



Geological Survey Bulletin 612

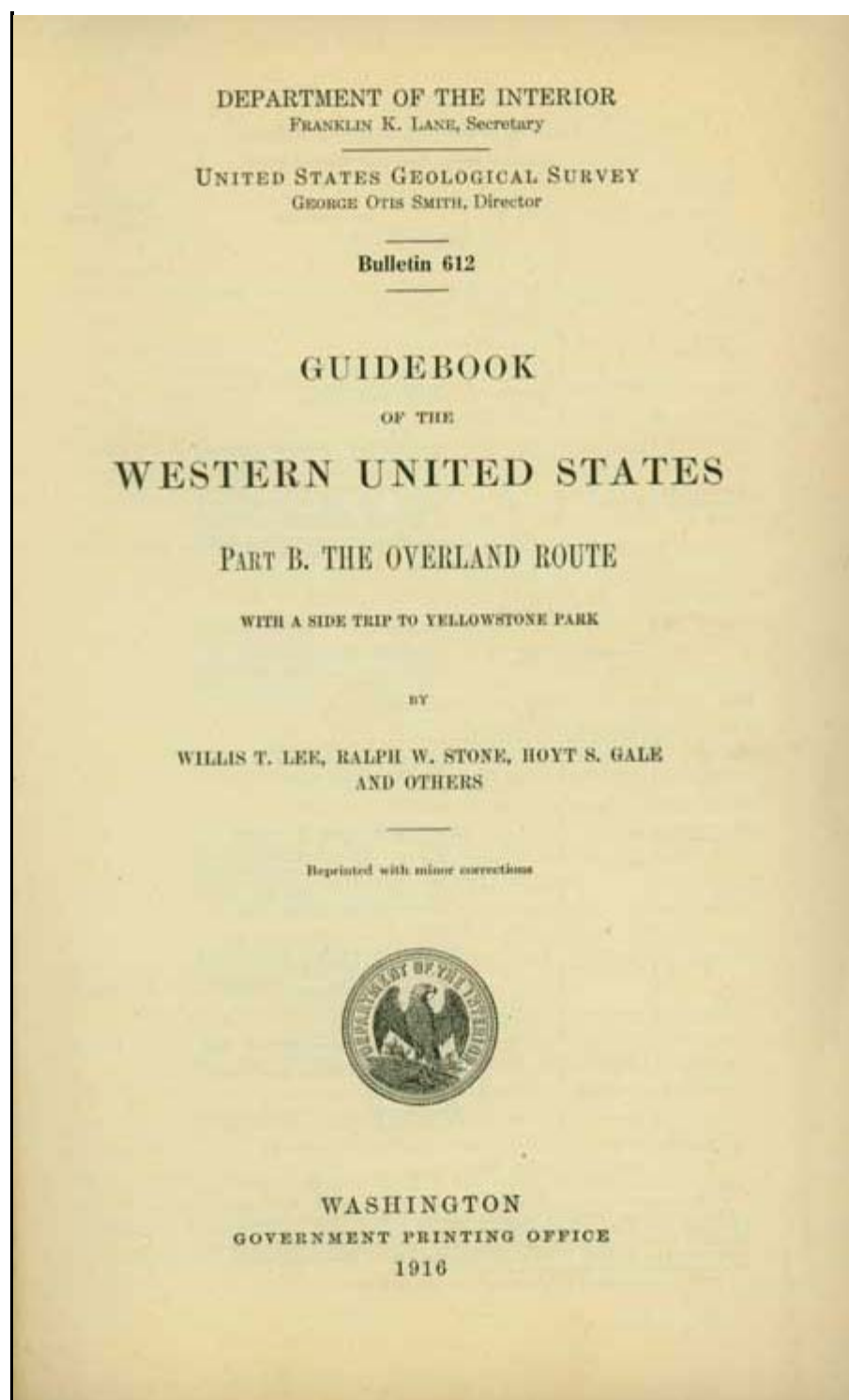
Guidebook of the Western United
States: Part B. The Overland Route

GUIDEBOOK OF THE WESTERN UNITED STATES

PART B. THE OVERLAND ROUTE WITH A SIDE TRIP TO YELLOWSTONE PARK

**By
Willis T. Lee, Ralph W. Stone, Hoyt S. Gale and others**

Reprinted with minor corrections



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1916

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DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, *Secretary*

UNITED STATES GEOLOGICAL SURVEY
George Otis Smith, *Director*

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PRINCIPAL DIVISIONS OF GEOLOGIC TIME ^a

[A glossary of geologic terms is given on pp. [182-85](#).]

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 backboned 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.

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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, Northern Pacific Route, with a side trip to Yellowstone Park (Bulletin 611); Part B, Overland Route, with a side trip to Yellowstone Park (Bulletin 612); Part C, Santa Fe Route, with a side trip to Grand Canyon of the Colorado (Bulletin 613); Part D, 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 Overland Route the geographic and geologic information already published as well as unpublished material in the possession of the Geological Survey has been utilized, but to supplement this material Messrs. Lee, Stone, and Gale made a field examination of the entire route in 1914, Mr. Lee working between Omaha and Ogden, Mr. Stone between Ogden and Yellowstone, and Mr. Gale between Ogden and San Francisco. Information has been furnished by Profs. J. C. Merriam and G. H. Louderback, as well as by others to whom credit is given in the text. Cooperation has been rendered by the United States Reclamation Service and by bureaus of the Department of Agriculture. 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, 29 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 these maps of the route were made by C. H. Birdseye and J. L. Lewis.

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GUIDEBOOK OF THE WESTERN UNITED STATES.

PART B. THE OVERLAND ROUTE, WITH A SIDE TRIP TO YELLOWSTONE.

By WILLIS T. LEE, RALPH W. STONE, HOYT S. GALE, and others.

INTRODUCTION

The westbound traveler over the Union Pacific Railroad will view in the course of his journey some of the most conspicuous geographic features of the North American Continent. These are shown in the accompanying illustration (Pl. I). The east end of the route lies in the broad, well-watered Mississippi Valley, where an abundance of rainfall is indicated by the numerous branching streams. On leaving Omaha the traveler crosses the Great Plains, which rise gradually to the west and become progressively drier, merging into the relatively barren region formerly called the Great American Desert. This change in character is not very apparent to the traveler, because the railroad follows a valley whose bottom lands in the arid part of the Great Plains are irrigated and do not differ in general appearance from those farther east, where the rainfall supplies sufficient moisture for growing crops. On both sides of this valley in western Nebraska the land is utilized for grazing and for dry farming. The cultivation of the Great Plains by dry farming is rapidly spreading as new methods become more widely understood, and the region can no longer be called a desert. In eastern Wyoming the route is in a belt of grazing country.



PLATE I.—RELIEF MAP SHOWING SURFACE FEATURES OF THE WESTERN PART OF THE UNITED STATES. Areas shown on the sheets of the route map are indicated in red. (*click on image for an enlargement in a new window*)

West of the Great Plains lies a general mountainous country, known as the Cordilleran region, which extends westward to the Pacific coast. At Granite Canyon, Wyo., the railroad reaches the eastern margin of the Cordilleran region, marked by a spur of the southern Rocky Mountains—the Laramie Range—and thence westward it winds around detached mountain groups and through the intervening basins. The traveler may not realize that he is in a mountainous region, for most of the lofty mountains of southern Wyoming stand at considerable distances from the railroad. The mountainous part of the route is not well populated. Many of the stations are little more than section houses, and some consist only of a post on which is painted the name, to indicate the location of a sidetrack. This part of Wyoming is used mainly for stock raising, but in the irrigated valleys farther west, in Utah, there are orchards and well-tilled fields.

Soon after entering Utah the traveler crosses the Wasatch Mountains, one of the great ranges of the continent, through the canyon cut by Weber River, and then enters the valley of Great Salt Lake.

Leaving Ogden on the westward journey the traveler is fairly within the Great Basin, one of the major natural divisions or physiographic provinces of the United States, and he will be passing through it for more than 16 hours. The Great Basin is called a desert and as a whole gives an impression of dreariness and desolation, but it has a peculiar interest not possessed by any other part of the transcontinental route. It is one of the most productive mining regions of the world. That it is not all a desert is shown by the fact that large numbers of cattle and sheep are raised within its limits. It is developing, moreover, to an increasing extent in agriculture.

Beyond the Great Basin lies the Sierra Nevada, which on this route marks approximately the boundary between Nevada and California. Through the forest zone of the Sierra the traveler descends into the Great Valley of California and, crossing its broad plains, passes, by way of the one tidal outlet through the Coast Ranges, to the metropolis of the Pacific coast.

NOTE.—For the convenience of the traveler the sheets of the route map in this bulletin are so arranged 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 is made in the text to each map at the place where it should be so unfolded. The areas covered by these sheets are indicated on Plate I, and a list of the sheets and the other illustrations is given on pages [237-240](#). A glossary of geologic terms is given on pages [232-236](#), and an index of stations on pages [241-244](#).

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Part B

ITINERARY

COUNCIL BLUFFS, IOWA, TO OGDEN, UTAH.

Council Bluffs, Iowa.
Elevation 980 feet.
Population 29,292.

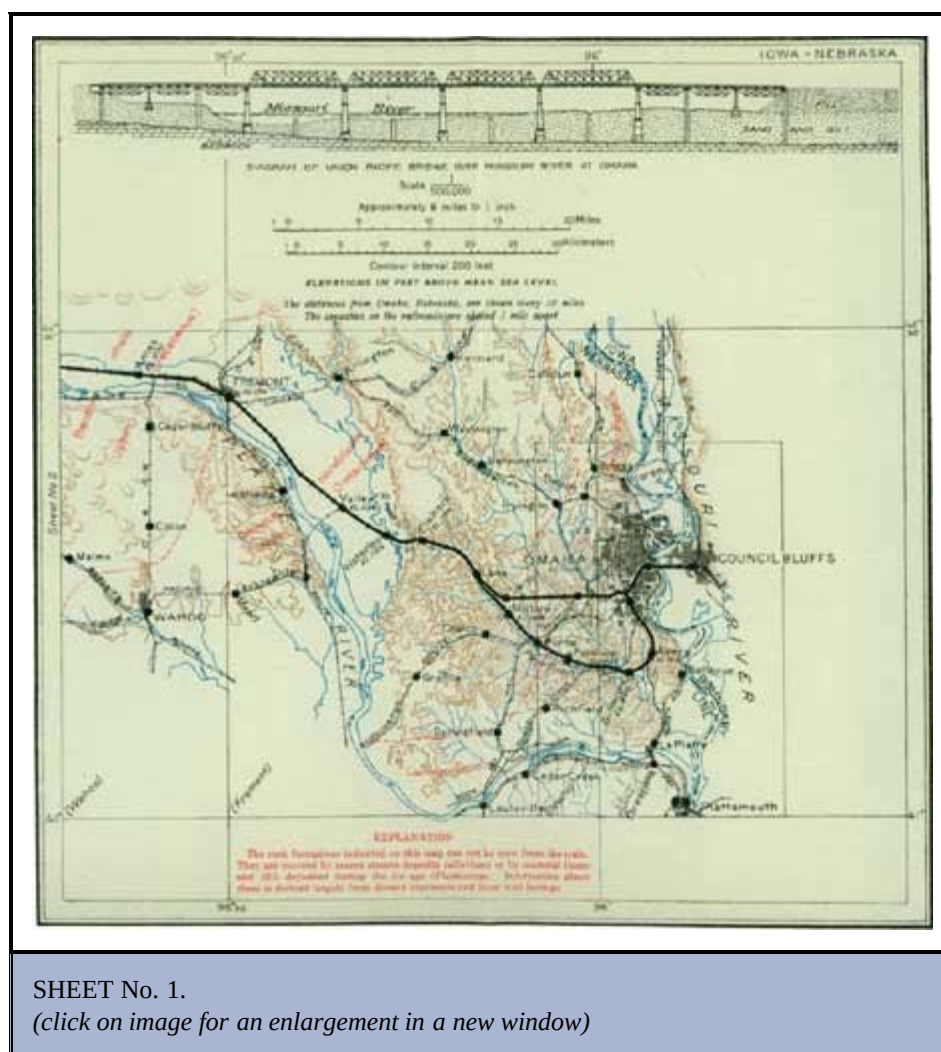
Abraham Lincoln established the eastern terminus¹ of the Union Pacific Railroad on the east side of Missouri River, so that the Overland Route begins at Council Bluffs, Iowa (see sheet 1, p. 18), although the offices, shops, and general terminal facilities of the road are west of the river, at Omaha. Council Bluffs is on the broad flood plain of Missouri River, at the foot of high bluffs composed mainly of a claylike material known as loess. According to tradition these bluffs were used for centuries by the Indians as a common meeting ground; here the several tribes held their pow-wows, smoked their pipes of peace, or declared hostilities, as their inclinations moved them. The name Council Bluffs was originally applied to a locality about 20 miles north of Omaha, where Lewis and Clark held council with the Indians. Later it was transferred to the site of the present city.

¹President Lincoln's Executive order of November 17, 1863, and a supplemental order of March 7, 1864, were issued under the law of July 1, 1862, which created the Union Pacific Railroad Co. and which authorized the President of the United States to establish its eastern terminus on the western boundary of Iowa. This required the company to provide for the difficult crossing of Missouri River.

The passage of this law authorizing the building of a road to the Pacific coast was preceded by a long debate. The northwestern region acquired by the Louisiana purchase of 1803 had been explored by Lewis and Clark, whose expedition started in 1804. Their report aroused great interest and stimulated many military, trading, and exploring expeditions, but there was great opposition to the holding of the "western wilderness" in the Union. This was voiced in 1825 by Senator Dickerson, of New Jersey, who said, in debate: "But is this Territory of Oregon ever to become a State, a member of this Union? Never. * * * The distance * * * that a Member of Congress of this State of Oregon would be obliged to travel in coming to the seat of government and returning home would be 9,300 miles. * * * If he should travel at the rate of 30 miles per day, it would require 306 days. Allow for Sundays, 44, it would amount to 350 days. This would allow the Member a fortnight to rest himself at Washington before he should commence his journey home. This traveling would be hard, as a greater part of the way is exceedingly bad, and a portion of it over rugged mountains where Lewis and Clark found several feet of snow in the latter part of June. Yet a young, able-bodied Senator might travel from Oregon to Washington and back once a year; but he could do nothing else. It would be more expeditious, however, to come by water round Cape Horn, or to pass through Bering Strait,

round the north coast of this continent to Baffin Bay, thence through Davis Strait to the Atlantic, and so on to Washington. It is true, this passage is not yet discovered, except upon our maps, but it will be as soon as Oregon shall be a State."

But when California was acquired by the United States, and especially after the discovery of gold, the Pacific coast became of great importance to the citizens of the East, and routes leading to it were carried across what had been a trackless wilderness. The western migration which received its greatest impetus in the gold rush of 1849, developed some famous trails, one of which, the "Overland Trail," was the forerunner of the Union Pacific and Central Pacific railroads. The convincing arguments in favor of its construction seem to have been military and political rather than commercial. President Lincoln advocated it not only as a military necessity but also as a means of keeping the Pacific coast in the Union. The name Union Pacific probably resulted from the belief that the road would bind the Union together.



The loess¹ north of Council Bluffs lies above loose sand and gravel known as the Aftonian gravels (fig. 1). The outcrop of these gravels is marked by a line of springs, for the underground water passes through them more readily than it passes through the less porous material above and below. From these gravels in some parts of Iowa have been collected the bones of mastodons, camels, and many other animals no longer found in North America.²

(See Pl. II, p. 10.)

¹Loess is a peculiar silt, claylike loam, or fine-grained sand, which strongly resists weathering. The name is supposed to be derived from the German word *loesen* (to loosen), because of the tendency of the material to split off in vertical columns. In color loess is generally buff or yellowish brown. It covers large areas in North America, where its beds were probably formed after the ice of the glacial period had disappeared. Its mode of origin is not certainly known. Some beds of it consist of material lifted by the wind from the valleys where it had been deposited by streams. Others probably were deposited in water along stream courses or in temporary lakes. In places it contains bones and teeth of animals and shells of snails. If properly watered it makes good soil.

²The animals of the Pleistocene (*plice'-toe-seen*) epoch (see table on p.2) are interesting because they are nearer to us in time than others of the past and therefore most nearly like some animals now living; yet those that lived in North America during this epoch were very different from those living here to-day. To find the descendants or near relatives of the Pleistocene animals of North America we must go to other continents, for some of them as far away as India. The North American animals were doubtless scattered by the changes in climate that resulted in the advances and retreats of the continental ice sheet during the Great Ice Age.

The fauna, or assemblage of animals, of early Pleistocene time was varied in character. The animals were adapted to the mild climate that then prevailed and remained until after the southward advance of the ice sheet, but were driven away or exterminated before the close of the ice age, and their place was taken by animals such as are now found only in the frozen areas of the North. When the ice melted away and a climate as mild as that of the present day was established, these arctic species followed the retreating ice front northward, and their place was taken by animals adapted to life in a temperate climate.

One of the effects of the climatic changes and the resulting migration of animals was a radical change of fauna. Could one of the Pleistocene men return and view the present-day animals they would seem as strange to him as those of an African jungle are to an inhabitant of the Great Plains. Prof. W. B. Scott, in his history of land mammals, says of the Pleistocene fauna:

"It is probable that the Pleistocene fossils already obtained give us a fairly adequate conception of the larger and more conspicuous mammals of the time but no doubt represent very incompletely the small and fragile forms. With all its gaps, however, the record is very impressive. * * * The fossils have been gathered over a very large area, extending from ocean to ocean and from Alaska to Central America. Thus their wide geographical range represents nearly all parts of the continent and gives us information concerning the mammals of the forests as well as of the plains.

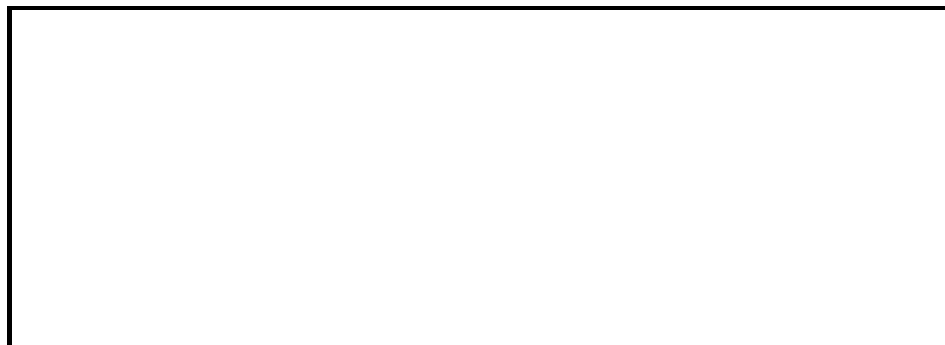
"Those divisions of the early and middle Pleistocene which enjoyed milder climatic conditions had an assemblage of mammals, which from one point of view seems very modern, for most of the genera and even many of the species which now inhabit North America date back to that time. From the geographical standpoint, however, this is a very strange fauna, for it contains so many animals now utterly foreign to North America, to find near relatives of which we should

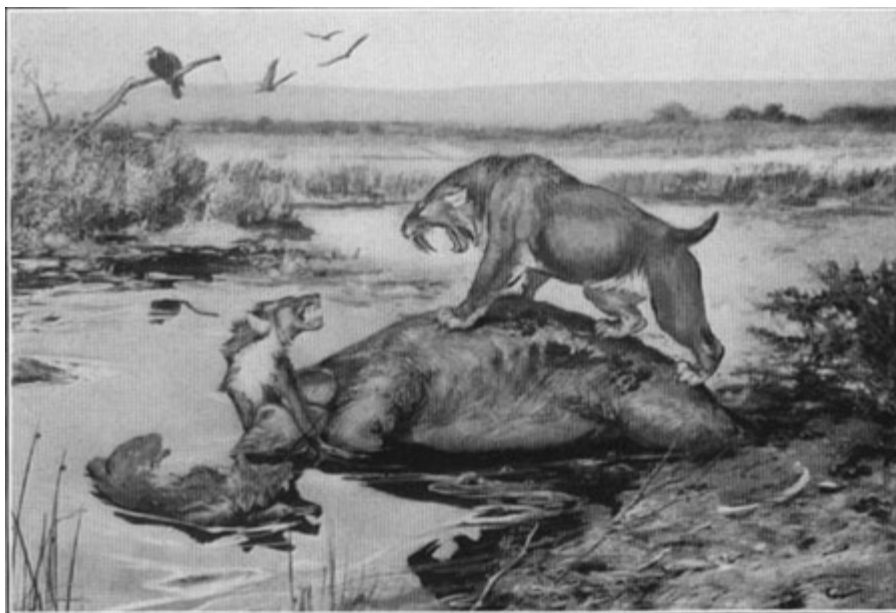
have to go to Asia or South America. Some of these animals which now seem so exotic, such as the llamas, camels, and horses, were yet truly indigenous and were derived from a long line of ancestors which dwelt in this continent but are now scattered abroad and are extinct in their original home, while others were migrants that for some unknown reason failed to maintain themselves. Others again are everywhere extinct.

"Most surprising, perhaps, in a North American landscape is the presence of the Proboscidea, of which two very distinct kinds, the mastodons and the true elephants, are found together. Over nearly the whole of the United States and southern Canada, and even with sporadic occurrence in Alaska, ranged the American mastodon (*Mastodon americanus*), which was rare in the plains but very abundant in the forested regions, where it persisted till a very late period and was probably known to the early Indians. This animal, while nearly related to the true elephants, was yet quite different from them in appearance. * * * The tusks were elephant-like, except that in the male there was a single small tusk in the lower jaw, which can not have been visible externally; this is a remnant of an earlier stage of development, when there were two large tusks in the lower as well as the upper jaw. The creature was covered with long, coarse dun-colored hair; such hair has been found with some of the skeletons.

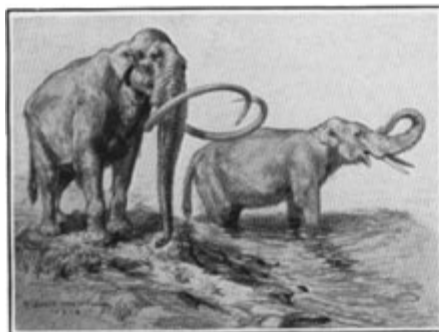
"Of true elephants, the North American Pleistocene had three species. Most interesting of these is the northern or Siberian mammoth (*Elephas primigenius*), a late immigrant from northern Asia, which came in by way of Alaska, where Bering Land (as we may call the raised bed of Bering Sea) connected it with Asia. The mammoth was abundant in Alaska, British Columbia, and all across the northern United States to the Atlantic coast. Hardly any fossil mammal is so well known as this, for the carcasses entombed in the frozen gravels of northern Siberia have preserved every detail of structure. It is thus definitely known that the mammoth was well adapted to a cold climate and was covered with a dense coat of wool beneath an outer coating of long, coarse hair, while the contents of the stomach and the partly masticated food found in the mouth showed that the animal fed upon the same vegetation that occurs in northern Siberia to-day. * * * This is the smallest of the three Pleistocene species—9 feet [high] at the shoulder. The mammoth was not peculiar to Siberia and North America, but extended also into Europe, where it was familiar to paleolithic man, as is attested by the spirited and lifelike carvings and cave paintings of that date. Thus, during some part of the Pleistocene, this species ranged around the entire northern hemisphere."

Two notable contemporaries of the mammoth were the Columbian elephant, *Elephas columbi* [Pl.II, B], which attained a height of about 11 feet, the size of the largest African elephants, and the imperial elephant, *Elephas imperator*, the largest of the American forms, which attained a height of 13 feet 6 inches.

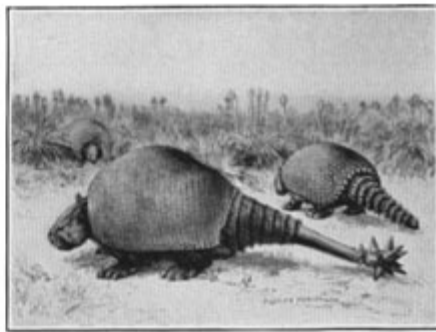




A.



B.



C.



D.



E.

PLATE II.—ANIMALS THAT LIVED IN CENTRAL NORTH AMERICA DURING PLIOCENE AND PLEISTOCENE TIME. A, Saber-toothed tiger and giant wolves on the carcass of a Pleistocene elephant; B, Pleistocene elephants (*Elephas columbi*), much larger than the modern elephants; C, Glyptodonts, Pleistocene armadillo-like animals (South American forms); D, Pleistocene musk ox, an animal as big as a small cow; E, Pliocene horned gophers, animals about the size of woodchucks. After Scott. Published by permission of The Macmillan Co.

"This great creature [the imperial elephant] was characterized not only by its enormous stature but also by the proportionately very large size of its grinding teeth and was a survivor from the preceding Pliocene epoch; it is not known to have passed beyond the middle Pleistocene and was thus the first of the species to become extinct. In geographical range the imperial elephant was a western form, extending from the Pacific coast almost to the Mississippi River, east of

which it has never been found, and from Nebraska southward to the City of Mexico. The meaning of this distribution is probably that this elephant shunned the forests and was especially adapted to a life on the open plains. * * *

"Many hoofed animals, far more than now inhabit North America, are found in this Pleistocene fauna. The Perissodactyla were represented by horses and tapirs, but not by rhinoceroses; it might seem superfluous to say that there were not rhinoceroses, but, as a matter of fact, that family had a long and varied American history and became extinct only during or at the end of the Pliocene epoch. The horses were extremely numerous, both individually and specifically, and ranged, apparently in great herds, all over Mexico and the United States and even into Alaska. All the known species (at least 10 in number) belong to the genus *Equus*, but the true horse (*Equus caballus*) to which all the domestic breeds are referred, is not represented. The smallest known member of the genus is the pygmy *Equus tau*, of Mexico. [These ranged in size from ponies as large as a Shetland to horses that exceeded in size the heaviest modern draft horses.] * * * The Great Plains must have been fairly covered with enormous herds of horses, the countless bones and teeth of which, entombed in the Sheridan formation, have given to it the name of 'Equus beds.' * * *

"To one who knows nothing of the geological history of North America it would be natural to suppose that the Pleistocene horses must have been immigrants from the Old World which failed to establish themselves permanently here, since they completely disappeared before the discovery of the continent by Europeans. This would, however, be a mistaken inference, for North America was for long ages the chief area of development of the equine family, which may here be traced in almost unbroken continuity from the lower Eocene to the Pliocene. On the other hand, it is quite possible that some of the species were immigrants."

Tapirs, which are now confined to southern Asia, Central America, and South America, were abundant east of the Mississippi but are not known west of that river. Wild hogs, camels, and llamas were abundant. The hoofed animals, such as deer and bison, were numerous, and also the carnivores or flesh eaters. Conspicuous among these were the saber-toothed tigers (see Pl. II, A), which were contemporaneous with primitive man and doubtless were his formidable enemies. They have appealed so strongly to the imagination and have been referred to so often in literature that they are among the best known of the extinct animals.

The Pleistocene fauna was not without its grotesque features. Among the most curious animals of the time may be mentioned the ground sloths and the giant armadillos (Pl. II, C), of which Prof. Scott says:

"The ground sloths were great, unwieldy herbivorous animals covered with long hair, and in one family there was a close-set armor of pebble-like ossicles in the skin, not visible externally. They walked upon the outer edges of the feet, somewhat as the ant bear uses his fore paws, and must have been very slow moving creatures. Their enormous claws may have served partly as weapons of defense and were doubtless used also to drag down branches of trees and to dig roots and tubers. Apparently, the latest of these curious animals to survive was very large *Megalonyx*, which it is interesting to note was first discovered and named by Thomas Jefferson. The animals of this genus were very abundant in the forests east of the Mississippi River and on the Pacific coast, but much less common in the plains region, where they would seem to have been confined to

the wooded river valleys. The still more gigantic Megatherium which had a body as large as that of an elephant and much shorter though more massive legs, was a southern animal and has not been found above South Carolina. Mylodon, smaller and lighter than the preceding genera, would seem to have entered the continent earlier and to have become extinct sooner. It ranged across the continent but was much commoner in the plains region and less so in the forested areas than Megalonyx, being no doubt better adapted to subsisting upon the vegetation of the plains and less dependent upon trees for food.

"The glyptodonts [armadillos see Pl. II, C] were undoubtedly present in the North American Pleistocene, but the remnants which have been collected so far are very fragmentary and quite insufficient to give us a definite conception of the number and variety of them." They were abundant, however, in the South American Pleistocene and hence are well known.

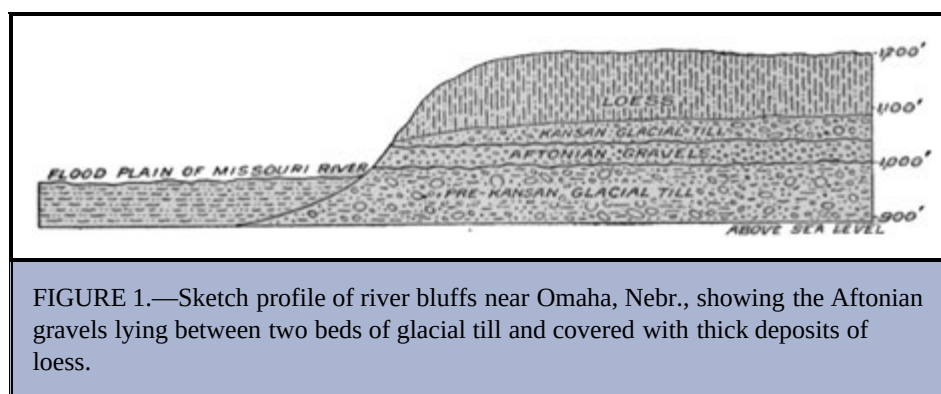


FIGURE 1.—Sketch profile of river bluffs near Omaha, Nebr., showing the Aftonian gravels lying between two beds of glacial till and covered with thick deposits of loess.

The Aftonian gravels separate two glacial deposits known as till, consisting of sandy clay in which are fragments of rock ranging from grains of sand to boulders 2 feet or more in diameter. These fragments are of limestone, sandstone, quartz, and other rocks, but the largest and most conspicuous are of quartzite and granite, including blocks of a pink rock known as Sioux quartzite, because the rock mass from which they came is exposed near Sioux Falls, S. Dak. Many of the granite boulders were carried by the glaciers hundreds of miles, for the nearest native rock of this kind occurs far to the north. (For description of glacial deposits see note on pp. 21-23.)

