdon, Cal
Soledad, Cal
Somis, Cal
Soto, Cal
South San Francisco, Cal
South Tacoma, Wash
South Winlock, Wash
Springfield Junction, Oreg

Steilacoom, Wash
Steinman, Oreg
Strathearn, Cal
Sudden, Cal
Suisun, Cal
Summerland, Cal
Summit, Cal
Sumner, Wash
Sunnyvale, Cal
Surf, Cal
Sutherlin, Oreg

T.

Tacoma, Wash
Tajiguas, Cal
Talent, Oreg
Tangair, Cal
Tangent, Oreg
Tehama, Cal
Templeton, Cal
Tenino, Wash
Ternez, Cal
Thrall, Cal
Tolo, Oreg
Tropico, Cal
Turner, Oreg
Tyler, Cal

V.

Vader, Wash
Vallejo Junction, Cal
Van Asselt, Wash
Vancouver, Wash
Vancouver Junction, Wash
Ventura, Cal
Vine, Cal
Visitacion, Cal

W.

Wabash, Wash
Waldorf, Cal
Walker, Oreg
Washington, Cal
Watsonville Junction, Cal
Weed, Cal
Wellsona, Cal
West Fork, Oreg
West Glendale, Cal

Wheatland, Cal
Wilbur, Oreg
Willbridge, Oreg
Willlams, Cal
Willows, Cal
Willsburg, Oreg
Winchester, Oreg
Winlock, Wash
Wolf Creek, Oreg
Woodburn, Oreg
Woodland, Cal
Woodland, Wash
Wunpost, Cal

Y.

Yelm, Wash
Yolo, Cal
Yoncalla, Oreg

Z.

Zamora, Cal
Zelzah, Cal
Zuleka, Cal

<<< [Previous](#)

<<< [Contents](#) >>>

bul/614/stations.htm
Last Updated: 8-Jan-2007



GEOLOGIC AND TOPOGRAPHIC MAP OF THE

SHASTA ROUTE

From Seattle, Washington, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

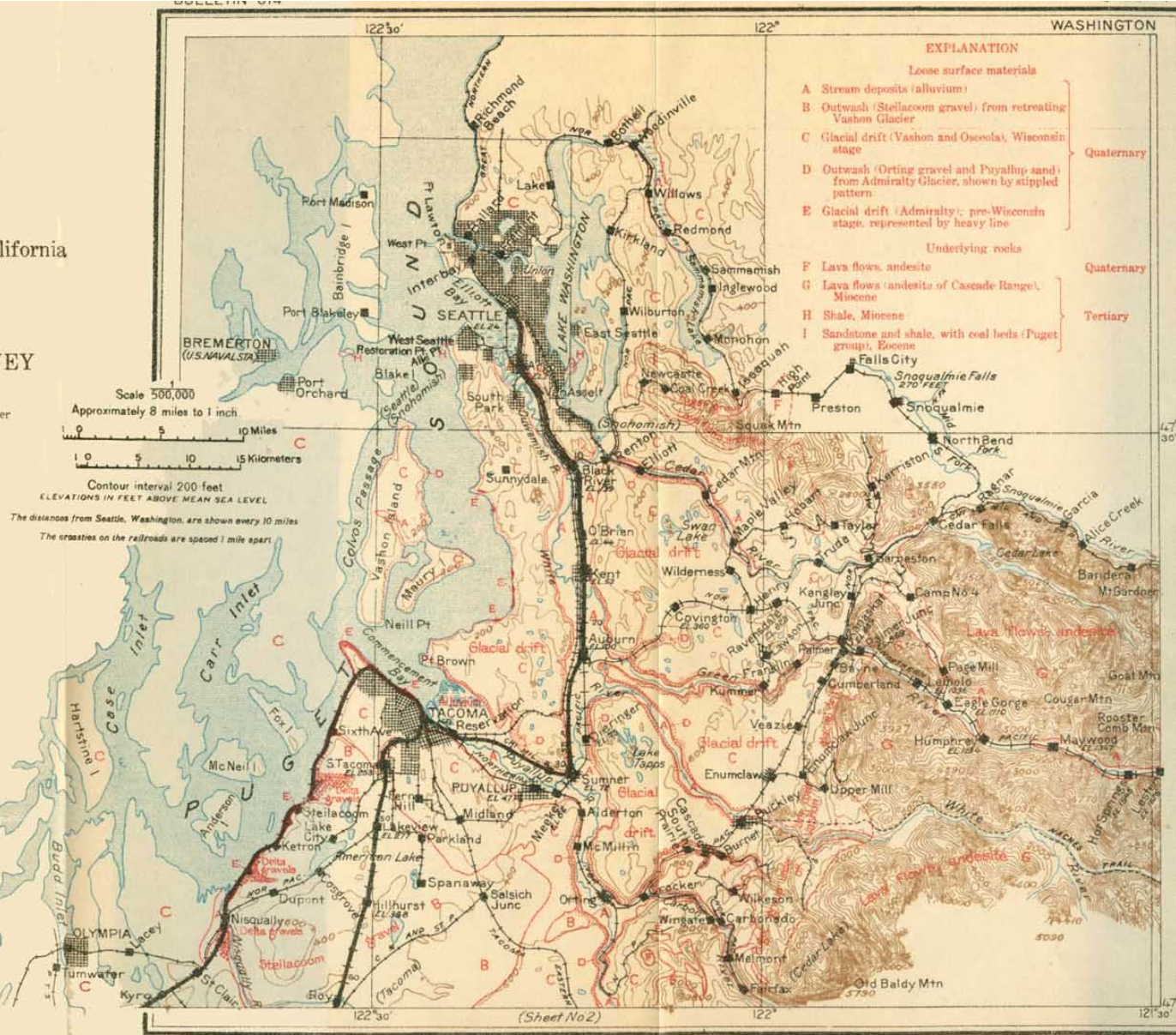
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name





GEOLOGIC AND TOPOGRAPHIC MAP
OF THE

SHASTA ROUTE

From Seattle, Washington, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

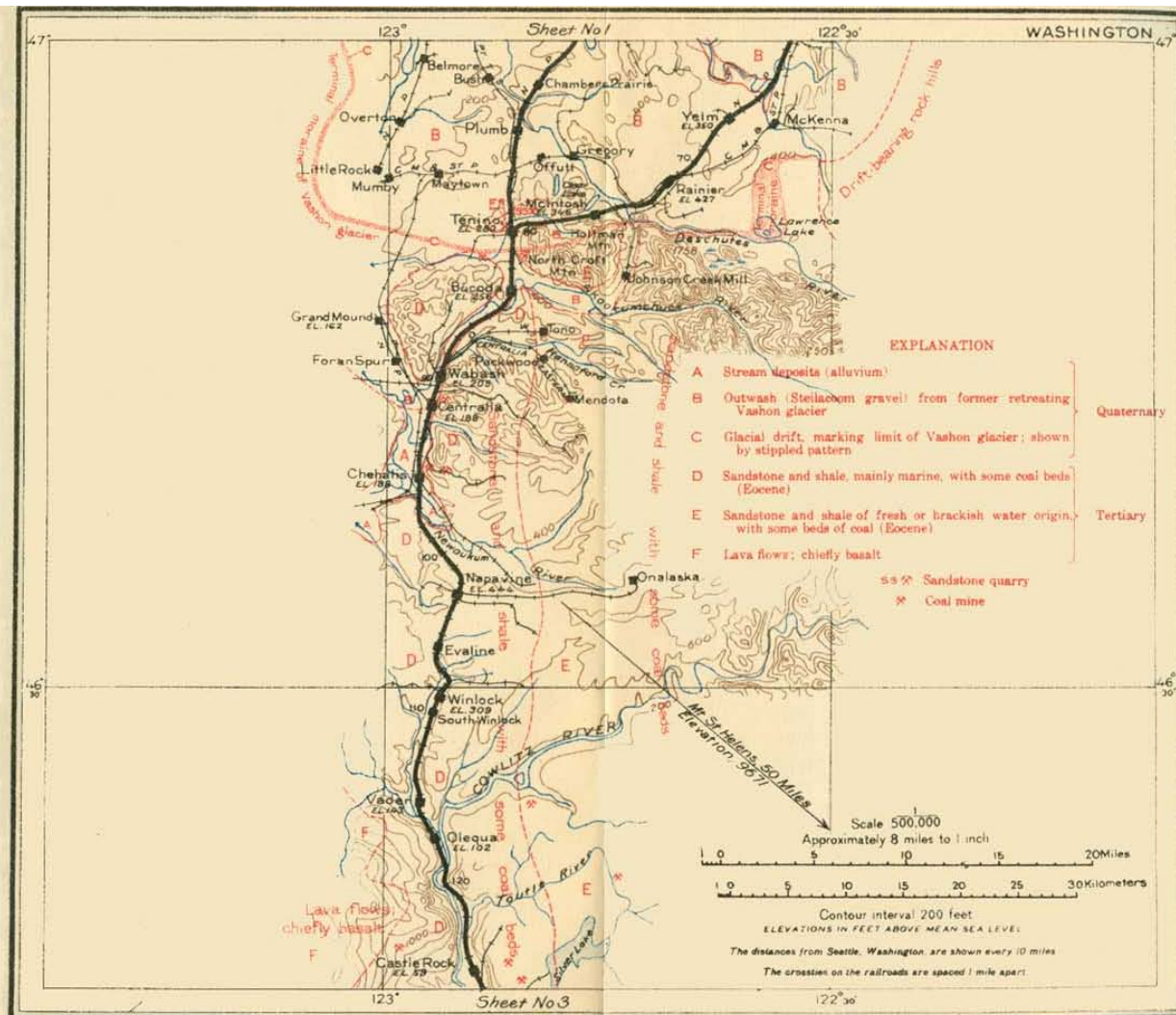
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.



GEOLOGIC AND TOPOGRAPHIC MAP
OF THE

SHASTA ROUTE

From Seattle, Washington, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

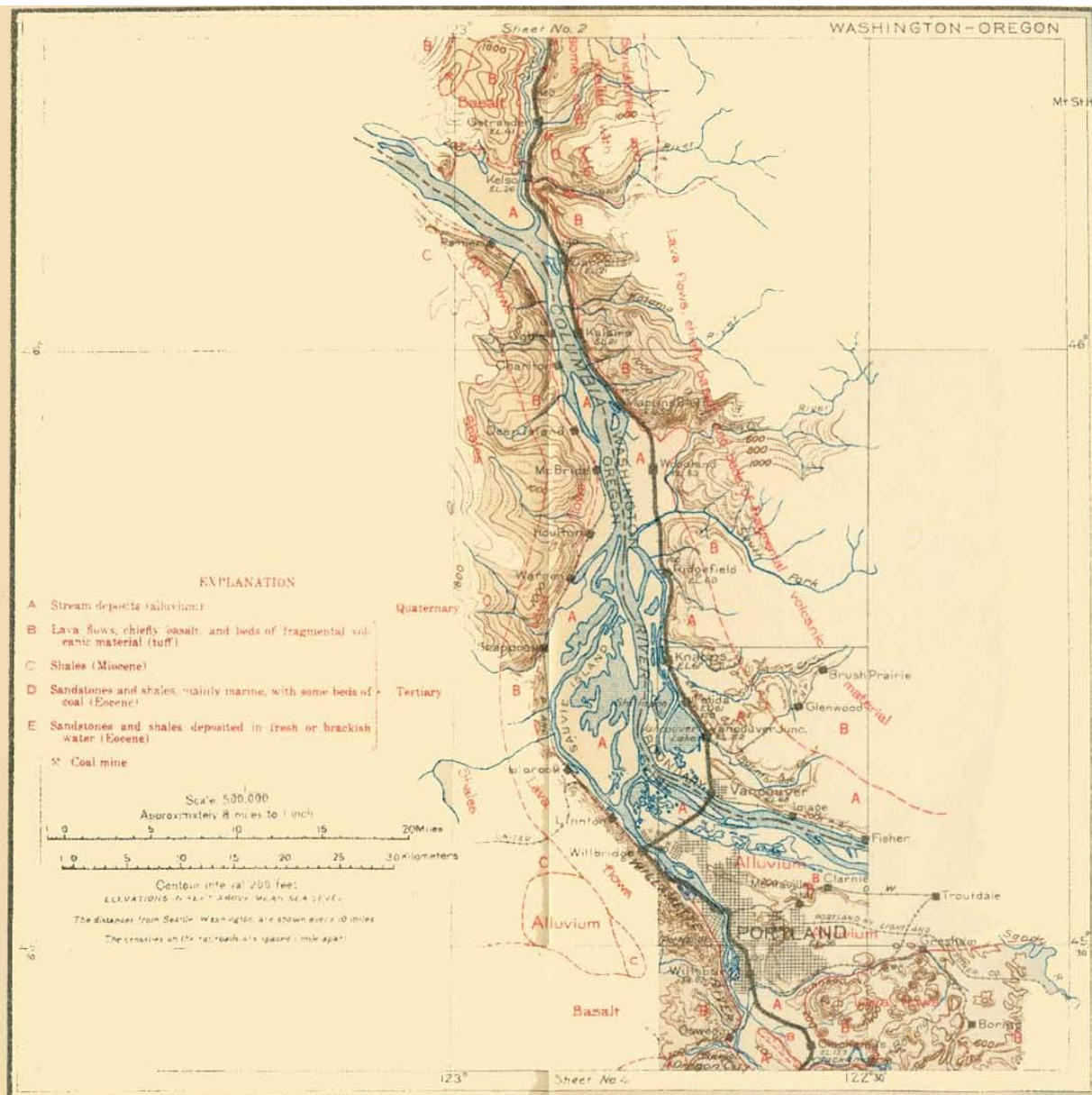
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist.

R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.





GEOLOGIC AND TOPOGRAPHIC MAP
OF THE

SHASTA ROUTE

From Seattle, Washington, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

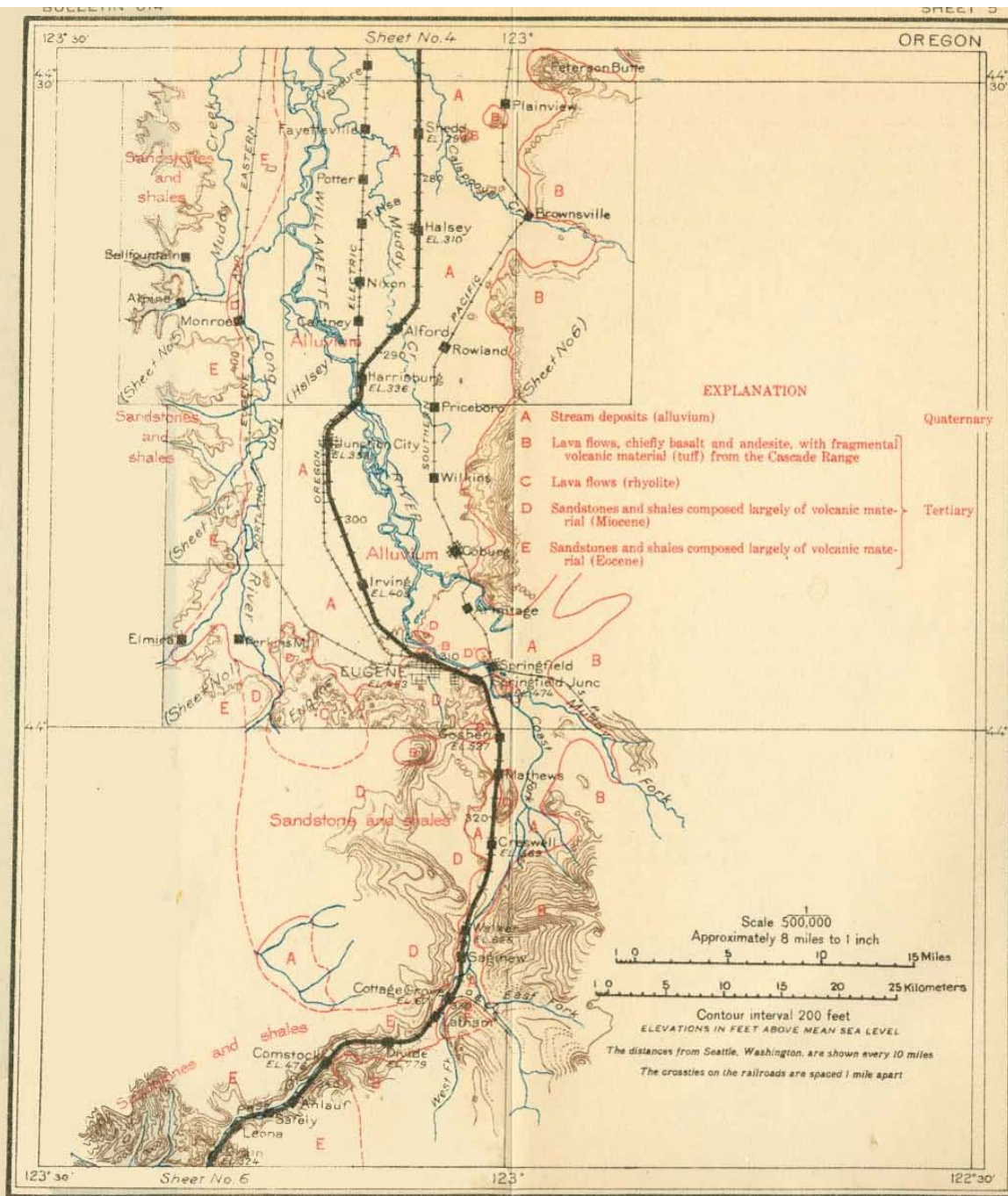
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.





GEOLOGIC AND TOPOGRAPHIC MAP
OF THE

SHASTA ROUTE

From Seattle, Washington, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

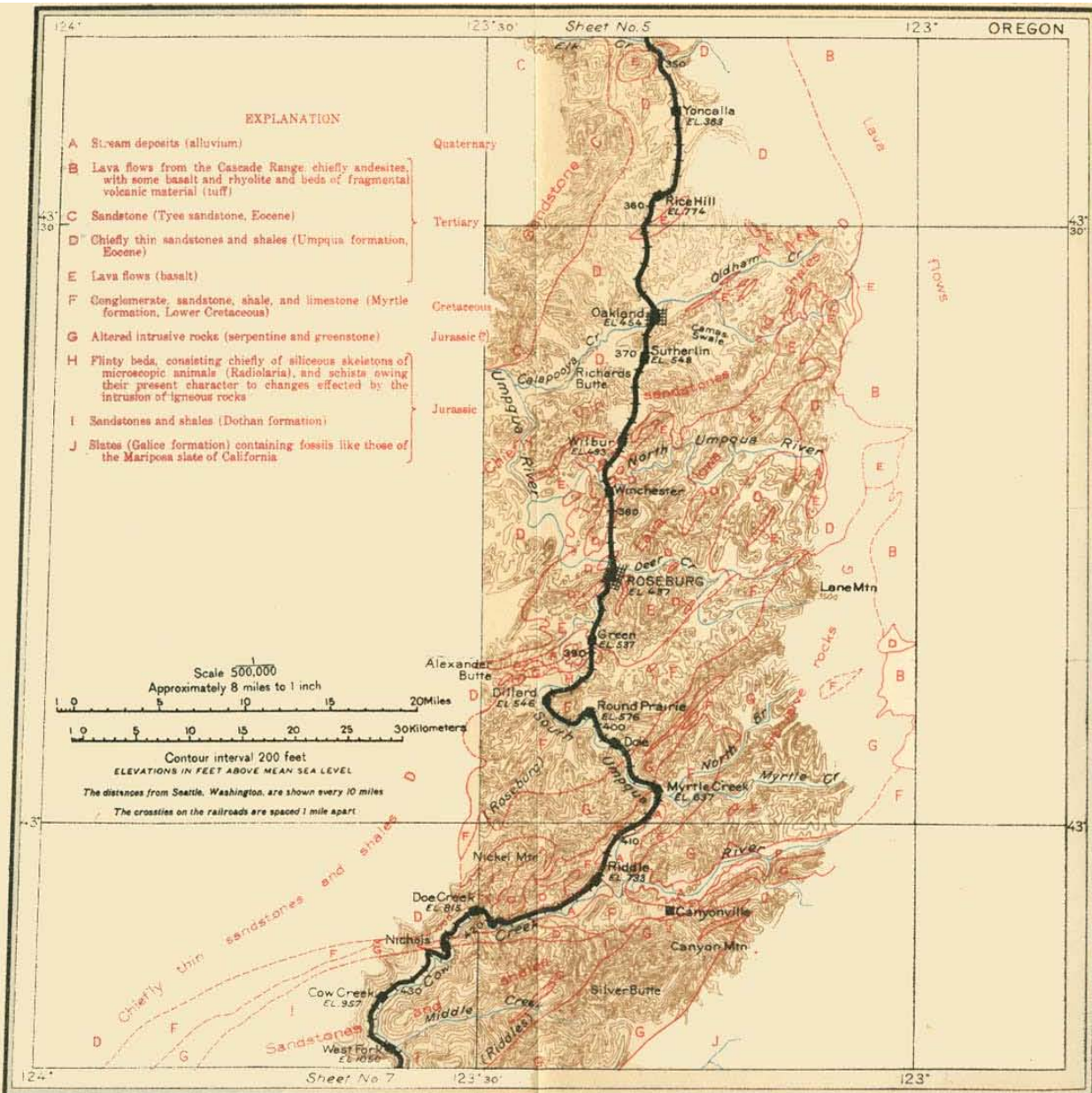
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.





GEOLOGIC AND TOPOGRAPHIC MAP
OF THE

SHASTA ROUTE

From Seattle, Washington, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

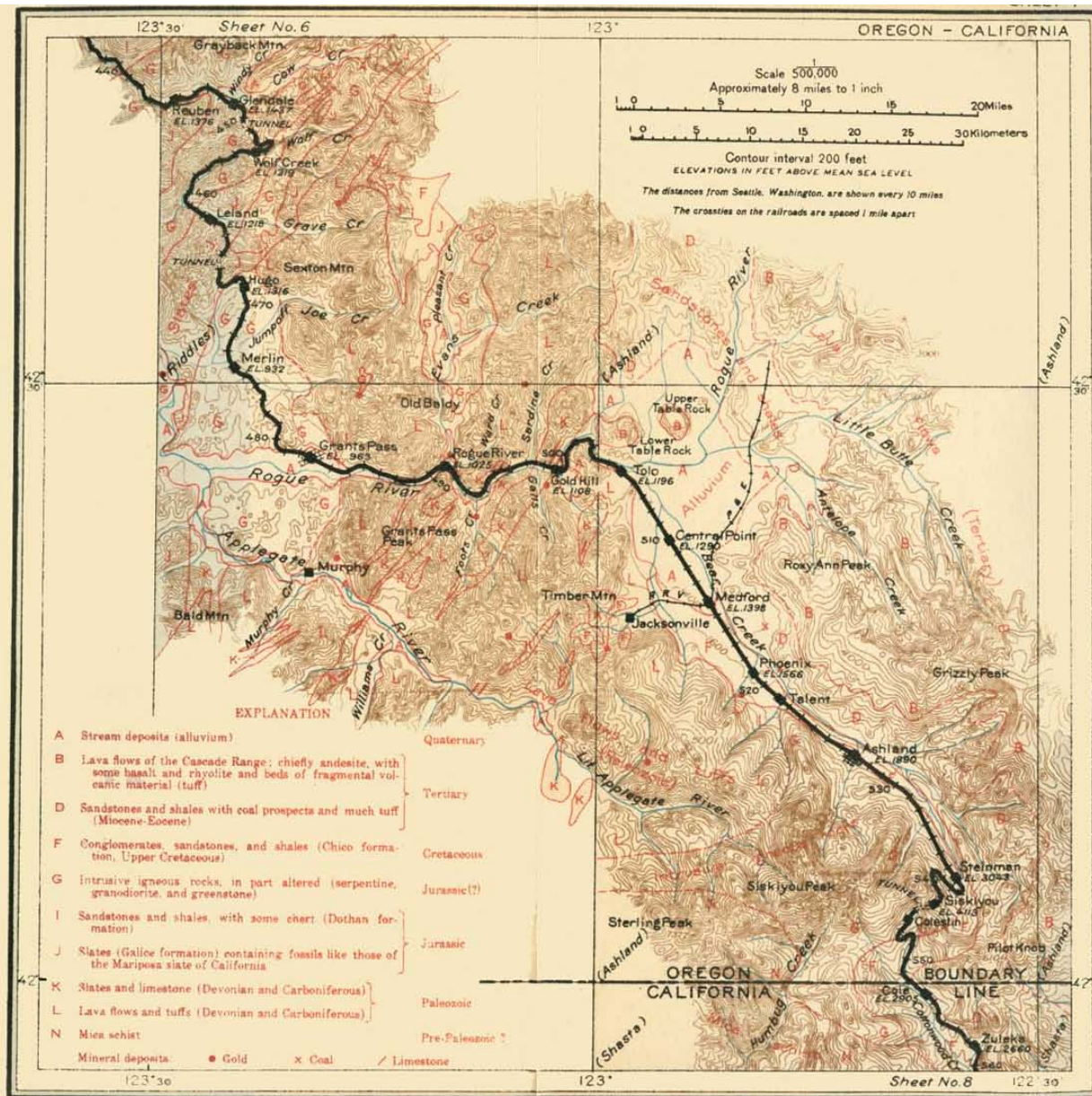
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.





GEOLOGIC AND TOPOGRAPHIC MAP

OF THE

SHASTA ROUTE

From Seattle, Washington, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

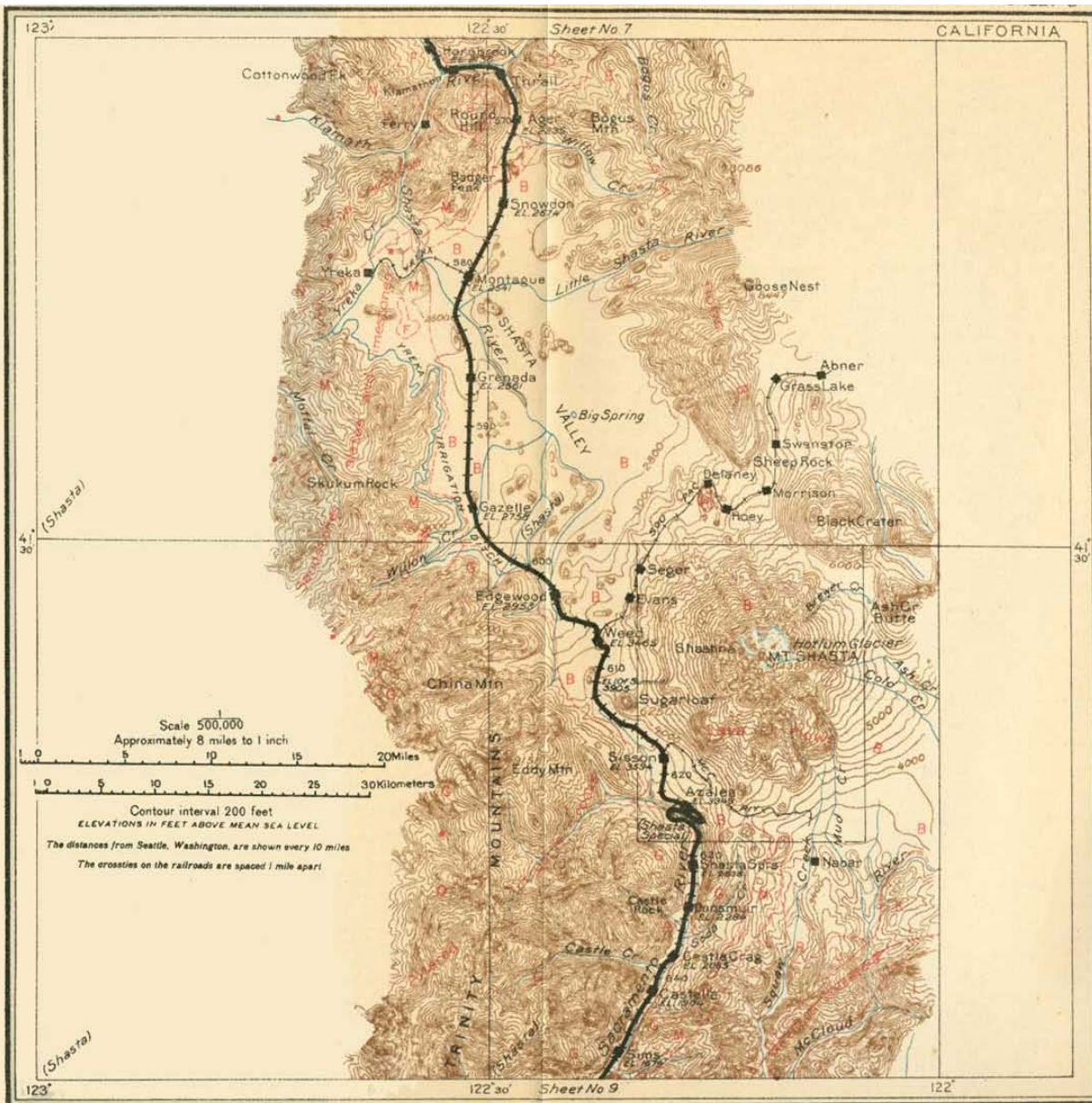
R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name

EXPLANATION

- | | | |
|---|--|-------------------|
| B | Lava flows of the Cascade Range, chiefly andesite, including Sacramento River flow, with some basalt and rhyolite and beds of fragmental volcanic material (tuffs) | Tertiary |
| D | Sandstones and shales containing "some coal" lava flows, and much tuff (Miocene Eocene) | |
| F | Forgonerates, sandstones, and shales containing fossils (Chico formation, Upper Cretaceous) | Cretaceous |
| G | Chiefly altered (intrusive rocks (serpentine and gabbro) and some altered lavas (greenstones) | Jurassic (?) |
| I | Shale (Bryok shale) and limestone (Hoselkus limestone) underlain by thin-bedded sandstones, shales, and tuffs (Pit formation) | Triassic |
| K | Tuffs (Noseon) and limestone (McCloud) of Pennsylvanian age, underlain by tuffs, sandstone, and shale (Baird) of Mississippian age | Carboniferous |
| L | Thin-bedded sandstones, shales, and conglomerates with pebbles containing Devonian fossils (Braden formation, of Mississippian age) | |
| M | Sandstones, slates, and limestones, in part at least Devonian | Devonian |
| N | Mica schists with ancient lavas and intrusive igneous rocks | Pre Paleozoic (?) |
- Mineral deposits: ∇ Limestone $\bullet$ Gold $\circ$ Quicksilver $\triangle$ Chromium $\times$ Coal





GEOLOGIC AND TOPOGRAPHIC MAP OF THE

SHASTA ROUTE

From Seattle, Washington, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

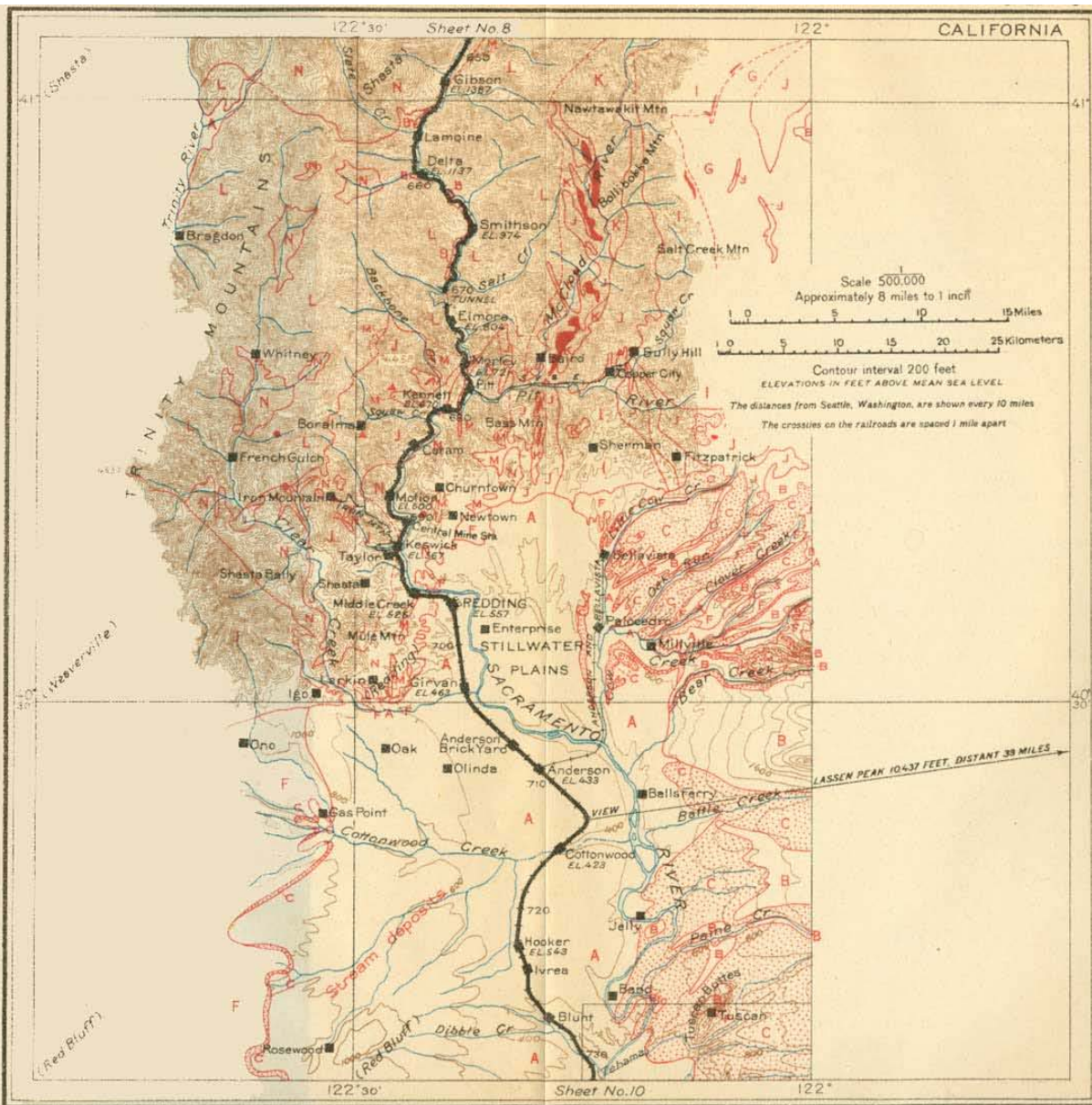
R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.

EXPLANATION

- | | | | |
|-------------------|--|---------------|---|
| A | Stream deposits (alluvium and Red Bluff formation) | Quaternary | |
| B | Lava flows (chiefly basalt) east of the Sacramento Valley and andesite in the upper Sacramento Canyon, flow from Mount Shasta | Tertiary | |
| C | Tuffs (Tuscan tuff, Pliocene); gravels, sands, and clays (Ione formation, Eocene) (stippled pattern) | | |
| F | Conglomerates, sandstones, and shales: (Chico, Horse-town, and Knoxville formations), containing Cretaceous fossils | Cretaceous | |
| G | Sandstones and shales composed largely of volcanic material (Potem and Modin formations), containing Jurassic fossils | Jurassic | |
| I | Shale (Brock shale) and limestone (Hosselkus limestone) underlain by thin-bedded sandstones, shales, and tuffs (Pit formation) | Triassic | |
| J | Lavas, tuffs, and granular intrusive rocks of Triassic to Cretaceous age | Meozoic | |
| K | Tuffs (Nasoni) and limestone (McCloud) of Pennsylvanian age, underlain by tuffs, sandstone, and shale (Baird) of Mississippian age | Carboniferous | |
| L | Thin-bedded sandstones, shales, and conglomerate; pebbles contain Devonian fossils (Bragdon formation, of Mississippian age) | | |
| M | Sandstone, shales, and limestone (Kennett formation) | Devonian | |
| N | Altered lavas and tuffs (meta-andesite) | Pre-Devonian | |
| Mineral deposits: | | | |
| ● | Gold predominant | ▲ | Copper predominant |
| △ | Chromium and iron predominant | | Limestone: represented by solid red color |





GEOLOGIC AND TOPOGRAPHIC MAP OF THE

SHASTA ROUTE

From Seattle, Washington, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

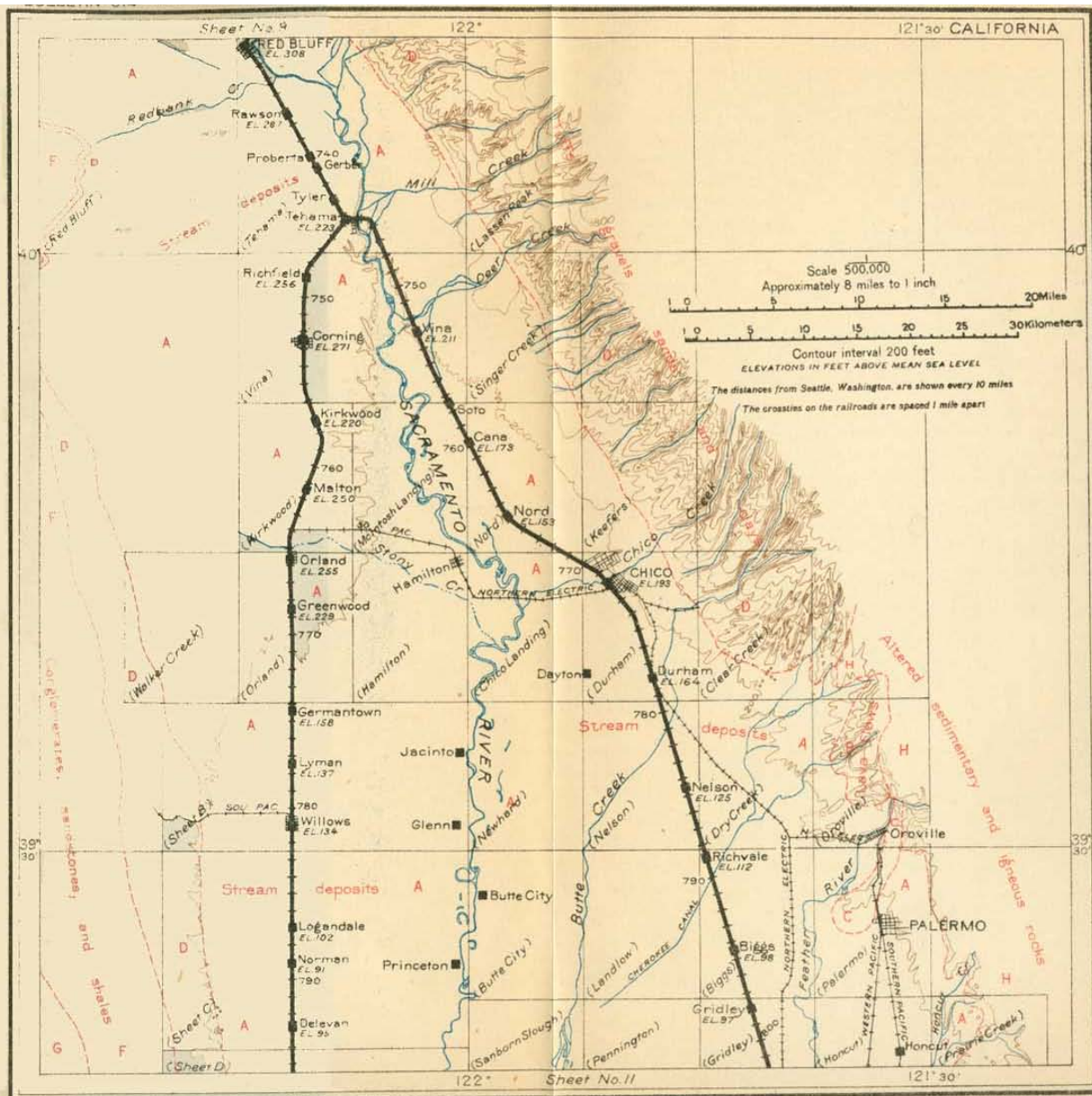
R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.

EXPLANATION

- | | | |
|---|--|------------------------|
| A | Stream deposits (alluvium and Red Bluff formation) | Quaternary |
| B | Lava flows (basalt) | |
| C | Auriferous river gravels and fine tuff | Tertiary |
| D | Tuffs (Tuscan tuff, Pliocene); gravels, sands, and clays (lone formation, Eocene) | |
| F | Conglomerates, sandstones, and shales (Chico, Horse-town, and Knoxville formations) | Cretaceous |
| G | Sandstones and shales, with flinty beds (cherts) made up of microscopic siliceous skeletons of radiolarians and limestones made up of microscopic calcareous foraminifers (Franciscan group) | Jurassic (?) |
| H | Altered sedimentary and igneous rocks underlying auriferous gravels of Sierra Nevada | Mesozoic and Paleozoic |





GEOLOGIC AND TOPOGRAPHIC MAP OF THE

SHASTA ROUTE

From Seattle, Washington, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

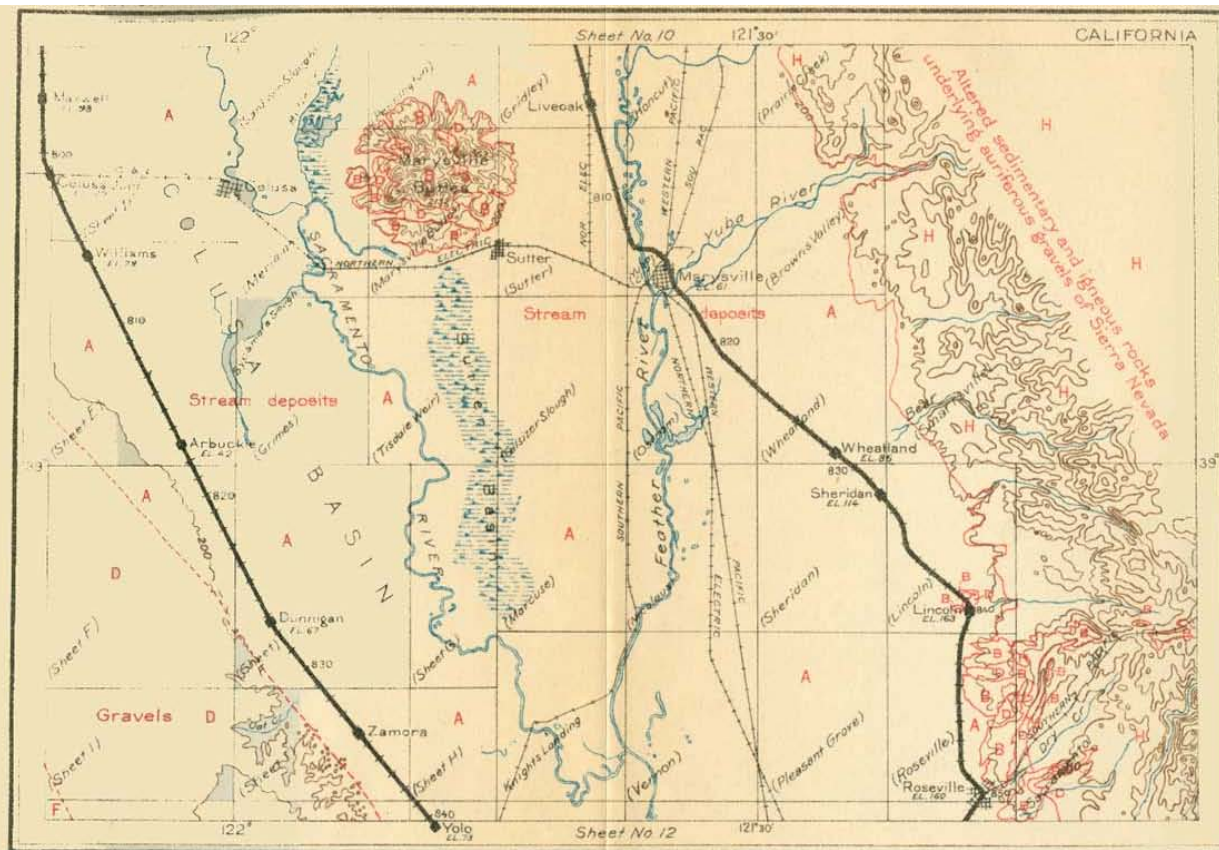
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

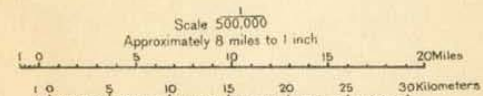
1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name