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GLOSSARY OF GEOLOGIC TERMS

Alluvial fan. The outspread sloping deposit of boulders, gravel, and sand left by a stream where it passes from a gorge out upon a plain. (See Pl. XLII, p. 188.)

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 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-grained 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 of the layer

makes with a horizontal plane. (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, gravel, and silt—carried by a glacier. Drift includes the unsorted material known as till and deposits made by streams flowing from the 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 grains as tools or abrasives. Erosion is aided by weathering. See 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 fig. 12, p. 100, and fig. 16, p. 188.)

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.

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.

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 by a plant or animal. This preservation is in variably accompanied by some change in substance, and in impressions the original substance has all been removed. (See Pl. IV, p. 20, and Pl. XIX, p.75.)

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 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. (See Pl. XXXVII, p. 177.)

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 that have been so changed are termed metamorphic. Marble, for example, is metamorphosed limestone.

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 accumulation or body of oil in 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 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. The valuable materials in placers have been 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 illustrated by 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.

Shale. A rock consisting of thin hardened 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. (See figs. 12 and 13, p. 100.) 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.

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 is called 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 indicate 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 regarded as leaves in the volume of geologic history, an unconformity marks a gap in the record. (See p. 42.)

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.

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Cannon, Cal
Cape Horn, Cal
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Carson, Nev
Carter, Wyo
Castle Rock, Utah
Cedar, Nev
Central City, Nebr
Chapman, Nebr
Chappell, Nebr
Cherokee, Wyo
Chester, Idaho
Cheyenne, Wyo
Church Buttes, Wyo
Cisco, Cal
Clark, Nev
Clarks, Nebr
Clipper Gap, Cal
Cluro, Nev
Cobre, Nev
Coin, Nev
Colfax, Cal
Colin, Utah
Collinston, Utah
Colores, Wyo
Colton, Nebr

Columbus, Nebr
Como, Wy
Comus, Nev
Cooper Lake, Wyo
Corlett, Wyo
Cornish, Utah
Cotton, Idaho
Cosgrave, Nev
Council Bluffs Iowa
Cozad, Nebr
Creston, Wyo
Crystal Lake, Cal
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D.

Dale Creek, Wyo
Daleys Ranch, Wyo
Dana, Wyo
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Dayton, Idaho
Deeth, Nev
Derby, Nev
Desert, Nev
Devils Slide
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E.

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Floriston, Cal
Forebay, Cal
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Fort Russell, Wyo
Fort Steele, Wyo
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G.

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Gothenburg, Nebr
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Green River, Wyo
Grenville, Wyo
Groome, Utah

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Hampton, Wyo
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Imlay, Nev
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Island Park, Idaho

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Knobs, Wyo
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Korty, Nebr

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Lander, Cal
Lane, Nebr

Laramie, Wyo
Latham, Wyo
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Lawton, Nev
Lemay, Utah
Leroy, Wyo
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Lodgepole, Nebr
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Loomis, Cal
Loray, Nev
Lorenzo, Idaho
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Madsen, Utah
Magra, Cal
Mare Island Navy Yard
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Massie, Nev
Maxwell, Nebr
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Megeath, Nebr
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O.

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Oxford, Idaho
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P.

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Penryn, Cal
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Perth, Nev
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Pigeon, Utah
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Ridge, Wyo
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Robinson, Wyo
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Rock Springs, Wyo
Rocklin, Cal
Rodeo, Cal
Rogers, Nebr
Roscoe, Nebr
Rose Creek, Nev
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Ryndon, Nev

S.

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Saline, Utah
Salt Lake City, Utah
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Sampo, Wyo
San Francisco, Cal
San Pablo, Cal

Sarpy, Nebr
Satanka, Wyo
Schuyler, Nebr
Seymour, Nebr
Shelley, Idaho
Shelton, Nebr
Sherman, Wyo
Sidney, Nebr
Silver Creek, Nebr
Smart, Cal
Smeed, Nebr
Sobrante, Cal
Soda Springs, Cal
Solon, Wyo
Sparks, Nev
Spring Valley, Wyo
Spruce, Cal
Stonehouse, Nev
Strawberry, Utah
Steamboat Springs, Nev
Strong Knob, Utah
Sugar City, Idaho
Suisun, Cal
Summit, Cal
Sunol, Nebr
Sutherland, Nebr
Swan Lake, Idaho
Swingle, Cal

T.

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Tamarack, Cal
Teck, Utah
Tecoma, Nev
Thayer Junction, Wyo
Thisbe, Nev
Thornton, Idaho
Thummel, Nebr
Tioga, Nev
Tipton, Wyo
Tobin, Cal
Tonka, Nev
Tormey, Cal
Toulon, Nev
Towle, Cal
Toy, Nev
Tracy, Wyo
Trenton, Utah
Truckee, Cal
Trude, Idaho
Tulasco Nev
Tule, Nev
Twin Grove, Idaho

Tyhee, Idaho

Tyrol, Nev

U.

Ucon, Idaho

Uinta, Utah

Ullin, Nev

Umbria Junction, Utah

Union Mill, Cal

Upsal, Nev

V.

Valery, Nev

Vallejo Junction, Cal

Valley, Nebr

Valley Pass, Nev

Valmy, Nev

Verdi, Nev

Verne, Wyo

Virginia, Idaho

Virginia City, Nev

Vista, Nev

Vivian, Nev

Vroman, Nebr

W.

Wahsatch, Utah

Walcott, Wyo

Wamsutter, Wyo

Wapello, Idaho

Warm River, Idaho

Washington, Cal

Waterloo, Nebr

Weir, Colo

Wells, Nev

West Weber, Utah

Weston, Idaho

Wheelon, Utah

White Plains, Nev

Wilcox, Wyo

Wilford, Idaho

Willard, Utah

Willow Island, Nebr

Winder, Idaho

Winnemucca, Nev

Wirt, Cal

Wood River, Nebr

Woolsey, Nev

Wyoming, Wyo

Wyuta, Utah

Y.

Yellowstone, Mont
Yuba Pass, Cal

Z.

Zenda, Idaho
Zola, Nev

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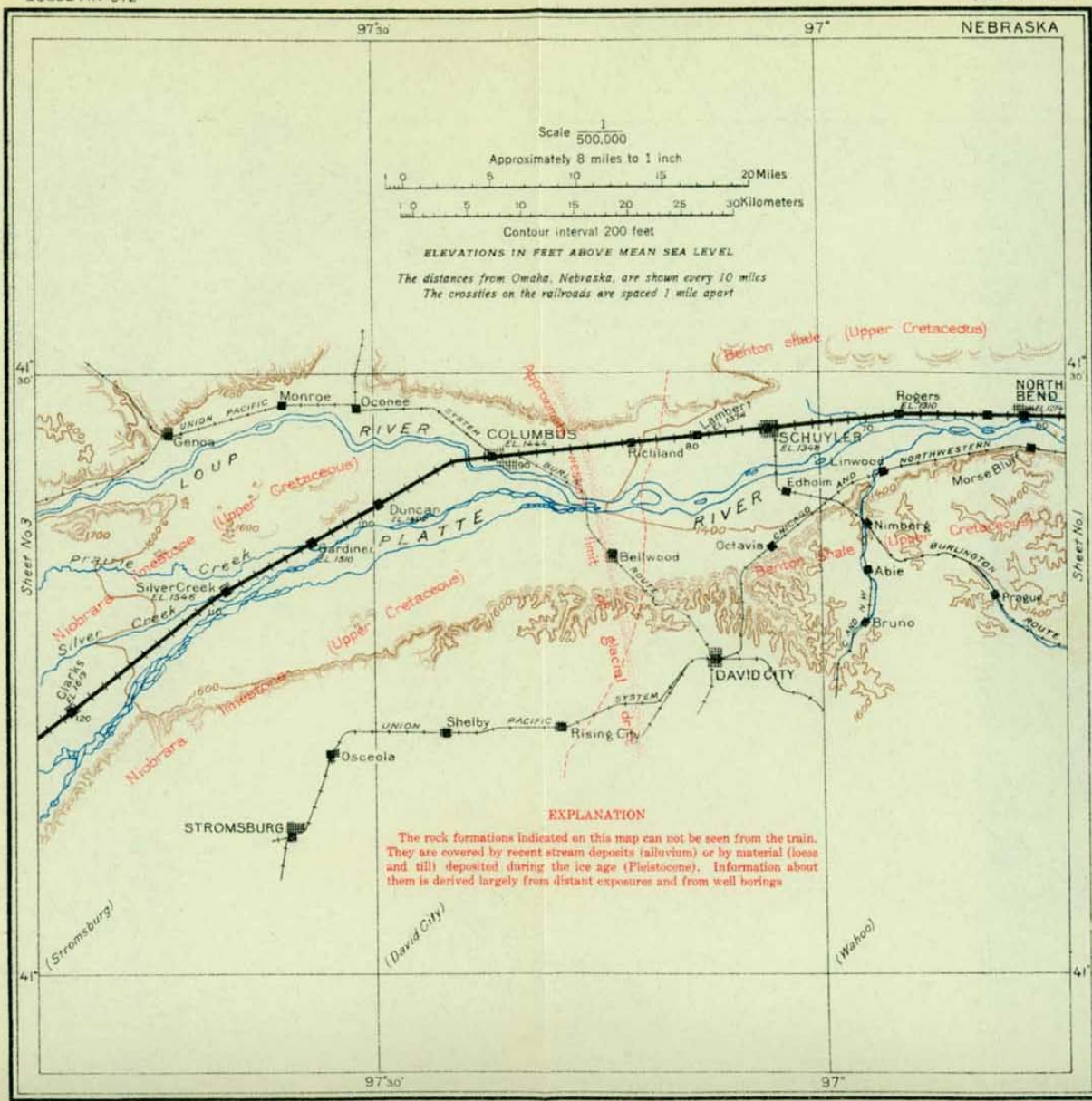
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bul/612/stations.htm
Last Updated: 28-Mar-2006



MAP OF NORTH AMERICA, SHOWING DISTRIBUTION OF LAND AND SEA IN UPPER CRETACEOUS (BENTON) TIME

Area not shaded indicates land, shaded area indicates sea





GEOLOGIC AND TOPOGRAPHIC MAP OF THE

OVERLAND ROUTE

From Omaha, Nebraska, to San Francisco, California

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

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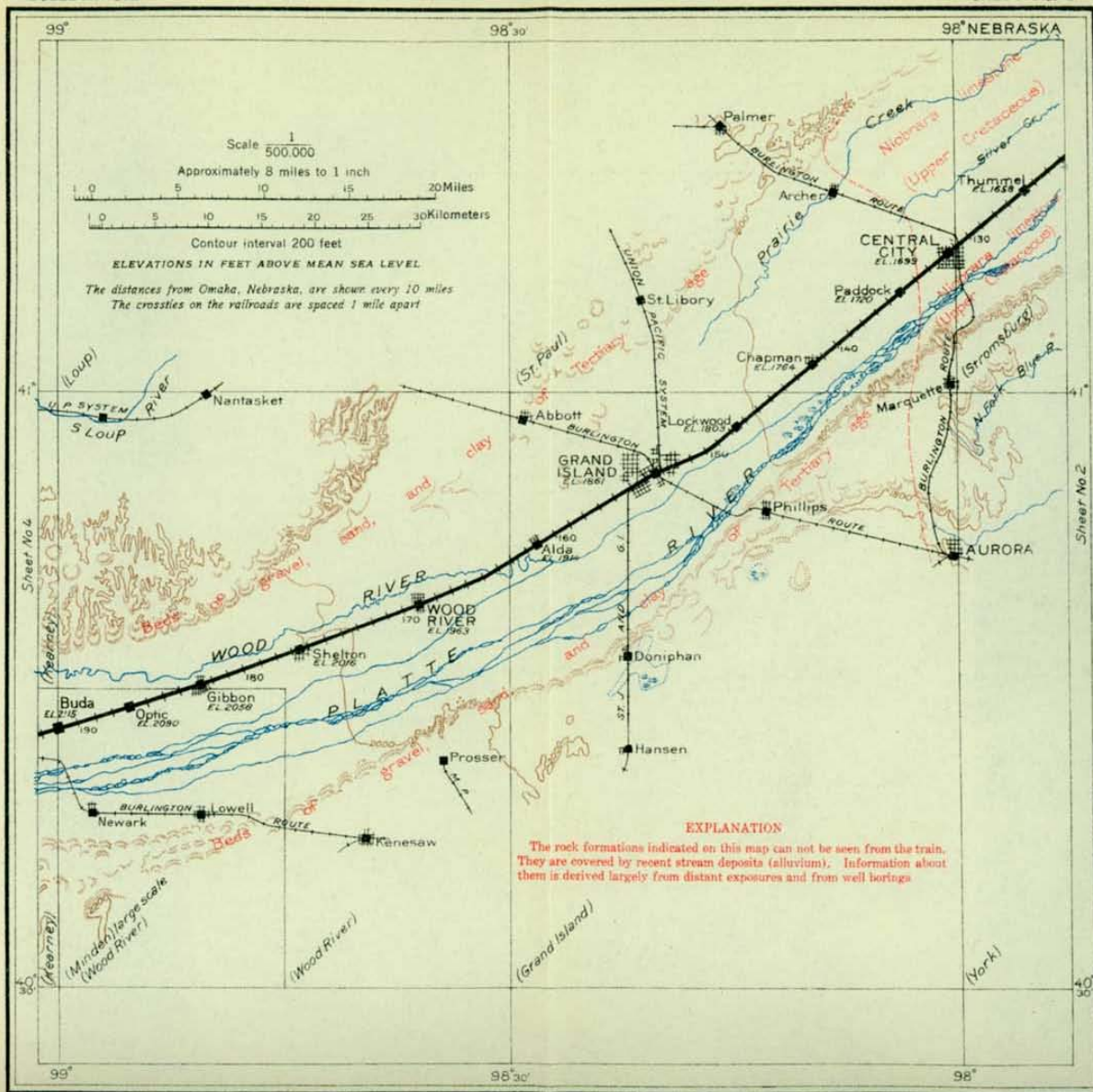
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1915

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BULLETIN 612

SHEET No. 3





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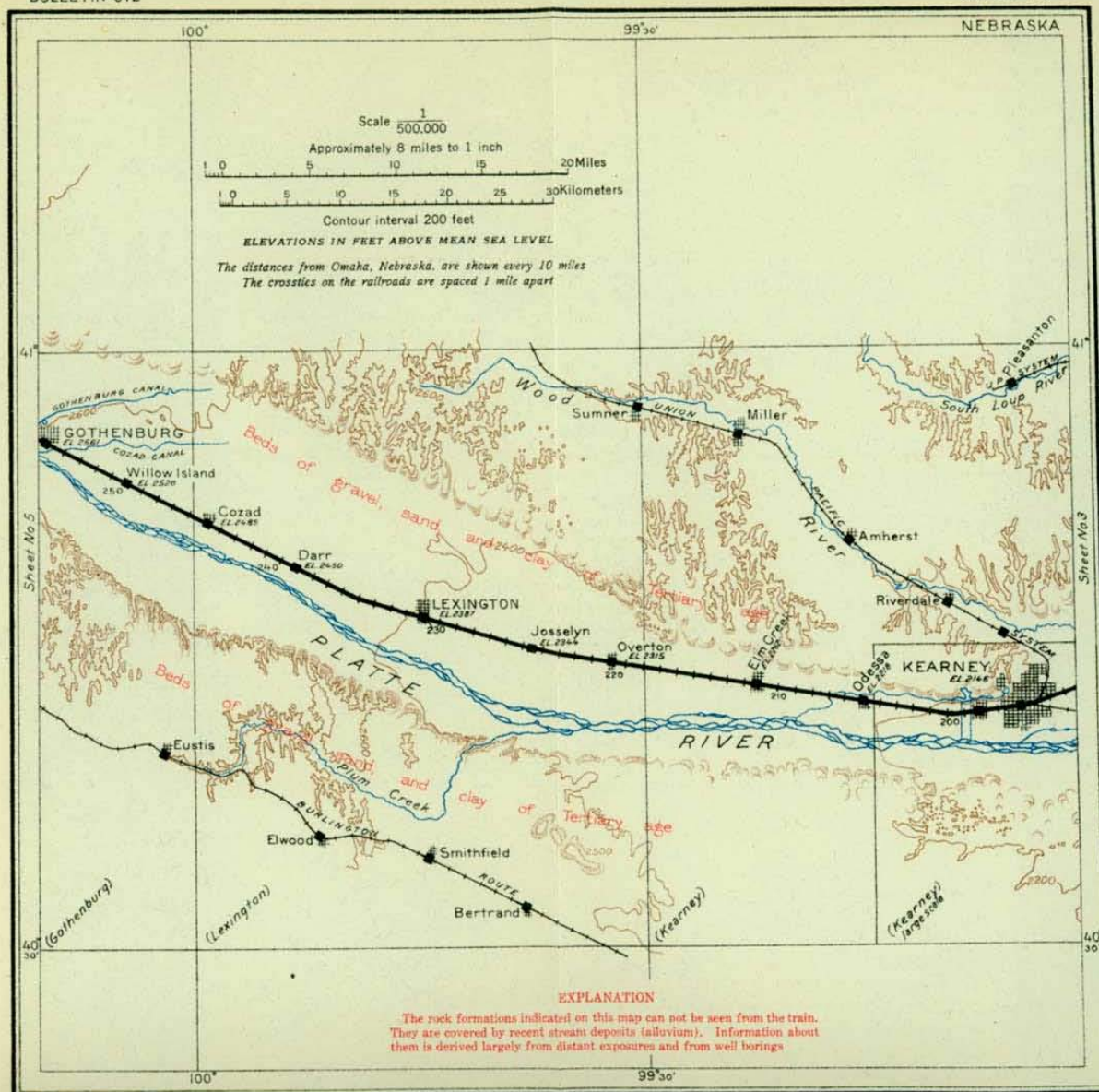
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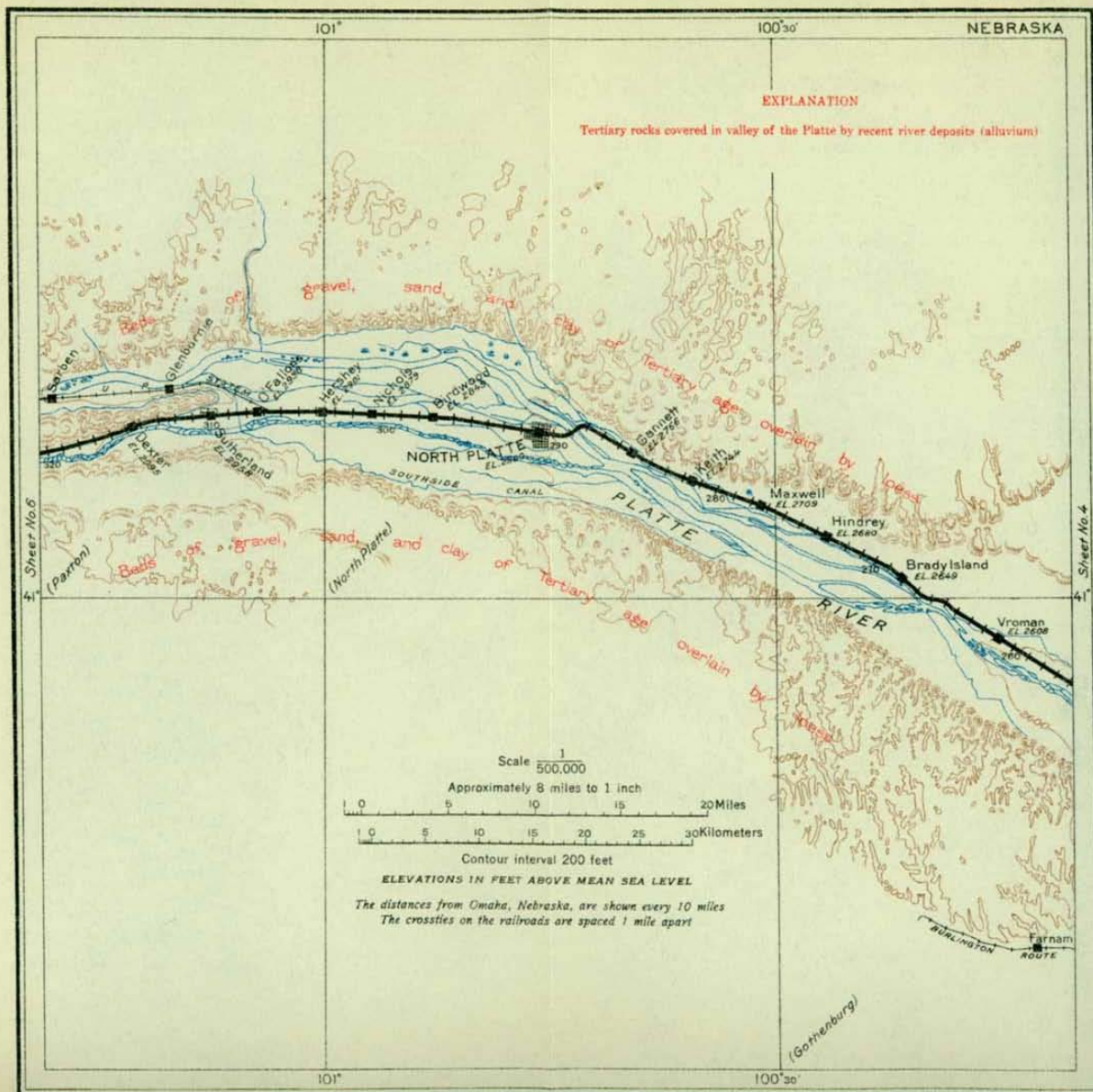
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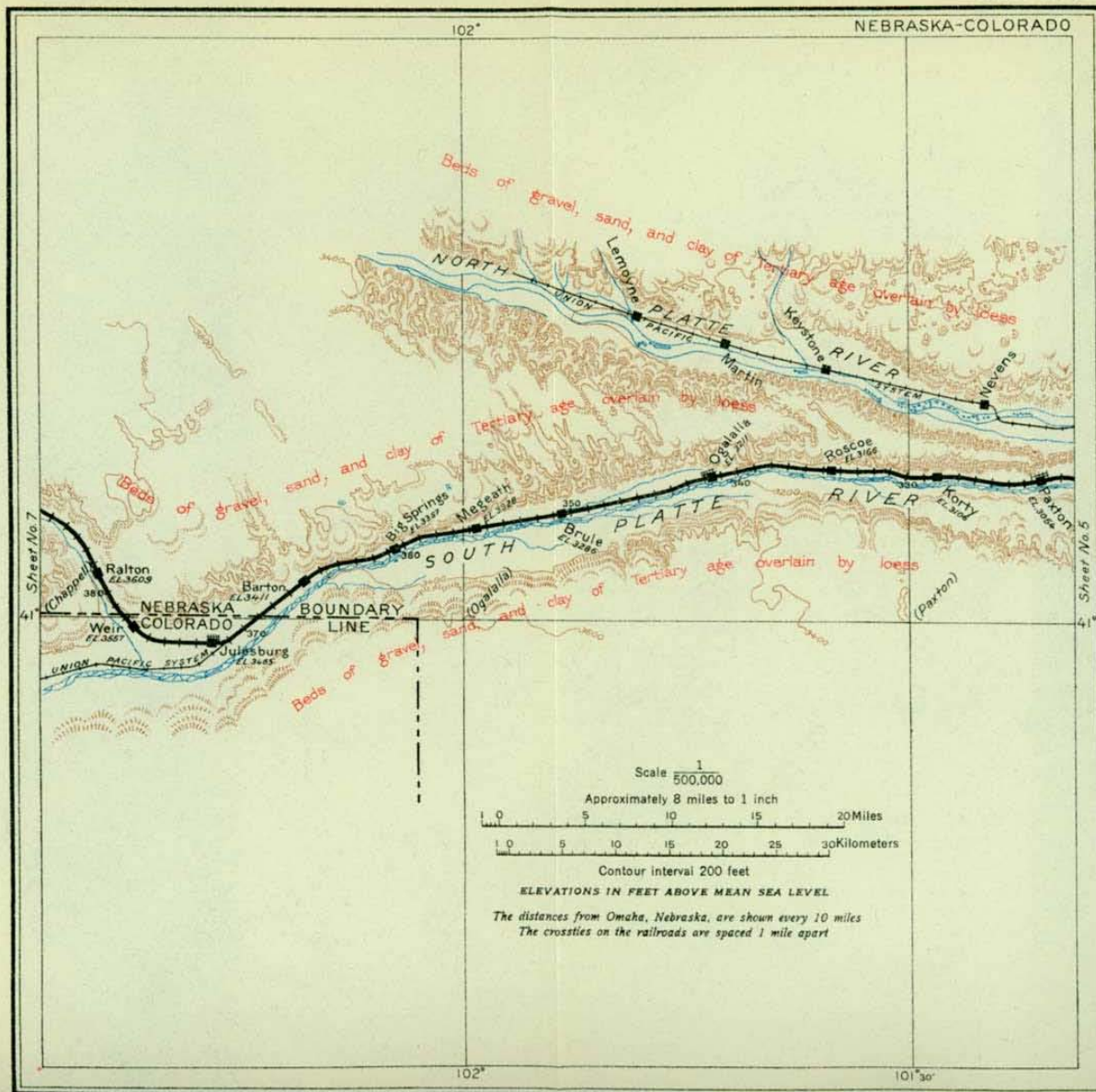
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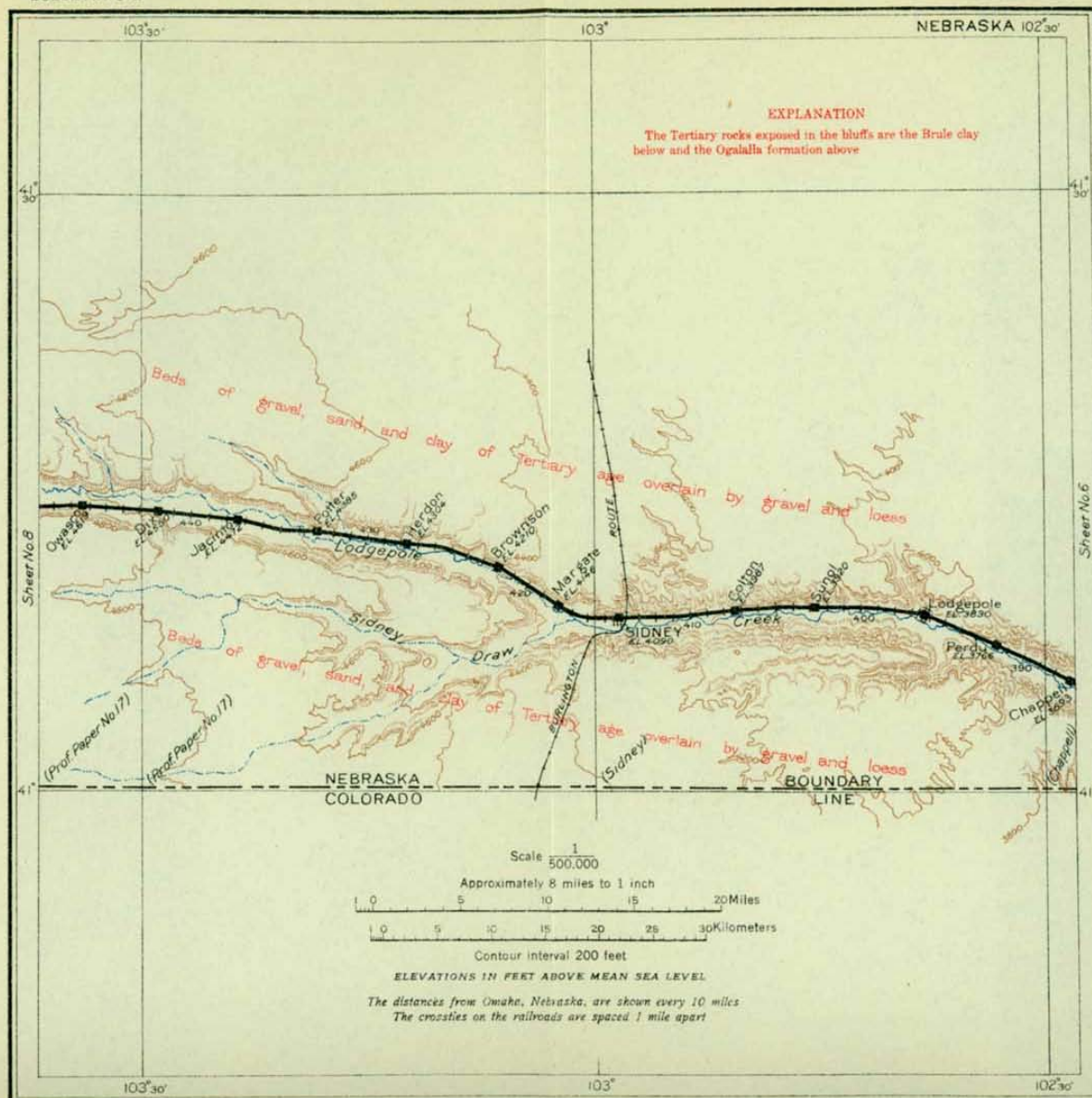
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GEOLOGIC AND TOPOGRAPHIC MAP OF THE

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UNITED STATES GEOLOGICAL SURVEY