EXPLANATION

- | | | |
|---|---|------------------------|
| A | Stream deposits (alluvium and Red Bluff formation) | Quaternary |
| B | Lava flows and tuffs (andesites and some rhyolites) | Tertiary |
| C | River gravels (auriferous) and fine tuffs | |
| D | Gravels, in part marine, locally auriferous, with marine sandstones and clays (Lone and Tejon formations) | Cretaceous |
| F | Conglomerate, sandstones, and shales (Chico, Horse-town, and Knoxville formations) | |
| H | Altered sedimentary and igneous rocks underlying auriferous gravels of Sierra Nevada | Mesozoic and Paleozoic |



Scale 500,000
Approximately 8 miles to 1 inch
Contour interval 200 feet
ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL
The distances from Seattle, Washington, are shown every 10 miles
The cross-ticks on the railroads are spaced 1 mile apart



GEOLOGIC AND TOPOGRAPHIC MAP
OF THE

SHASTA ROUTE

From Seattle, Washington, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

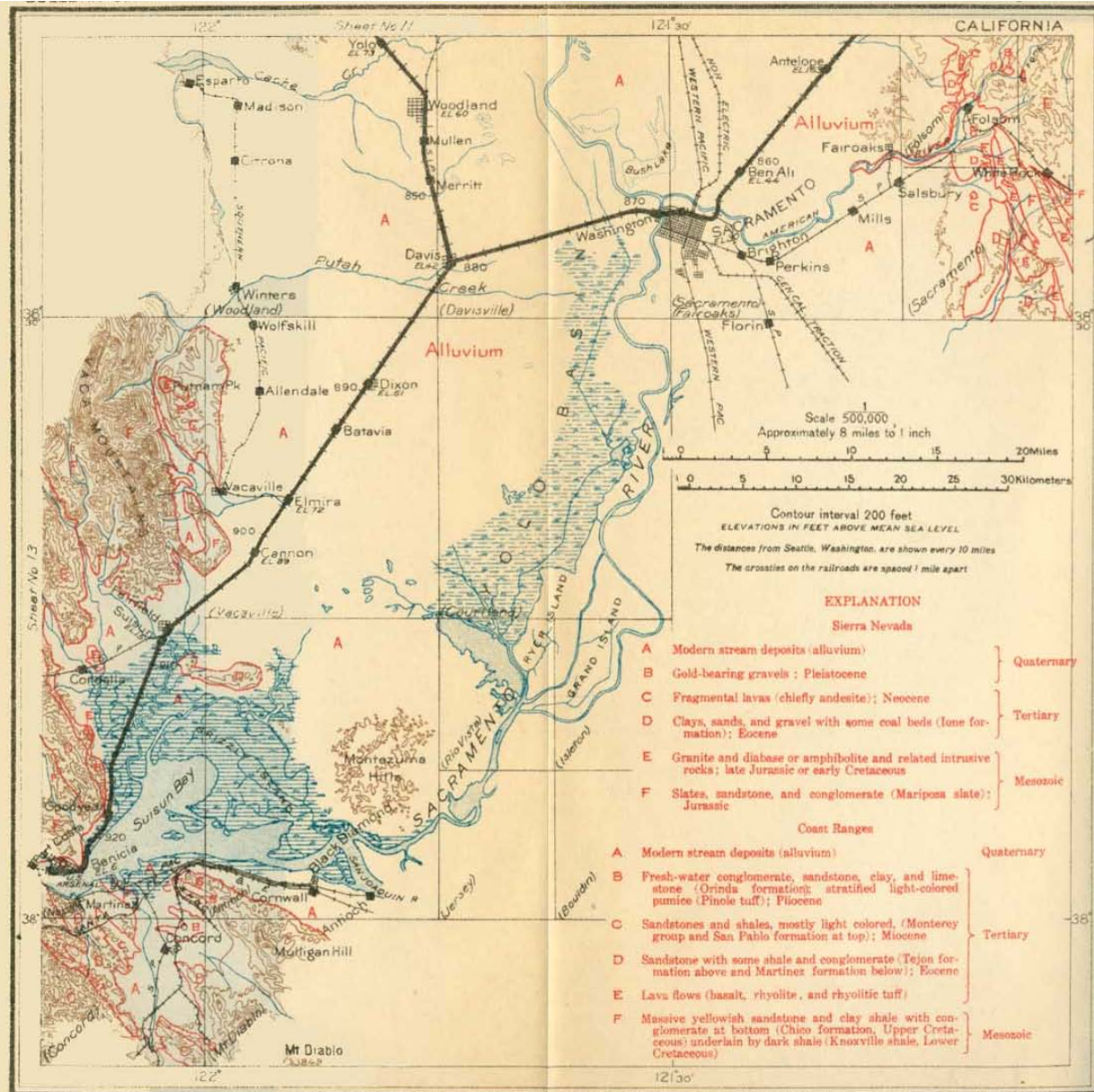
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.





GEOLOGIC AND TOPOGRAPHIC MAP OF THE

SHASTA AND COAST ROUTES

From Seattle, Washington, to San Francisco, California
and
From Los Angeles, California, to San Francisco, California

Base compiled from United States Geological Survey Atlas
Sheets, from railroad alignments and profiles supplied by
the Southern Pacific Company and from additional information
collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

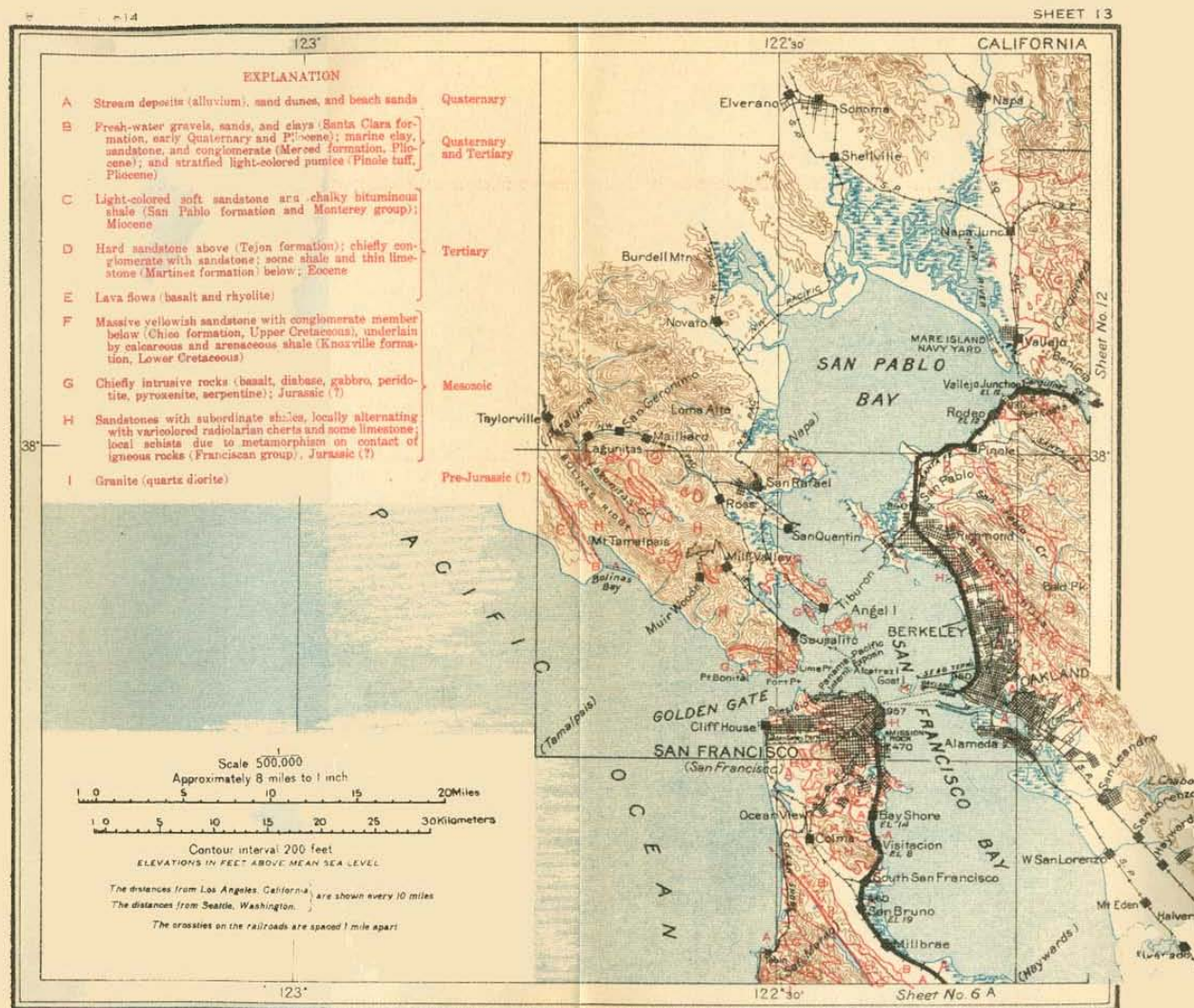
Each quadrangle shown on the map with a name in parentheses, in the
lower left corner is mapped in detail on the U.S. Geological Survey
Atlas of that name



MAP SHOWING GEOLOGIC FORMATIONS ALONG THE SOUTH SHORE OF SAN PABLO BAY



TOPOGRAPHIC MAP OF THE SOUTH SHORE OF SAN PABLO BAY



SHEET 13

CALIFORNIA

Sheet No. 12

Sheet No. 6 A

EXPLANATION

- A Stream deposits (alluvium), sand dunes, and beach sands
- B Fresh-water gravels, sands, and clays (Santa Clara formation, early Quaternary and Pliocene); marine clay, sandstone, and conglomerate (Merced formation, Pliocene); and stratified light-colored pumice (Pinole tuff, Pliocene)
- C Light-colored soft sandstone and chalky bituminous shale (San Pablo formation and Monterey group); Miocene
- D Hard sandstone above (Tejon formation); chiefly conglomerate with sandstone; some shale and thin limestone (Martinez formation) below; Eocene
- E Lava flows (basalt and rhyolite)
- F Massive yellowish sandstone with conglomerate member below (Chico formation, Upper Cretaceous); underlain by calcareous and arenaceous shale (Knoxville formation, Lower Cretaceous)
- G Chiefly intrusive rocks (basalt, diabase, gabbro, peridotite, pyroxenite, serpentine); Jurassic (?)
- H Sandstones with subordinate shales, locally alternating with varicolored radiolarian cherts and some limestone; local schists due to metamorphism on contact of igneous rocks (Franciscan group); Jurassic (?)
- I Granite (quartz diorite)

Quaternary
Quaternary and Tertiary
Tertiary
Mesozoic
Pre-Jurassic (?)

Scale 500,000

Approximately 8 miles to 1 inch

0 5 10 15 20 25 30 Miles
0 5 10 15 20 25 30 Kilometers

Contour interval 200 feet
ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL

The distances from Los Angeles, California, are shown every 10 miles
The distances from Seattle, Washington, are shown every 10 miles

The crossings on the railroads are spaced 1 mile apart



GEOLOGIC AND TOPOGRAPHIC MAP OF THE COAST ROUTE

From Los Angeles, California, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.





GEOLOGIC AND TOPOGRAPHIC MAP OF THE COAST ROUTE

From Los Angeles, California, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

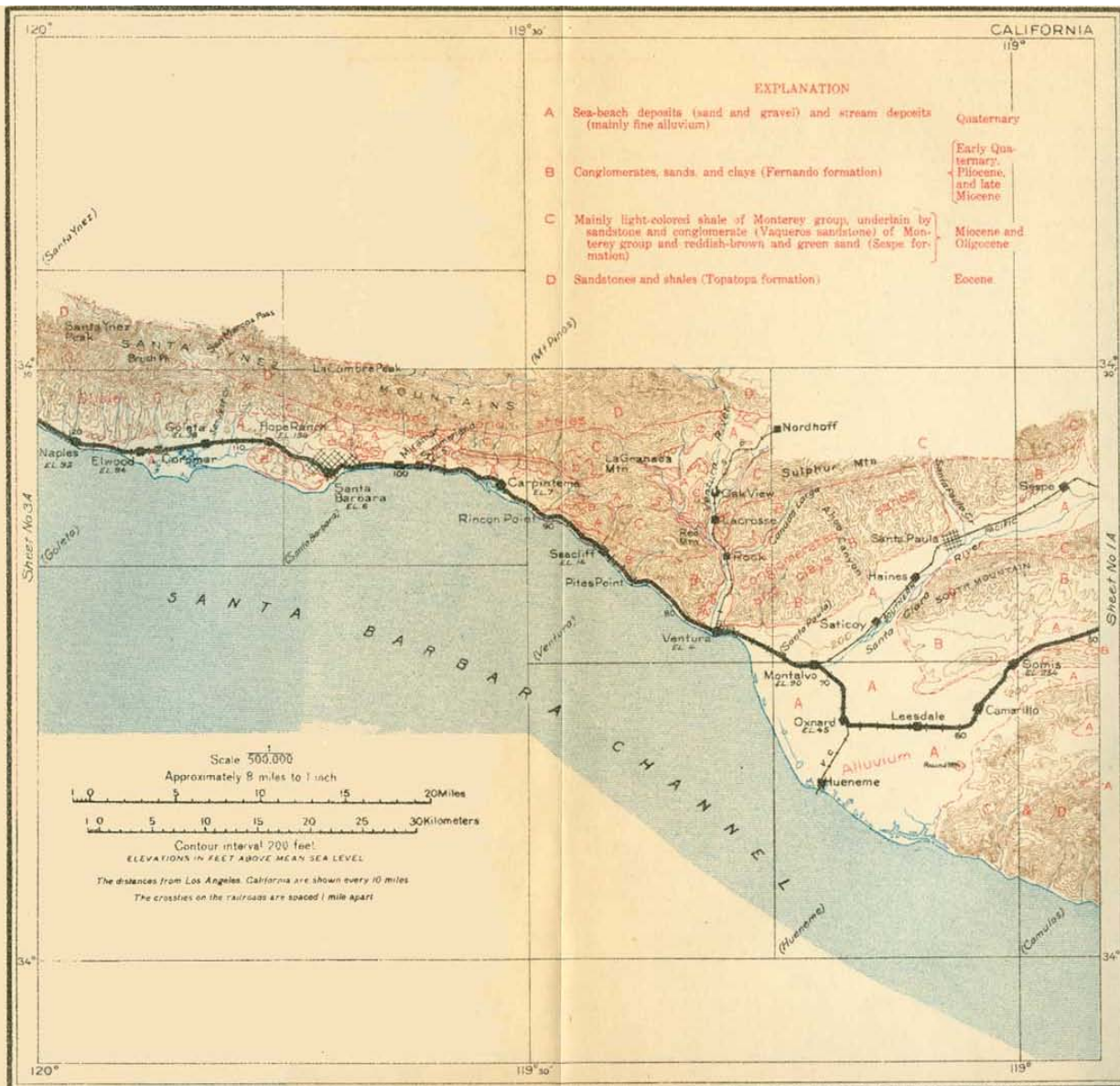
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.





GEOLOGIC AND TOPOGRAPHIC MAP OF THE

COAST ROUTE

From Los Angeles, California, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company.

UNITED STATES GEOLOGICAL SURVEY

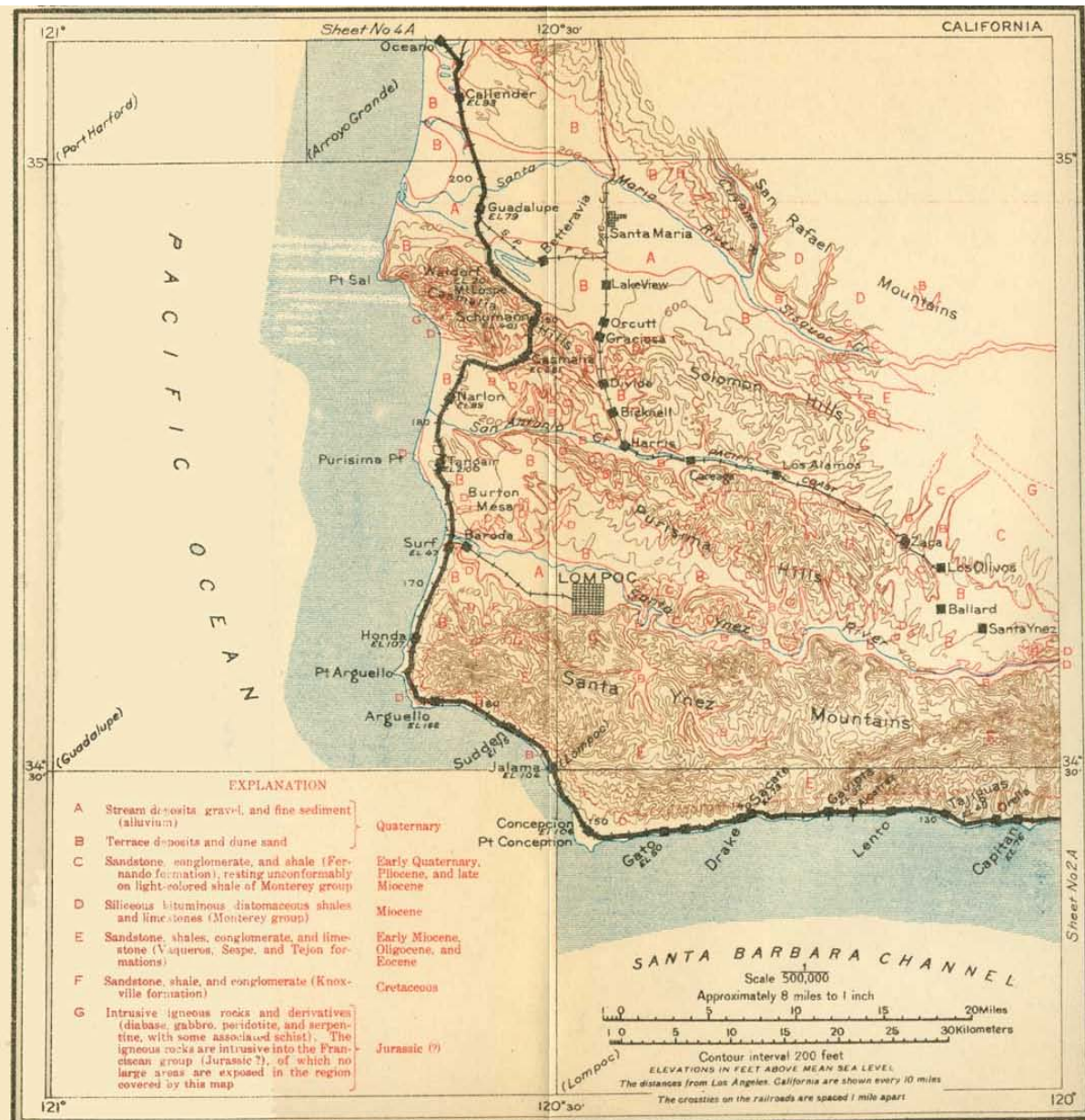
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.



GEOLOGIC AND TOPOGRAPHIC MAP
OF THE

COAST ROUTE

From Los Angeles, California, to San Francisco, California

Base compiled from United States Geological Survey Atlas Sheets, from railroad alignments and profiles supplied by the Southern Pacific Company and from additional information collected with the assistance of this company

UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

Each quadrangle shown on the map with a name in parenthesis in the lower left corner is mapped in detail on the U. S. G. S. Topographic Sheet of that name.



GEOLOGIC AND TOPOGRAPHIC MAP
OF THE

COAST ROUTE

From Los Angeles, California, to San Francisco, California

Base compiled from United States Geological Survey Atlas
Sheets, from railroad alignments and profiles supplied by
the Southern Pacific Company and from additional informa-
tion collected with the assistance of this company.

UNITED STATES GEOLOGICAL SURVEY

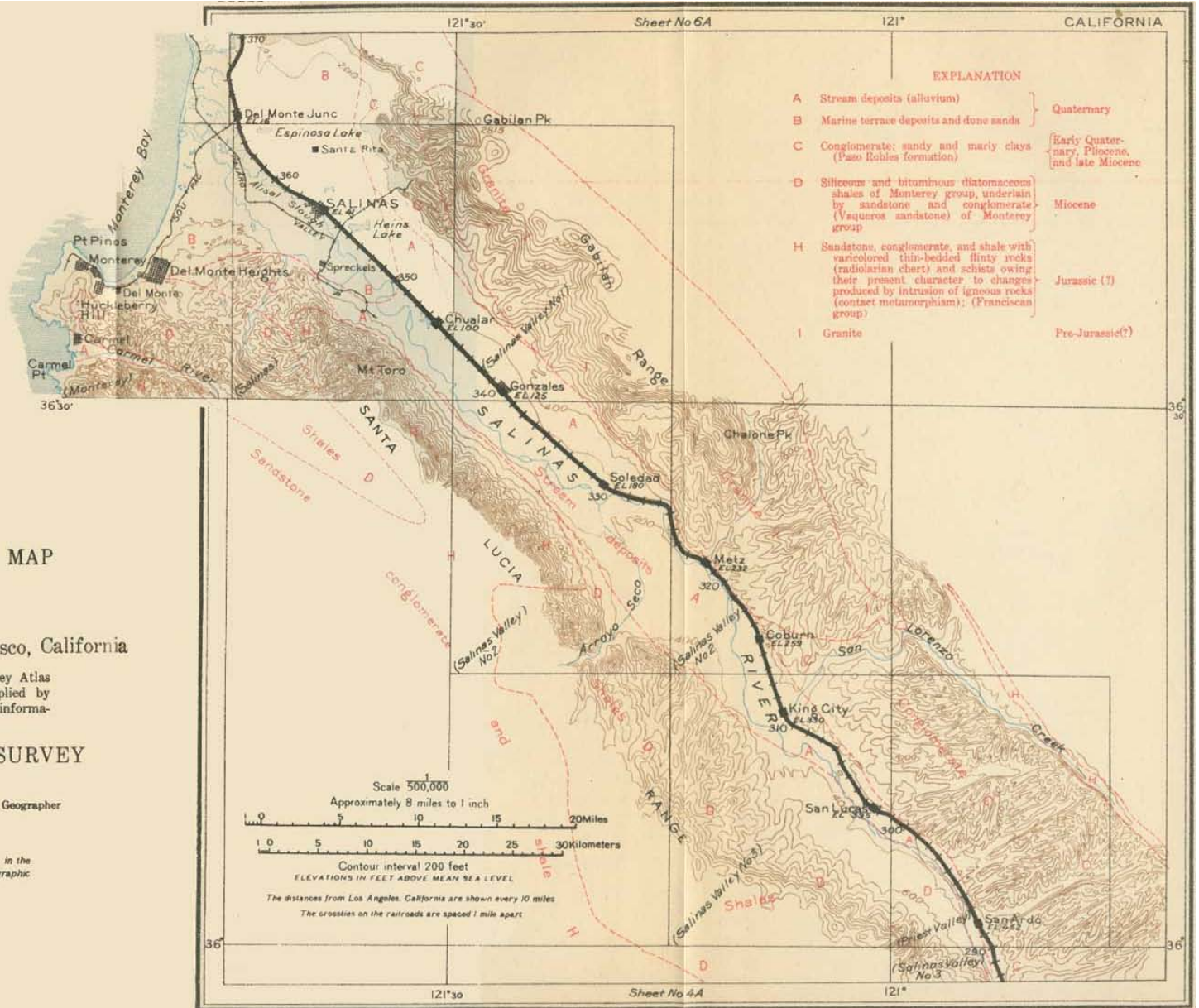
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist

R. B. Marshall, Chief Geographer

1915

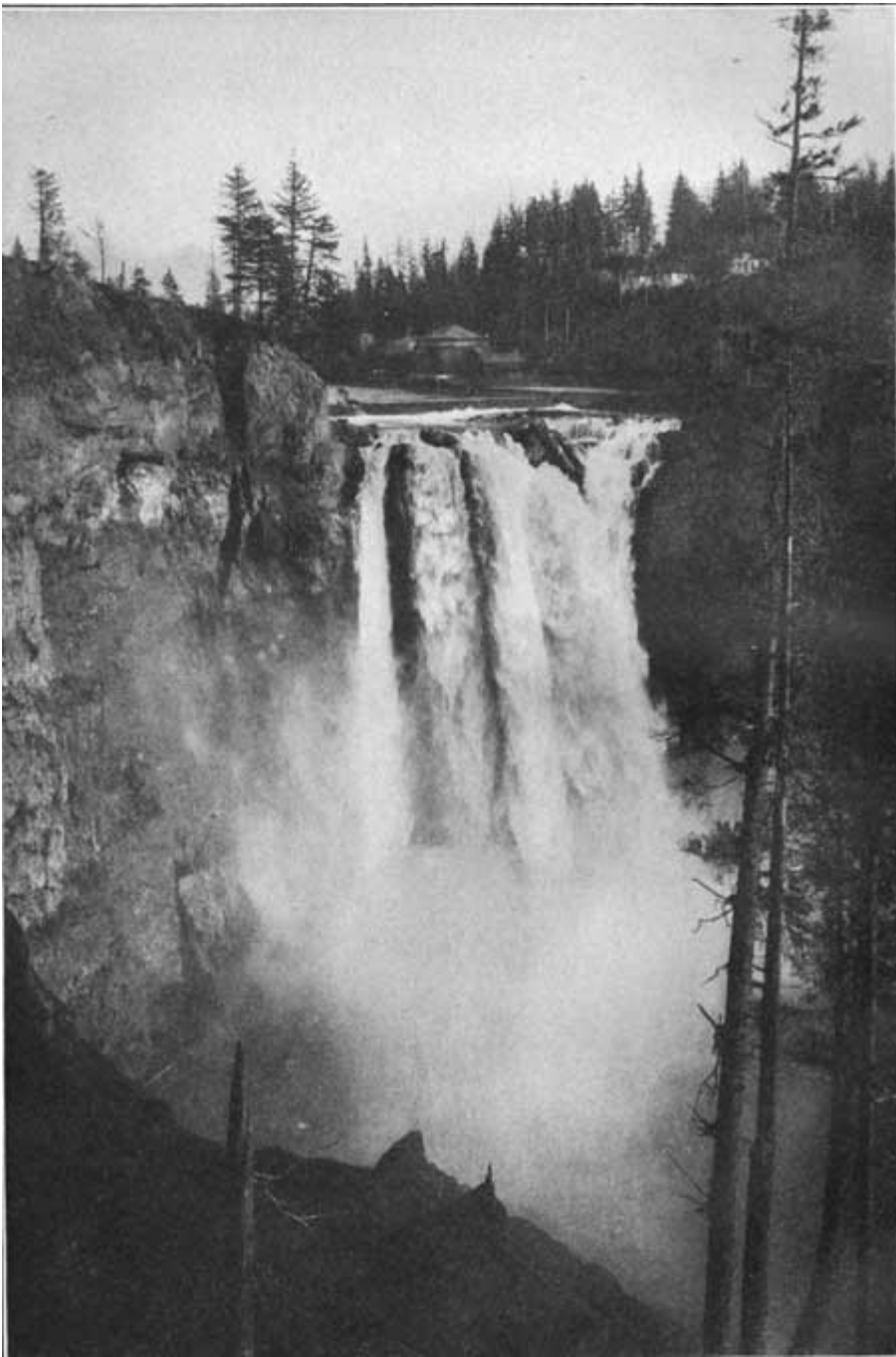
Each quadrangle shown on the map with a name in parenthesis at the
lower left corner is mapped in detail on the U. S. G. S. Topographic
Sheet of that name.