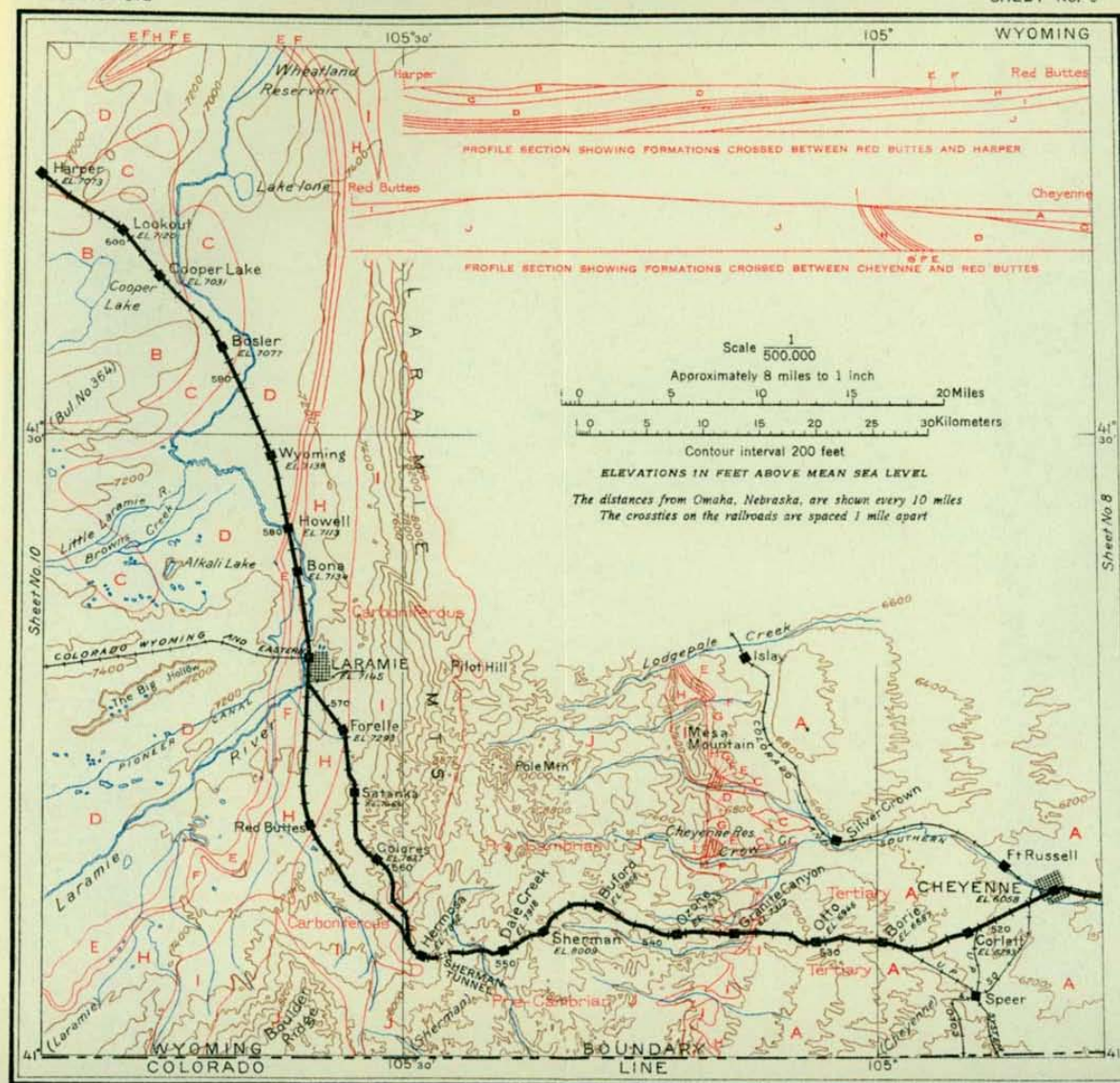
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EXPLANATION

	Thickness in feet	
A { Sand, gravel, and clay; fresh-water deposits (Arkaree and Gering formations) Sandy clay; fresh-water deposit (Brule clay) Sand and gravel; fresh-water deposit (Chadron formation)	200-250 25-250 20-100	Tertiary
B Sandstone, conglomerate, shale, and coal; fresh-water deposits ("Upper Laramie" and younger formations)	10,000	Tertiary possibly including some Cretaceous
C { Sandstone; marine deposit (Fox Hills sandstone east of Sherman) Sandstone, shale, and coal; marine and brackish water deposits (Mesa Verde formation west of Sherman)	700- 2,000	
D { Shale; marine deposit (Pierre shale east of Sherman) Shale; marine deposit (Steele shale west of Sherman) Limestone and shale; marine deposits (Niobrara limestone) Shale; marine deposit (Benton shale)	5,000 2,500-3,000 325-400 700-1,000	Cretaceous
E Sandstone and shale, probably includes equivalents of Dakota sandstone, Fuson formation, and Lakota sandstone; fresh and brackish water deposits (Cloverly formation)	70-100	
F Sandstone and shale; fresh-water deposit (Morrison formation)	150-200	Jurassic or Cretaceous
G Sandstone and shale; marine deposit (Sundance formation)	30-60	Jurassic
H Red sandstone, shale, and gypsum; fresh or brackish water deposits (Clugwater formation)	1,100	Triassic or Permian
I { Limestone; marine deposit (Forrele limestone) Sandy shale and gypsum; marine or brackish water deposits (Satanka shale) Limestone and red sandstone; marine deposits (Casper formation)	0-20 0-220 800-1,000	Carboniferous
J Granite, gneiss, schist, igneous rocks (mainly Sherman granite)		Pre-Cambrian



GEOLOGIC AND TOPOGRAPHIC MAP
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From Omaha, Nebraska, to San Francisco, California

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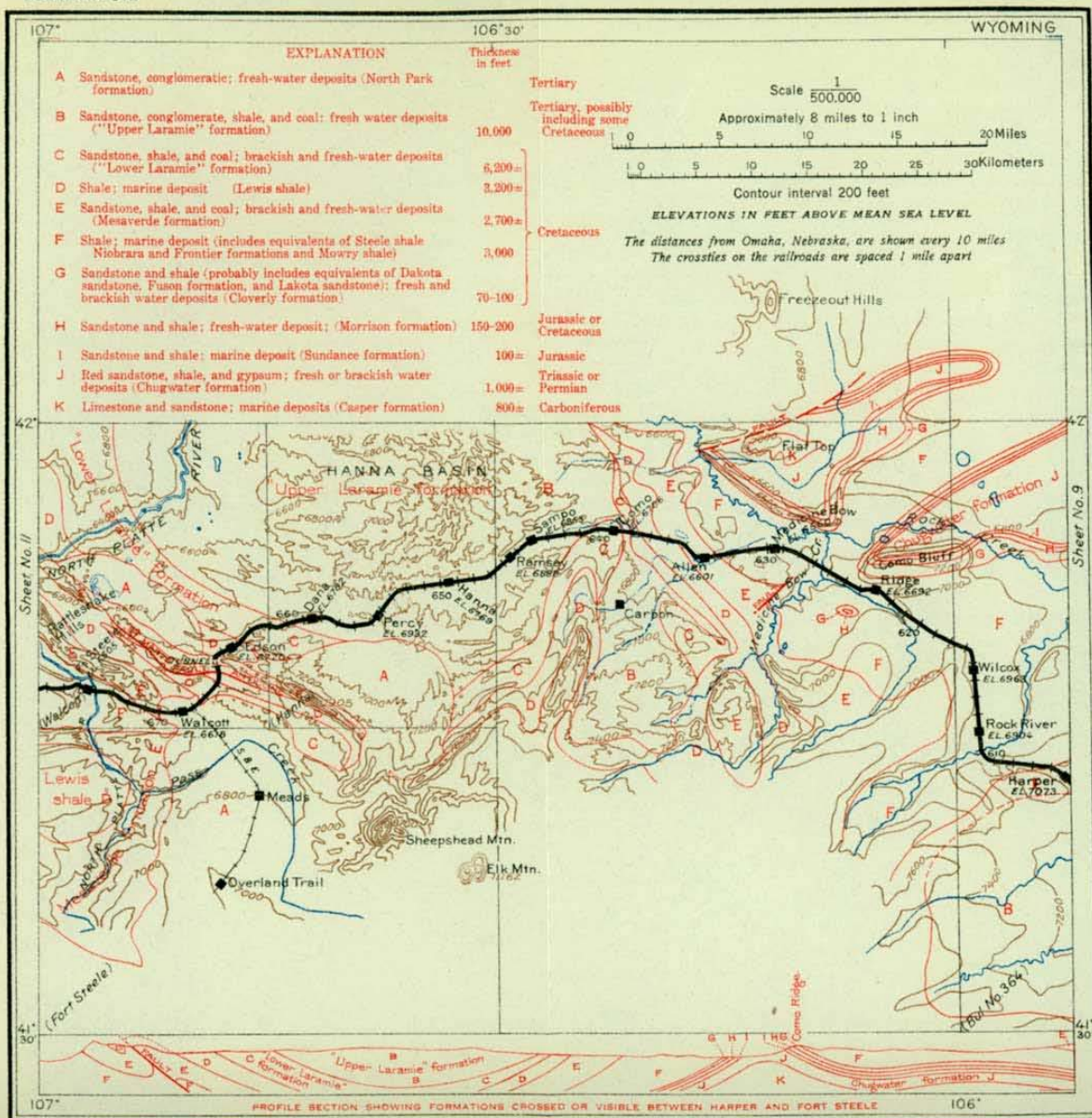
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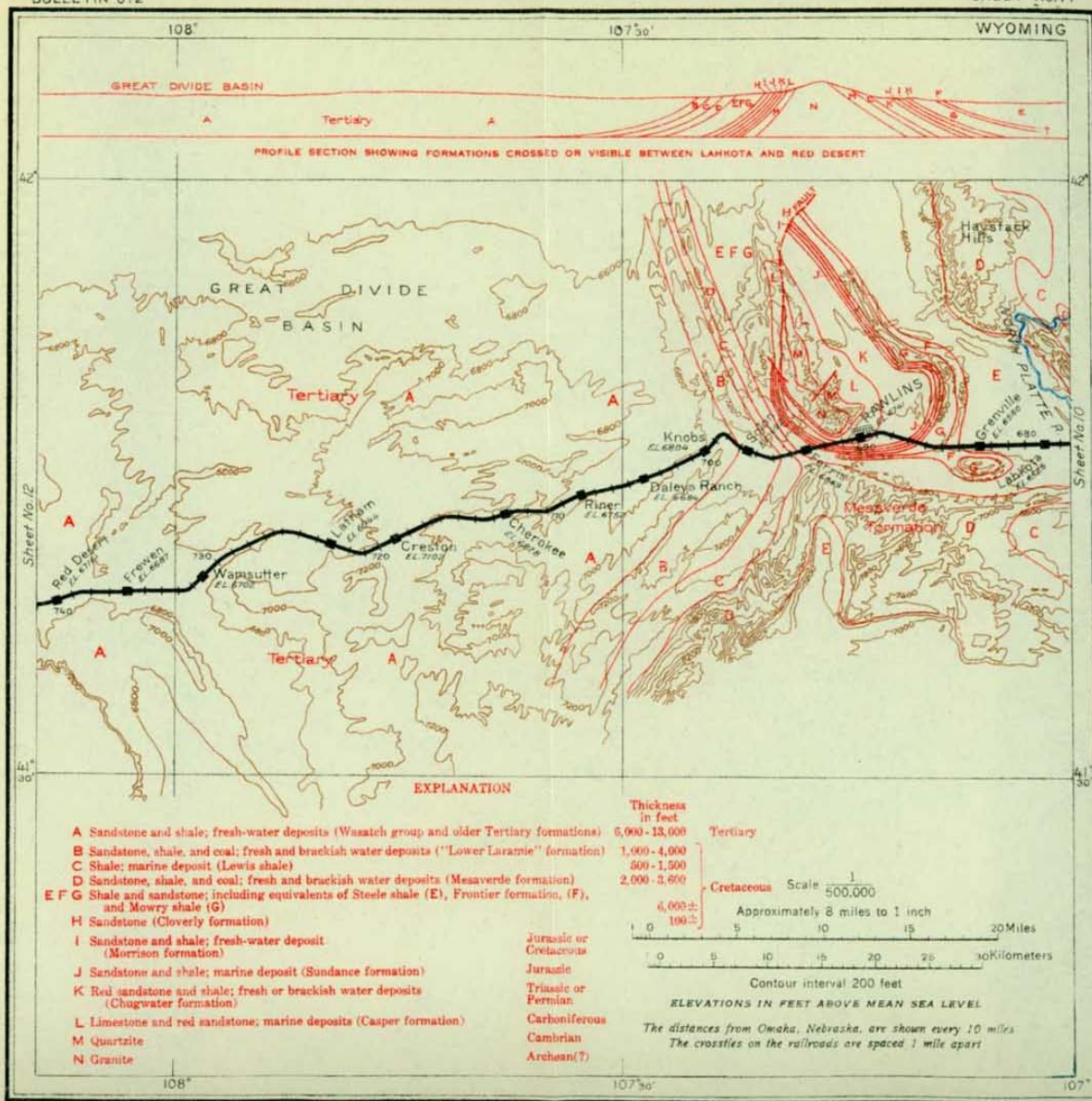
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GEOLOGIC AND TOPOGRAPHIC MAP OF THE

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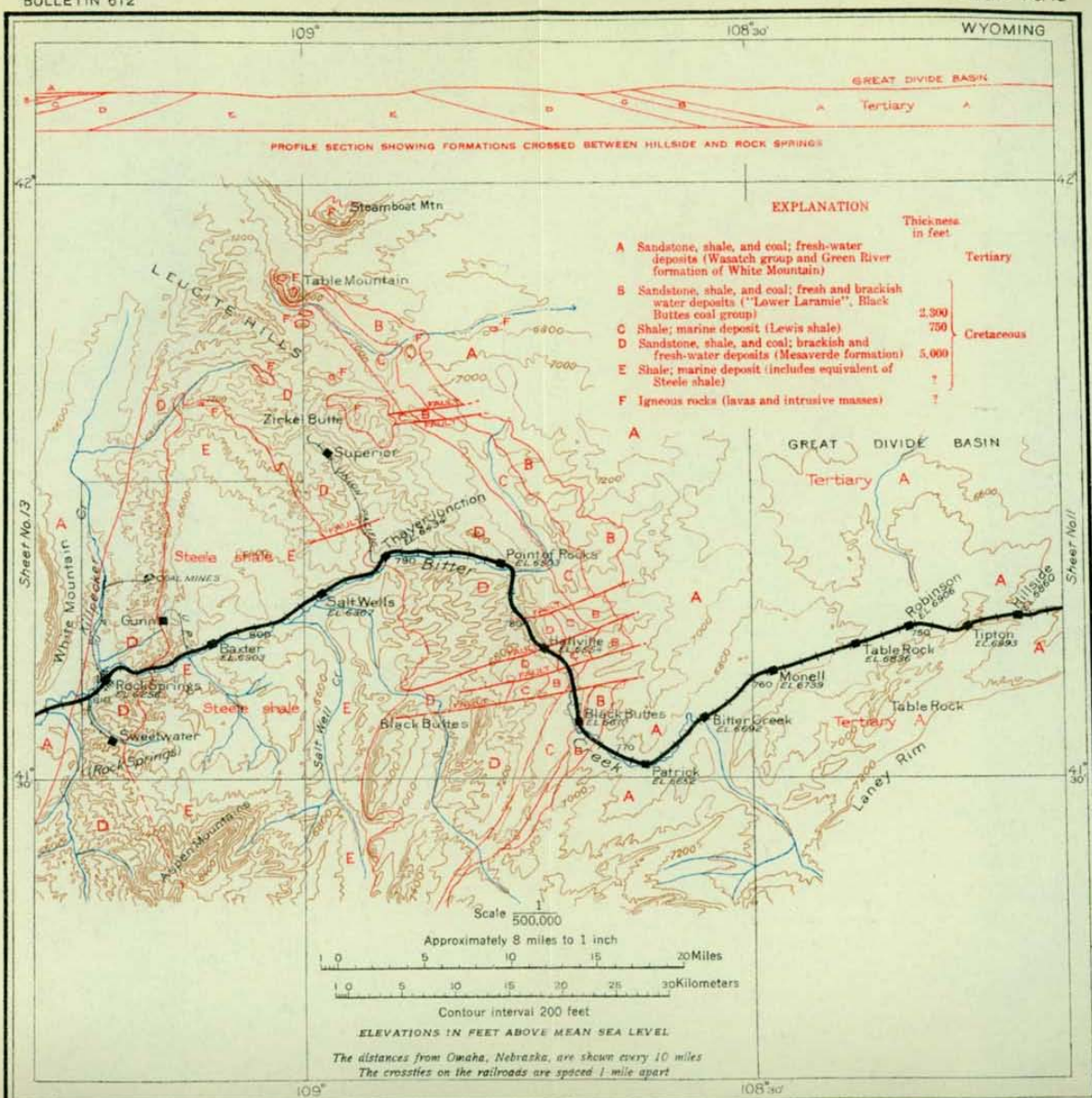
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GEOLOGIC AND TOPOGRAPHIC MAP
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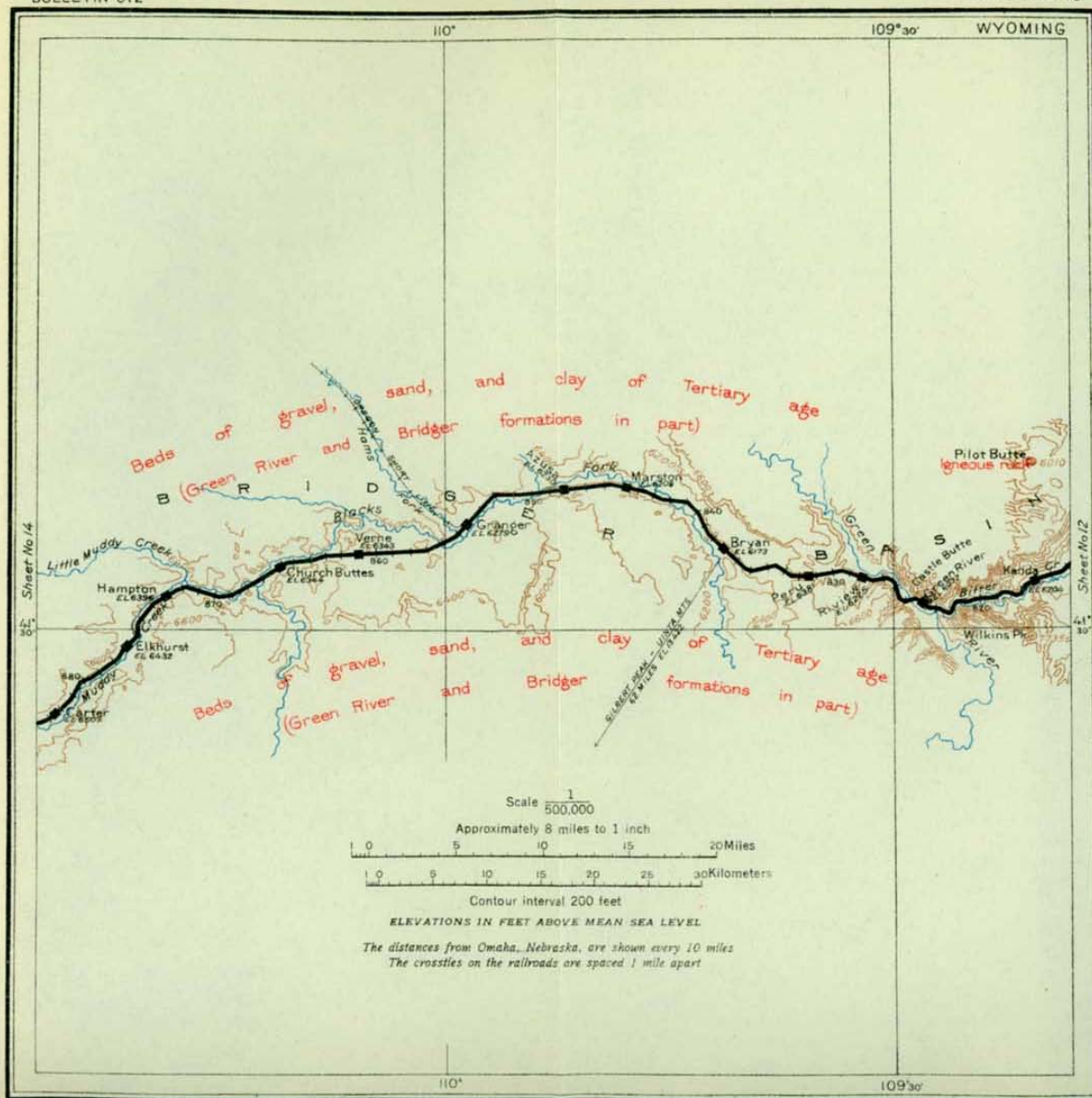
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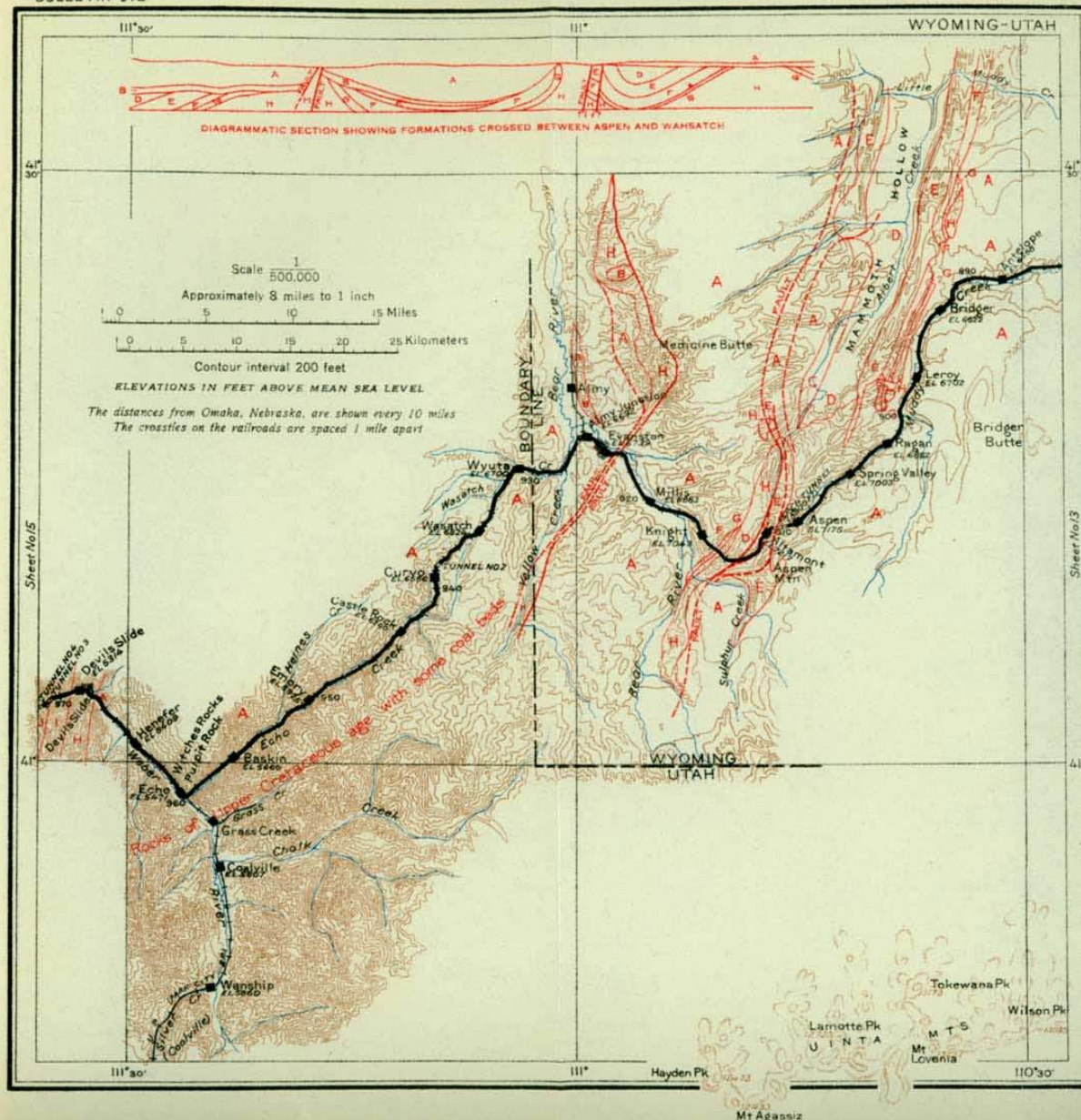
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EXPLANATION		Thickness in feet	
A	Sandstone and conglomerate; fresh-water deposits; includes Knight, Fowkes, and Almy formations (Wasatch group)	2,600-6,200	Tertiary
B	Sandstone, shale, and coal; fresh-water deposits (Evanston formation)	0-1,600	Cretaceous or Tertiary
C	Sandstone and shale; brackish and fresh-water deposits (Adaville formation)	4,000	
D	Shale; marine deposit (Hilliard formation)	5,500-6,800	
E	Sandstone, shale, and coal, (includes Oyster Ridge sandstone member); marine and brackish water deposits (Frontier formation)	2,200-2,600	Cretaceous
F	Shale; marine deposit (Aspen formation)	1,500-2,600	
G	Sandstone and shale; fresh and brackish water deposits (Bear River formation)	500-5,000	
H	Sandstone, conglomerate, shale, and limestone; marine and fresh-water deposits (Beckwith and Twin Creek formations)	3,800-5,500	Jurassic possibly some Cretaceous
I	Sandstone and shale; marine deposits (Nugget (1,700 ±), Ankara (1,500 ±), Thayne (1,700 ±), and Woodside (1,000 ±) formations)	5,900	Triassic may include some Jurassic
J	Limestone; marine deposit (Park City formation)	1,500 ±	
	Quartzite; marine deposit (Weber quartzite)	4,000 ±	Carboniferous

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SHEET No. 14





GEOLOGIC AND TOPOGRAPHIC MAP OF THE

OVERLAND ROUTE

From Omaha, Nebraska, to San Francisco, California

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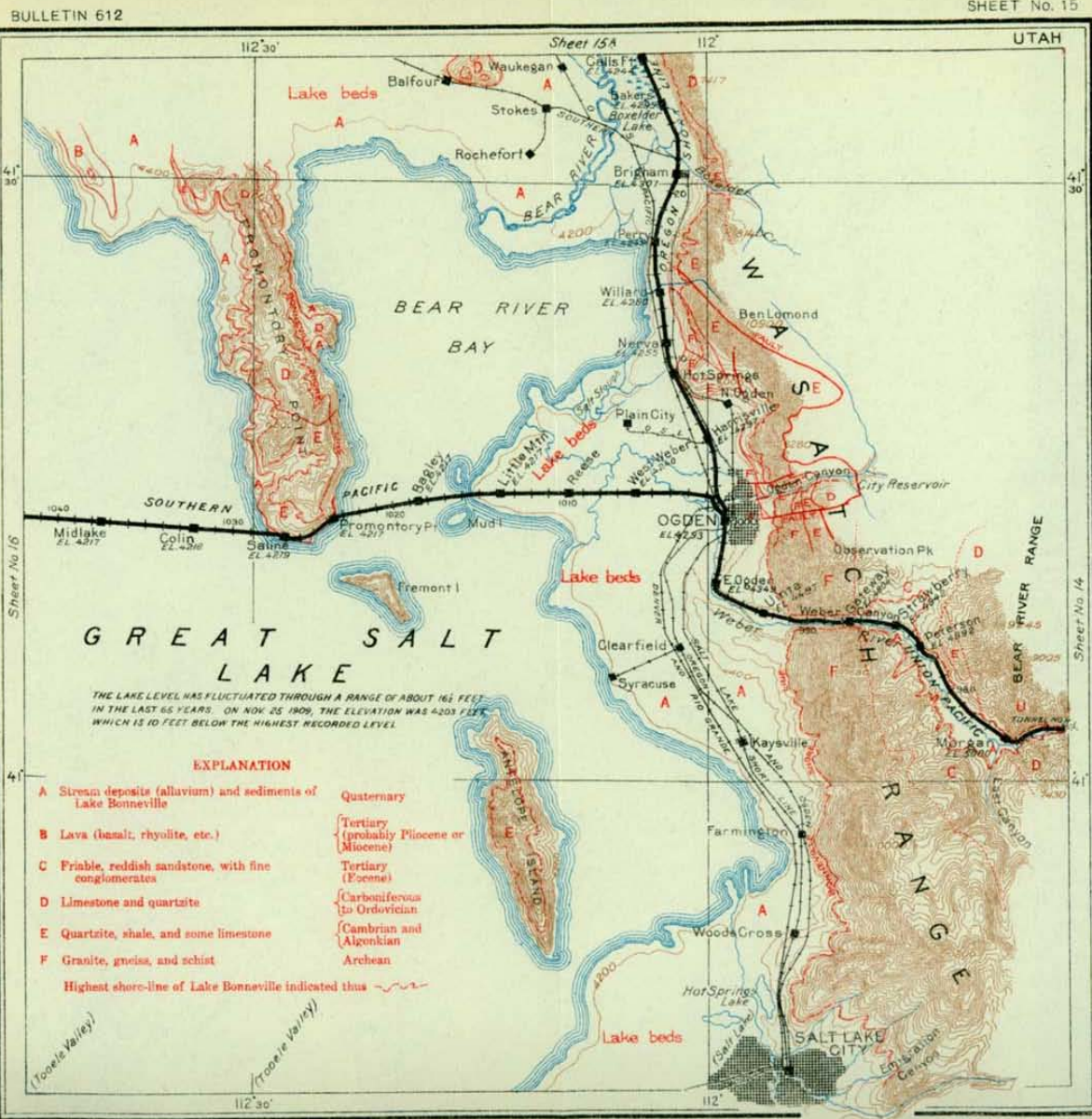
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GEOLOGIC AND TOPOGRAPHIC MAP OF THE YELLOWSTONE PARK ROUTE