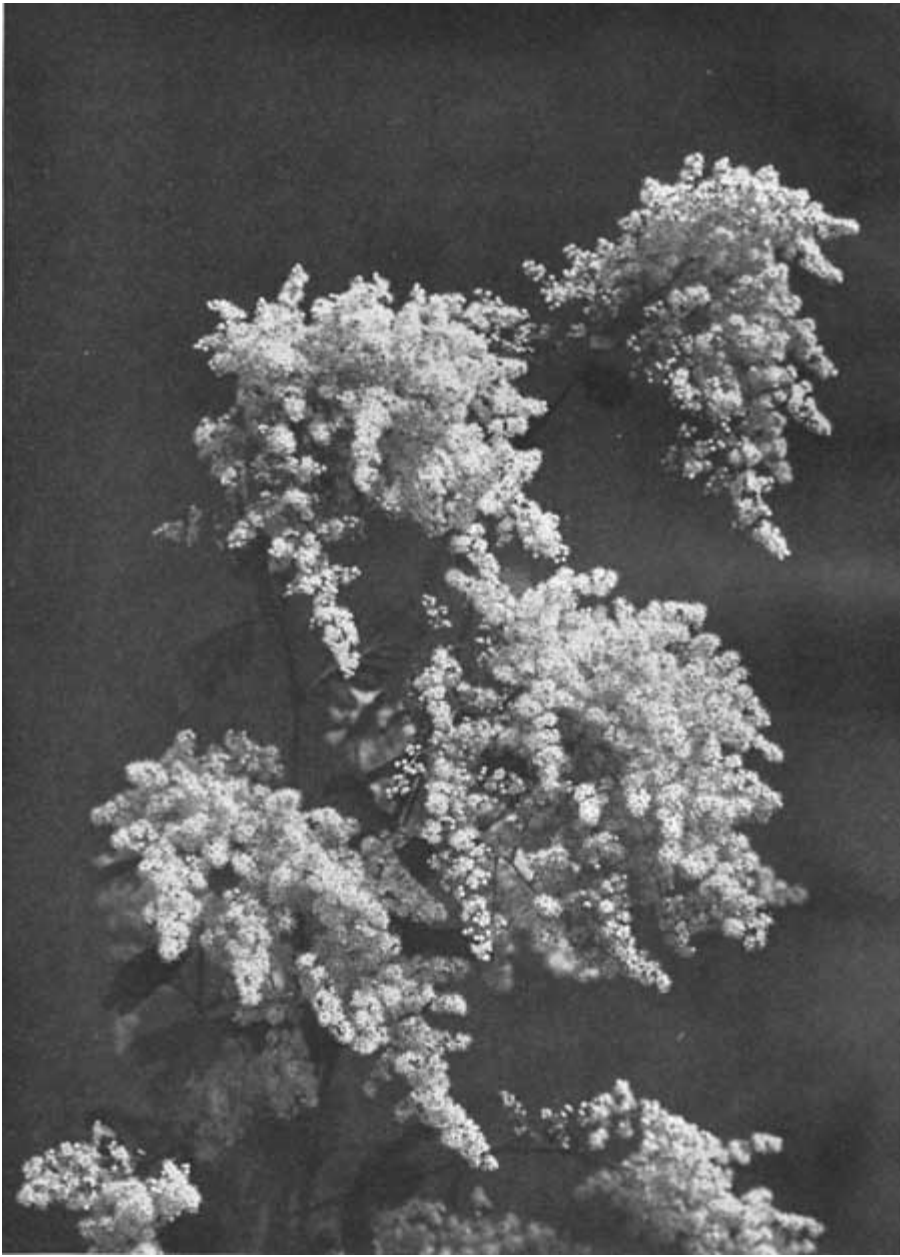












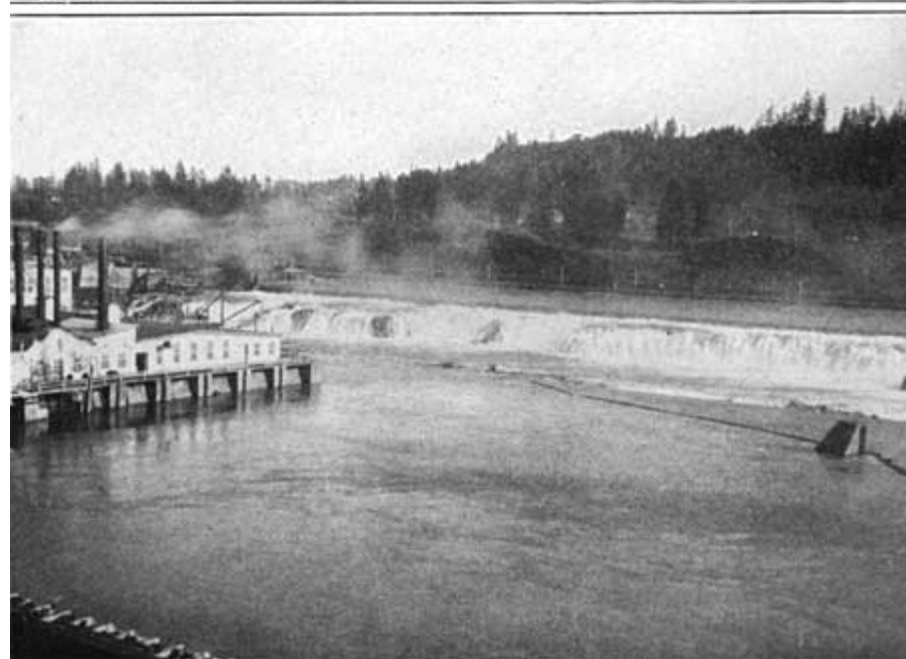




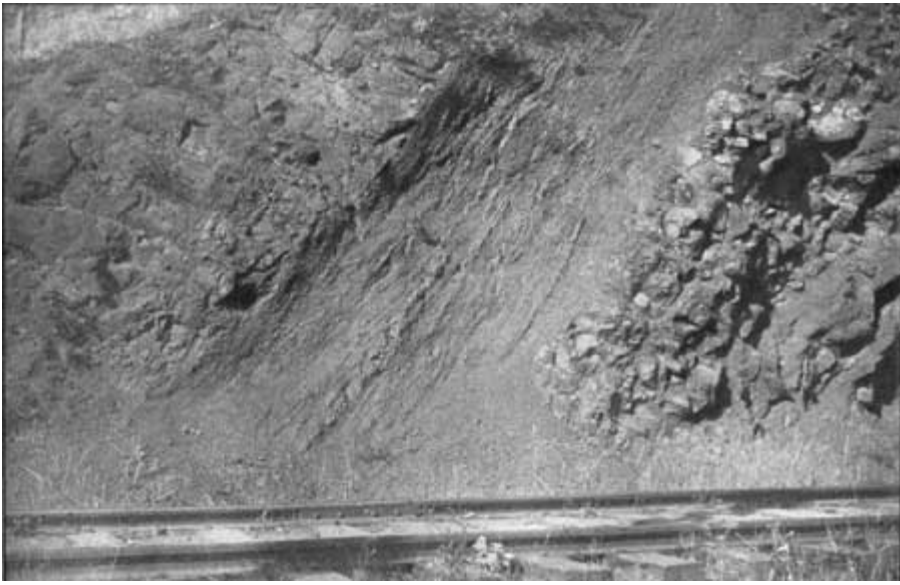




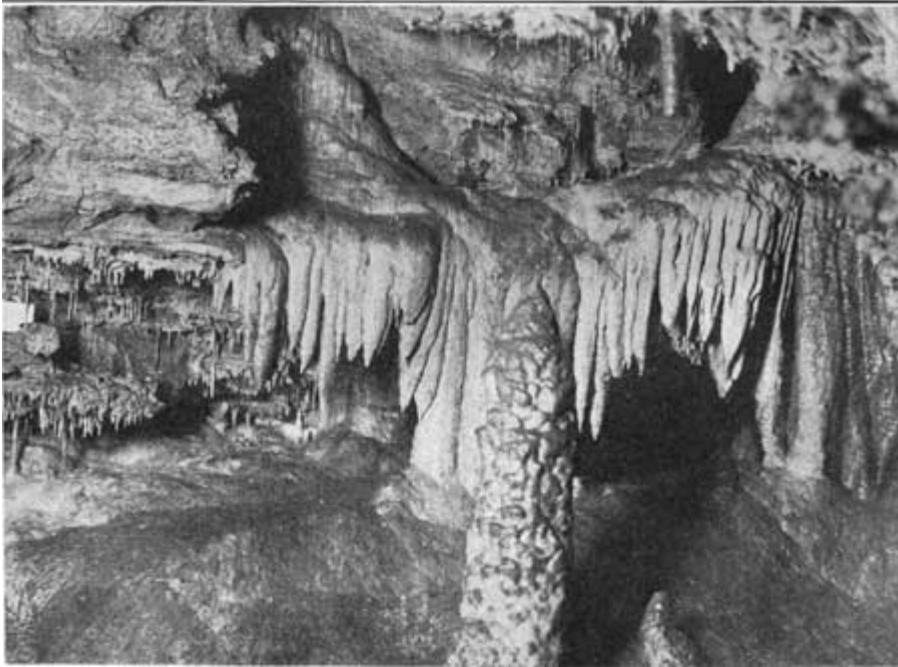




















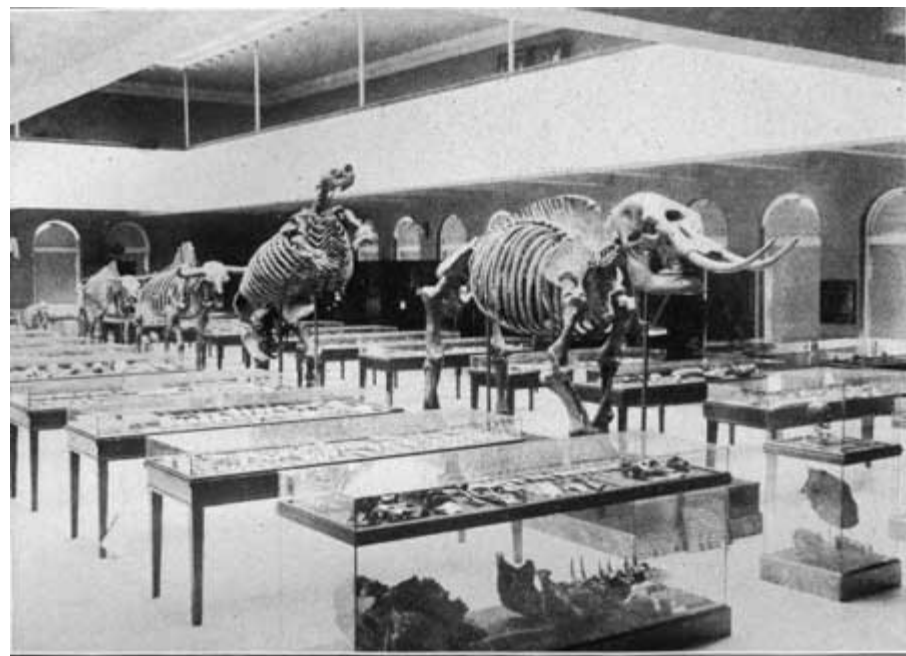






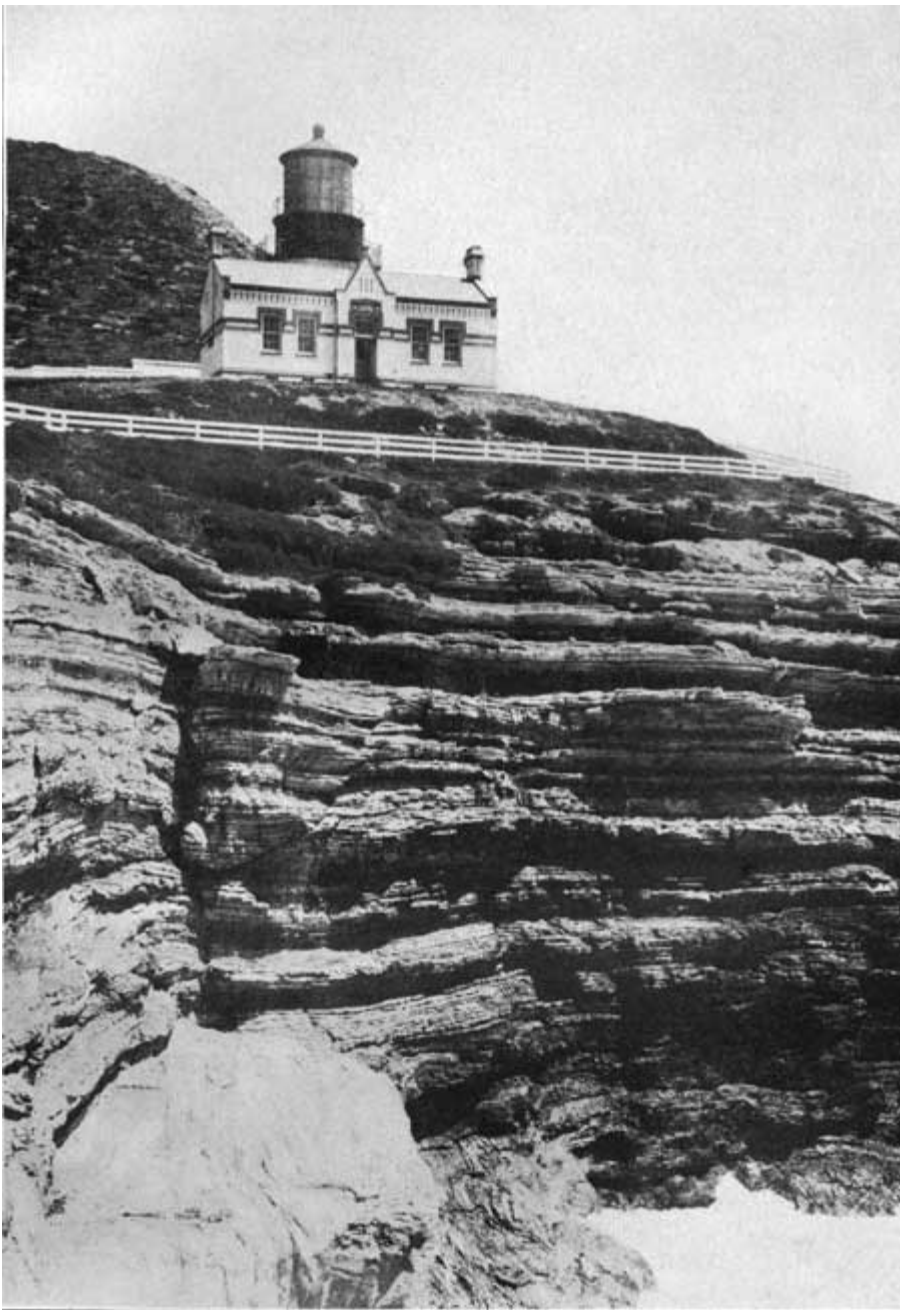




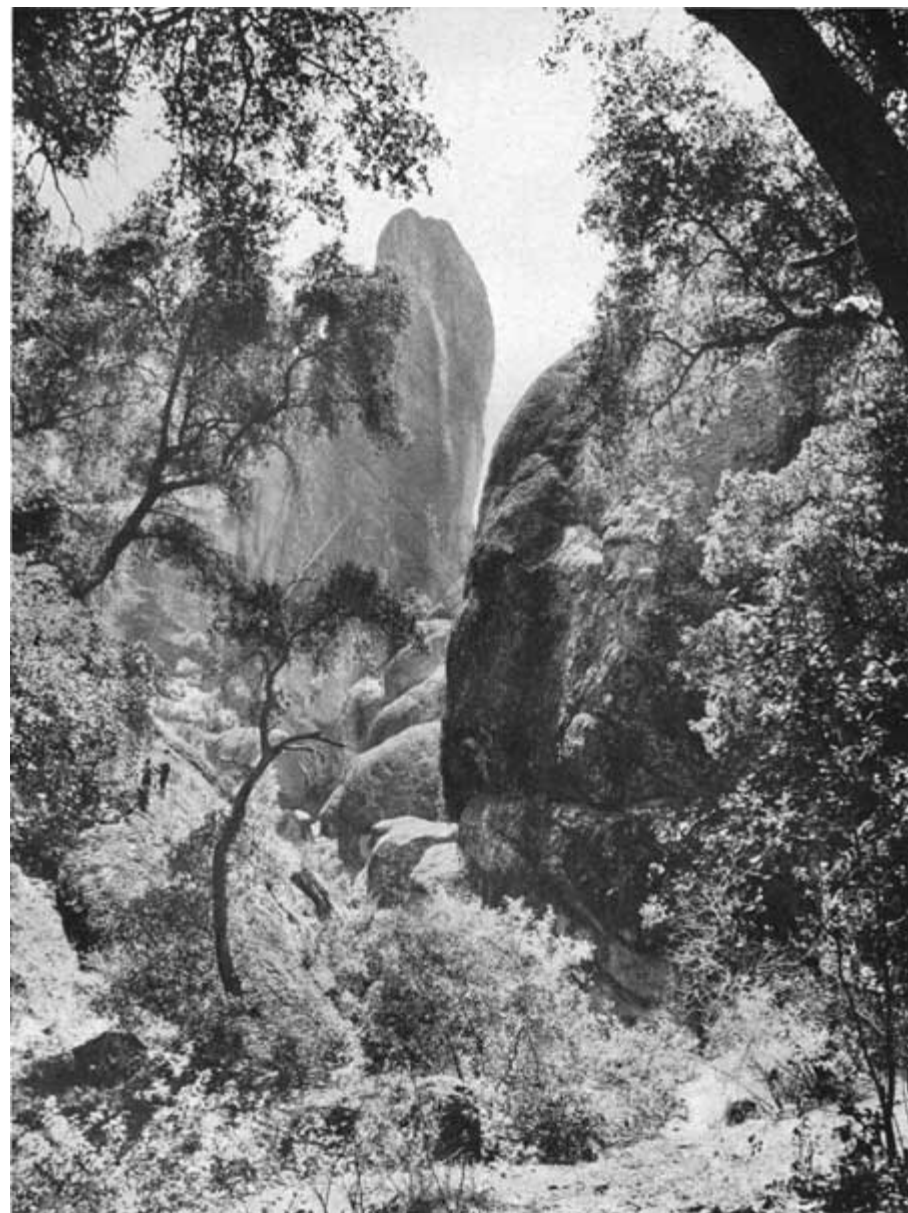






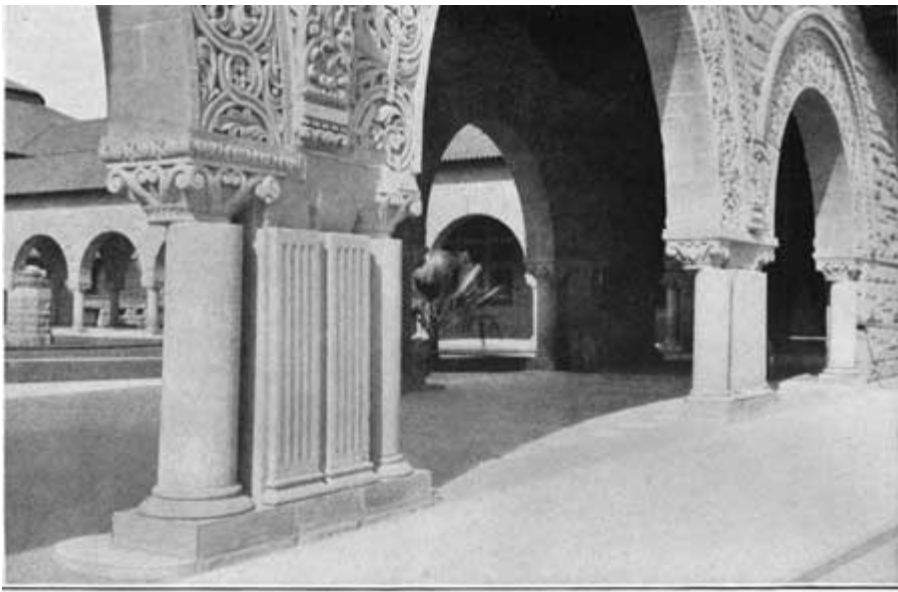








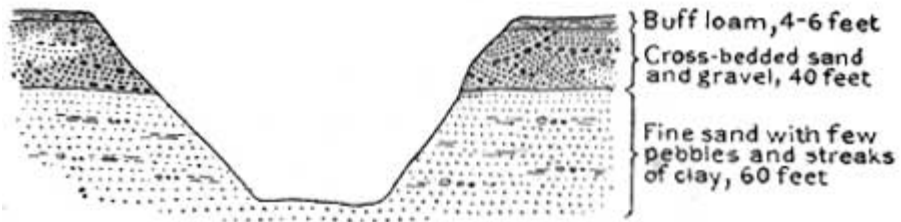




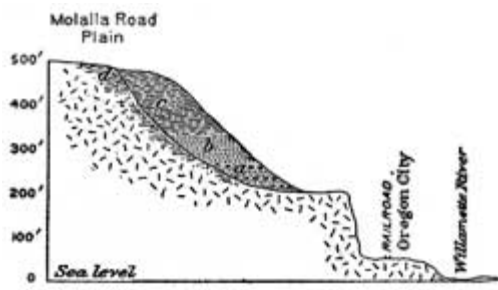


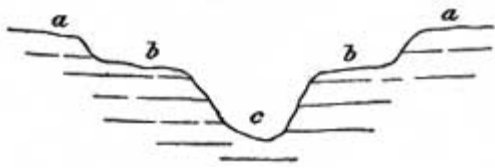


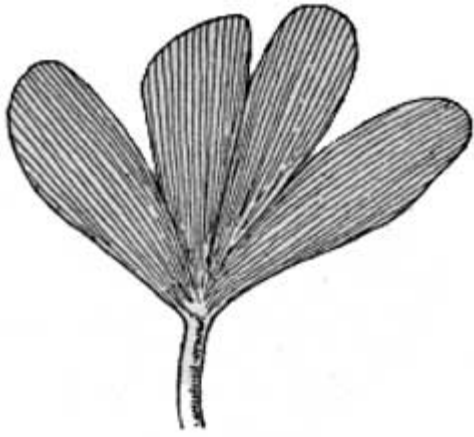


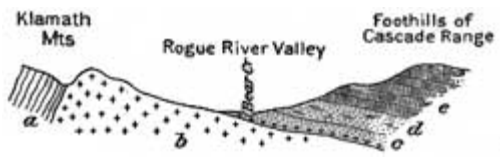


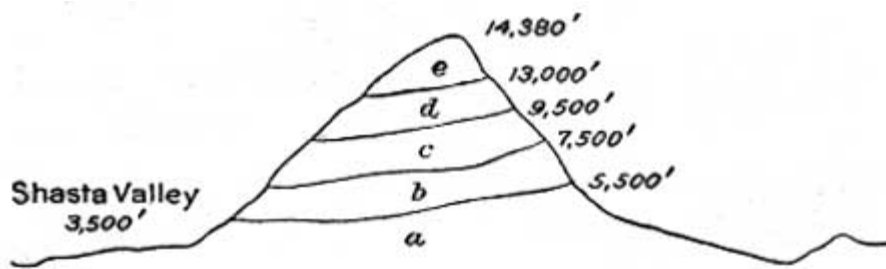


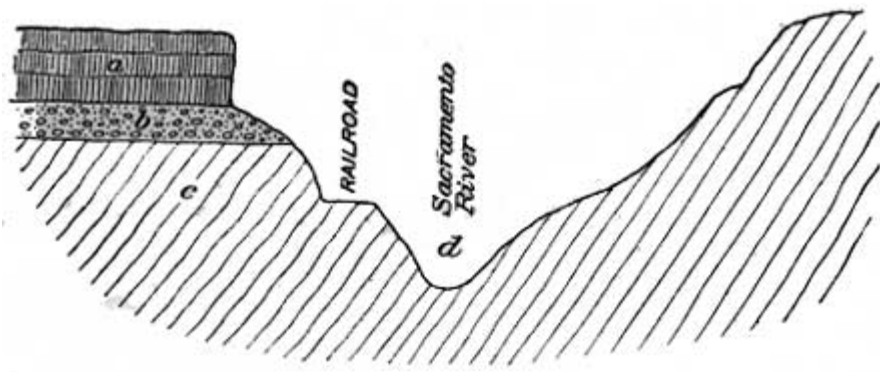


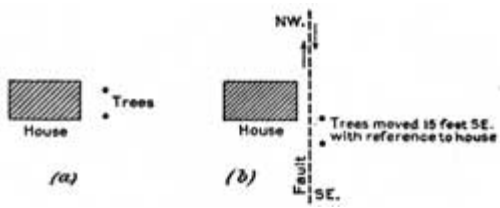




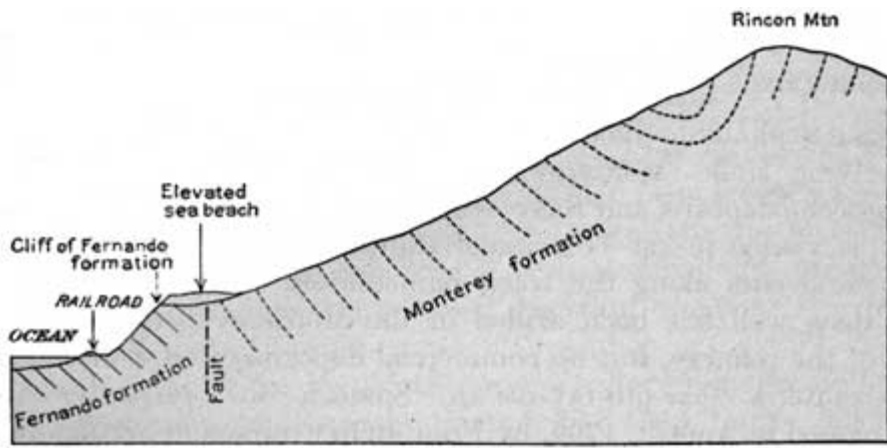


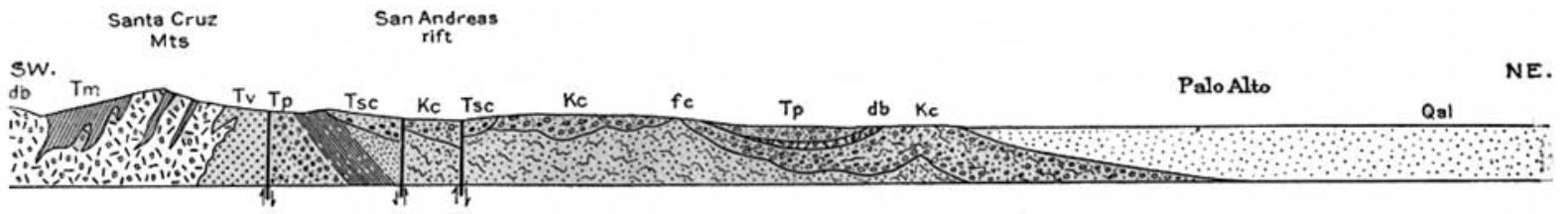










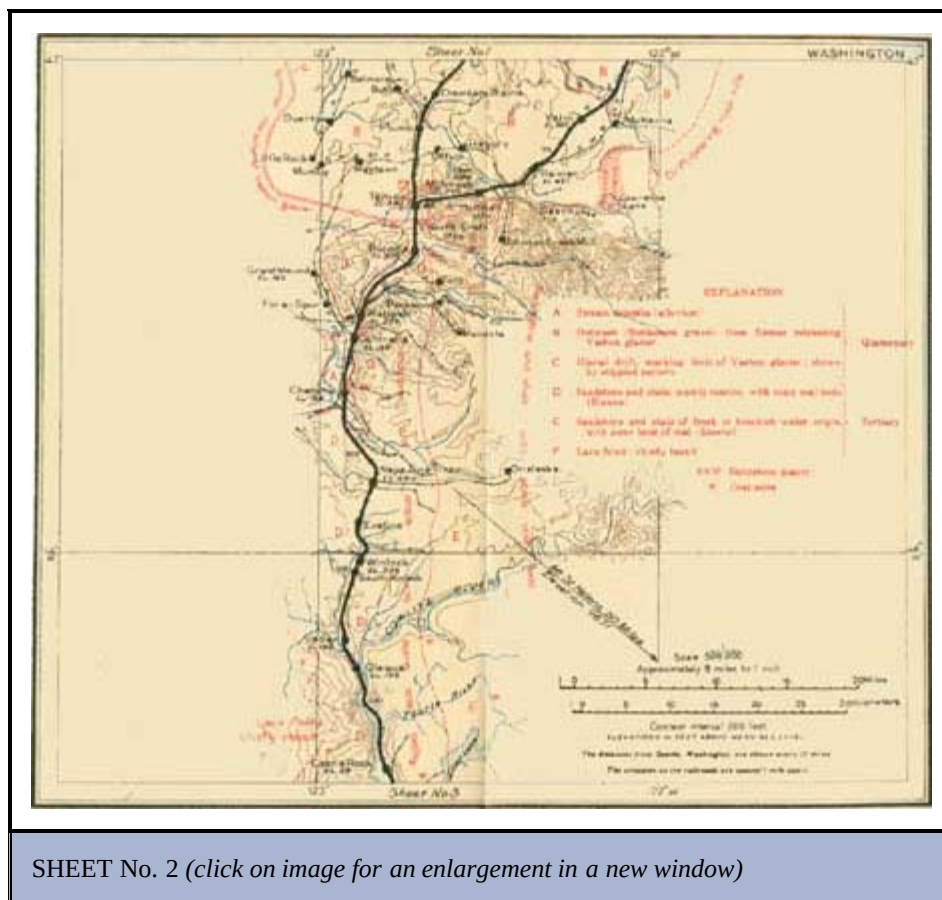




Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

ITINERARY



Kyro.

Seattle 71 miles.

The material of the terminal moraine southeast of Olympia is best exposed in the area surrounding Patterson Lake. The railway cuts are not deep, however, and are therefore not very satisfactory to the geologic observer. The open prairies on the glacial outwash plain (that is, the plain formed by gravel washed from the front of the glacier) begin at Kyro. They present a sharp contrast with the dense forests around them and are probably due to some peculiarity of soil or drainage that is unfavorable to forest growth. Several miles beyond is Chambers Prairie, which is 2 miles north of the railroad station of the same name. (See sheet 2, p. 24.) From this prairie excellent views may be obtained of Mount Rainier, in the rear, to the left, and of the Black Hills, ahead, to the right. Just before Plumb is reached there is another fine view of Mount Rainier, across a meadow.

Plumb.

Seattle 81 miles.

At milepost 38 the railway enters Rocky Prairie, which is notable for its curious mounds. The origin of these mounds has been fully discussed by Prof. J. H. Bretz, of the University of Chicago, who concludes that

they are not the result of erosion, as some have thought, but that the gravel of which they are composed was deposited in hummocks. Similar mounds are abundant on some other prairies.

Tenino.

Elevation 280 feet.

Population 1,038.

Seattle 87 miles via Plumb;

81 miles via Yelm.

After traversing another belt of terminal moraine and of hills composed largely of Tertiary shales the railway enters Tenino, which stands near the end of a projecting spur of the Cascade Range. On the right, near the station, is a quarry of a sandstone that is widely known to builders in the Northwest as the "Tenino sandstone." It is generally fine grained, well cemented, and easily worked, and has the valuable property of hardening after being quarried. The high school and Trinity Church in Seattle are built of this sandstone. The rock is of Eocene age. About a mile north of Tenino, near the old line of the Northern Pacific, is a large quarry in the same sandstone, from which the Government has obtained rock for the Grays Harbor jetty.

The Puget Sound glacier, of the Vashon substage, is believed to have had its southern boundary, at its time of greatest extension, near the line where the prairies end against the timbered hills south of the town. There is, however, no terminal moraine marking this limit for some miles east or west of Tenino.

At Tenino the railway is joined by the old line of the Northern Pacific from Tacoma. This line passes through much prairie country on the great outwash gravel plain formed by the melting of the Puget Sound glacier. A few miles north of Hillhurst and at Yelm the traveler may enjoy fine views of Mount Rainier.

Bucoda.

Elevation 256 feet.

Population 855.*

Seattle 84 miles.¹

As Bucoda is approached the valley widens. The railway crosses Skookumchuck River (Chinook jargon for "mighty water") and runs between bluffs of coal-bearing Eocene sandstone on the left and the river on the right. Just south of Hannaford Creek the beds in the bright-red cliff on the left stand vertical. The brilliant colors have the effect of a burned coal bed. Waters flowing from the Puget Sound glacier found an outlet down this valley as far as Centralia and thence went northwestward by way of the Chehalis River valley.

¹Distances by the old line are given for stations beyond Tenino, and to get the distance actually traveled from Seattle by the new line 6 miles should be added.

Centralia.

Elevation 188 feet.

Population 7,311.

Seattle 91 miles.

Centralia, about a mile above the mouth of the Skookumchuck, is an important railway junction and the center of a large lumber industry. The town is also becoming a coal-mining center, and much attention is given to dairying and to the growing of small fruits, especially strawberries. The coal-bearing rocks, of Eocene age, lie east of the town. The beds to the west (Astoria shale) are Oligocene, and are succeeded by still younger formations toward the coast.

Below Centralia the Skookumchuck enters the broad valley of the Chehalis, a river which drains a section of the Cascade Range and flows across the Coast Range to the Pacific at Grays Harbor. Two railway lines, a branch of the Northern Pacific and a line of the Oregon-Washington Railroad & Navigation Co., connect Centralia with the coast by way of Chehalis Valley.

Chehalis.

Elevation 188 feet.

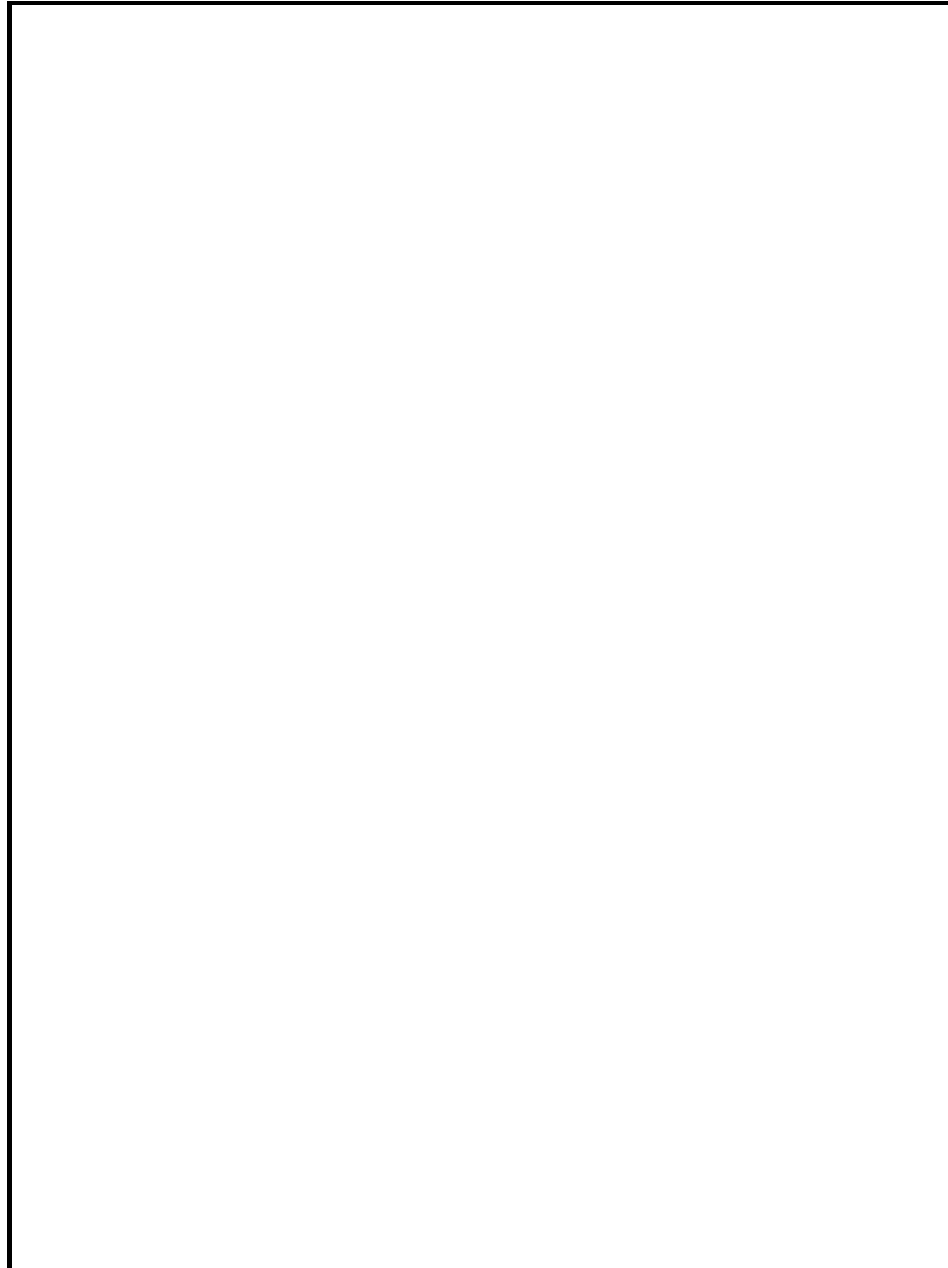
Population 4,507.

Seattle 95 miles.

Chehalis is the center of a large dairying district and has a condensed-milk factory. A branch line runs west from this place to South Bend. The State Training School stands on a terrace formed by gravel with soft decomposed pebbles, which is well exposed in several street cuttings a few blocks west of the railway station and at many other points farther down Chehalis River, especially at Satsop.

These gravels were deposited during the early part of the Pleistocene epoch by the floods from the melting glaciers.

South of Chehalis the river is joined by Newaukum River. The valley at their confluence is broad and fertile and contains many thriving farms, chiefly on the left. A group of yellow monkey flower (*Mimulus*) brightens the wayside in spring and summer. Other plants likely to attract attention are the thimbleberry, with its white blossoms; the salmonberry, with its yellow fruit; the pink freweed; the white, plumose, gracefully pendant ocean spray, or arrowwood (*Sericotheca discolor*, Pl. V, p. 17); and other forms growing among larger plants on the wooded slopes. In the more open ground the almost omnipresent dandelion in June, with its fluffy crowns of seeds, the purple lupine, the red and white clover, the white yarrow, and a host of other flowers give the beauty of varied coloring to the views in this forest land.



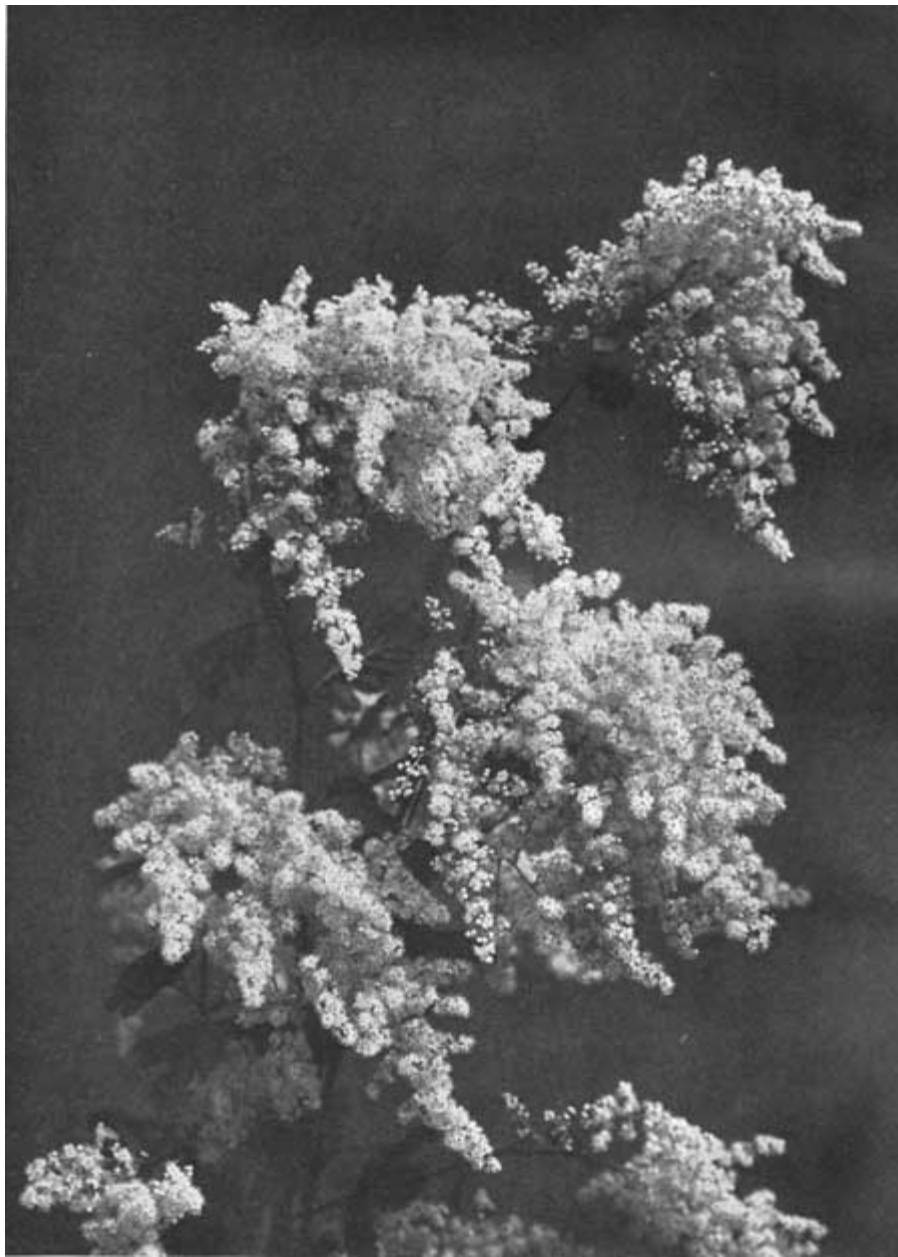


PLATE V.—OCEAN SPRAY (*SERICOTHECA DISCOLOR*), A COMMON FLOWER IN WASHINGTON. Sometimes called arrowwood, because the branches are used by the Indians in making arrows. Photograph by Barnes, Parkland, Wash.

From Seattle to Portland the great forests of Washington are almost continuous. The exceptions are the so-called prairies of the outwash gravel plains; the great stretches, bristling with the blackened trunk of many a forest monarch, which the lumbermen leave in their wake; and the long alluvial valleys which the farmer has cleared and tills. Alder and maple are the usual successors to the firs in the valleys.

Napavine.

Elevation 444 feet.

Population 1,304.*

Seattle 103 miles.

Beyond Chehalis the railway gradually ascends through shallow cuts in Eocene sandstone and early Pleistocene gravel to Napavine, situated near the crest of a low east-west divide (450 feet above sea level) that separates Chehalis River from the Cowlitz, a tributary of the Columbia. The broad surface of the divide is the level top of an extensive deposit of gravel that is well exposed in the cuts along the railway. In this locality the gravel consists largely of volcanic materials, the white quartz

pebbles that are so common in many gravels being absent. About 3 miles beyond Napavine, near Evaline, may be seen the brownish Eocene sandstone which underlies the gravel.

The railway crosses Olequa Creek, along which is a well-developed bench or terrace eroded in the same gravel formation that was seen near Napavine. A similar terrace, at a corresponding height above the stream, is a prominent feature of the Cowlitz, Willapa, and other valleys in southwestern Washington. A bluff of the same gravels, here 150 feet in thickness and overlying Oligocene beds, appears on the left as Winlock is entered.

Winlock.

Elevation 309 feet.

Population 1,140.

Seattle 109 miles.

Winlock is commonly known as "Bungalow Town" and the station has been built in that style. About 3 miles beyond Winlock the valley opens and on the right a fine view is obtained of Abernathy Mountain, a spur of the Coast Range. On the left are some remarkably tall alders with a background of firs.

Vader.

Elevation 143 feet.

Seattle 116 miles.

Near Vader station are the ovens, which are supplied by clay obtained near by. A mile beyond the town, on the right, is a small gas plant. The gas is made from the slabs rejected by the adjacent sawmill and is supplied to the town at the rate of \$3 a month for five lights and a kitchen stove. The salable by-products of the gas plant are pyrogalllic acid, creosote, tar, and charcoal.

Olequa Creek is again crossed and the train enters a short gorge. On the left, by looking ahead down the gorge, the traveler may get a fine view of the snow-covered top of Mount St. Helens, standing above deep-green forests of fir. Nearer at hand, on the left, a bluff exposes a sheet of lava overlying Eocene shales,¹ and on the right are Pleistocene sands.

¹This is the region of the type section of the Olequa formation, described by Arnold and Hannibal as extending from the Ewing ranch, 2 miles above Little Falls [Vader], southward down Olequa Creek to Olequa, a distance of 5-1/2 miles.

Olequa.

Elevation 102 feet.

Population 485.*

Seattle 118 miles.

Olequa Creek joins the Cowlitz, on the left, at Olequa station. Some hop fields and hop dryers are visible up the Cowlitz. On the left at the end of the bridge a bluff of columnar basalt (lava) overlies Eocene shales, and the railway passes through a deep cut in this basalt that resembles the Bergen Hill cut, near New York. At the south end of the cut, on the left, the Eocene shales are well exposed. Much of the lava of this region was probably poured out at intervals over the sea bottom while the sediments that were later consolidated into sandstones and shales were accumulating, the lava thus becoming interbedded with the coal-bearing Eocene strata. Later horizontal sheets of lava overlie the tilted coal-bearing beds near the volcano St. Helens, from which they issued, but these later lava beds, although some of them probably extend for a long distance west of the volcano, are not visible from the railway.

Toutle River is crossed near its junction with the Cowlitz, and that river, bearing numerous log rafts, may now be seen at many places on the right-hand side of the railway.

Castle Rock.

Elevation 59 feet.

Population 998.

At Castle Rock frost is rare. Here are extensive farms among the low-rounded hills of the region and some small orchards of prunes, cherries, and apples. The railway cuts near Castle Rock expose 60 feet of stratified light-gray sand, forming a terrace whose top has an

Seattle 125 miles. elevation of 120 feet above the sea.

<<< [Previous](#)

<<< [Contents](#) >>>

[Next](#) >>>

bul/614/sec2.htm
Last Updated: 8-Jan-2007



Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

ITINERARY



Watsonville Junction.

Elevation 21 feet.

Los Angeles 375 miles.

From Watsonville Junction (see sheet 6A, p. 130) a branch line turns to the left (west) and makes a detour through Santa Cruz and other points, rejoining the main line to the north at San Jose. Passengers may take this route to San Francisco but will have to change cars. The Santa Cruz route affords an opportunity to see a fine group of "big trees" (Pl. XXXI, p. 125), the coast redwood (*Sequoia sempervirens*), which, although smaller than *Sequoia gigantea* of the Sierra Nevada, are still gigantic, the largest measuring 70 feet in circumference. This route, crossing the Santa Cruz Mountains at an altitude of more than 1,000 feet, passes through beautiful country. The geology is complicated, old crystalline rocks and later rocks of Jurassic (?), Cretaceous, and Tertiary age being much folded and faulted. The great rift or crack (San Andreas fault) along which occurred the earthquake of 1906 is crossed by this route west of Alma.





PLATE XXXI—BIG TREES (SEQUOIA SEMPERVIRENS) AT SANTA CRUZ, CAL.

North of Watsonville Junction the main Coast Line crosses a rich apple country, in which the orchards reach part way up the slopes of the bordering hills.

Aromas.

Elevation 98 feet.

Los Angeles 381 miles.

The hills to the right and left, gradually approaching as the valley narrows, are composed of Tertiary strata, with a narrow belt of Quaternary deposits along Pajaro River. Just beyond Aromas the train enters Pajaro Gap. Here a small fault, cutting across the range, has weakened the rocks and thereby enabled the river to wear its way through. On the left is the river, and on the right are bluffs of crumpled and crushed rocks, largely diorite (an igneous rock resembling granite, but containing little or no quartz), which are artificially further reduced by rock crushers for railroad ballast.

Chittenden.

The country opens abruptly as the train crosses the bridge over the Pajaro near Chittenden; and the diorite of the gorge gives

Elevation 123 feet.
Los Angeles 383 miles.

place to the Tertiary sediments of the Chittenden-Sargent oil field. This change is due to the fact that the Tertiary beds are much softer than the diorite and have been eroded out into a valley. Traces of the San Andreas fault, a slight recurrence of movement along which produced the earthquake of 1906, are here visible for the first time to the traveler from Los Angeles to San Francisco over the Coast Line, although the crack continues into southern California to the east of Los Angeles. The hillsides to the northwest (left) are scarred by the earthquake rift, and one-third of a mile beyond Chittenden, around a curve, on the left near the track, is a knoll blackened by the oil from a storage tank that was wrecked by the earthquake.

The Sargent oil field produces approximately 40,000 barrels a year, and some of the oil is shipped from Chittenden. The oil-bearing rocks—shales, sandstones, and conglomerates of the lower part of the Monterey group—cover a wide area. They are bent into anticlines and synclines and are covered by younger shales of the Monterey group and in part also by younger Miocene and Pliocene sediments. The rocks of the lower slopes near which the train passes just beyond Chittenden, on the right, are Pliocene (Merced formation). About 2-1/2 miles from Chittenden, near milepost 88, San Benito River and Llagas Creek join to form Pajaro River. The railroad turns to the left up Llagas Creek to Sargent.

Sargent.
Elevation 134 feet.
Los Angeles 387 miles.

West of Sargent, beyond the oil field, the Franciscan rocks form the higher portions of the range. Beyond Sargent the railroad soon passes out of the low hills into the southern portion of the broad Santa Clara Valley. This portion, a great alfalfa and stock country irrigated by electric pumps, is drained by Pajaro River to the Bay of Monterey. Across the valley in the distance can be seen Pacheco (pa-chay'co), Antimony, St. Anna, Mariposa (the highest), and other peaks of the Mount Hamilton division of the Diablo Range, which separates the Santa Clara Valley from the San Joaquin Valley.

The Santa Clara Valley extends from San Francisco Bay southeastward to and beyond San Benito, a distance of nearly 100 miles. It has a notable peculiarity in that it is divided transversely by a scarcely noticeable soil-covered divide. The southern portion is drained by Pajaro River, but the northern portion drains through Coyote River directly into San Francisco Bay, and the alluvial plain is continuous across the divide.

From Carnadero (car-na-day'ro) Junction, 4 miles beyond Sargent, a branch line runs southeast to Holster, in San Benito Valley, where it is said there is "silver in eggs" and "gold in apples." From the junction the main line continues northward through the Santa Clara Valley to San Francisco Bay, passing through one of the most productive fruit-growing regions in the world.

Gilroy.
Elevation 190 feet.
Population 2,437.
Los Angeles 393 miles.

The town of Gilroy is the point of departure for the Gilroy Hot Springs, which lie 13 miles to the northeast. Oaks appear about Gilroy, and alfalfa begins to give way to grain and especially to fruits. Grapes, prunes, peaches, and apricots are grown in large quantities. The mountains on the right are markedly different in aspect from those on the left, although both are composed, at least in part, of rocks belonging to the Franciscan group, partly covered by Tertiary sediments. The mountains on the right have a nearly even crest line (Pl. XXXII, p. 126). Along their base, beyond the orchards, is a much lower even-crested ridge. Between this ridge and the mountains is Coyote River, which flows northwestward to San Francisco Bay. The valley in the foreground is drained to the southeast by Llagas Creek to Pajaro River and Monterey Bay.





PLATE XXXII—SANTA CLARA VALLEY NEAR GILROY, CAL. The green crest of the distant ridge of Franciscan rocks suggests a plain of erosion. The narrow valley between the two distant ridges is due to faulting and contains Coyote River. Santa Clara Valley, with its fine orchards, in the middle ground, is filled with alluvium that is continuous from San Francisco Bay to the Bay of Monterey. For explanation see page 124.

Madrone.

Elevation 342 feet.

Los Angeles 405 miles.

At Madrone the valley narrows. The rocky slopes on the left are near the railroad and several little cuts expose serpentine, which is a characteristic accompaniment to the Franciscan group. The summit of the transverse divide (elevation 345 feet) is reached near Perry, about 2 miles beyond Madrone, but there is no break in the continuity of the alluvial plain, and the traveler will probably not notice, unless his attention is called to it, that he is passing from the drainage basin of Pajaro River to that of Coyote River. The Coyote enters Santa Clara Valley from the mountains on the right (east).

It has been suggested that all the drainage that now finds its way into San Francisco Bay and thence to the ocean by way of the Golden Gate, once flowed southward through Santa Clara Valley to Monterey Bay. Those who maintain this view think that the submarine channel across Monterey Bay was cut by the more powerful stream that then flowed through Pajaro Valley. A striking resemblance that has been noted between the strictly fresh-water fishes and other forms of life inhabiting Sacramento and Pajaro rivers tends to confirm the conjecture that the two streams were formerly one. Later investigations by Dr. J. C. Branner, however, have suggested a different interpretation of this evidence.

A study of the material of the divide shows that it has the low conical form of an alluvial fan—that is, a deposit made by a stream where it issues from a canyon upon a plain. At such a place the velocity of the stream generally becomes less, and the water is compelled to drop much of the sand and gravel that it swept along with ease in the mountains. This particular deposit was made by Coyote River during a period (probably glacial) when the land stood at a higher level than now and the creek carried a large load of detritus. As the alluvial fan grew Coyote River shifted its position from time to time to lower parts of the conical slope, and thus flowed sometimes to San Francisco Bay and sometimes to Monterey Bay. In this way opportunity may have been given for fishes and other living things to pass over the divide by way of Coyote River. If this happened, it would of course not be necessary to account for the

similar faunas of Sacramento and Pajaro rivers by supposing the streams to have been at one time directly united.

Coyote.

Elevation 248 feet.

Population 200.

Los Angeles 412 miles.

Six miles southwest of Coyote, in the hills composed of rocks belonging to the Franciscan group, is the New Almaden quicksilver mine, which has yielded more quicksilver than any other mine in the United States. At milepost 59 on the right may be had the first view of Lick Observatory, on Mount Hamilton (elevation 4,209 feet). The observatory may be visited from San

Jose.

Just north of Coyote is the narrowest part of the valley. Serpentine occurs here on the left but is on the right at Edenvale, where the valley widens and a belt of Tertiary rocks forms foothills to mountains that are composed chiefly of Franciscan rocks.

San Jose.

Elevation 85 feet.

Population 28,946.

Los Angeles 424 miles.

At San Jose (ho-say'), which is by far the largest city in the Santa Clara Valley, the branch line running through Santa Cruz joins the main Coast Line. The New Almaden mine may be reached by a spur from this branch. Other railroad lines run from San Jose east of San Francisco Bay to Oakland and have connections across the Diablo Range, through Livermore Valley,

with the several lines in San Joaquin Valley.

The city is built on the fertile plain between Guadalupe and Coyote rivers, 11 miles southeast of the head of San Francisco Bay. Its delightful climate, beauty of surroundings, fertility of soil, and consequent profusion of flowers and fruits make San Jose a favored spot even in California.

From San Jose automobile stages run to Mount Hamilton (26 miles). All the sedimentary rocks seen on this trip belong to the Franciscan group. Some beautiful drives may be enjoyed in the suburbs and in the country around the town. During the rose season the drive along Alameda Avenue from San Jose to Santa Clara, about 3 miles, is particularly recommended. This trip may also be made by trolley car.

At College Park, on the left as the train leaves San Jose, is the College of the Pacific. Well-kept orchards of prunes, apricots, peaches, pears, and cherries, as well as vineyards, lie on both sides of the railroad throughout this part of the valley. Acres of sun-drying prunes are a common sight in August.

Santa Clara.

Elevation 69 feet.

Population 4,348.

Los Angeles 427 miles.

Santa Clara College, the white building of which may be seen on the left near the center of the town of Santa Clara, was founded in 1851 by the Jesuits. The chapel is one of the old mission buildings erected in 1777 and is well preserved. Several large canneries may be seen along the railroad and are kept busy for most of the year by the wide range of fruit and vegetable

products which the Santa Clara Valley affords. Two miles beyond Santa Clara on the right, barely visible in the distance across the broad fields of barley hay and between groves of oak and eucalyptus, is Agnew Asylum for the Insane, a State institution.

The Santa Clara Valley widens northward and the fertile bottom land grades near the south end of the Bay of San Francisco into extensive salt marshes. The railroad bears to the west from Santa Clara, toward the mountains which form the backbone of the peninsula of San Francisco.

Although fields of hay with scattered oaks predominate near

Sunnyvale.

Elevation 93 feet.

Population 1,859.*

Los Angeles 433 miles.

Sunnyvale, there are large tracts devoted to orchards and market gardens. The climate and soil of the lower Santa Clara Valley between San Jose and Sunnyvale, like that of Lompoc Valley (p. 111), are such that seeds mature well, and there are several large seed farms near Sunnyvale and Santa Clara.

Mountain View.

Elevation 76 feet.

Population 1,161.

Los Angeles 435 miles.

Near Mountain View the railroad runs nearer to the foothills of the Santa Cruz Range. The lowest hills are composed of sandstone belonging to the lower part of the Monterey group. Black Mountain (elevation 2,787 feet), the culminating point of Monte Bello Ridge, is the most prominent peak of this part of the range. Just behind it lies the San Andreas fault or rift. (See pp. 89-90.). The upper slopes of Black Mountain are mainly sandstone with some lenticular masses of limestone, several thousand tons of which are crushed annually and shipped to beet-sugar factories. Some of the best red wine made in California is produced near Mountain View.

From Castro, about a mile beyond Mountain View, is visible on the right the Dumbarton Bridge on the railroad freight route from Oakland to San Francisco.

Palo Alto.

Elevation 58 feet.

Population 4,486.

Los Angeles 441 miles.

At milepost 33 on the left, ahead and more than a mile away, may be seen among the trees the red-tiled roofs of the Stanford University buildings. The entrance to the university grounds is on the left, near the Palo Alto station, and the university buildings, a mile away, hidden from the station by trees, may be reached by a trolley line. Leland Stanford Junior University, founded by Senator and Mr. Stanford and opened in 1891, has nearly 2,000 students, both men and women. The medical department is in San Francisco and the biological laboratory at Pacific Grove. The buildings of the other departments are on the Stanford University tract, 8,400 acres. The buildings (see Pl. XXXIII, A), designed originally by H. H. Richardson, take their architectural motif from the cloisters of the San Antonio mission, and the combination of buff sandstone with red tiled roofs gives striking color effects. The buff sandstone came from the quarries at Graystone, about 10 miles south of San Jose, and is of early Miocene (Monterey) age. The San Andreas fault, the line of the San Francisco earthquake, lies 4 miles southwest of Stanford University and is easily reached from that point. The university suffered much from the earthquake but has completely recovered.





PLATE XXXIII—A. THE ARCHES, STANFORD UNIVERSITY, CAL.
The displacement of the capitols of the small columns supporting the arches is an effect of the earthquake of 1906.

B. FURROW A MILE NORTHWEST OF OLEMA, CAL., MADE BY THE
MOVEMENT WHICH CAUSED THE EARTHQUAKE OF 1906.
On the left is the rift valley, which extends from Bolinas Lagoon to Tomales Bay and is a result partly of earlier movements, partly of erosion along a cone of crushed rocks.

The accompanying cross section from Palo Alto to the summit of Santa Cruz Mountains (fig. 15, p. 128) shows the general geologic structure of the region.

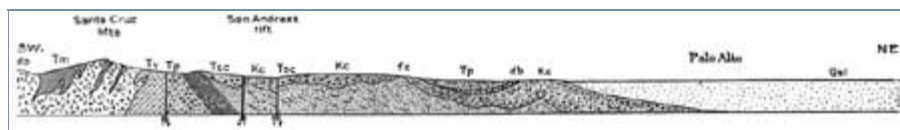


FIGURE 15.—Section from Palo Alto, Cal., to the summit of the Santa Cruz Range, showing the folds and faults of the several formations about the San Andreas rift. Qal, Alluvium; Tsc, Santa Clara formation (Tertiary); Tp, Purisima formation (Tertiary); Tm, Monterey shale (Tertiary); Tv, Vaqueros formation (Tertiary); db, diabase and basalt; Kc, Chico formation (Cretaceous); fc, Franciscan formation (Jurassic?). ([click on image for an enlargement in a new window](#))

By looking ahead from the Palo Alto station the traveler may see on the right of the track the tall tree (Spanish, palo alto) for which Senator Stanford's estate was named. It is the only redwood (*Sequoia sempervirens*) near the main line of the railroad. It stands on the bank of San Francisquito Creek, and the Southern Pacific Co. has built a wall of concrete to protect it from floods.

Menlo Park.

Population 820.

Los Angeles 442 miles.

In Menlo Park, a village of beautiful parks and grounds, reside many well-to-do business and professional men who pass their working days in San Francisco. On the right, near the bay beyond Menlo Park, is a large tannery, and far out in the marsh a station for drying Alaskan codfish.

Redwood.

Elevation 7 feet.

Population 4,299.

Los Angeles 445 miles.

The town of Redwood was formerly the center of the redwood lumber industry of the Santa Cruz Range, then completely forested. Most of the redwood trees are gone, but a few of them can be seen scattered along the crest of the distant range. The trees in view, however, are largely a second growth. On the left, near Redwood, is a factory where magnesite is ground.

Between Redwood and San Carlos there is a good view to the left (west) of an even-crested ridge well clothed with forest. This is Cahill Ridge. Between it and the rounded oak-strewn foothills that lie nearer to the railroad is the narrow, rectilinear valley of the San Andreas rift. Two lakes, San Andreas and Crystal Springs, have been formed in this part of the valley by damming and supply much of the water used in San Francisco.