From Ogden, Utah, to the Yellowstone National Park

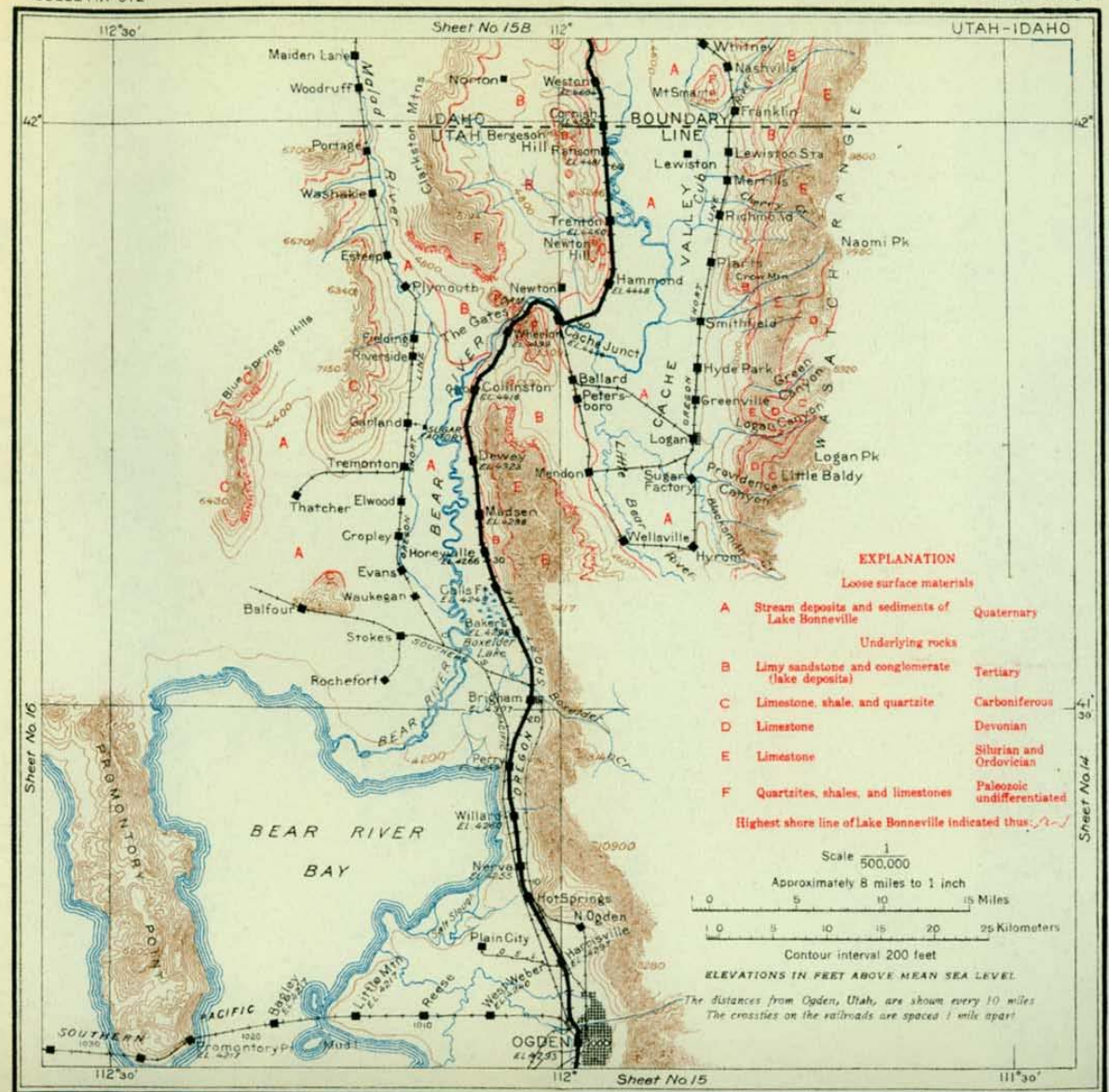
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GEOLOGIC AND TOPOGRAPHIC MAP OF THE YELLOWSTONE PARK ROUTE

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UNITED STATES GEOLOGICAL SURVEY

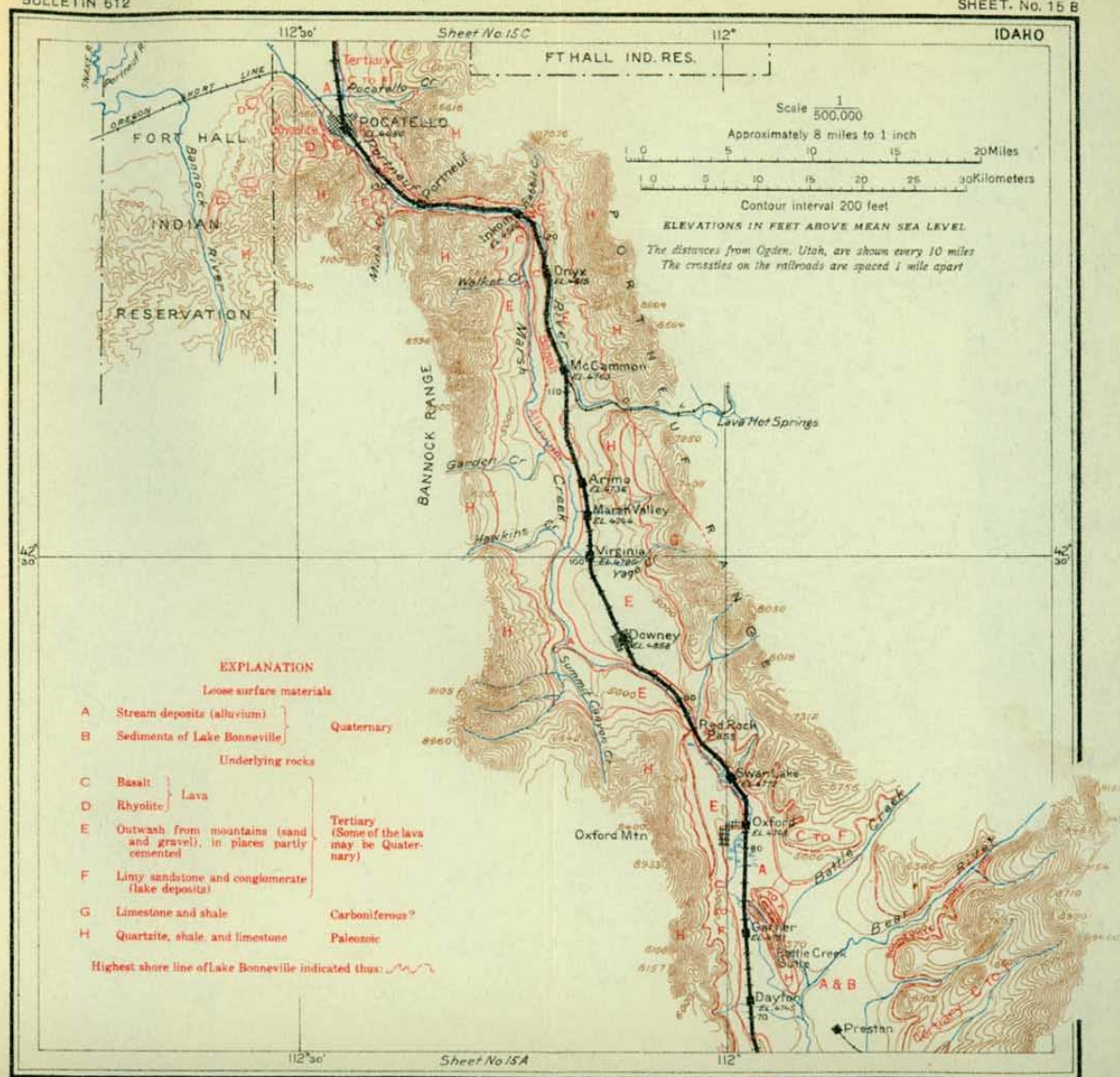
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SHEET. No. 15 B





GEOLOGIC AND TOPOGRAPHIC MAP OF THE YELLOWSTONE PARK ROUTE

From Ogden, Utah, to the Yellowstone National Park

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UNITED STATES GEOLOGICAL SURVEY

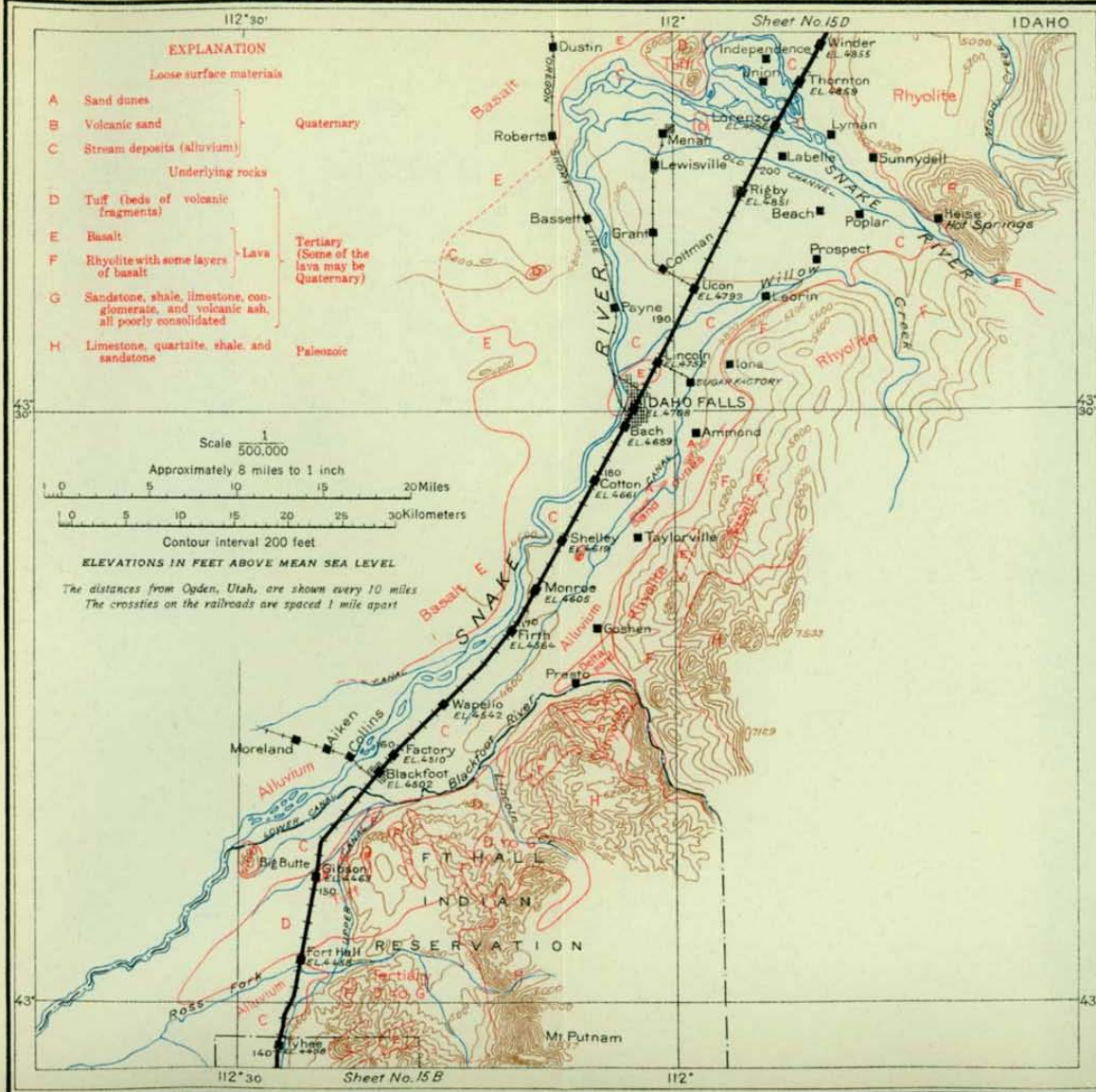
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SHEET No. 15 C





GEOLOGIC AND TOPOGRAPHIC MAP OF THE YELLOWSTONE PARK ROUTE

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UNITED STATES GEOLOGICAL SURVEY

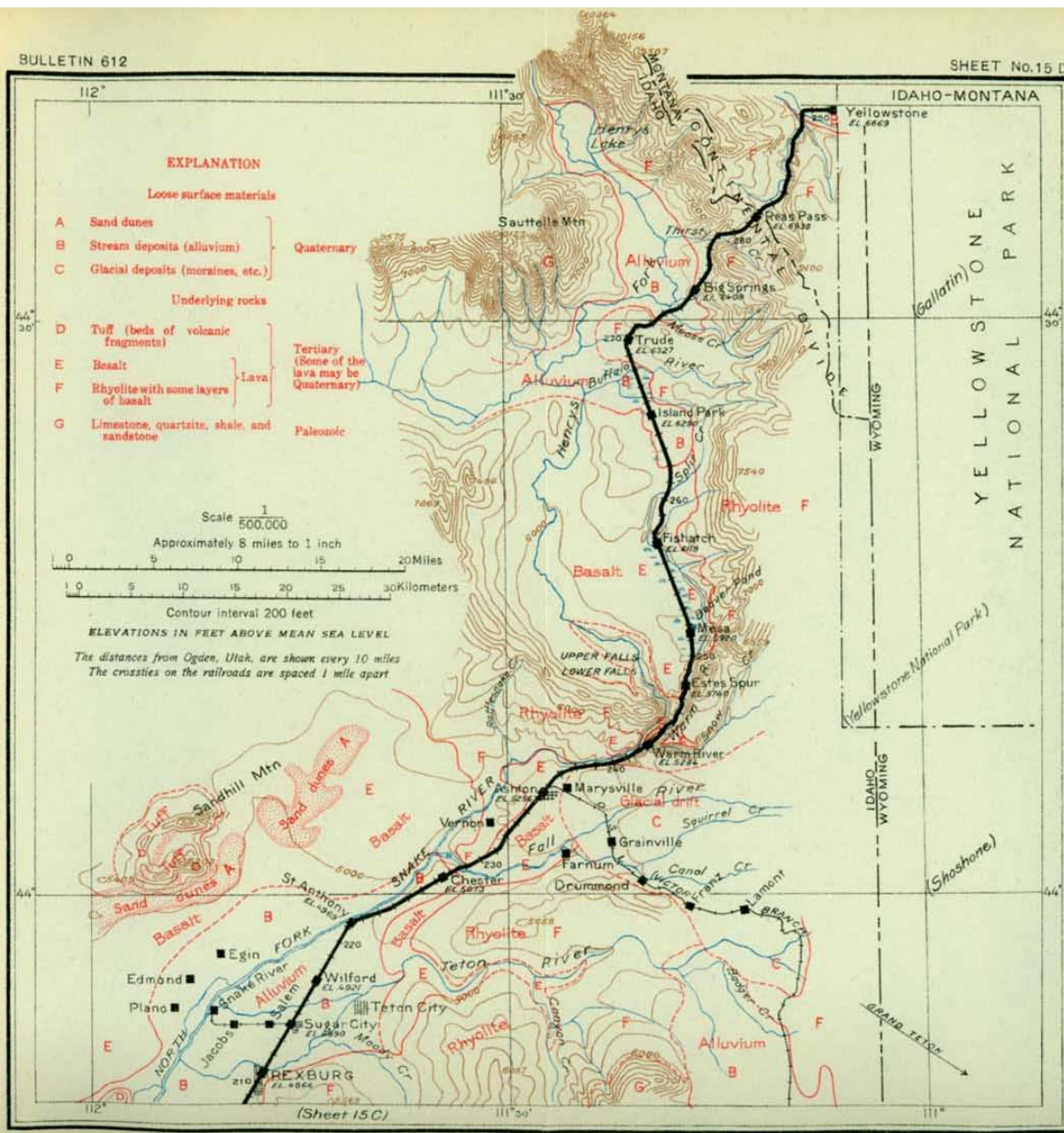
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SHEET No. 15 D





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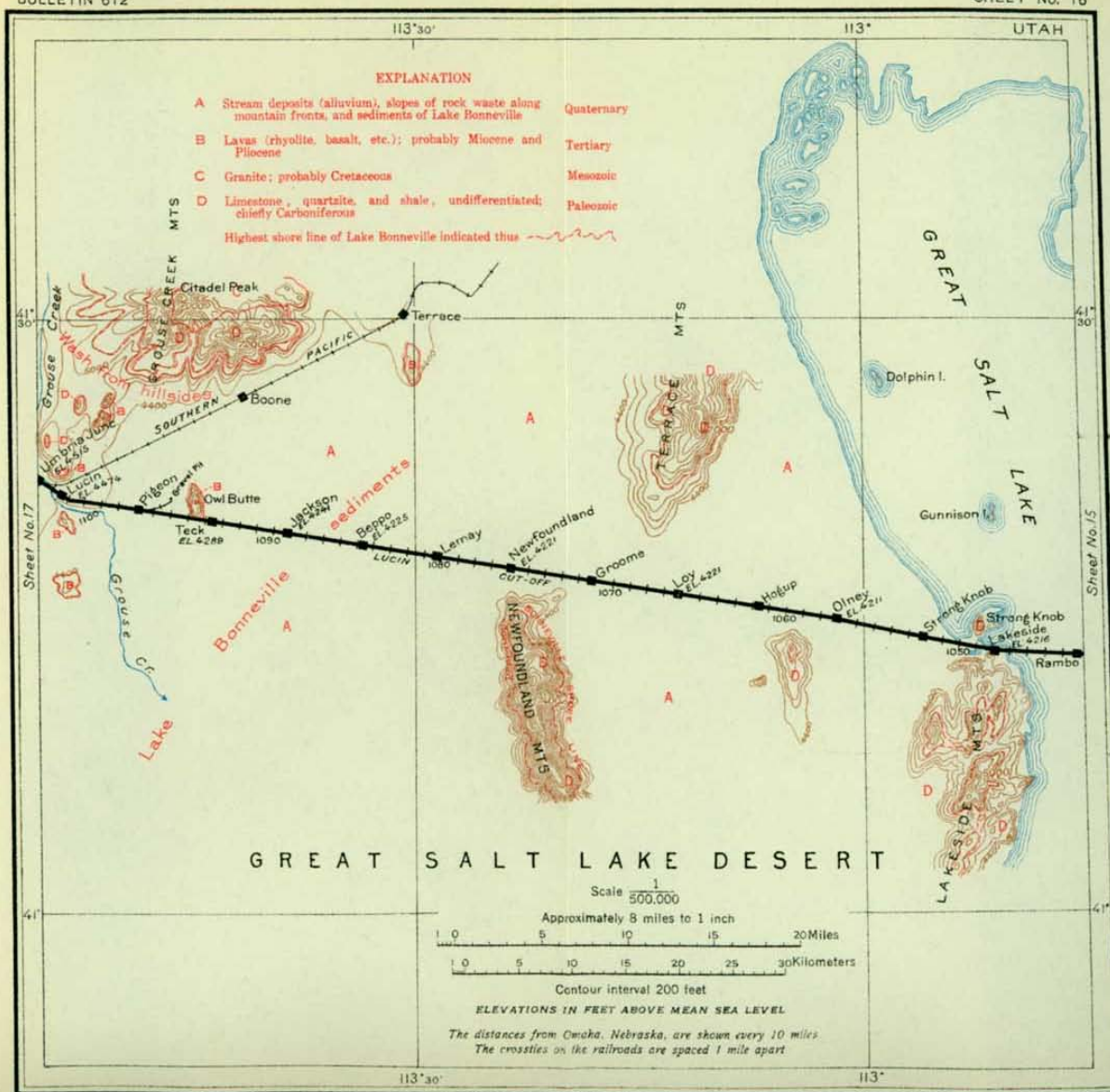
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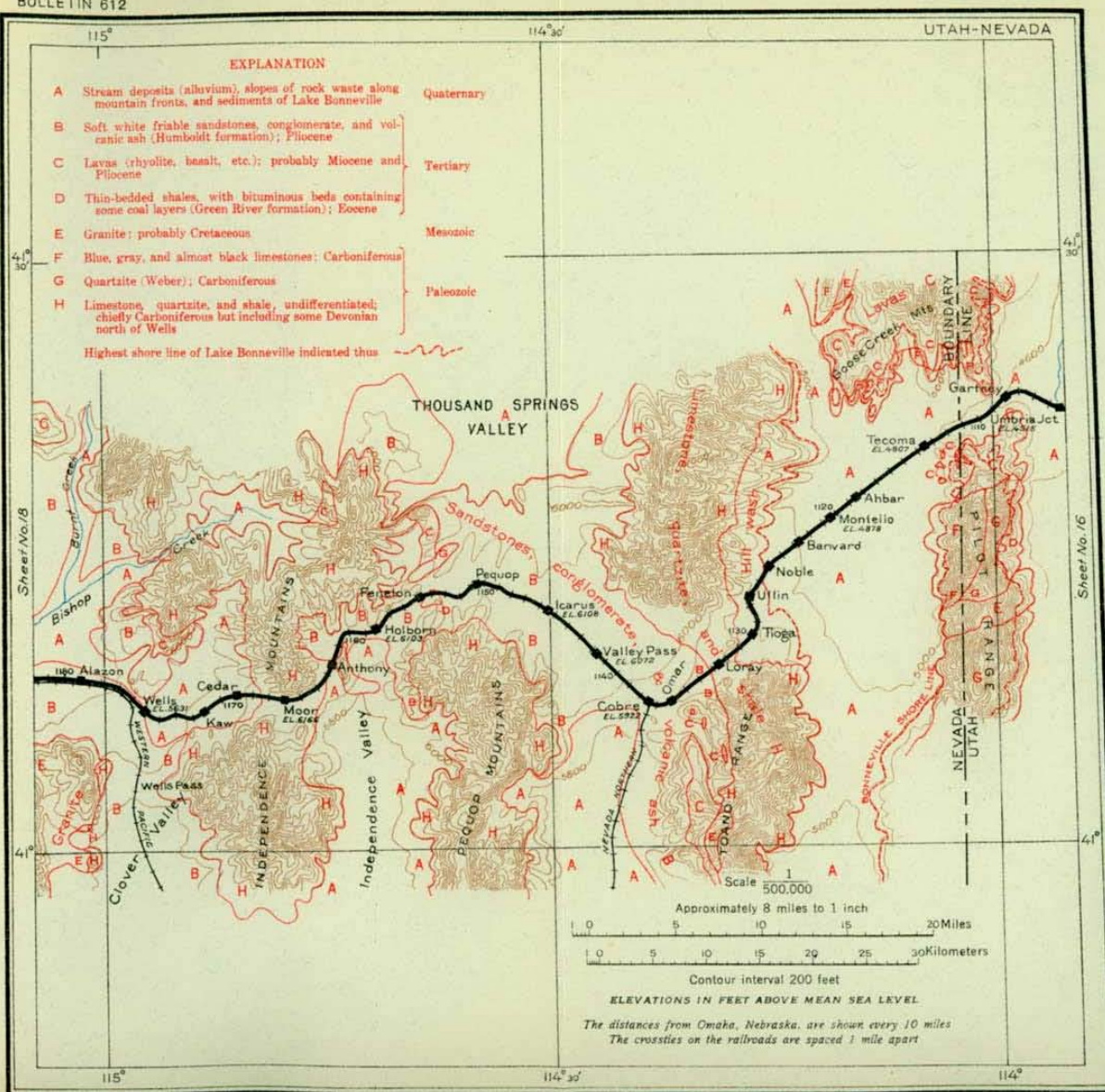
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GEOLOGIC AND TOPOGRAPHIC MAP
OF THE

OVERLAND ROUTE

From Omaha, Nebraska, to San Francisco, California

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

UNITED STATES GEOLOGICAL SURVEY

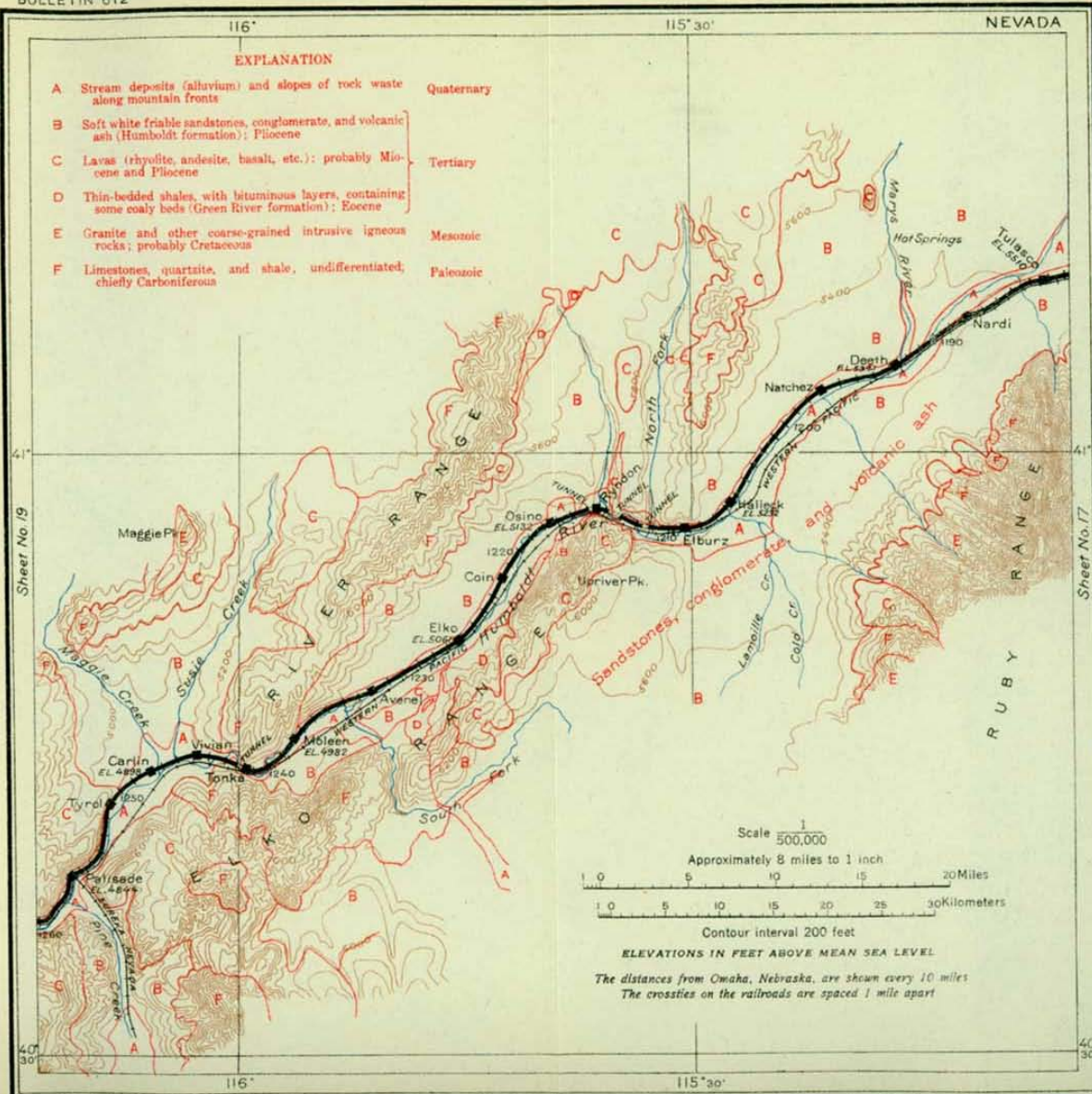
GEORGE OTIS SMITH, DIRECTOR

David White, Chief Geologist R. B. Marshall, Chief Geographer

1915

BULLETIN 612

SHEET No. 18





GEOLOGIC AND TOPOGRAPHIC MAP OF THE OVERLAND ROUTE From Omaha, Nebraska, to San Francisco, California

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UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

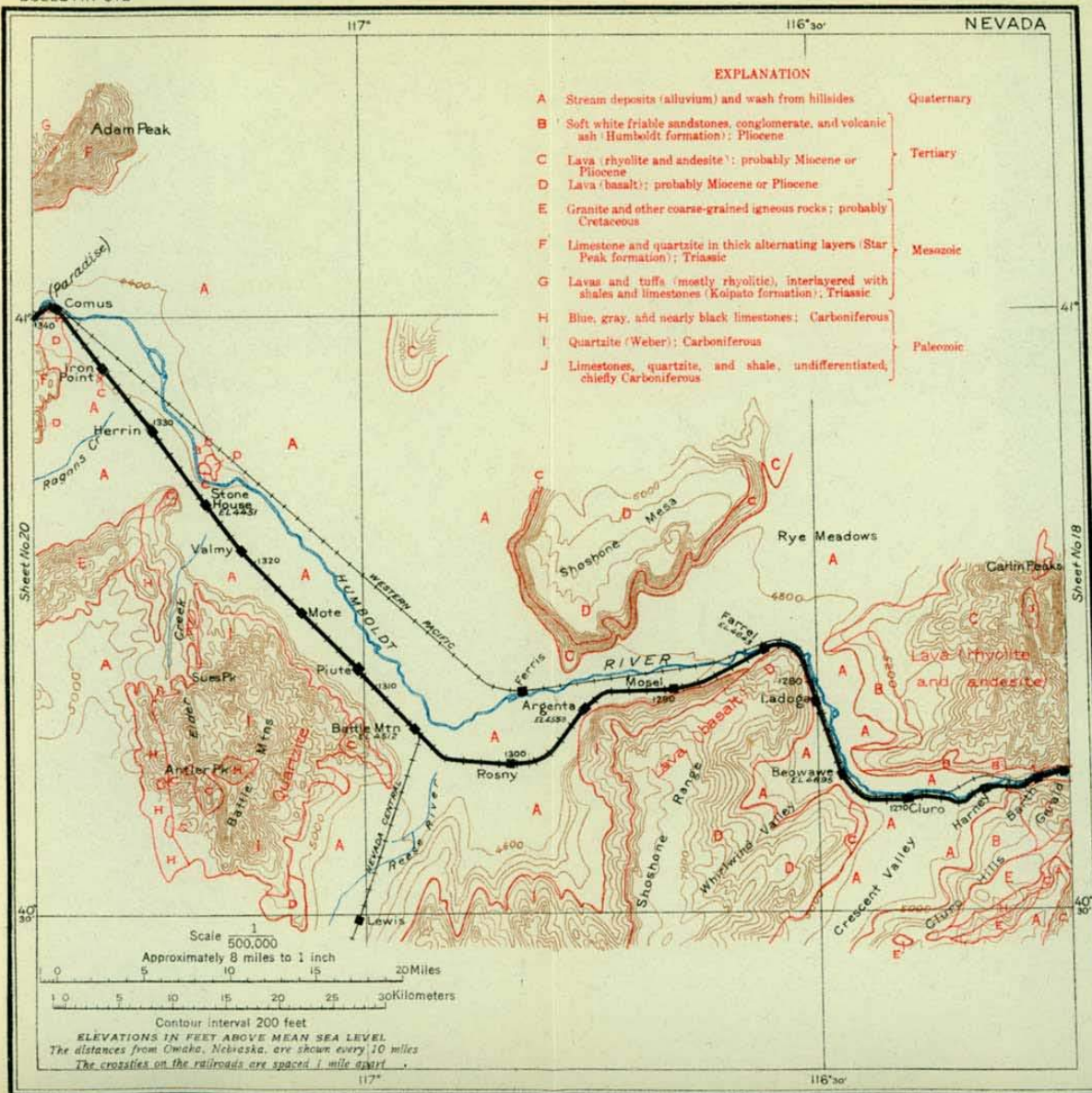
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GEOLOGIC AND TOPOGRAPHIC MAP OF THE OVERLAND ROUTE