San Carlos.

Elevation 25 feet.

Los Angeles 447 miles.

Just beyond San Carlos, on the left (west), is an iron standpipe forming part of the water supply system of San Francisco, and below it, near the railroad, is one of the pumping stations. Here the oak-crowned hills composed of sandstones and other rocks of the Franciscan group come close to the bay and leave only a

narrow belt of alluvium between the foothills and the salt marshes.

Belmont.

Elevation 30 feet.

Los Angeles 449 miles.

Soon after leaving Belmont the train passes through a shallow cut in sandstones and cherts of the Franciscan group. The chert is quarried for use on roads. Half a mile beyond Belmont there is an extensive view to the right across the marshes and bay to the white salt fields of the Union Salt Works, where salt is obtained by solar evaporation of water from the bay. Along this portion of the salt marsh bordering the bay fresh water

is obtained from wells of various depths up to 400 feet. This water evidently lies below the salt water. Generally the fresh water can be obtained from these wells only by pumping, but

at high tide, when the flats are covered by salt water, which is heavier than fresh, the hydrostatic pressure of the salt water on the deeper fresh water makes some of the wells overflow.

Leslie.

Los Angeles 451 miles.

At Leslie there are artificial ponds (vats) in which the water of the bay is evaporated for salt. In the mill close by the salt is refined and prepared for market at the rate of about 8 carloads there so a day. The bay water contains only about half as much salt as an equal volume of ocean water, but are many more bright days in this locality than there are along the coast that it is more profitable to use the weaker brine.

San Mateo.

Elevation 19 feet.

Population 4,384.

Los Angeles 452 miles.

San Mateo (ma-tay'o) is a pretty town noted for its beautiful live oaks and handsome suburban residences. Here the road crosses San Mateo Creek, which, at the point where it issues from the San Andreas rift valley, about 3-1/2 miles southwest of San Mateo, has been dammed by a high concrete structure that holds back the waters of Crystal Springs Lake.

A daily stage plies between San Mateo and Pescadero (pes-ca day'ro, Spanish for fishmonger), near Pebble Beach on the coast, a distance of 33 miles. This stage ascends the valley of San Mateo Creek and crosses Crystal Springs Lake on a dividing dam, made of earth, which was cut and displaced by the movement along the fault at the time of the San Francisco earthquake but was soon repaired. The road to Pescadero passes near the interesting old village of Spanishtown and reaches the coast at Pebble Beach, noted for its agate pebbles. The trip from Pescadero to San Mateo may be conveniently taken in connection with one from San Francisco to Pescadero by the Ocean Shore Railroad.

Burlingame.

Elevation 26 feet.

Population 1,565.

Los Angeles 454 miles.

At Burlingame (pronounced locally bling'um), a place of residence in favor with people of wealth and leisure, there is a country club, with golf links and polo grounds. (See sheet 13, p. 90.) In this vicinity, as elsewhere in California south of San Francisco, there are three trees which figure characteristically in the landscape—the Australian eucalyptus, the Peruvian pepper tree, and the sturdy native oak. The eucalyptus, a tall, slim tree that is rather untidy about its bark, grows rapidly and is much used not only along the roadsides but as windbreaks. The pepper tree, which has pendant plumose foliage, is highly ornamental and is largely used in cities as a street tree and in parks and gardens. But of all the trees that adorn the fertile bottom lands of the great interior valleys the native valley oak (*Quercus lobata*) is by far the most important.

Millbrae.

Elevation 8 feet.

Los Angeles 457 miles.

The large hay ranch on the left (west) near Millbrae belongs to the estate of the late D. O. Mills, a well-known capitalist and philanthropist. On the right in the bay are the oyster beds of the Morgan Oyster Co. The native oyster is small and of coppery flavor, and although esteemed by epicures for oyster cocktails is generally inferior to the eastern oyster. Attempts to establish colonies of eastern oysters on the Pacific coast have been unsuccessful. The young oysters, or spat, however, are brought from the Atlantic seaboard and are matured on the western coast.

Ahead is San Bruno Mountain, beyond which lies San Francisco. On the left are some parallel ridges running northwest. The nearest is Buriburi Ridge (elevation 700 feet), composed of sandstones and shales of the Merced formation (Pliocene), underlain by Franciscan sandstones and igneous rocks, which form the mass of the ridge. Beyond is Sawyer Ridge (1,100 feet), consisting of Franciscan rocks. In the valley between them, 1-3/4

miles southwest of Millbrae, is San Andreas Lake.

San Bruno.

Elevation 19 feet.

Los Angeles 459 miles.

At San Bruno the railroad branches. The main line (a cut-off), built only a few years ago and now used for the through traffic, bears to the right along the bay shore around the east end of San Bruno Mountain and through five tunnels reaches the station at Third and Townsend streets in San Francisco. The old line bears to the left up Merced Valley and round the west end of San Bruno Mountain and by a heavier grade and greater distance reaches the same station.

The San Francisco Peninsula, at whose northern extremity is the city of San Francisco, is divided into two parts by the northwestward-trending Merced Valley. Each of these parts is a block of the earth's crust with a fault along its southwest side, upheaved along that side so that it has a gentle slope to the northeast. Both fault blocks have been much carved and worn by erosion so that their original blocklike character has been in great part lost. Both are composed of pre-Tertiary rocks, and the valley between them is filled with the Merced formation (Pliocene), covered for the most part by alluvium. The fault which limits the San Bruno fault block on the southwest is concealed by the alluvium. North of San Bruno Mountain, between it and the Golden Gate, is an irregular group of hills composed of Franciscan rocks and dune sand. On and between these hills is the city of San Francisco.

South San Francisco.

Elevation 11 feet.

Los Angeles 461 miles.

South San Francisco is a manufacturing town, whose chief industry is the refrigeration and preparation of meats. Here also there are steel, glazing and terra-cotta, brick, paint, pipe, and ice works.

The five tunnels between South San Francisco and San Francisco are from 1,088 to 3,547 feet in length. All are in rocks of the Franciscan group. The first, through Sierra Point, is in sandstone, of which there is a line exposure in an open cut beyond the tunnel. The second, the longest tunnel, penetrates a complex ridge of sandstone, radiolarian chert, and diabase. The large railroad traffic near San Francisco is indicated by the great freight yards in Visitation Valley, between the second and third tunnels. As the train emerges from the third tunnel, which is in sandstone, Hunter Point appears ahead. Beyond Hunter Point, on the left (west), across the salt marsh of Islais (ees-lah'ees) Creek, is the city garbage incinerator. The last two tunnels are in serpentine. Near the new terminal station a sugar refinery and the Union Iron Works, where the famous battleship *Oregon* and many other warships have been built, are to be seen on the right.

A short description of San Francisco is given on pages 86-87.

<<< [Previous](#)

<<< [Contents](#) >>>

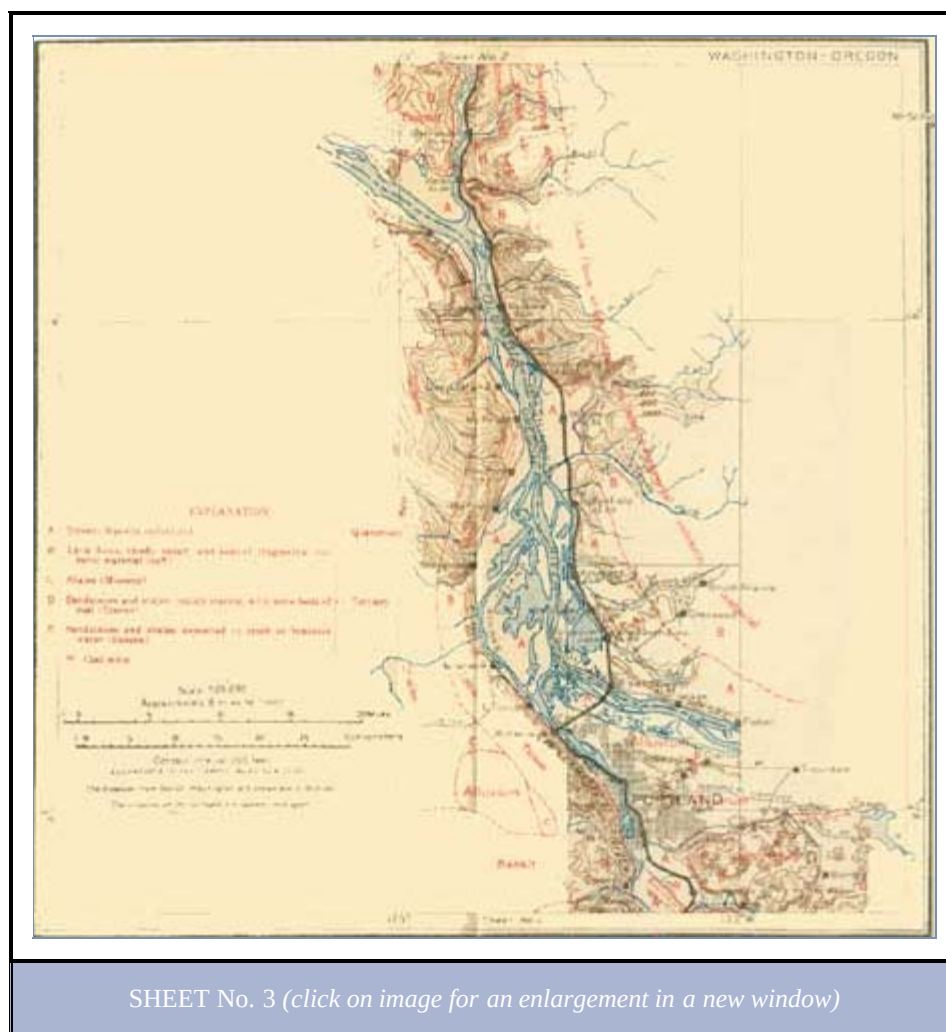
[Next](#) >>>



Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

ITINERARY



Ostrander.

Elevation 41 feet.

Population 339.*

Seattle 131 miles.

At Ostrander (see sheet 3, p. 32) logs floated down the Cowlitz are chained into flat or cigar-shaped rafts for further transportation to the mills on the Columbia and elsewhere. This place is noted for the size of the timber that it can supply. A sawn stick 215 feet long can be seen by the station, and one 44 inches square and 100 feet long was prepared for the Chicago exposition.

Kelso.

Elevation 26 feet.

Population 2,039.

A few miles beyond Ostrander the railway enters a 1,200-foot tunnel through a spur of basalt, from which it emerges into a broader part of the valley. Small stern-wheel steamers ascend the Cowlitz for 17 miles beyond Kelso. The smelt fisheries (Pl. VI, A) in the Cowlitz

Seattle 135 miles. yield about \$50,000 annually. Canned smelts sell here at a cent a pound, and they are shipped as far east as New York.

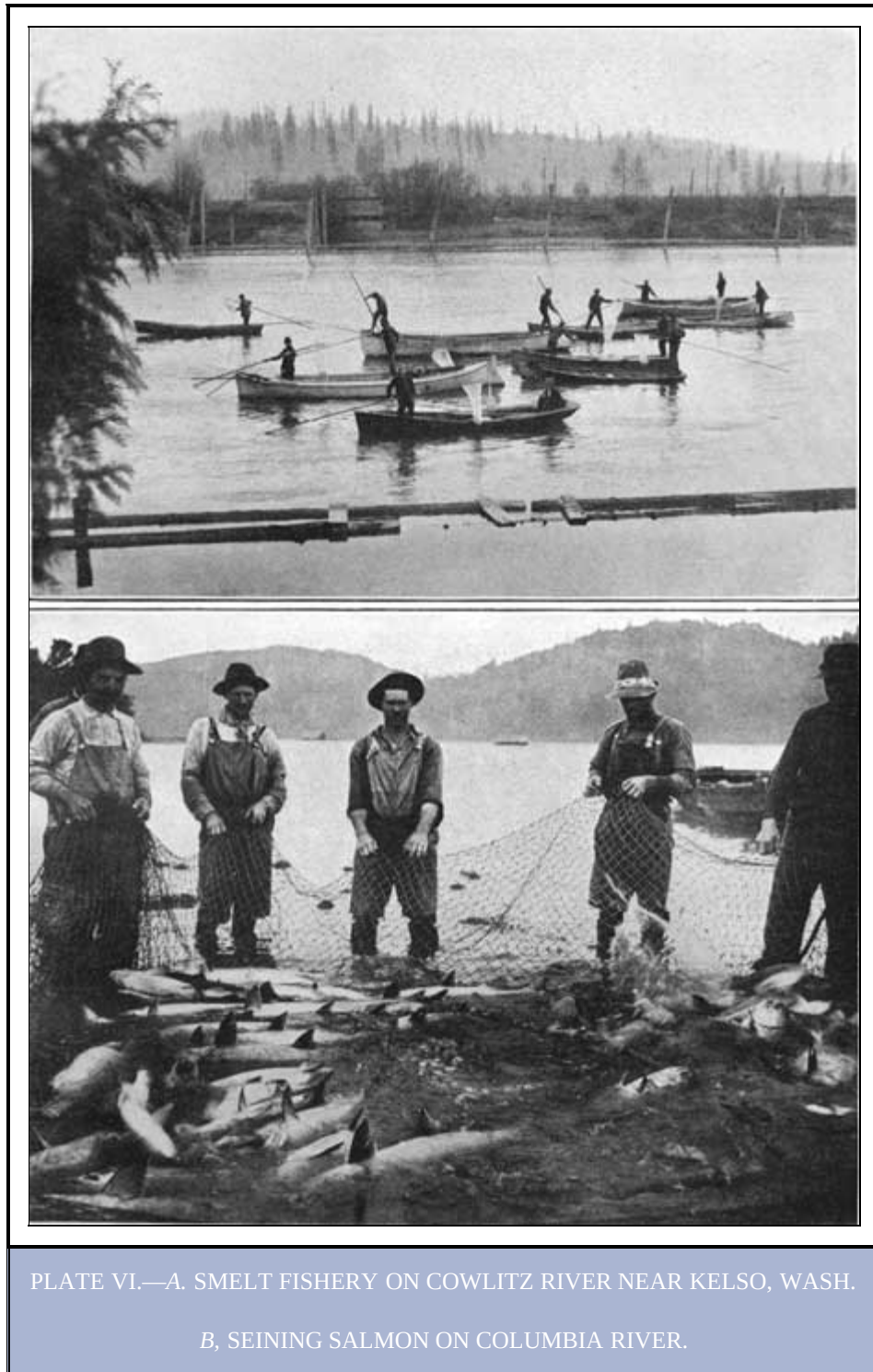


PLATE VI.—A. SMELT FISHERY ON COWLITZ RIVER NEAR KELSO, WASH.

B, SEINING SALMON ON COLUMBIA RIVER.

The Cowlitz Valley contains lignite coal, and some of the seams have been worked, but the decreasing demand for coal due to the competition of California oil has put a stop to mining for the present.

Mount Coffin, on the right, a few miles down the Columbia from the mouth of the Cowlitz, was an Indian burying ground and received its name from the large number of coffins exposed on it. On this mountain Commander Wilkes, in 1841, made astronomical observations to determine its position.

Ahead, to the right, over the flats at the mouth of the Cowlitz and beyond the Columbia, may be seen some even-crested hills about 1,000 feet in height. These continue on the southern horizon from this point to Portland Heights. Similar flat-topped hills stand also on the north side of the Columbia. If an observer so situated as to be able to overlook the whole valley of the Columbia in this region should imagine all the ravines and valleys which now separate these hills to be filled to the general level of the flat hilltops he would then see spread out before him a very broad, shallow, flat-bottomed valley and would realize that the present hills are all that is left of such a valley after its floor has been deeply furrowed and carved by streams. The hilltops are flat because they are parts of what was once such a continuous valley surface. This old broad valley was worn in basalt by Columbia River in early Pleistocene or glacial time, when the land stood 1,000 feet lower than now. When the land started to rise the streams began to cut into the old valley floor and fashioned it into the flat-topped hills of the present landscape.

Carrolls.

Elevation 21 feet.
Seattle 141 miles.

At Carrolls may first be seen the cliffs of basalt which form the banks of the Columbia for hundreds of miles and attain imposing heights along the stretch of river between Portland and The Dalles.

Kalama.

Elevation 21 feet.
Population 816.
Seattle 145 miles.

The Northern Pacific once ferried across Columbia River from Kalama to Gobel, Oreg., and the old boat, which could carry 24 cars and an engine, can still be seen at its wharf. The railway now continues up the east side of the river to Vancouver. Seines set for salmon fishing (Pl. VI, B) may usually be seen near Kalama.

The dark bluffs on the left, which the railroad now skirts for several miles, with the river on the right, are in part solid flows of basaltic lava, but are mainly beds made up of fragments of volcanic rock associated with some sandstone and shale. At milepost 111 a deposit of sand and gravel overlies lava and shales.

Woodland.

Elevation 53 feet.
Population 384.
Seattle 135 miles.

As Woodland is approached a fine view opens on the left, up Lewis Valley. Mount Adams is in sight, and a little farther on, to the left of it, appears the white cap of Mount St. Helens. Finally Mount Hood comes into view to the right of Mount Adams. Near milepost 115, scattered over an alluvial bottom, are some large oaks, the forerunners of those to be seen later in Oregon and California.

At 157 miles from Seattle Lewis River is crossed. The bluffs of basalt on the left here give place to slopes of gravel, sand, and clay. These deposits were laid down by Columbia River in early Pleistocene time and now form hills of pleasing rounded contours.

Two miles beyond the crossing of Lewis River are well-stratified sands and clays like those near Tacoma, and just beyond is a horizontal sheet of lava (basalt) showing the peculiar feature called columnar jointing. The columns are due to cracks produced in the lava by contraction on cooling and may be compared with the polygonal cakes into which a layer of mud breaks on drying. The mud cakes are thin in comparison with the long, regular columns found in some bodies of basalt, but the modes of formation are analogous.

Ridgefield.

Elevation 60 feet.
Population 297.
Seattle 161 miles.

Gravels deposited by the Columbia when its bed was higher than it is now occur between Ridgefield and Knapps, where they form an extensive terrace 50 feet above sea level. On the left, near Felida, is a bluff of gravel and sand, which are older than the Pleistocene gravel of Columbia River.

Felida.

At Vancouver Junction the rounded hills are covered with prune orchards. From this place a branch line runs northeastward 28

Elevation 61 feet.
Seattle 169 miles.

miles to Yacolt.

Vancouver Junction.
Elevation 62 feet.
Seattle 172 miles.

Vancouver, Wash.
Elevation 65 feet.
Population 9,300.
Seattle 176 miles.

Vancouver is the military headquarters of the Department of the Columbia. Here Dr. John McLoughlin, the factor of the Hudson's Bay Co., who in 1824-25 ruled the region with iron hand but benevolent purpose, built Fort Vancouver, which soon became not only a thriving port for ocean vessels engaged in the western fur trade but also an outfitting point for exploring parties. In 1841 the Wilkes exploring expedition ascended the Columbia and camped at Fort Vancouver for some months, exploring the great river and its tributaries. An overland party under Lieut. Emmons, including the geologist J. D. Dana, was dispatched by way of the Willamette

Valley, Mount Shasta, and Sacramento to San Francisco. In 1843 John C. Frémont visited Fort Vancouver, having floated down the Columbia from The Dalles, a route then in favor by emigrants who came into the country over the Oregon Trail. On arklike rafts loaded with farm and household belongings these emigrants glided down the river, those bound for the Puget Sound country turning northward from the Columbia at the mouth of the Cowlitz, and those for the Willamette Valley turning southward opposite Vancouver. Later, in 1853-1855, came the exploring parties of the Pacific railroad surveys in search of the best transcontinental and coast routes. They traversed the country from Puget Sound to the Gulf of California along the routes since followed by the Southern Pacific Co.

Columbia River.

The Columbia¹ is the great waterway from the interior of the continent through the Cascade Range to the coast. In 1805 it bore the canoes of the first transcontinental explorers, Lewis and Clark, from the slopes of the Rocky Mountains to the sea. Their party spent the winter on the Pacific coast and returned by the same route in 1806.

¹Columbia River from the lower cascades to its mouth, a distance of 140 miles, is, like the Hudson, a good example of what geographers term a "drowned river." The earth's surface is not absolutely stable but is subject to upward and downward movements. As a rule these are so slow as to escape notice except in so far as their effects can be seen and interpreted by those who make a study of land forms. When a broad section of coast land traversed by a river moves downward, the sea water advances into the depressed and thereby deepened river channel, the river water is backed up, perhaps for many miles, and the lower part of the river so affected becomes a narrow inlet whose waters, instead of gliding steadily to the sea, ebb and flow with the tides.

As was explained on page 24, the Columbia in early Pleistocene time, many thousands of years ago, flowed in a broad valley whose floor is now represented by the flat tops of the hills seen near Kalama. The land, which probably had been stationary for a long period, then began to rise. The slope of the river channel was increased, the water flowed faster, and, with the sand and boulders of its channel as abrasives, the river began to wear down its bed. This went on until the land stood higher than at present and the river had cut its bed to a very gentle grade. Then the earth movement was reversed. The land very gradually sank and the ocean water backed up into the Columbia. It was this sinking that transformed the lower Columbia into a navigable stream, deep enough for ocean-going steamers, and made possible the commercial development of Portland and Vancouver. This is merely one of many illustrations of the direct bearing of past geologic events and processes on modern life. The influence of some of these

processes, such as the formation of coal, is plain enough to all. The influence of others, though equally real, is not so obvious.

The mean range of the tide at Lower Cascades is only 0.2 foot, at Vancouver 0.8 foot, at Portland 1 foot, and at Astoria 6.4 feet. The fluctuation in the height of the river due to changes in meteorologic conditions is more than 20 feet at Portland and Vancouver, so that the tidal oscillations there are of very slight practical importance.

Rivers are the sculptors of their own valleys. The wild gorge through which the Columbia traverses the Cascade Range (Pl. VII, p. 23) is the noblest of its kind on this continent. Its history has not been fully made out, but it appears that the Cascade Range was slowly uplifted as in the form of a series of broad arches or uptilted blocks of the earth's crust along a north-south axis, and that the river, which is thought to have had nearly its present course before the range was formed, maintained its channel by wearing down its bed as rapidly on the whole as the mountains rose. The larger tributaries cut down their channels also and carved deep ravines which open on the river (Pl. VIII). The smaller streams, however, have been unable to keep pace with the main stream in lowering their channels, and reach the river by plunging over the cliffs as falls (Pl. IX). Tributary valleys perched on the sides of a main stream valley in this way are called "hanging valleys."