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UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

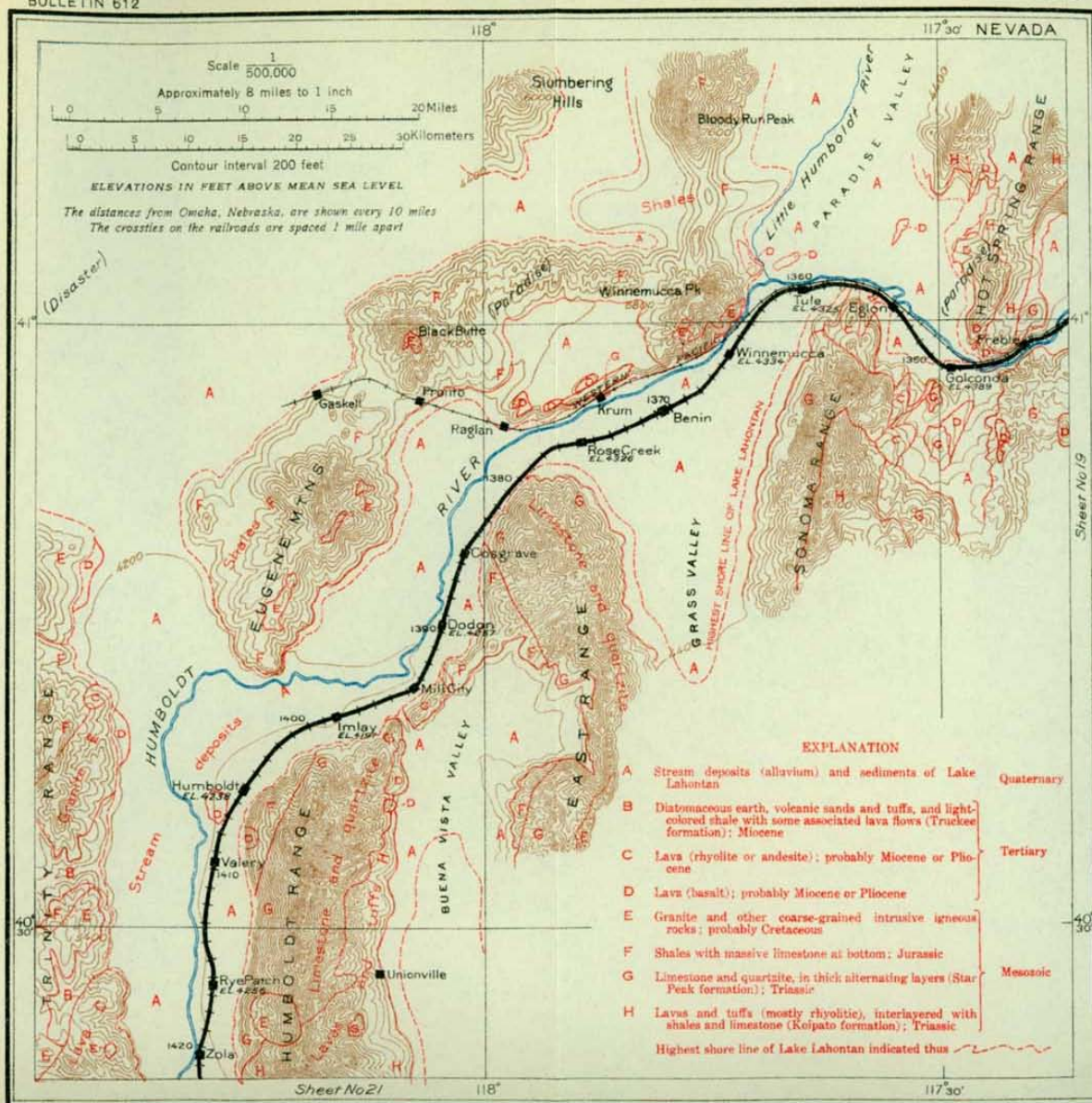
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BULLETIN 612

SHEET No. 20





GEOLOGIC AND TOPOGRAPHIC MAP OF THE OVERLAND ROUTE

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UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

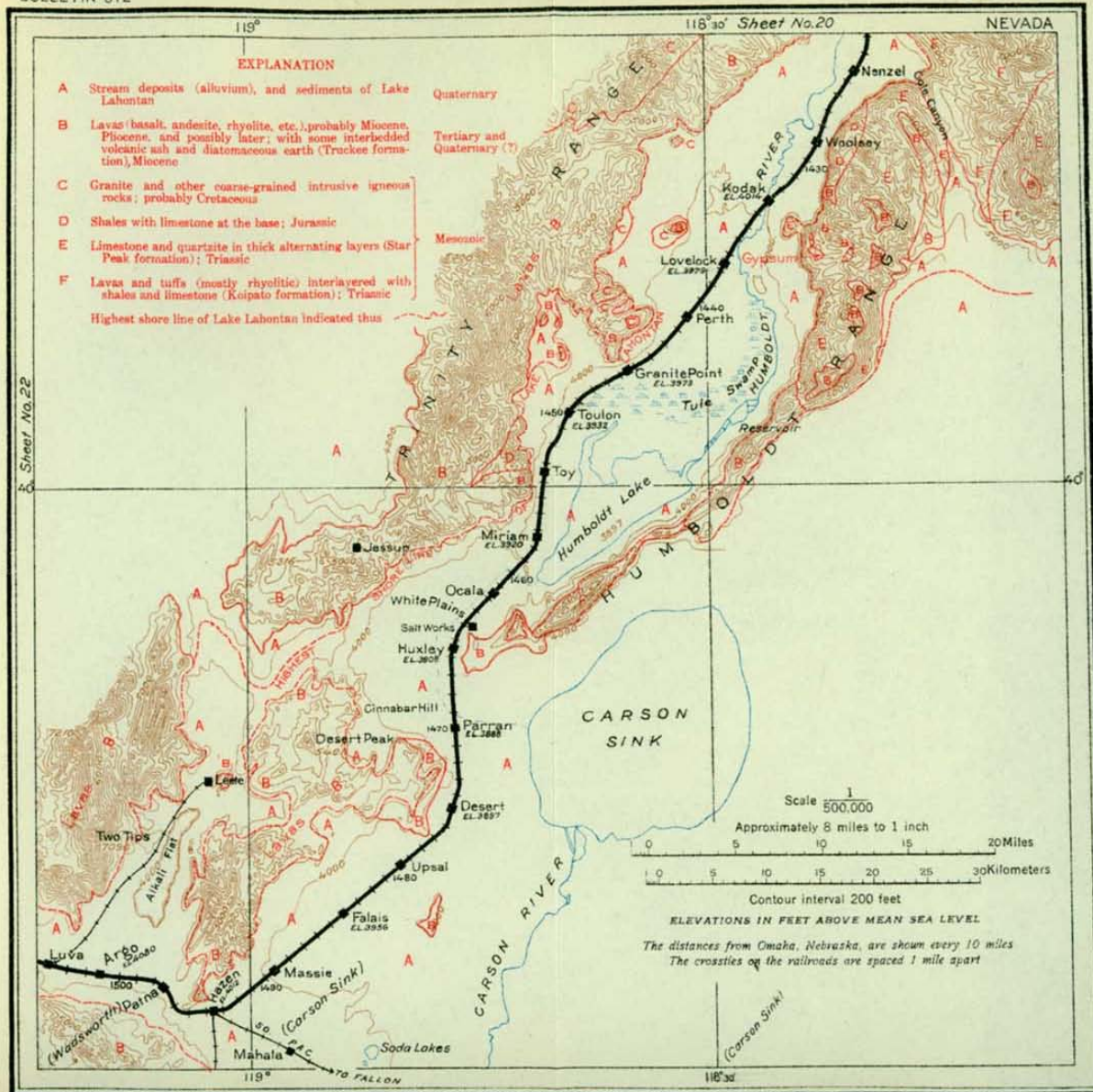
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GEOLOGIC AND TOPOGRAPHIC MAP OF THE OVERLAND ROUTE

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UNITED STATES GEOLOGICAL SURVEY

GEORGE OTIS SMITH, DIRECTOR

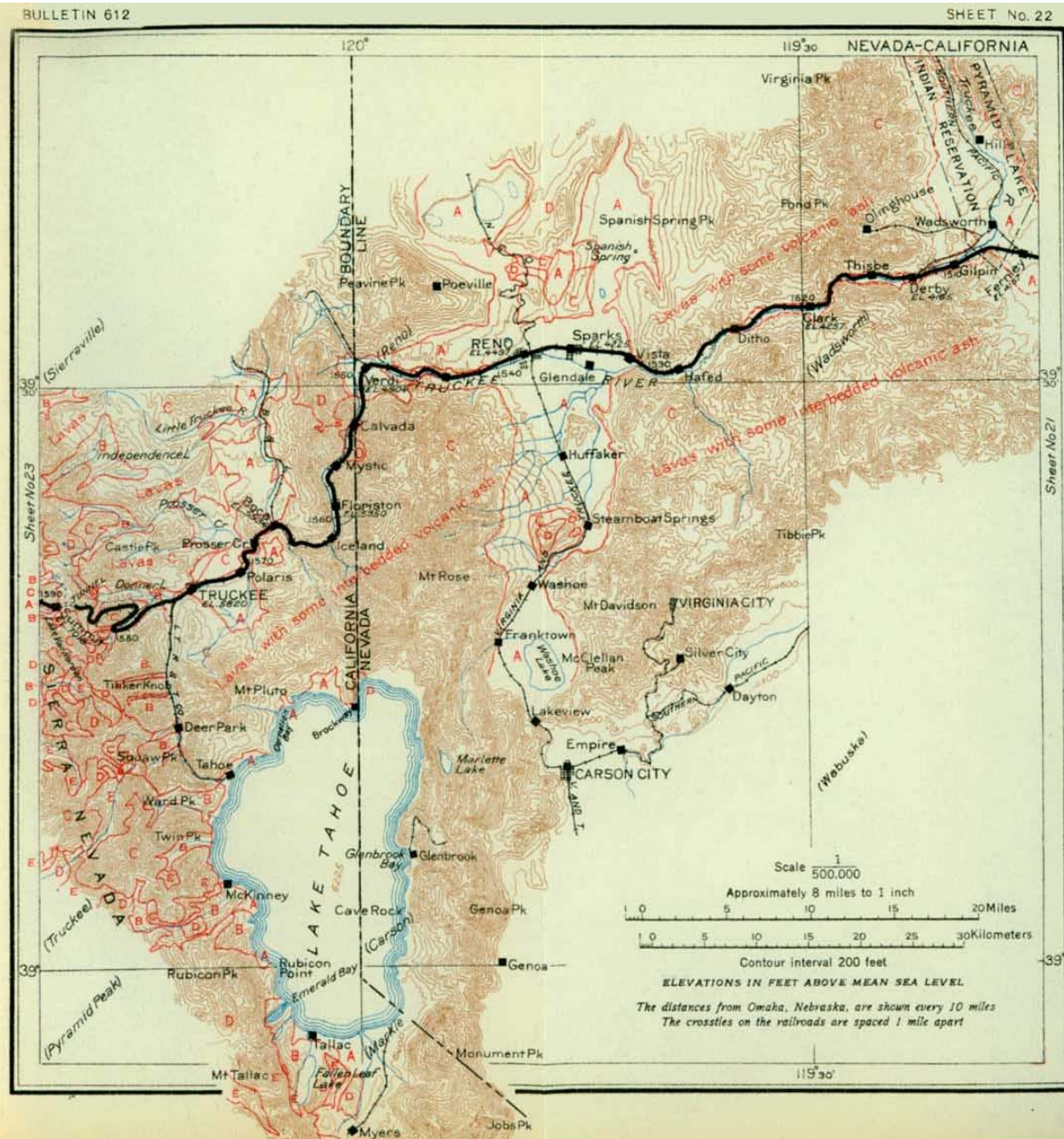
David White, Chief Geologist R. B. Marshall, Chief Geographer

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), sediments of Lake Lahontan, and, in upper valley of Truckee River, other lake deposits | Quaternary |
| B Glacial deposits, moraines; Pleistocene | |
| C Lavas (rhyolite, andesite, basalt, etc.), probably Miocene, Pliocene and later; with some interbedded volcanic ash and diatomaceous earth (Truckee formation), Miocene | Tertiary and Quaternary (?) |
| D Granite and other coarse-grained intrusive igneous rocks (granodiorite, gabbro, etc.); late Jurassic or early Cretaceous | |
| E Slate, schist, and quartzite (including Sailor Canyon formation, Triassic) | Mesozoic |
| Highest shore line of Lake Lahontan indicated thus | |





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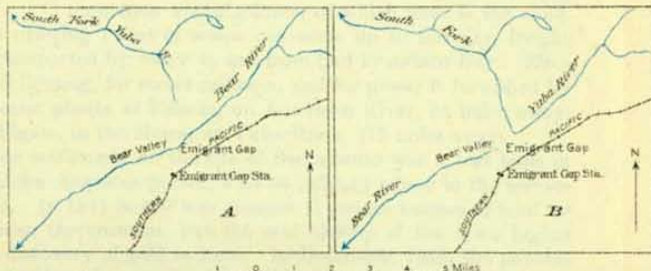
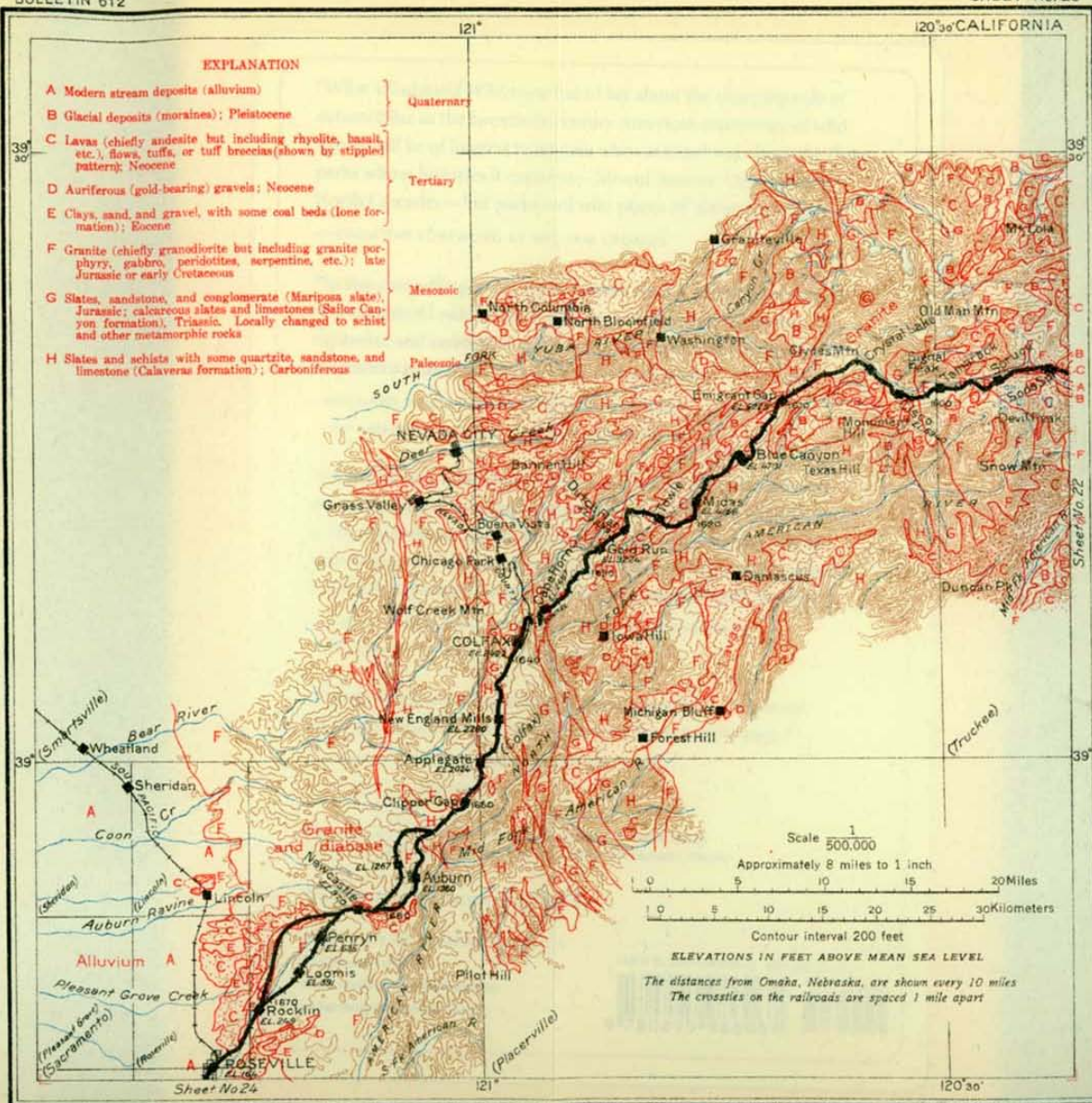


FIGURE 17.—SKETCH MAPS SHOWING CAPTURE OF UPPER PART OF BEAR RIVER BY SOUTH FORK OF YUBA RIVER. A, BEFORE CAPTURE, B, AFTER CAPTURE. RAILROAD SHOWN TO IDENTIFY LOCATION.





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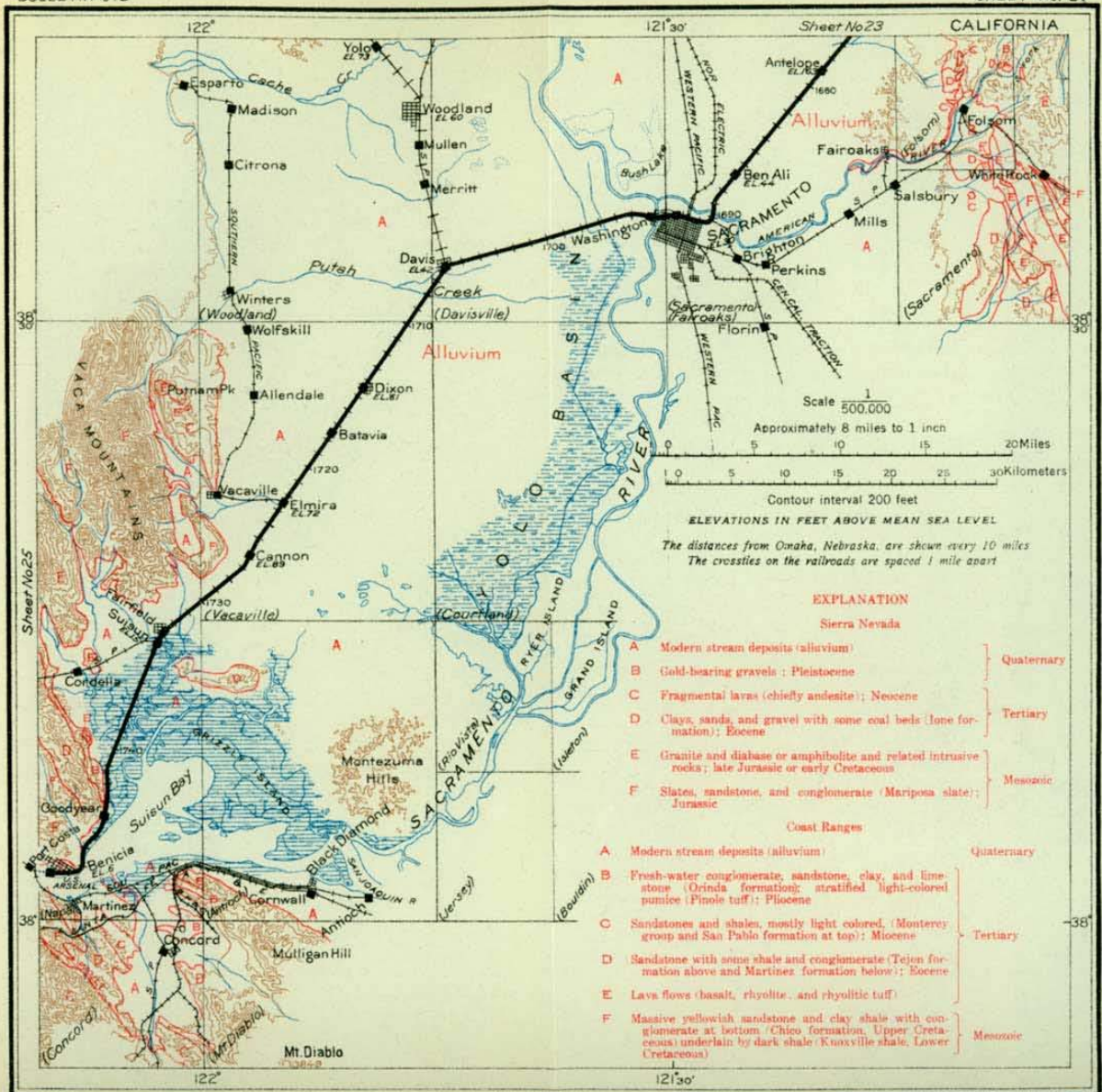
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FIGURE 19.—MAP SHOWING GEOLOGIC FORMATIONS ALONG THE SOUTH SHORE OF SAN PABLO BAY.

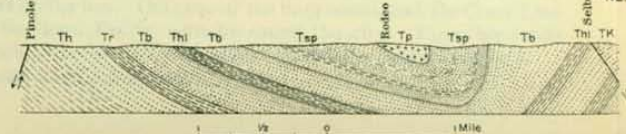
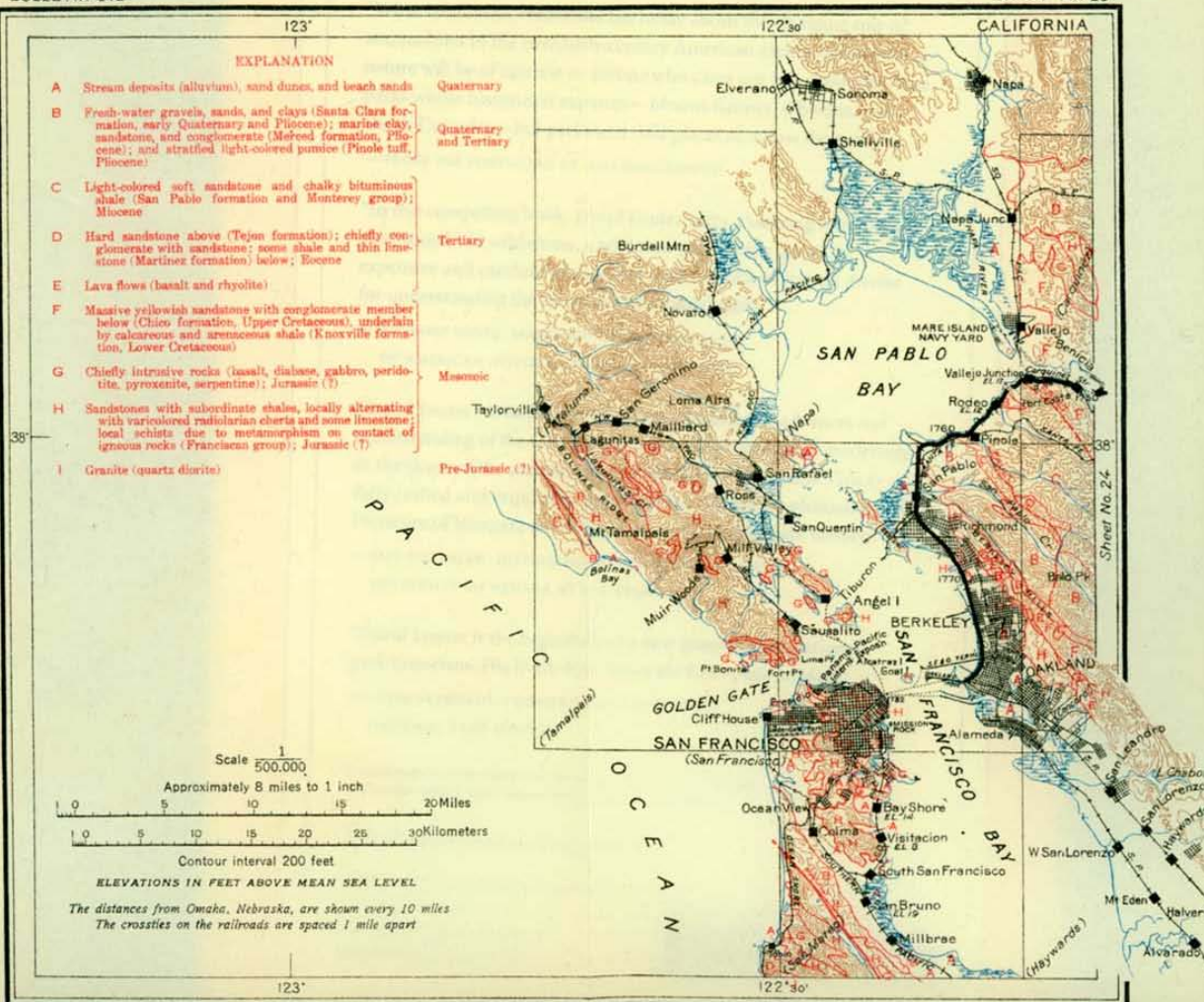
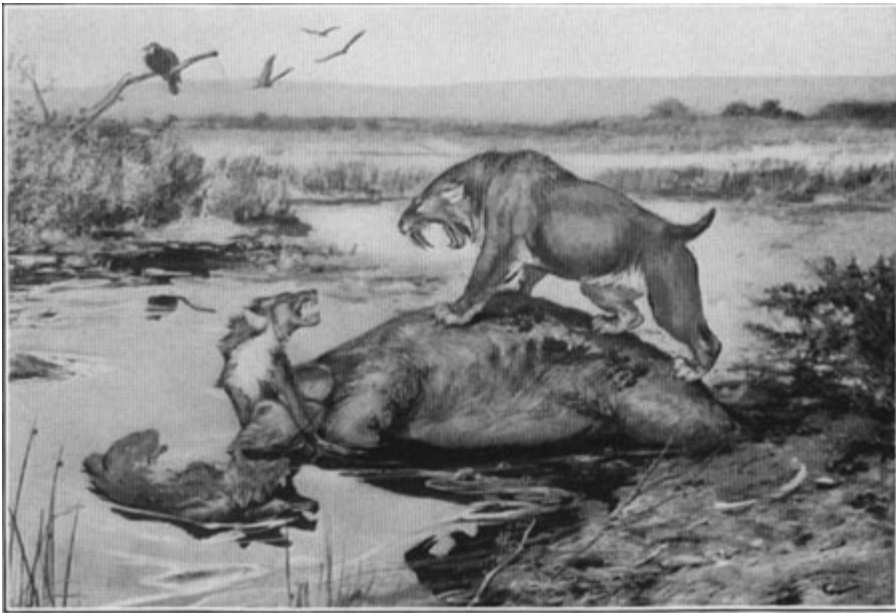


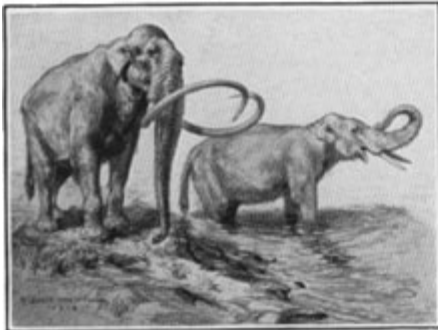
FIGURE 20.—SECTION SHOWING STRUCTURE ALONG THE SOUTH SHORE OF SAN PABLO BAY.



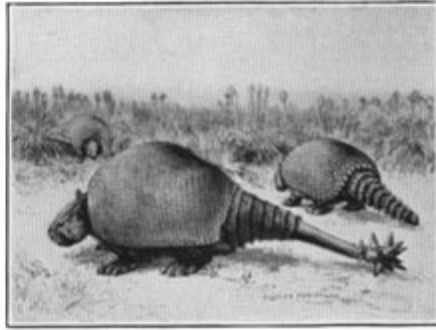




A.



B.



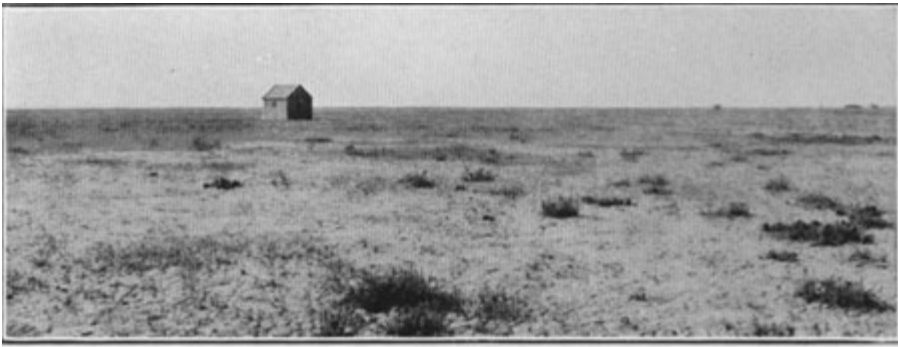
C.



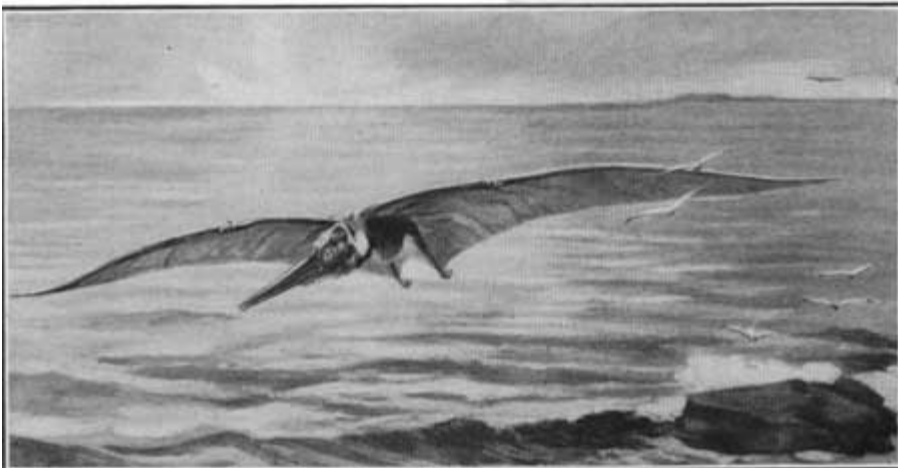
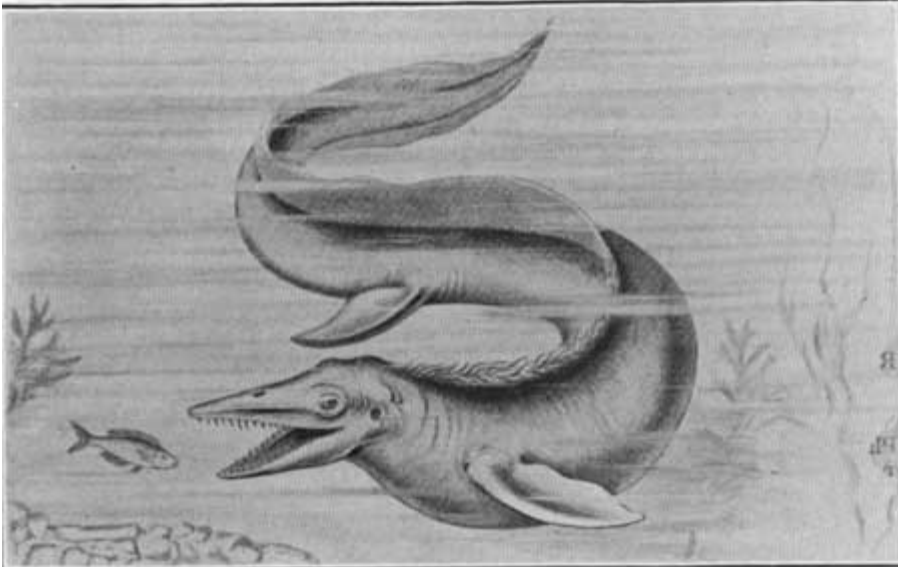
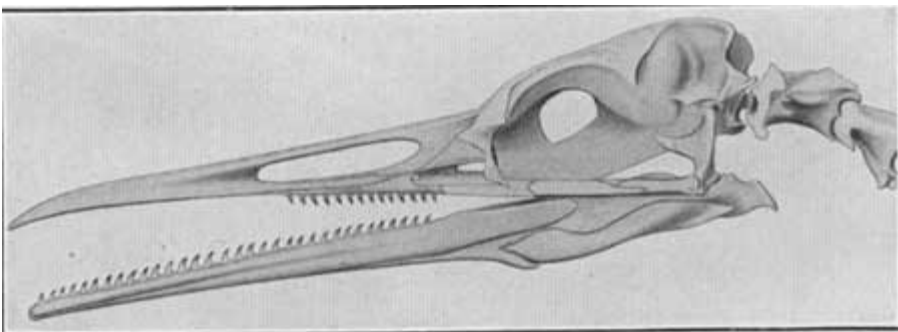
D.



E.

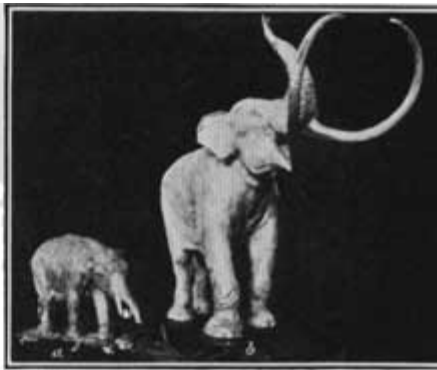




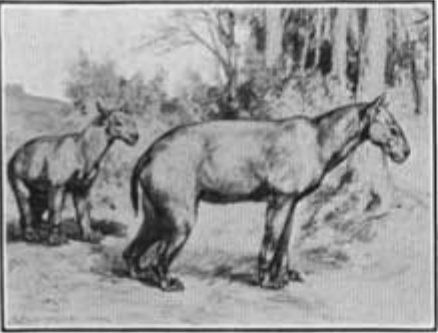




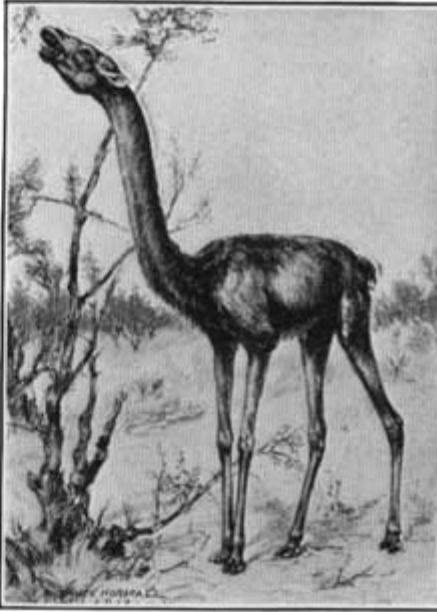
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B.



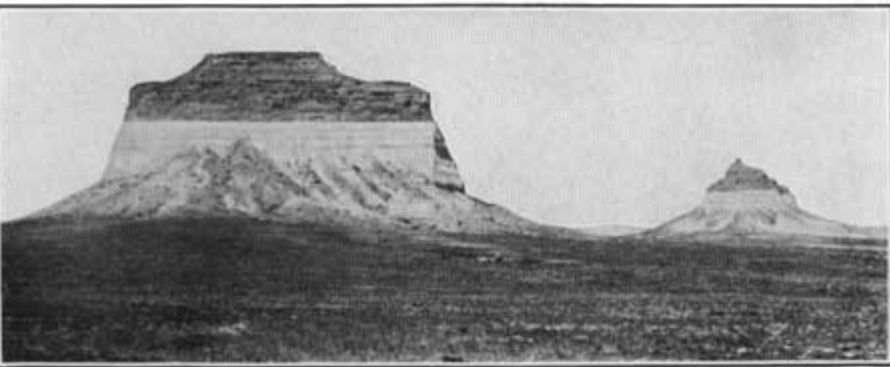
C.



E.



D.



F.



A.



B.



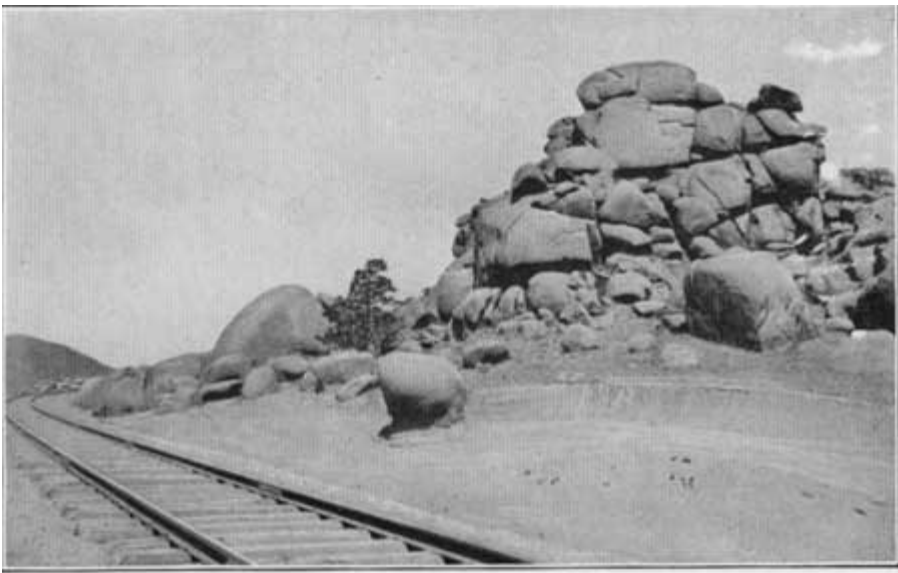
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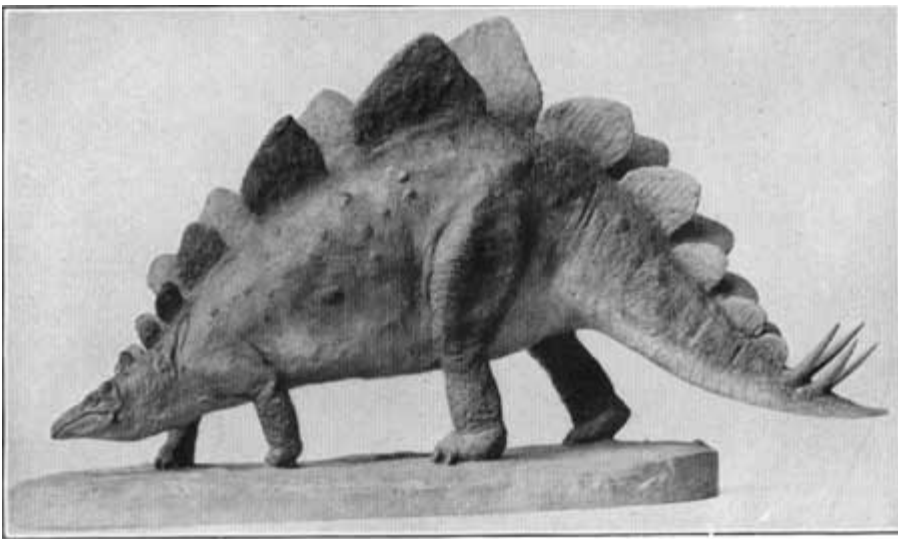
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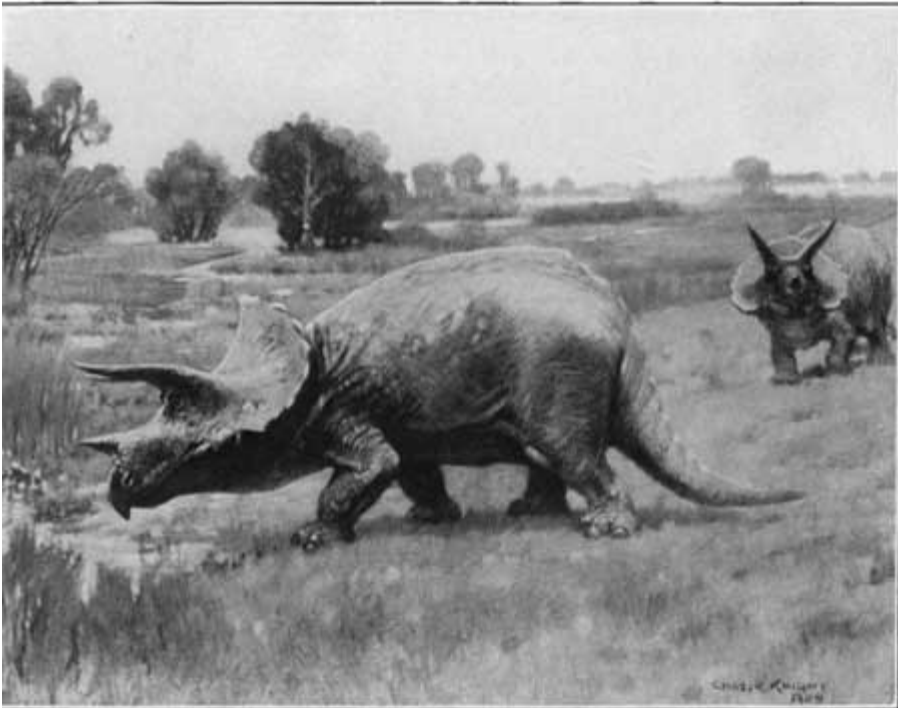
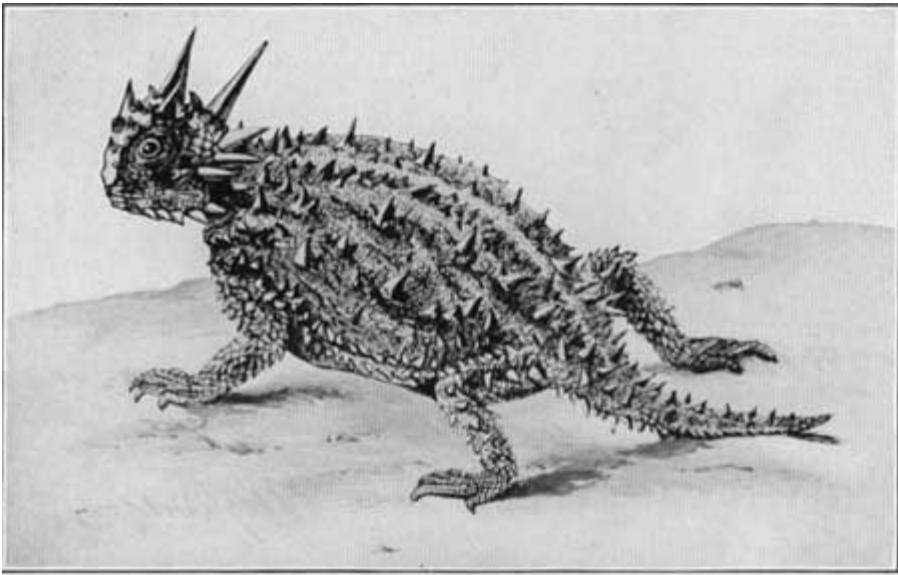


E.

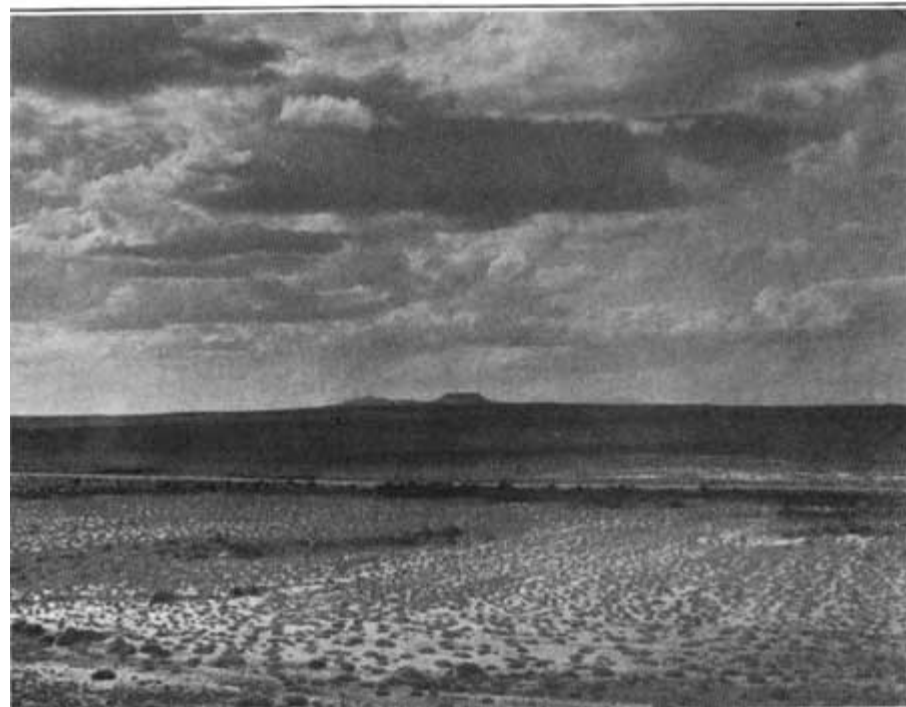


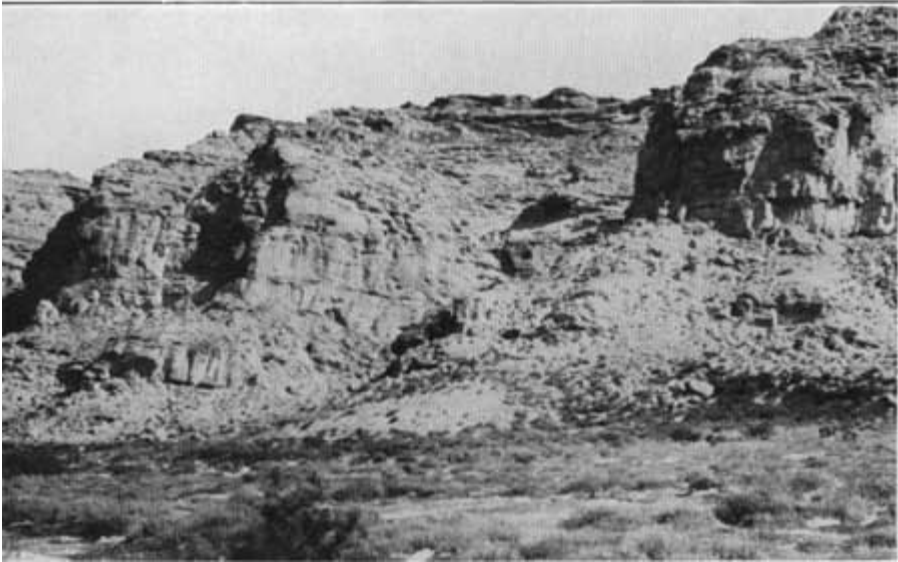


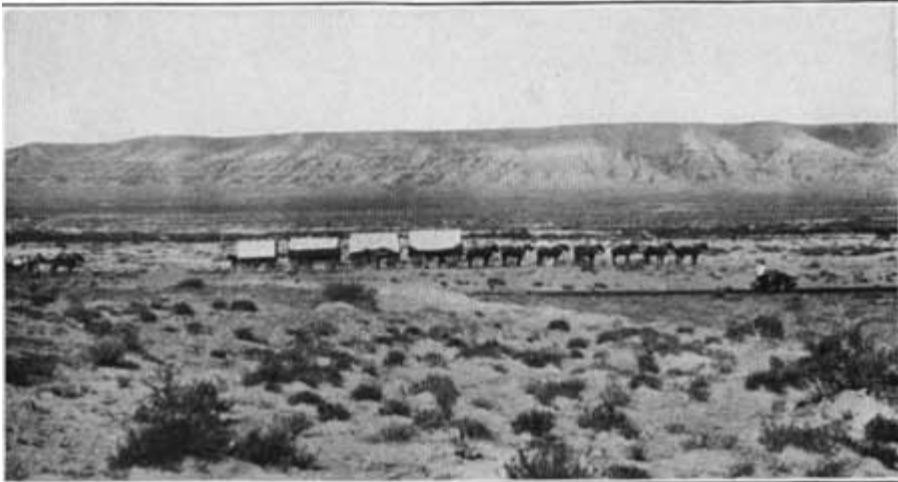






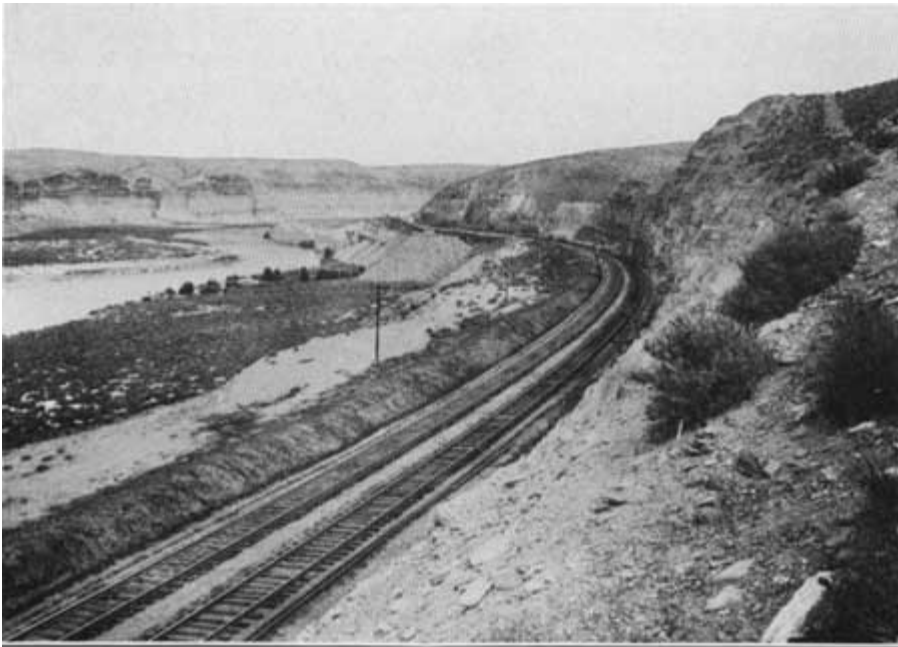


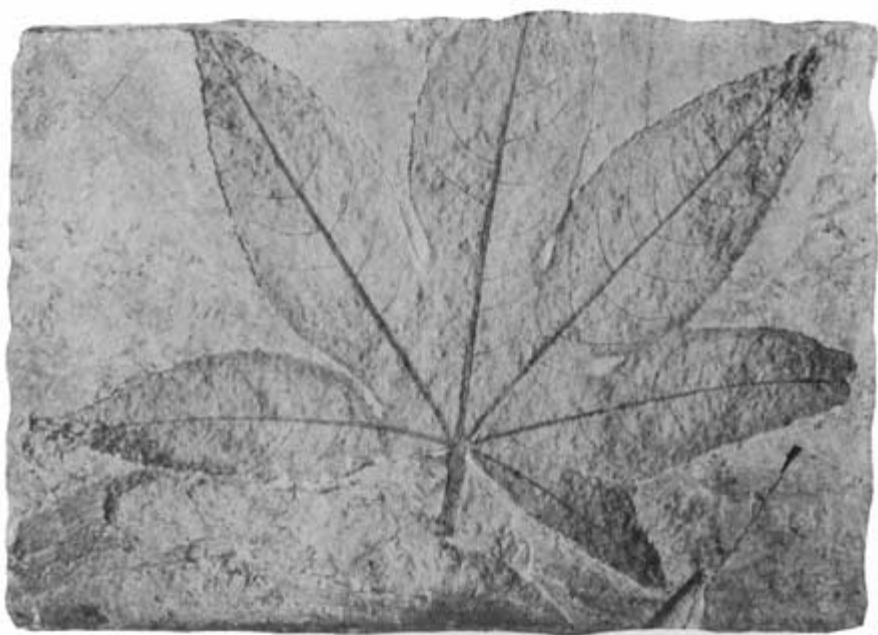
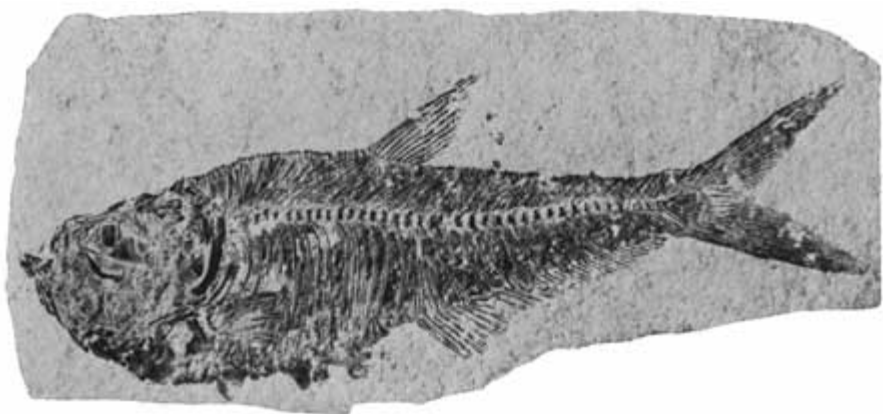