PLATE VII.—VIEW UP COLUMBIA RIVER FROM COLUMBIA HIGHWAY AT CHANTICLEER INN, ABOUT 20 MILES EAST OF PORTLAND, OREG. On the left across the river is Cape Horn, against which the flat-topped terrace ends. This terrace, as explained on page 26, is part of the floor of a former higher valley of the Columbia. The canyon of the Columbia is comparable to the valley of Hudson River, in New York. Photograph copyrighted by Weister Co., Portland. (See also Pls. VIII and IX.)



PLATE VIII.—ONEONTA GORGE, COLUMBIA RIVER, NEAR ONEONTA, OREG. The tributary stream is strong enough to cut down its bed about as rapidly as the main Columbia, making a gorge. (Compare Pl. IX.)



PLATE IX.—LATOURELLE FALLS, COLUMBIA RIVER, NEAR LATOURELLE, OREG. The small tributary stream here, unable to cut down its bed as rapidly as the main Columbia, enters the river by a fall. (Compare Pl. VIII.) The lava adjoining the lower part of the falls illustrates columnar structure. Photograph copyrighted by Weister.

At Cascade Locks, in the very axis of the Cascade Range, the river has been unable to maintain a uniform grade and falls 50 feet in a series of rapids to the tidal portion of the stream. Above the cascades the river is ponded, as if the obstruction over which it falls were acting as a dam. At one time the ponding was more extensive than at present, as shown by the occurrence, some miles above the cascades, of trees belonging to species now living that have been killed by the water and partly buried in silts (Pl. X,A, p. 28) containing their fossilized leaves.



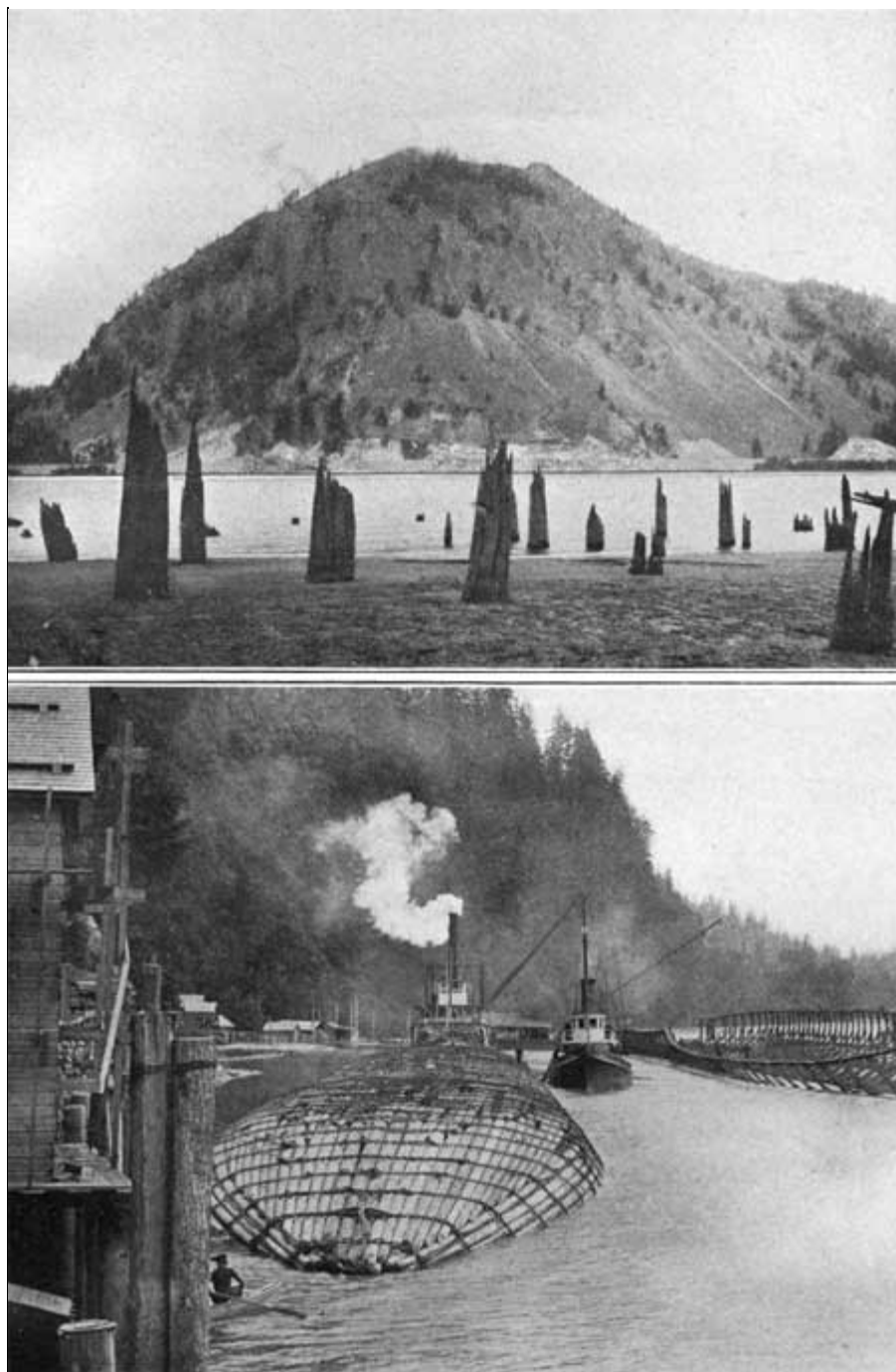


PLATE X.—A. TRUNKS OF TREES OF A SUBMERGED FOREST, COLUMBIA RIVER ABOVE CASCADE LOCKS, OREG. Opposite Wind Mountain, Wash. It is possible that a landslide into the river from the north side dammed back the water and us to drown the trees and cover them partly with mud.

B. CIGAR-SHAPED RAFT OF LOGS FOR OCEAN TRAVEL. On the right is the cradle in which the raft was made.

Three explanations have been suggested for the occurrence of the obstruction at the cascades and the consequent damming of the river above them. One is that it represents a hump that has been produced across the river channel by the continued slow uplift of the Cascade Range. It is supposed, in accordance with this view, that the uplift of the range at this place has proceeded a little faster than the river could cut down its bed. Another and more probable explanation, in

view of the localized character of the obstruction, is that it is due to faulting—that is, to movement along a crack in the rocks that runs approximately at right angles with the course of the river, the formation of the crack being followed by a slipping of the rocks along it in such a way that the country east of it has sunk a little or the country west of it has risen a little. A third and still more probable suggestion is that a large mass of rock has slid into the river from the cliffs and thus made a dam which has not yet been wholly washed away. Not enough geologic work has been done in the vicinity to determine which explanation is the true one.

Columbia River, including its tributaries, has a drainage area of about 259,000 square miles and a total navigable length of 2,136 miles. The system as a whole is capable of furnishing an estimated maximum of about 19,740,000 horsepower, of which only 351,249 horsepower, less than 2 per cent, was developed in 1909, the latest year for which complete statistics are available. In five States, Oregon, Idaho, Wyoming, Montana, and Washington, 1,072 power wheels were turned by waters of streams in the Columbia River basin during that year.

The most valuable fisheries in the world, except only the oyster and herring fisheries, are those supported by the salmon. Of the salmon fisheries by far the largest are those of the Pacific coast of North America. Columbia River is justly celebrated as having afforded more salmon than any other river in the world, and Astoria is the chief center of the industry.

In early days the salmon were merely dried by the Indians. About 1833 they were first salted in old rum kegs. In 1864 the canning of salmon was begun on Sacramento River, in California, and two years later on the Columbia, where it has flourished ever since. The fish are caught in nets of various kinds, but also, and most effectively, in the salmon wheel, which may be seen at many points along the shores of the Columbia. By this device, which is kept in motion by the stream, the fish are automatically scooped up and thrown into a tank.

From Vancouver the Columbia is crossed by a new bridge more than a mile in length. The depth of the river here is 29 feet. The character and the natural sorting of the material of the river bed are well illustrated by the deposits of fine-grained sand dredged opposite Vancouver, of coarse sand opposite Russell Landing, and of gravel opposite Fishers, 9 miles above Vancouver. Halfway across the Columbia River bridge the traveler passes into the State of Oregon.

[<<< Previous](#)

[<<< Contents >>>](#)

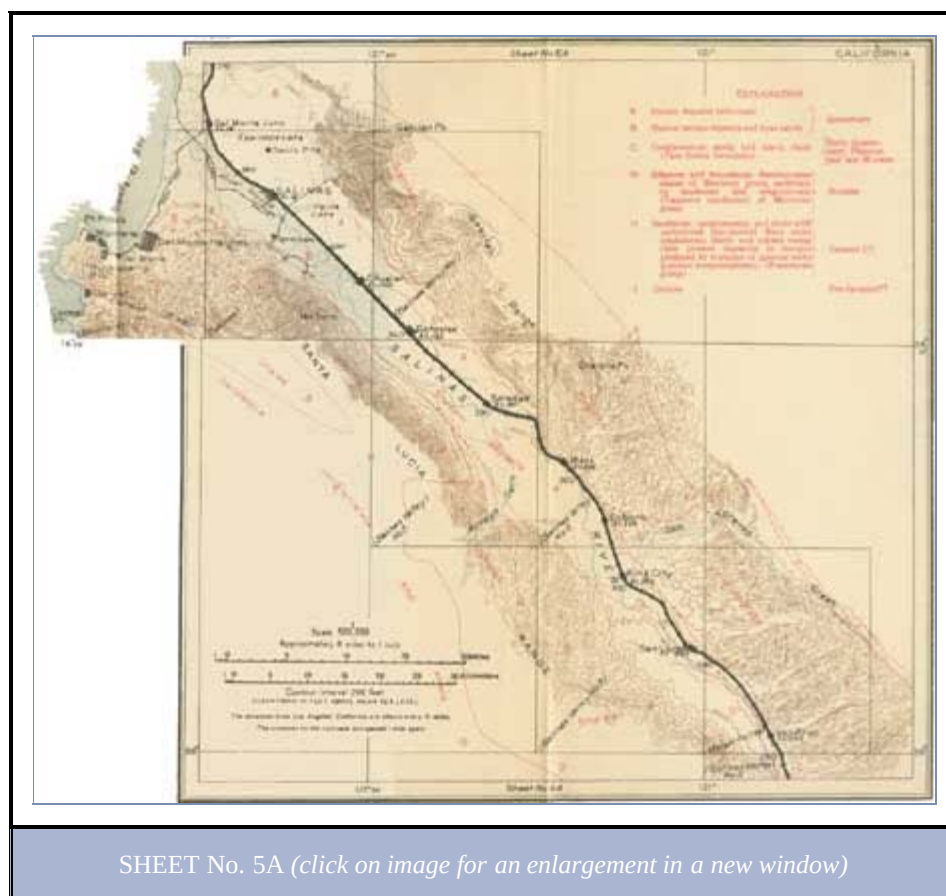
[Next >>>](#)



Geological Survey Bulletin 614

Guidebook of the Western United States:
Part D. The Shasta Route and Coast Line

ITINERARY



San Ardo.

Elevation 452 feet.

Population 365.*

Los Angeles 292 miles.

The village of San Ardo (see sheet 5A, p. 122) is surrounded by a wheat and stock country which includes the rolling low hills along the river. An exposure of the Santa Margarita formation begins about 6 miles south of San Ardo and extends in a northwesterly direction to a point on the west edge of the valley immediately opposite San Ardo. This strip of Santa Margarita beds consists of white sandstone that at several localities contains fossils. The geologic structure immediately west of San Ardo is complex. The hills for several miles back from the river on the west side are composed of Monterey shale.

San Lucas.

Elevation 395 feet.

Los Angeles 302 miles.

Three miles northwest of San Ardo the Paso Robles gravels on the east side of the valley give place to sandstones of the Santa Margarita formation, which occupy an area of many square miles extending in a northeasterly direction from San Lucas. Fossils, including numerous sea urchins and oysters, occur at

several points throughout the area. The Santa Lucia Range, which bounds Salinas Valley on the southwest, culminates in Santa Lucia Peak and Vaquero Peak, in the region west of San Lucas. The upper slopes of these mountains consist of coarse heavy-bedded fossiliferous Vaqueros sandstone dipping toward the valley. This sandstone, toward the railroad, is overlain by the upper formation of the Monterey group. Along the northeast edge of Salinas Valley the Monterey in turn is overlain by the Paso Robles formation, which either rests directly on the Monterey or at some places on intervening beds of the Santa Margarita formation.

Extending north for 3 miles and west for 4 or 5 miles from San Lucas is a gravel terrace probably deposited by the river at an earlier stage in its history.

King City.

Elevation 330 feet.

Population 1,563.*

Los Angeles 311 miles.

King City is a shipping point for gypsum obtained from the hills, about 15 miles to the north-northeast. At Elsa, 3 miles farther north, the raising of sugar beets is an important industry. The Paso Robles gravels continue to occupy both sides of the Salinas Valley to a point within 3 miles of Metz. From Chalone Creek, which is crossed at Metz, northward the main Gabilan Range becomes more rugged and consists chiefly of granite with some schist and crystalline limestone. This part of the range, which has been little studied, contains some metalliferous deposits, especially ores of quicksilver.

At milepost 147 the railroad leaves Salinas River and surmounts a terrace which borders the river for some miles. The deposits forming this terrace are comparable with those near San Lucas.

Soledad.

Elevation 180 feet.

Population 1,194.*

Los Angeles 331 miles.

Soledad (so-lay-dahd', Spanish for solitude) is built on a fertile plain which forms part of the terrace just mentioned. From the town may be had fine views of the valley and bordering mountains, and the vicinity affords some delightful drives. Across the river are the ruins of the mission church built in 1791. A stage runs from Soledad southwest 8 miles to Paraiso Hot Springs, at an altitude of 1,400 feet in the Santa Lucia Range. About 14 miles northeast of Soledad are The Pinnacles (Pl. XXX, p. 124), picturesque masses that have been sculptured by erosion from some rock whose character and geologic age have not been ascertained. The prominent peaks 6 or 7 miles east of Soledad are the Chalone Peaks, which are composed of marbles and other crystalline rocks that are probably older than any others in the Coast Range. North of them is an area of rocks in which copper and quicksilver occur. Flanking these peaks and extending northward along the northeast side of Salinas Valley are some hills of moderate height composed partly of sandstone.



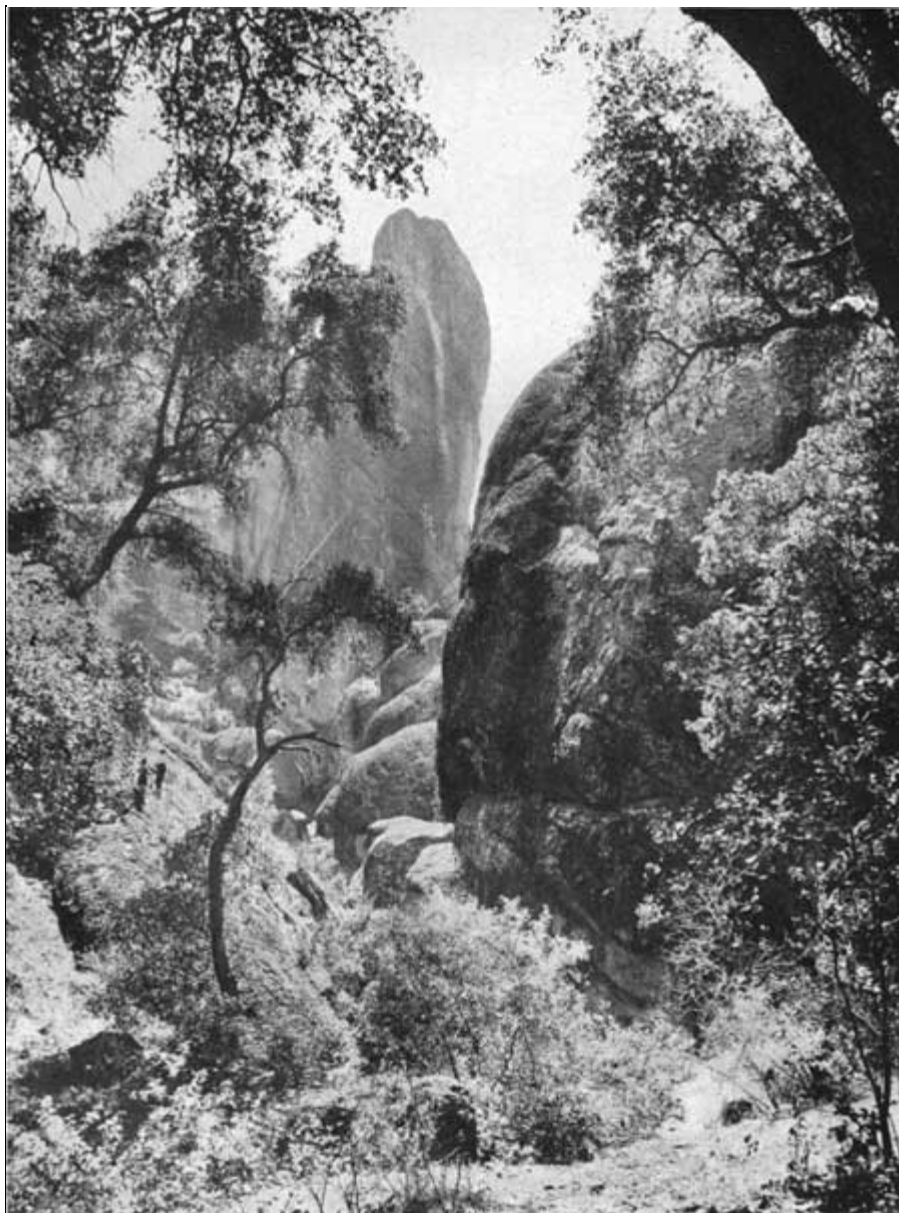


PLATE XXX—THE PINNACLES, 12 MILES NORTHEAST OF SOLEDAD CAL.
Formed by erosion of fragmental rocks.

On the west side of the Salinas Valley, opposite Soledad and Camphora, are some old alluvial fans that merge with the terrace deposits along the river. Recent erosion has cut trenches in some of these fans, but as a rule they stand out as nearly perfect examples of this type of stream deposit.

Gonzales.

Elevation 125 feet.

Population 1,305.*

Los Angeles 340 miles.

Along this part of Salinas Valley the same contact observed farther south persists; the mountain slope on the northeast is comparatively gentle, but that on the southwest is steep. The southwest slope, as previously noted, is probably a fault scarp or fault cliff, worn back and cut into by erosion.

Chualar.

Elevation 100 feet.

Los Angeles 346 miles.

Beyond Gonzales (gohn-sah'lace), in the neighborhood of Chualar (chwa-lar'), the valley gradually widens northwestward, toward Monterey Bay. Great quantities of alfalfa hay and grain are produced in this vicinity. The terraces found all along the Salinas Valley from Templeton northward are here well

Salinas.

Elevation 41 feet.
Population 3,736.
Los Angeles 357 miles.

Del Monte Junction.
Elevation 16 feet.
Los Angeles 365 miles.

developed and grow broader toward the mouth of the river.

The town of Salinas (Spanish for salt pits) is the center of a large beet-sugar industry. Besides sugar beets, beans are extensively grown in this region, especially near the coast. Opposite Salinas the river flows at the extreme west edge of the valley.

Del Monte Junction lies but a few miles from the mouth of Salinas River and Monterey Bay. A branch line, over which pass through trains to and from San Francisco, runs southwest from this junction to Del Monte, Monterey, and Pacific Grove.¹

¹The Hotel Del Monte, in grounds world-famous for their beauty, is situated on one of the most charming and interesting parts of the whole California coast. Near by are the combinations of rocks, sea, woodland, and hills such as delight an artist. Old buildings and associations appeal to the student of early California history. There are ample facilities and opportunities for the pursuit of sport of many kinds. Finally, the region is of exceptional geologic interest and is the type locality of the white shale of the Monterey group. This shale, although soft when quarried, hardens on exposure and withstands the sea air without crumbling.

Monterey, although visited and named by the Spaniards in 1602, was not permanently settled until 1770. In that year Gaspar de Portolá, the first governor of Alta California, arrived by land, and Padre Junípero Serra, of the Franciscans, a few days later by sea. Serra founded at Monterey his first mission in Upper California. The mission at Carmel, where Serra lived and died, was founded the next year. San Carlos Church, Monterey (Pl. XXIX, B, p. 119), is sometimes confused with the San Carlos mission at Carmel. Commodore Sloat landed at Monterey July 7, 1846, and took possession for the United States. A monument to him and one to Serra stand in the Presidio. Monterey was the first capital of California, and in Colton Hall the first constitutional convention was held September 1, 1849. An association of more recent date that will endear the place to many is that here for a time lived Robert Louis Stevenson.

Monterey is the terminus of a pipe line from the Coalinga oil field, in the San Joaquin Valley, and from 12,000 to 15,000 barrels of oil is pumped through this line daily.

Soundings by the United States Coast and Geodetic Survey have shown that a deep depression extends across the bottom of the comparatively shallow Monterey Bay out to the steep submarine slope that marks the real boundary between continent and ocean. Some geologists have interpreted this depression as a valley of erosion cut by Salinas River when the land stood higher than at present and when the bottom of the bay was dry land. Prof. A. C. Lawson, however, has maintained that a similar submarine valley, in Carmel Bay south of Monterey, which is not quite in line with the present valley of Carmel River, is probably a structural sag or syncline and not an erosion valley at all. He can find no evidence of recent uplift of this part of the coast sufficient to have enabled the river to cut a valley across what is now the bottom of the bay.

Some terrace deposits may be seen east of Del Monte Junction. They extend northward to the edge of Pajaro Valley, the surface apparently rising to the north. The railroad traverses a

lower plain terrace descending from 16 feet at Del Monte Junction to 2 feet at Elkhorn station, beyond which it turns up a little valley cut by Elkhorn Creek in the marine terrace deposits. After crossing Elkhorn Slough and bearing to the left between some low hills, the railroad emerges, at about milepost 101, in the Pajaro Valley (pah'ha-ro, Spanish for bird).

<<< [Previous](#)

<<< [Contents](#) >>>

[Next](#) >>>

bul/614/sec5a.htm
Last Updated: 8-Jan-2007