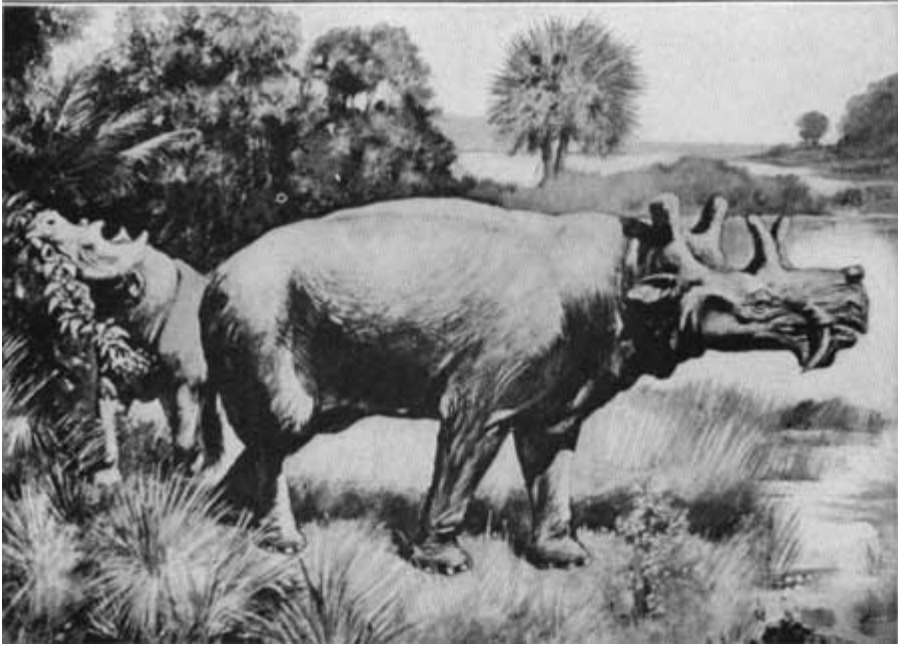


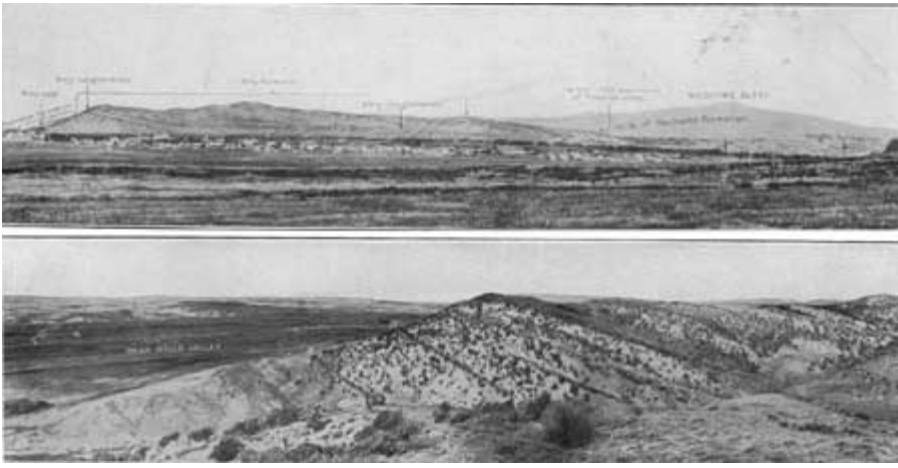


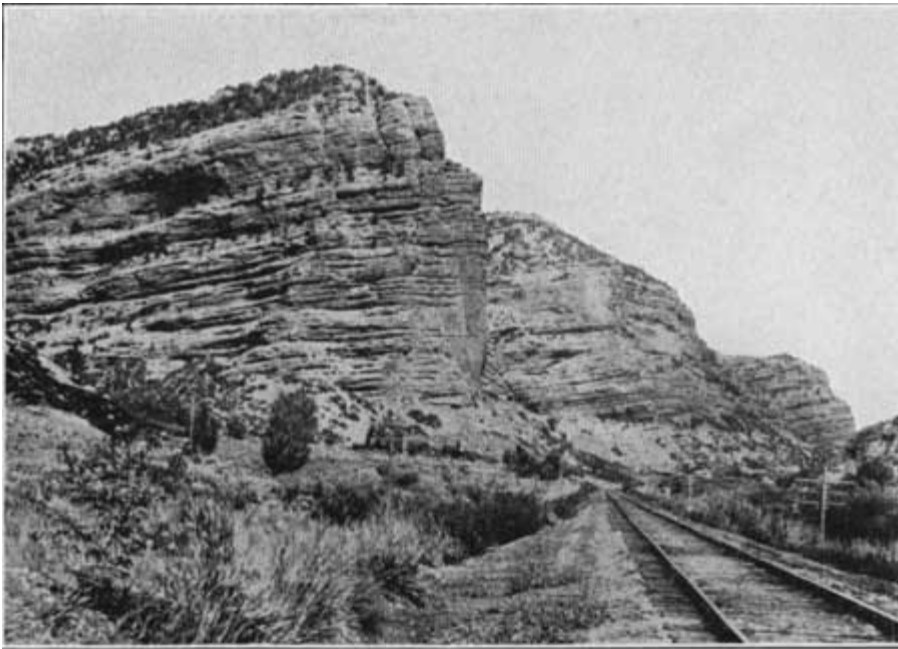


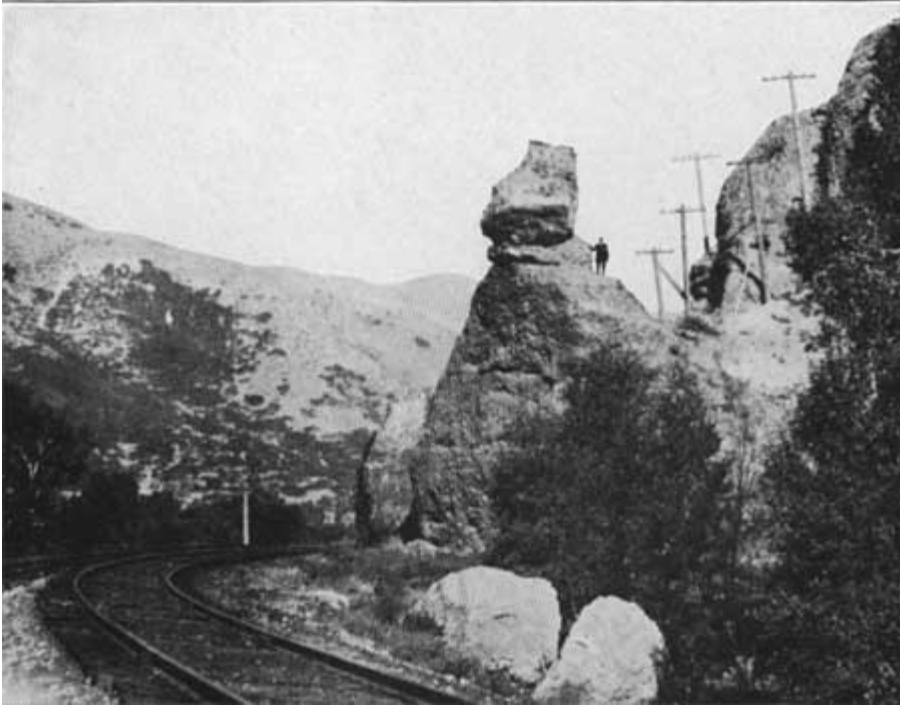
















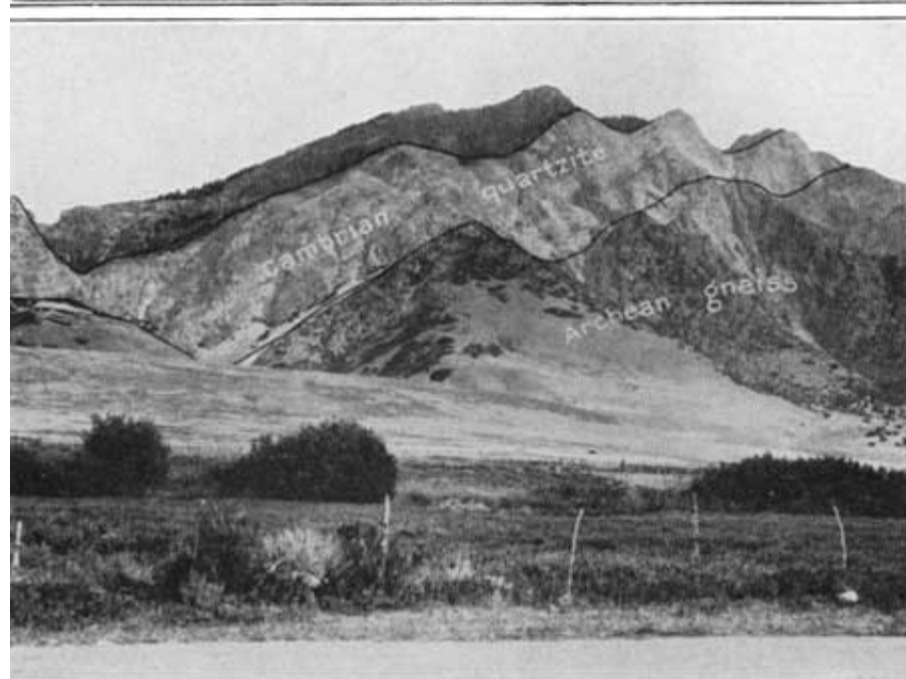






A. WEST FRONT OF WASATCH RANGE AT OGDEN, UTAH.



























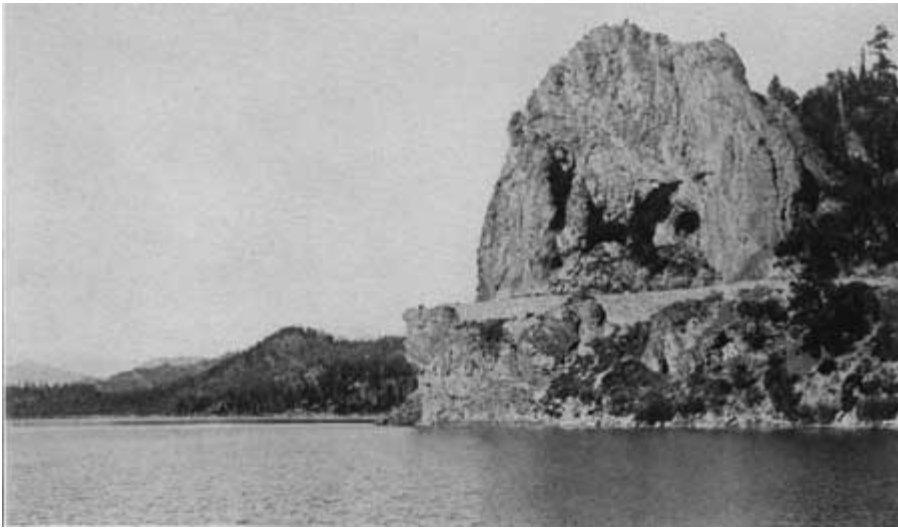




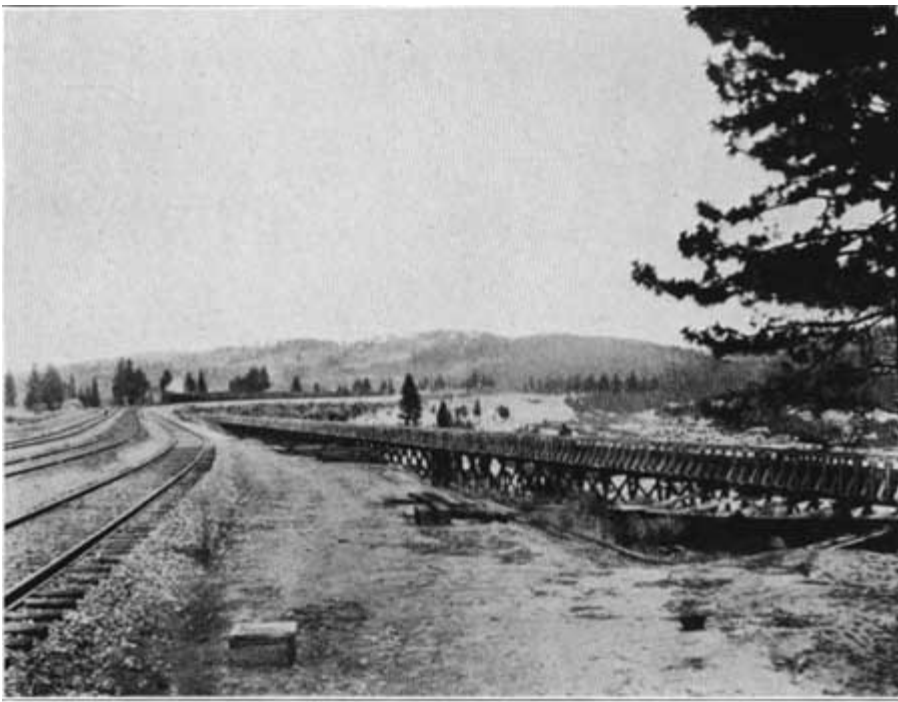






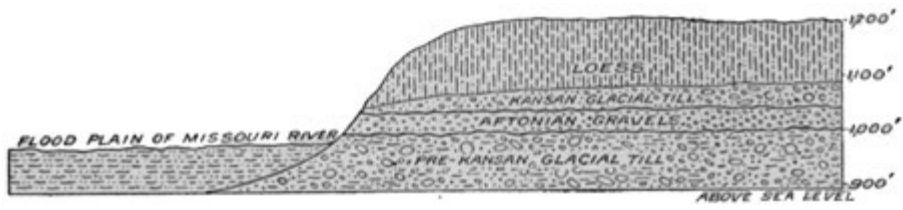




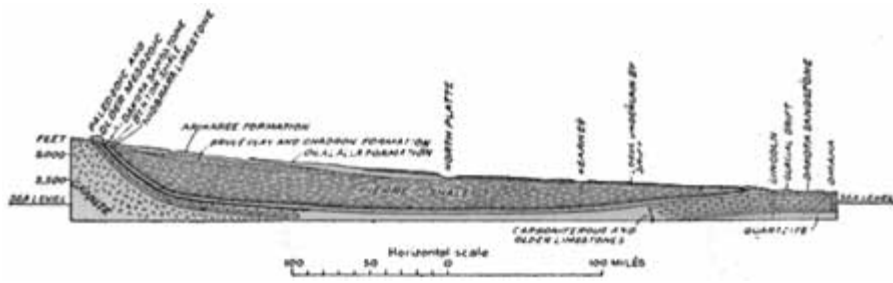




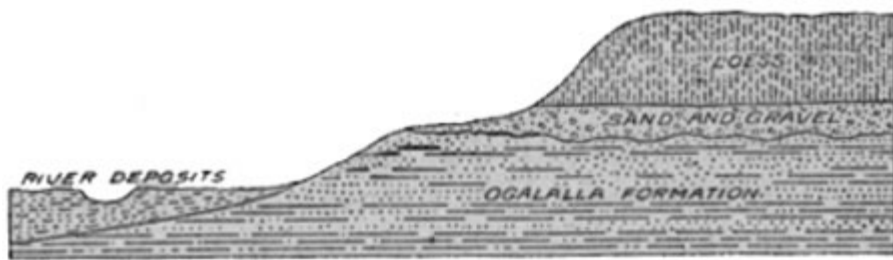


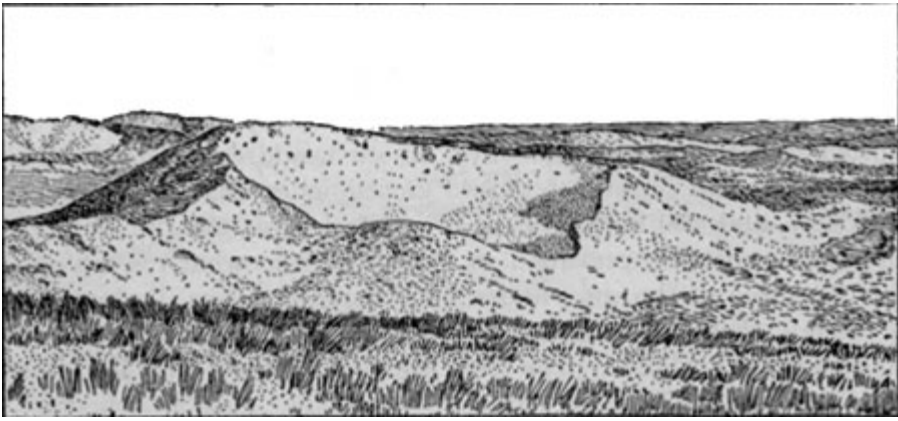




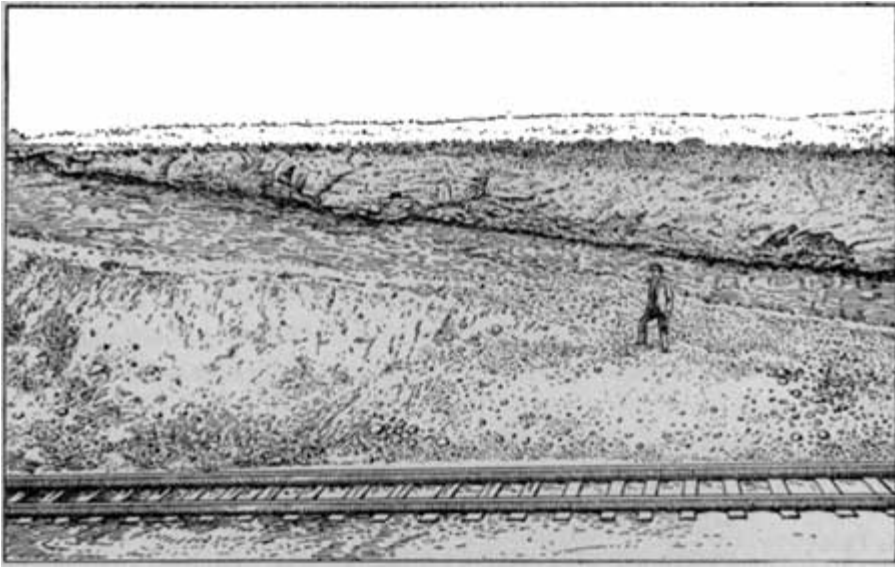




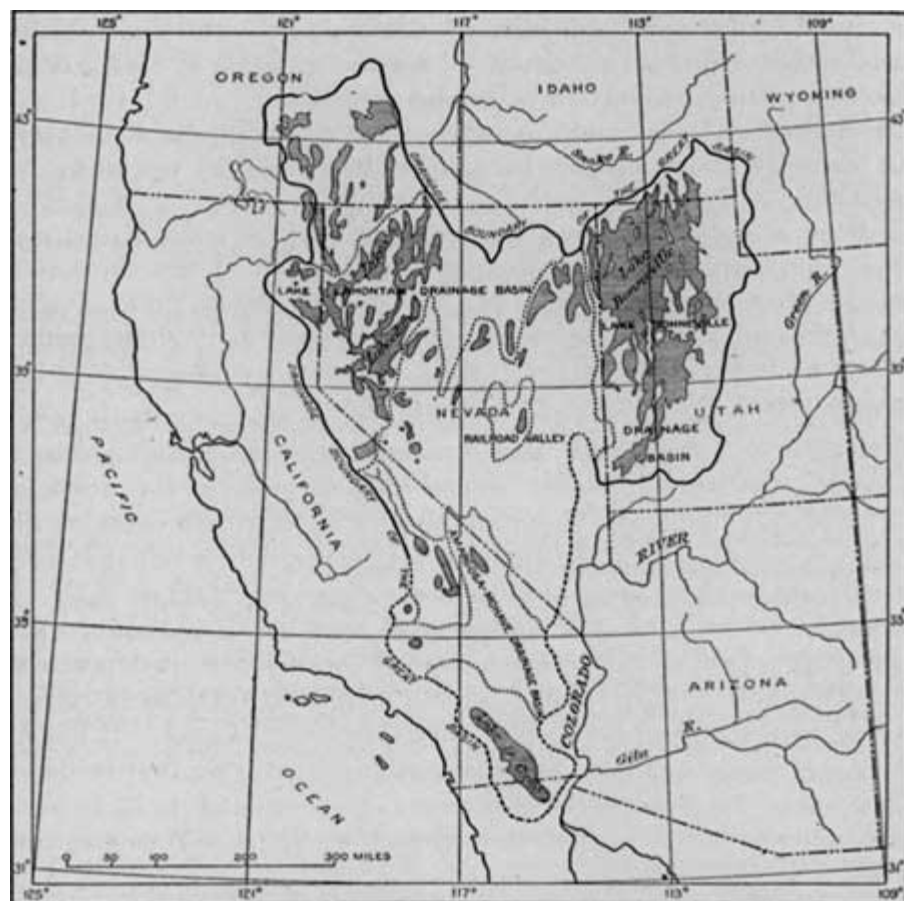












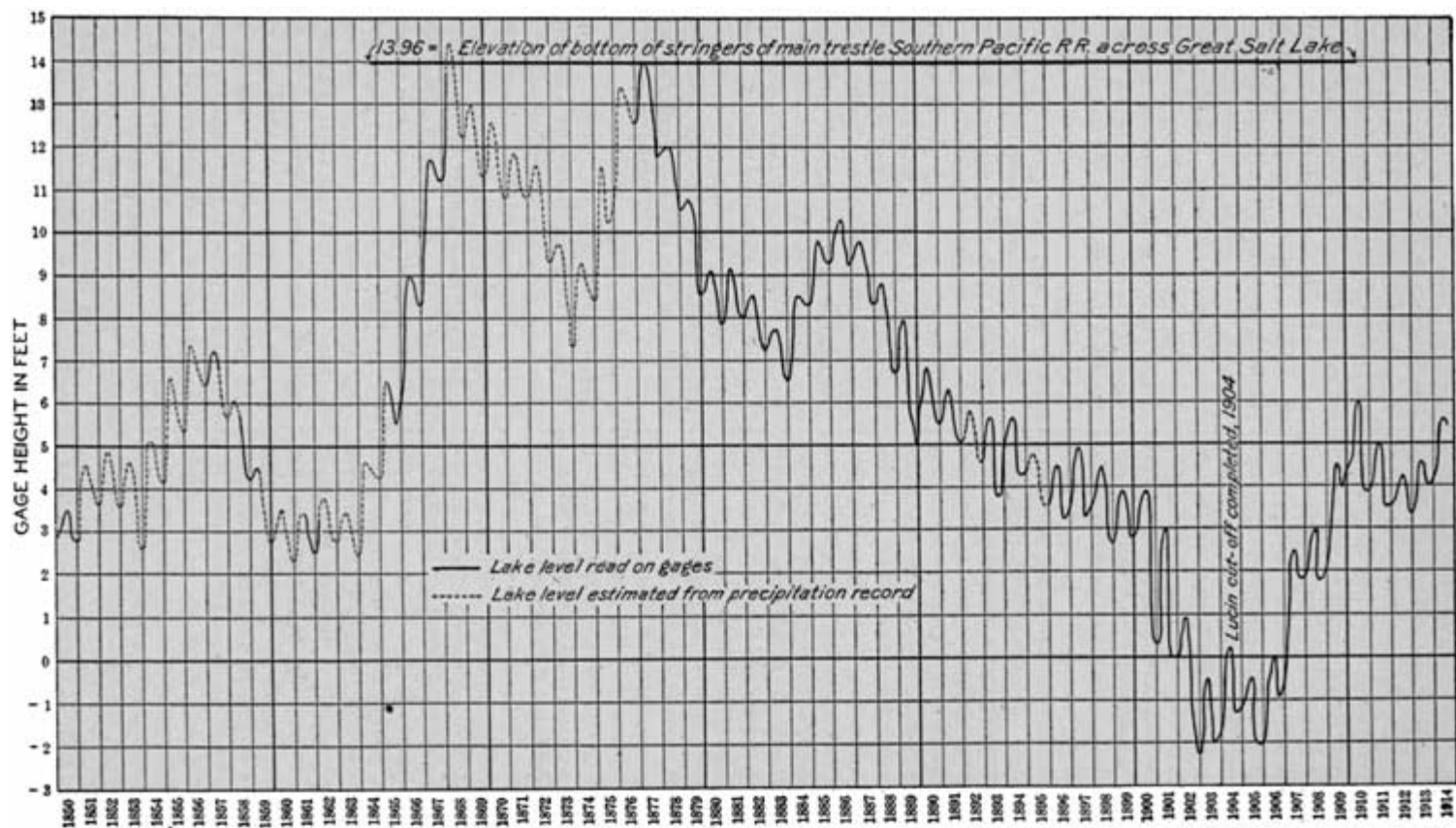
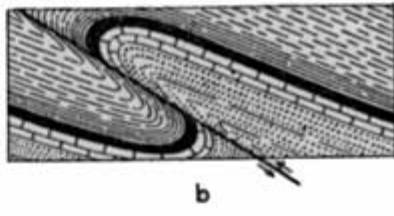
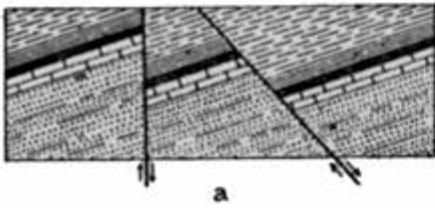
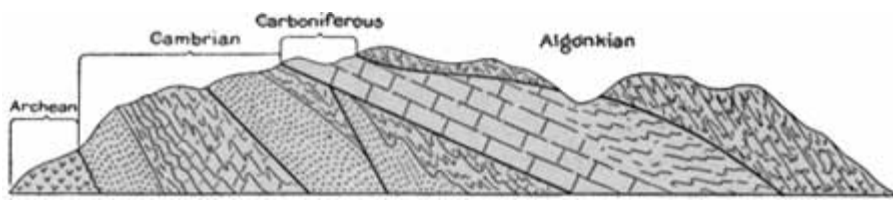
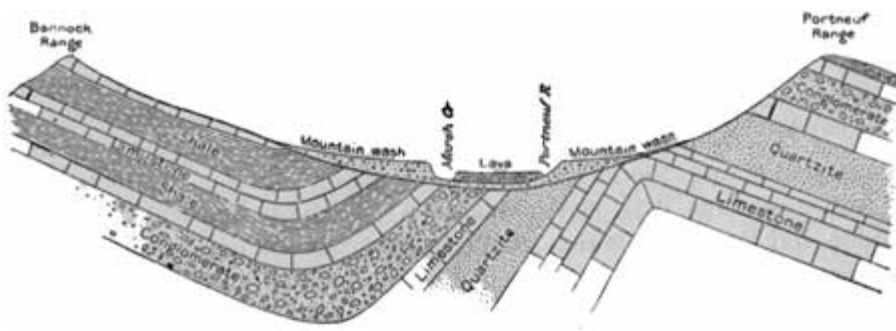
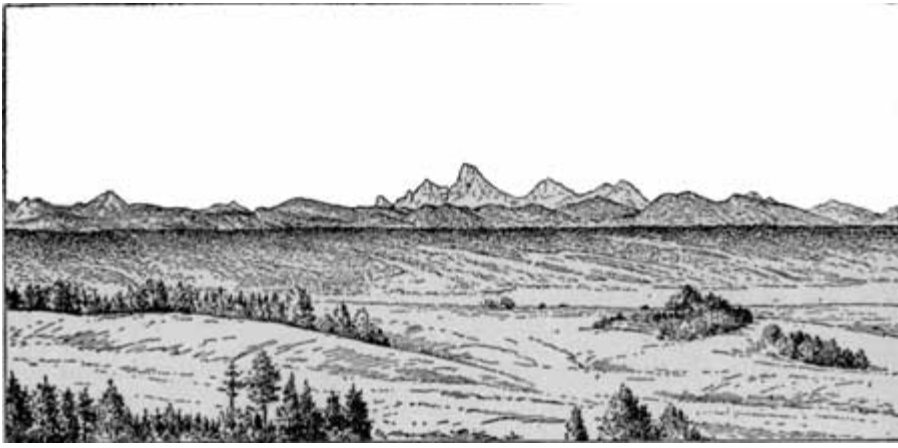


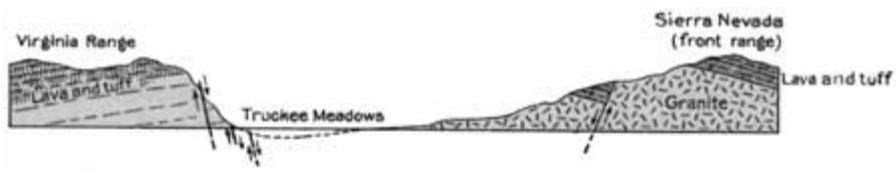
FIGURE 11.—Diagram showing fluctuations of water surface of Great Salt Lake, Utah, from 1850 to 1914.

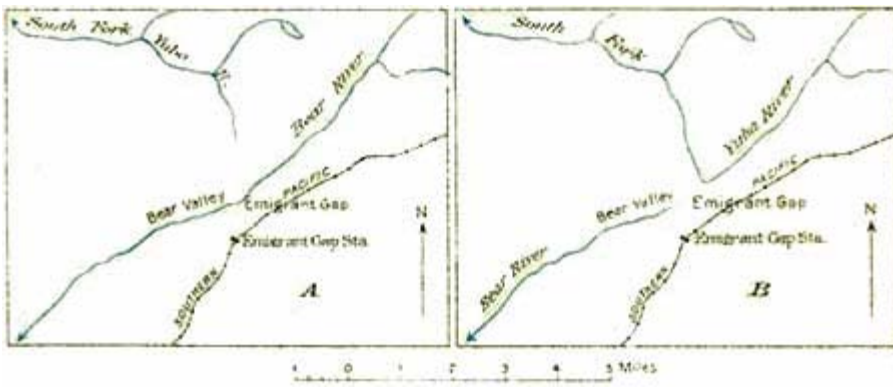


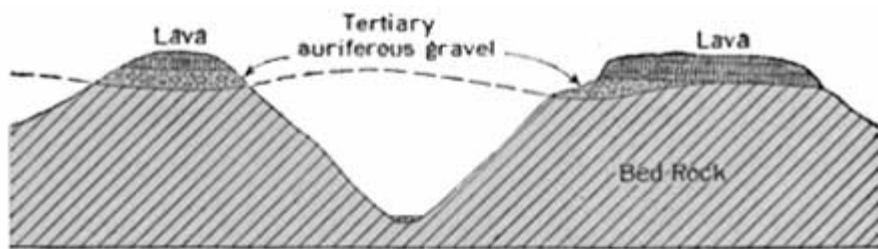




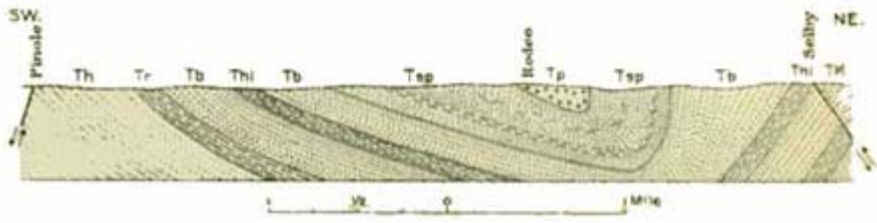














Geological Survey Bulletin 612

Guidebook of the Western United States:
Part B

ITINERARY

Missouri River.

On leaving Council Bluffs the train gradually rises on a filled incline, about 2 miles long, to the bridge, which is about 60 feet above the ordinary water level of Missouri River. From this incline a good view may be obtained of the broad flood plain over which the river winds in a constantly changing course and upon which at times of flood it deposits the rich loam gathered from the vast areas it drains. The productive fields that present so pleasing an aspect during the growing season and give the appearance of opulence at harvest time are the direct result of this constant activity of the river. But neither these fields nor anything else on the bottom lands can be regarded as permanent, for the great river is continually eating away the plain in some places and building it up in others. This action causes the stream to assume a winding course—that is, to meander in loops and bends that are called oxbows. In this process of shifting its course, when these bends become very sharp the river tends to straighten itself by cutting across the narrow necks, and it thus abandons parts of its former channel, which become bayous, or oxbow lakes. Cutoff Lake, which can be seen to the right,¹ 3 miles north of the bridge, is one of these abandoned oxbows. At the time the river was agreed upon as the boundary between Iowa and Nebraska. Cutoff Lake was a part of its channel, but in 1870 it straightened its course, so that the land partly inclosed by Cutoff Lake, although a part of Iowa, now lies west of the river and is almost surrounded by territory belonging to the State of Nebraska. This shifting of the river's course can be prevented to some extent by building levees, or embankments. North of Council Bluffs an embankment has been thrown up and faced with a hard quartz rock (Sioux quartzite) which was shipped for this purpose from Sioux Falls, S. Dak., 160 miles away. The necessity for this protection is obvious, for some of the lowland near Council Bluffs lies below river level.

¹The terms right and left as employed throughout this book apply to the westbound journey.

The building of the bridge² was regarded as a notable feat of engineering, and its present importance is indicated by the fact that the traffic of seven railroads passes over it. It spans one of the longest rivers in the world, the Missouri and Mississippi combined, 3,820 miles long. The bridge crosses this great river 669 miles above the junction with the Mississippi, and the drainage from 323,000 square miles, including large parts of Montana, North Dakota, and South Dakota, passes under it. The water surface has a known range of level of 25 feet at this point; the lowest water recorded was in 1867, and the highest in 1881. The discharge at Omaha averages about 50,000 second-feet; that is to say, on the average, 50,000 cubic feet (374,000 gallons) of water passes under the bridge every second.

²The first bridge built at Council Bluffs was begun by the railroad company in

1869 and completed in 1872 at a cost of \$1,750,000. It carried a single track, consisted of 11 spans, each 250 feet long, and was about 60 feet above ordinary flood level, or 50 feet above the highest recorded level. This height served two useful purposes—it brought the track to the level of the bluffs west of the river and allowed boats which were formerly used on the river to pass under it, thus obviating the necessity of a drawbridge. The two eastern spans of this bridge were wrecked by a tornado in 1877, but the bridge was used with temporary repairs until 1886, when it was replaced by the present double-track structure.

The river here during low water is about 900 feet wide. The bridge over the main channel rests on five piers, 250 feet apart, that extend to bedrock at a maximum depth of 76 feet below the level of the flood plain. These were built midway between those of the old bridge. (See diagram on sheet 1, p. 18.) They carry the four main spans, and on each end are three additional deck spans, making the total length of the bridge 1,750 feet. Although the records give no intimation of the kind of rock on which the piers rest, it is supposed to consist of limestone and sandstone of Carboniferous (Pennsylvanian) age, which are known from well borings to underlie the glacial drift in the vicinity of Omaha. These rocks are exposed in the river bluffs near South Omaha but can not be seen from the train.

Although designed to accommodate foot passengers and wagons, the bridge has never been so used. Local traffic passes over the bridge of the Omaha & Council Bluffs Street Railway Co., half a mile farther north, and beyond this is a drawbridge of the Omaha Bridge & Terminal Co., over which pass the trains of the Illinois Central Railroad.

The Missouri is the muddiest river in the Mississippi Valley; it carries more silt than any other large river in the United States except possibly the Rio Grande and the Colorado. For every square mile of country drained it carries downstream 381 tons of dissolved and suspended matter each year. In other words, the river gathers annually from the country that it drains more than 123,000,000 tons of silt and soluble matter, some of which it distributes over the flood plains below to form productive agricultural lands but most of which finds its way at last to the Gulf of Mexico.

It is by means of data of this kind that geologists compute the rate at which the lands are being eroded away. It has been shown that Missouri River is lowering the surface of the land drained by it at the rate of 1 foot in 6,036 years. The surface of the United States as a whole is now being worn down at the rate of 1 foot in 9,120 years. It has been estimated that if this erosive action of the streams of the United States could have been concentrated on the Isthmus of Panama it would have dug in 73 days the canal which has just been completed, after 10 years' work, with the most powerful appliances yet devised by man.

Nebraska. Nebraska lies mainly in the Great Plains province of the western United States, in altitudes ranging from 842 to 4,849 feet above sea level, and is drained to the Missouri through the Niobrara, the Platte, and many minor streams. The annual rainfall in the State ranges from 13.30 to 31.65 inches and averages 23.84 inches. Dry farming is general and large crops of corn, wheat, and oats are raised. Nebraska claims a greater variety of native grasses than any other State in the Union, their number amounting to more than 200, of which 150 are valuable for forage. In the western part of the State some irrigation is practiced.

Nebraska is primarily an agricultural State and has been called "a State without a mine," but it does contribute to the country's mineral production by some utilization of its clay resources,

by a considerable output of sand, gravel, and building stone, and by a practical monopoly of the country's production of volcanic ash, or pumice. The packing industry is large.

The State includes 77,520 square miles and in 1910 had a population of 1,192,214.

Omaha, Nebr.

Elevation, 1,024 feet.

Population, 124,096.¹

The name Omaha is derived from that of a tribe of Indians that once inhabited this region. The first white settlement was made in 1854, but not until railroad construction began, about 10 years later, did it become a town of importance. Here ground was broken December 1, 1863, for the construction of the road, although little real construction work was done before the spring of 1865; here the first transcontinental train started for San Francisco on September 13, 1870; here occurred on November 1, 1897, "the world's greatest auction," when the Union Pacific, which had cost \$115,214,587.79 to construct, was sold for \$57,564,932.76; and here are situated the offices, shops, and general terminal facilities of the Union Pacific system.

¹The figures given for population throughout this book are those of the United States Census for 1910. For unincorporated places the census figures give the population of the election precinct, township, or other similar unit; such figures are marked with an asterisk (*).

The station at Omaha is built in a depression eroded in loess (see p. 8), and good exposures of this peculiar material may be seen on the left as the train leaves the station. Thence westward to Elkhorn it lies on either side of the track, through the entire length of the Lane cut-off, which is one of the notable engineering features on the Union Pacific route. Prior to 1908 the trains passed through South Omaha and thence up Papillion Creek to Elkhorn. To avoid this circuitous route a line was built nearly due west from Omaha, cutting to a maximum depth of 85 feet straight through the numerous hills and building across the broad valleys, making, at a cost of \$3,000,000, a level road bed nearly 12 miles long, which shortened the line by about 9 miles.²

²The material visible in these cuts is mainly loess and clay. In some places the glacial till under the clay is exposed, but the two can not be distinguished from the train. In nearly all the cuts, however, the division between the loess and the clay is readily discernible. The upper part of the bank in each cut consists of buff-colored loess 30 to 50 feet thick and is rather sharply separated from the lower part, which consists of brick-red clay. A somewhat singular relation may be observed in these cuts. The red material is exposed only in the center of each cut, and its surface in cross section has practically the same outline as the surface at the top. (See fig. 2.) The overlying loess is of nearly the same thickness in all places, as if it were a uniform blanket spread over an older surface that had the same shape as the present surface.

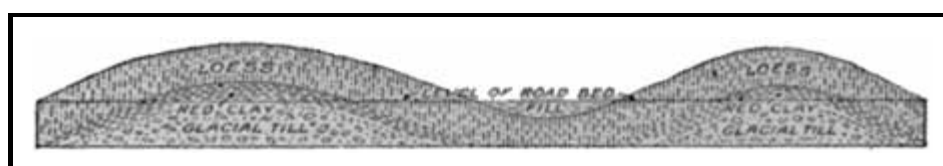


FIGURE 2.—Sketch profile showing relation of loess to underlying beds of clay and glacial till in railroad cuts west of Omaha, Nebr.

The city of Omaha is built on loess, and wherever grading has been done or excavations have been made the characteristic steep walls of this material may be seen. The loess is fine grained, massive, and compact and carries numerous small light-colored limy concretions. Nearly vertical walls of it have stood practically unchanged for 30 years, and other equally precipitous walls have the appearance of being much older.

The blanket of glacial debris and loess (see fig. 2) overlies limestone and sandstone of Carboniferous age,¹ which have been penetrated by a time when most of the coal beds in the eastern part of the United States were in numerous wells bored for artesian water, but which can not be seen from the train. The Carboniferous period was so named because in many parts of the World its rocks contain an abundance of carbon in the form of coal. In the central and eastern parts of the United States much coal is interlayered with rocks of this age, but only one coal bed has been found in the Carboniferous rocks of Nebraska, and that one is not of much economic value under present conditions. Attempts to mine it have not proved successful.

¹The only Paleozoic rocks which come to the surface in eastern Nebraska belong to the Carboniferous system, deposited at process of formation from vegetal deposits. (For types of Carboniferous vegetation see Pl. IV, C, p. 20.) They are economically the most important rocks in the State. Most of the building stone, clay, and lime produced in Nebraska come from them. Their relations to other rock formations exposed in eastern Nebraska are shown in the following table:

Geologic column showing relations of rocks exposed in eastern Nebraska.

Age.	Formation.	Character.
Quaternary.	Loess.	
	Kansan drift.	Glacial till.
	Aftonian gravels.	Sand and gravel; locally conglomerate.
	Pre-Kansan or Nebraskan drift.	Glacial till.
Tertiary.		Sand and clay.
Cretaceous.	Niobrara limestone.	Chalky limestone and shale.
	Benton shale.	Blue shale with limestone concretions (Carlile shale.)
		Hard slaty limestone and blue chalky clay. (Greenhorn limestone.)
		Dark sandy shale. (Graneros shale.)
	Dakota sandstone.	Soft massive yellow sandstone.
Carboniferous		Limestone, sandstone, and shale of Permian and Pennsylvanian age.

In eastern Nebraska the Carboniferous beds that appear at the surface comprise 200 feet of Permian and 1,200 feet of Pennsylvanian rocks. The lowest series of the Carboniferous, the Mississippian, does not outcrop here. The Pennsylvanian rocks consist of alternating limestones and shales. The rock formations below the Pennsylvanian in eastern Nebraska are of interest because they include certain

strata that supply water to artesian wells. Several of these wells drilled in and near Omaha found water at depths of 1,200 to 1,800 feet under pressure sufficient to flow at the surface. The lowest stratum yields the strongest flow.

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ITINERARY

San Francisco.

Population 416,912.

Omaha 1,782 miles.

San Francisco, the chief seaport and the metropolis of the Pacific coast, is the tenth city in population in the United States and the largest and most important city west of Missouri River. The population in 1910 showed a gain of 20 per cent since 1900. The city is beautifully situated at the north end of a peninsula, with the ocean on one side and the Bay of San Francisco on the other. The bay is some 50 miles in length and has an area of more than 300 square miles. The entrance to the bay lies through the Golden Gate, a strait about 5 miles long and a mile wide at its narrowest point.

The site of the city is very hilly, and a line of high rocky elevations run like a crescent-formed background from northeast to southwest across the peninsula, culminating in the Twin Peaks, 925 feet high. Telegraph Hill, in the northeastern part of the city, is 294 feet above sea level. Here stood the semaphore which signaled the arrival of ships in the days of the gold seekers. The city has been laid out without the slightest regard to topography; consequently many of the streets are so steep as to be traversable only by cable cars and pedestrians. The waters of the bay formerly extended westward to Montgomery Street, and most of the level land in the business section of San Francisco has been made by filling.

Golden Gate Park, containing 1,014 acres, and extending westward from the city to the ocean, was a waste of barren sand dunes in 1870, but skillful planting and cultivation have transformed it into one of the most beautiful semitropical public parks in the country. At its west end is the famous Cliff House, overhanging the sea, and a short distance out from the shore are the Seal Rocks, where the great sea lions may often be seen. The Sutro Baths, near by, named after Adolph Sutro, constructor of the famous Sutro tunnel on the Comstock lode, contain one of the largest inclosed pools in the world.

Commerce. San Francisco Bay is the largest and most active harbor on the Pacific coast. Besides the coastwise routes, the port maintains steamship connections with Australia, Hawaii, Mexico, Central and South America, the Philippines, China, and Japan. The direct foreign trade is chiefly with British Columbia, South America, China, and Japan. Although the export grain business has now largely shifted to the ports of Oregon and Washington, San Francisco's permanence as one of the greatest ports of the country is assured by its advantageous position, its wealth of back country, and its command of trans-Pacific and transcontinental trade routes. Three large railroad systems—the Southern Pacific (with two transcontinental lines), the Atchison, Topeka & Santa Fe, and the Western Pacific—connect it with the East. Lines of the Southern Pacific Co. connect the city with different parts of the State and with the northern transcontinental lines. The Northwestern Pacific serves Mendocino, Sonoma, and Mann counties, on the north, and several smaller lines radiate from different ports on the bay. Only one of the lines mentioned, the Coast Line of the Southern Pacific, actually enters the city. The other roads have their terminals in Oakland and other cities around the bay.

The first settlement on the present site of San Francisco dates from 1776. It **History.** consisted of a Spanish military post (presidio) and the Franciscan mission of San Francisco de Asís. In 1836 the settlement of Yerba Buena (yair'ba bway'na) was established in a little cove southeast of Telegraph Hill. The name San Francisco was, however, applied to all three settlements. The United States flag was raised over the town in 1846, and the population rapidly increased, reaching perhaps 900 in May, 1848. The news of the gold discoveries was followed by crowds of fortune seekers, so that by the end of 1848 the city had an estimated population of 20,000. From that time on San Francisco has grown rapidly. The first regular overland mail communication with the East was established by pony express in 1860, the charge for postage being \$5 for half an ounce. In 1869 the completion of the Central Pacific Railway to Oakland marked the beginning of transcontinental railway communication.

The city suffered from severe earthquakes in 1839, 1865, 1868, and 1906. In respect to property loss the disaster of April 18, 1906, was one of the great catastrophes of history. The actual damage to the city by the earthquake was comparatively slight, but the water mains were broken and it was consequently impossible to check the fires which immediately broke out and which soon destroyed a large part of the city, including most of the business section. Some 500 persons lost their lives, and the estimated damage to property was between \$350,000,000 and \$500,000,000. Reconstruction began at once, and the city was practically rebuilt in the three years following the earthquake.

Excursions from Santa Francisco. The Ocean Shore Railroad (station at Twelfth and Mission streets) and connecting automobile line afford a good opportunity to see the geology along the shore from San Francisco to Cruz. The return trip may be made by rail or stage across the Santa Cruz Mountains. For 4-1/2 miles north of Mussel Rock (11.9 miles from San Francisco) there is exposed in the bluffs along the coast a remarkable section of the Merced (Pliocene) formation, consisting of about 5,800 feet of highly inclined marine clays, shales, sandstones, conglomerates, and shell beds. In these beds have been found fossil remains of 53 species of marine animals, mostly mollusks, of which three-fourths are still represented by forms living in the ocean to-day. The San Andreas rift (the fracture along which displacement occurred in the San Francisco earthquake of 1906) passes out to sea at the mouth of a little ravine half a mile north of Mussel Rock and is crossed by the railroad. The exposures of the Merced formation along the sea cliffs were much finer before the San Francisco earthquake, which shook down some of the cliffs. From Tobin (18.1 miles) to Green Canyon (21.1 miles) the bed of the Ocean Shore Railroad is cut in bold sea cliffs high above the water and affords not only fine shore scenery but also an excellent section of rocks that probably belong to the Martinez (Eocene) formation. The contact of these rocks with a large mass of pre-Franciscan granite (quartz diorite), which forms Montara Mountain, a bold ridge that extends southeastward from this part of the coast, is crossed by the railroad between Tobin and Green Canyon. At the north end of Seal Cove, opposite Moss Beach station (24.1 miles), the bowldery and fossiliferous sea-beach beds here forming the base of the Merced (Pliocene) and resting on the granite of Montara Mountain are well exposed.

This delightful excursion may be extended down the coast to Pescadero, and the return made by stage across the range and rift zone to San Mateo; or the traveler may continue down the coast to Santa Cruz and return across the range on the Southern Pacific line either by way of the Big Trees and Los Gatos or by Pajaro and Gilroy.

The characteristic thin-bedded radiolarian chert of the Franciscan group is well exposed about Strawberry Hill, in Golden Gate Park. There are good exposures of the chert also on Hunter Point, reached most readily by the Kentucky Street cars from Third and Market streets. The principal rock of the point is serpentine. A mass of basalt in the sea cliffs on the

south side presents a remarkable spheroidal and variolitic structure.

The summit of Mount Tamalpais is very easily and comfortably reached by ferry to Sausalito, electric train to Mill Valley, and a mountain railway to the hotel on the top. The ferry trip is one of the best to be had on the bay. The steamer passes close to the island of Alcatraz, on which is a disciplinary barracks. To the west may be seen the ocean through the Golden Gate. Angel Island, with its interesting glaucophane schists, serpentine, and other rocks, lies to the right as the boat approaches Sausalito. The sedimentary rocks of both islands belong to the Franciscan group and are chiefly sandstone. The trip from Sausalito to Mill Valley by the Northwestern Pacific Railroad gives the traveler opportunity to see some characteristic bay-shore scenery and particularly to note how the waters of the bay appear to have flooded what was once a land valley. Mill Valley is named from an old Spanish sawmill, the frame of which is still standing. The views obtainable from the scenic railway and from the summit of Mount Tamalpais are extensive and varied. To the south may be seen San Francisco and Mount Hamilton (4,444 feet). To the southeast is Mount Diablo (3,849 feet), through which runs the meridian and base line from which the public-land surveys of a large part of California are reckoned. Nearer at hand is the bay, with its dark-green bordering marshes through which wind serpentine tidal creeks. Close under the mountain to the north is Lake Lagunitas (an artificial reservoir), and beyond it ridge after ridge of the Coast Range. To the west is the vast Pacific.

From the summit of Tamalpais one sees clearly that San Francisco Bay is a sunken area in which hilltops have become islands and peninsulas. This area is the northern extension of the crustal block whose sinking formed Santa Clara Valley. A later sag admitted the ocean into the valley, and the Golden Gate, formerly a river gorge, became a strait.

Mount Tamalpais has really three peaks: East Peak (2,586 feet), near which the Tavern of Tamalpais is situated; Middle Peak (about 2,575 feet); and West Peak (2,604 feet). From the grassy hills 1-1/2 miles west of West Peak there is a good view of Bolinas Lagoon, though which passes the San Andreas rift, but for close views of the rift topography the visitor should walk or drive through the valley between Bolinas Lagoon and Tomales Bay, where the effects of the movement of 1906 are still in many places clearly evident.

Mount Tamalpais is composed wholly of the sediments of the Franciscan group and the igneous rocks usually associated with them, though it is chiefly sandstone. A mass of radiolarian chert occurs near the tavern, and serpentine may be seen at several places beyond West Peak. To one fond of walking and of marine views, a trip on foot to West Peak, thence down the main ridge to Muir Woods (redwoods), and back across the hills to Mill Valley may be heartily recommended. The distance is probably 8 or 9 miles. The Muir Woods, which bear the name of California's greatest nature lover, form a national monument, presented to the nation by William Kent, now a Member of Congress from the first California district, for the purpose of preserving untouched by the lumberman one area of redwoods. No fitter memorial could be dedicated to the memory of John Muir, whose writings have contributed so much to the movement for preserving in national ownership, for public enjoyment, some of our finest scenic resources.

The earthquake rift.

The geologic event of greatest human interest on the Pacific coast in modern times was the San Francisco earthquake of 1906. It was produced by a sudden movement of the rocks (faulting) along opposite sides of a fracture which may be traced for many miles in the Coast Range. The fissure existed before the earthquake of 1906, and it is evident from the relations of hills and valleys along its course that it has been the scene of earlier and, for the most part, prehistoric movements. The last movement was mainly horizontal and in places amounted to about 20 feet. The San Andreas rift, as this fissure has been called, lies just west of San Francisco, and

its course is marked on sheet 25 (p. 224).

The cracks in the soil that mark the line of the last displacement and the parallel ridges and valleys that show older displacements along the fault zone are well displayed in Spring Valley, 13 miles south of San Francisco, and especially near Skinner's ranch, 40 miles northwest of San Francisco.

To reach Spring Valley the visitor should take the Southern Pacific train to San Mateo (18 miles), where a conveyance may be obtained for a trip through Spring Valley along Crystal Spring and San Andreas lakes.

Skinner's ranch can be reached by the ferry to Sausalito and the Northwestern Pacific Railroad to Point Reyes station, from which the ranch is only 2 miles distant, near Olema. In this region may be seen best the earth cracks along the fault line. Near the ranch house there is striking evidence of the horizontal character of the movement that produced the earthquake. The house formerly had two trees in front of it. The fault line, which trends northwest, passes between the trees and the house, and the trees were moved 15 feet to the southeast with reference to the house. There was no perceptible vertical movement nor any change in the water line along Tomales Bay.

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Elkhorn.

Elevation 1,164 feet.

Population 291.

Omaha 28 miles.

Elkhorn is the first station west of the Lane cut-off and is located on one of the branches of Papillion Creek. East of this station the railroad crosses the eastern margin of the widespread Dakota sandstone, but the rock is so completely covered by glacial drift and loess that in no place can it be seen from the train and, indeed, its exact position is not known.

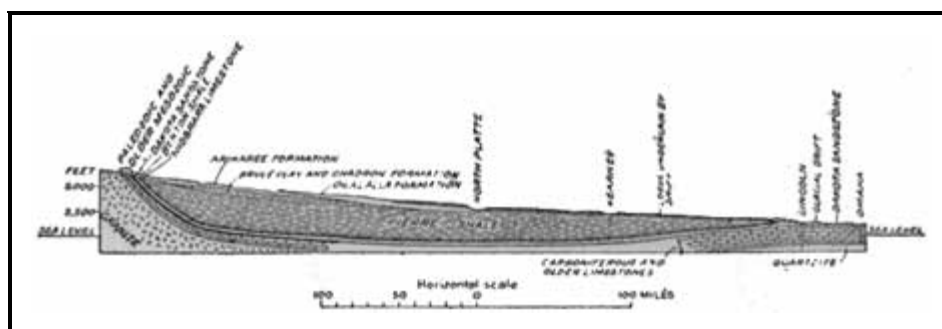


FIGURE 3.—Cross section of the rock formations from the Rocky Mountains to Omaha, Nebr., showing how some of the older rocks that crop out near Omaha extend westward underneath the younger formations and crop out again in the mountains, where all the stratified rocks have been upturned and eroded. (After N. H. Darton.)

Waterloo.

Elevation 1,124 feet.

Population 402.

Omaha 31 miles.

At Waterloo the railroad crosses Elkhorn River, which, unlike most other streams, does not here flow in a valley of its own making but for 25 miles or more meanders over the bottom lands of the Platte.

Between Elkhorn and Waterloo great differences are noticeable both in the character of the surface and in the soil. To the east the surface is diversified by low rolling hills and broad shallow valleys completely mantled with loess. The loess forms a fairly good soil, but its inferiority to the dark-colored loam of the bottom lands is obvious to the most casual observer of the vegetation. West of the hills, in Platte Valley, the surface is flat and unbroken and the soil is more productive. (See Pl. III, p. 11.)



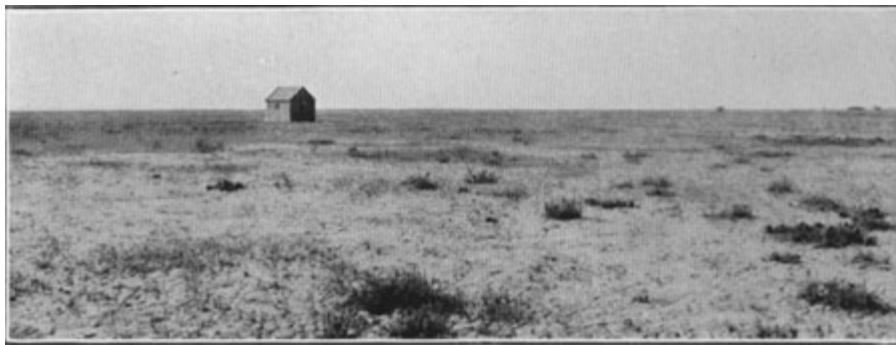


PLATE III.—THE PLAINS OF NEBRASKA. Top to bottom: A, Fifty years ago; B, Now covered with corn; C, When buffalo roamed over them; D, Supporting herds of domestic cattle. Photographs furnished by Union Pacific Railroad Co.

Valley.

Elevation 1,139 feet.

Population 810.

Omaha 35 miles.

about 350 miles.

Valley is the center of an agricultural district in the rich bottom lands of Platte Valley. Large quantities of garden seeds are grown here. About 3 miles west of Valley the traveler will obtain his first good view of Platte River. The railroad follows this river as far upstream as Julesburg, in northeastern Colorado, a distance of

Although Fremont, the seat of Dodge County, is on the flood plain

Fremont.

Elevation 1,196 feet.

Population 8,718.

Omaha 46 miles.

of Platte Valley, where few exposures of rock can be seen, it stands near the contact of the Dakota sandstone and the overlying Benton shale, a fact determined by observations made both north and south of the valley. The sandstone¹ may be seen in the bluffs at the south end of the wagon bridge south of the city, but the shale is not exposed. These bluffs consist mainly of glacial till mantled by loess.

¹The rocks in eastern Nebraska referred to the Dakota or basal sandstone of the Upper Cretaceous series are about 300 feet thick and consist of sand with clay and local beds of conglomerate. The sandstone was named for Dakota City, S. Dak., where collections were made of fossil plants that were described by Profs. Heer and Lesquereux and later became known as the characteristic Dakota flora, for many years the oldest deciduous-leaved flora known in North America. This flora comprises large and well-preserved leaves of poplars, willows, oaks, alders, birches, beeches, sycamores, persimmons, tulip trees, magnolias, and sassafras and shows that many of the familiar and still dominant types of plants had already been firmly established at this remote time. However, none of the particular species of Dakota plants here discovered are known to have survived in this region beyond the close of the Dakota epoch.

The Dakota is exposed in places in the bluffs of Platte River from Fremont to Plattsmouth. It is one of the greatest water-bearing formations in America. It rises gently toward the west, although covered by younger rocks, and crops out again in the foothills of the Rocky Mountains (see fig. 3), where the surface waters enter it. These waters slowly percolate through its sands for about 450 miles to supply the numerous wells in the Platte Valley and elsewhere. The Dakota sandstone extends 400 miles or more north of the Union Pacific Railroad and an equal distance to the south and underlies the surface of the country from the Rocky Mountains eastward to a maximum distance of 1,000 miles or more. It furnishes excellent water to the citizens of 11 States.

Fremont is on the main line of the old trail from Missouri River to California and Oregon, which before the Union Pacific was built was known as the Overland Trail.² In front of the station stands a rough-hewn monument of red granite with the inscription: "This boulder marks the overland emigrant trails though Fremont to Oregon, California, Utah, and Colorado. Erected September 23, 1912, by Lewis Clark Chapter, Daughters of the American Revolution." Similar monuments have been placed at many other railroad stations on the line of the old trail.

²Although four transcontinental railroad routes were surveyed by the Government, the results being published in 11 large volumes, the first line built, the Union Pacific, was explored and located by private enterprise. The Overland Trail seemed to offer the best advantages for railroad construction, inasmuch as it utilized the most feasible passage over the mountains. Gen. Grenville M. Dodge, the chief engineer of the Union Pacific during the period of construction, says of it: "This route was made by the buffalo, next used by the Indians, then by the fur traders, next by the Mormons, and then by the overland immigrants to California and Oregon. It was known as the great Platte Valley route. On this trail, or close to it, were built the Union and Central Pacific railroads to California and the Oregon Short Line branch of the Union Pacific to Oregon." Its

history as a definite route seems to have begun in 1804, when Lewis and Clark visited and described the locality that became its eastern terminus. A fur-trading company sent out by John Jacob Astor in 1810, which founded Astoria, Oreg., at the mouth of Columbia River, the following year, returned by a route which had never before been traversed, but which corresponded essentially with that later known as the Oregon Trail. Astor had planned a line of trading posts extending from the Great Lakes to the Pacific, the Sandwich Islands, and China, but the War of 1812 put a stop to this scheme. About 1824 William H. Ashley and Etienne Provost, of the Rocky Mountain Fur Trading Co., discovered South Pass, which made permanent the mountain-crossing route of the Oregon Trail and later attracted the Union Pacific locating parties. Gen. Dodge says further:

"In 1843 the pathfinder, Gen. John C. Fremont, began to spy out the military ways across the West, and the same year the Oregon pioneers took the first wagons westward to the Pacific. The trail that began with the journey of these early pioneers was widened and deepened by the wheels of the Mormons in 1847, and when the herald of the first California Golden Age sent forth a trumpet call in 1849, heard around the world, the trail was finished from Great Salt Lake across the mountains to the sea.

"That era had its great men, for great men make eras. Ben Holladay, William N. Russell, and Edward Creighton gave to the trail the overland stage line, the pony express, and the telegraph.

"Dating the beginning of transcontinental wagon travel from the days of forty-nine, it was 20 years before the railroad reached California. The period was one of great out of door men and women—the last of American pioneers. When the old trail was in full tide of life it was filled with gold seekers from the Missouri to the Pacific; 100,000 travelers passed over it yearly. Towns stirring and turbulent, some now gone from the map and some grown to be cities, flourished as the green bay tree. Omaha, Salt Lake, San Francisco and such lesser places as Julesburg, Cheyenne, Laramie, Carson, Elko, and Virginia City were picturesquely lively.

"The traffic of the old trail was of long wagon trains of immigrants; the great outfits laden with freight for the mines; of Holladay's coaches, six teams in full gallop; of the first riders of the pony express; and of all other manner of moving men and beasts. The protesting savages have no place upon it but, perceiving in it an instrument to alienate their domain, burned its wagon trains and destroyed its stages as opportunity offered. At times great herds of buffalo obliterated great sections of the trail, yet it held its own until the golden spike was driven and passed away as a wagon road only when the need for it had passed. But the railroad lines that took up the burden of stage coach and pony express and ox team have marked the way of the trail upon the map of the West so that it shall endure as long as the West endures."

Ames.

Elevation 1,230 feet.

Omaha 53 miles.

North Bend.

From Ames may be seen a gap in the line of bluffs south of Platte River that marks the course of an old valley occupied by the river at an early stage of its development, when its bed was about 100 feet higher than at present. The river then flowed southeastward past Wahoo and thence eastward to the valley which it now occupies south of Waterloo. This old channel is 5 or 6 miles wide and consists of a valley floor covered with loam and sand like the

Elevation 1,274 feet.
Population 1,105.
Omaha 61 miles.

floor of the present valley. Also like the present valley it is bordered along most of its course by steep banks of loess.

The town of North Bend (see sheet 2, p. 22) takes its name from the northward bend of Platte River at this point, west of which the railroad follows the river in a southwesterly direction for a long distance. South of the river, opposite North Bend, the bluffs are conspicuous, especially west of Morse Bluff, and consist of loess and glacial drift overlying shale of Benton (Cretaceous) age.¹ This shale was formed as a mud deposit at a time when Nebraska was at the bottom of a sea. It contains many fossil shells of extinct species of marine mollusks, such as oysters (see Pl. IV, A, B, p. 20), clams, and snails, as well as many fossils of types not represented by living forms, such as ammonites and scaphites. It underlies the superficial glacial deposits between Fremont and a point a few miles west of Schuyler.

¹The Benton shale lies conformably on the Dakota sandstone, that is, the beds of the Dakota were not affected by erosion before those of the Benton were laid down upon them. In Nebraska and some other areas a thin limestone (Greenhorn) near the middle of the Benton separates a lower shale (Graneros) from an upper shale (Carlile). The lowest beds crop out near Fremont, where the Dakota passes underneath it not to reappear at the surface again toward the west for a distance of about 450 miles. It is a marine shale representing the first deposits formed after the sea invaded the interior of North America in the Upper Cretaceous epoch.

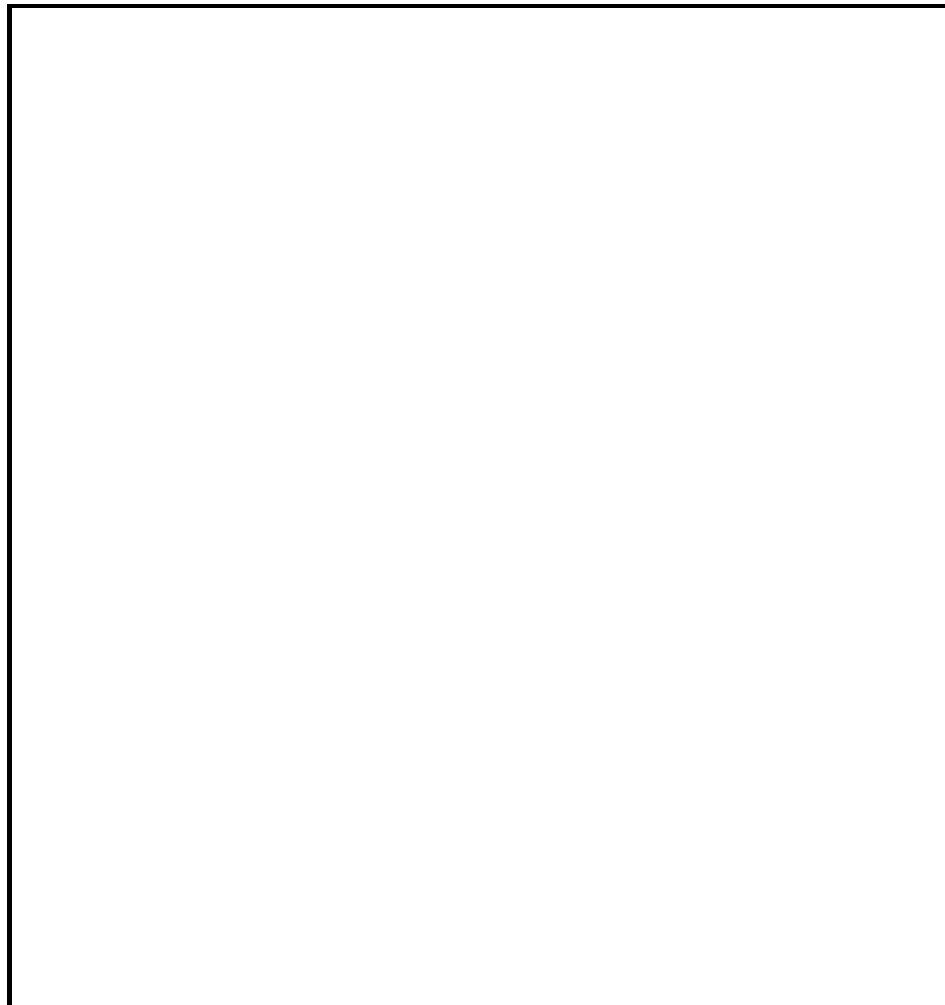




PLATE IV.—MARINE FOSSILS OF CRETACEOUS AGE. A (*top, left*), Oysters (*Ostrea congesta*); B (*top, right*), *Inoceramus labiatus*; CARBONIFEROUS FOREST. C (*bottom*). From vegetation of this sort the great deposits of coal were formed.

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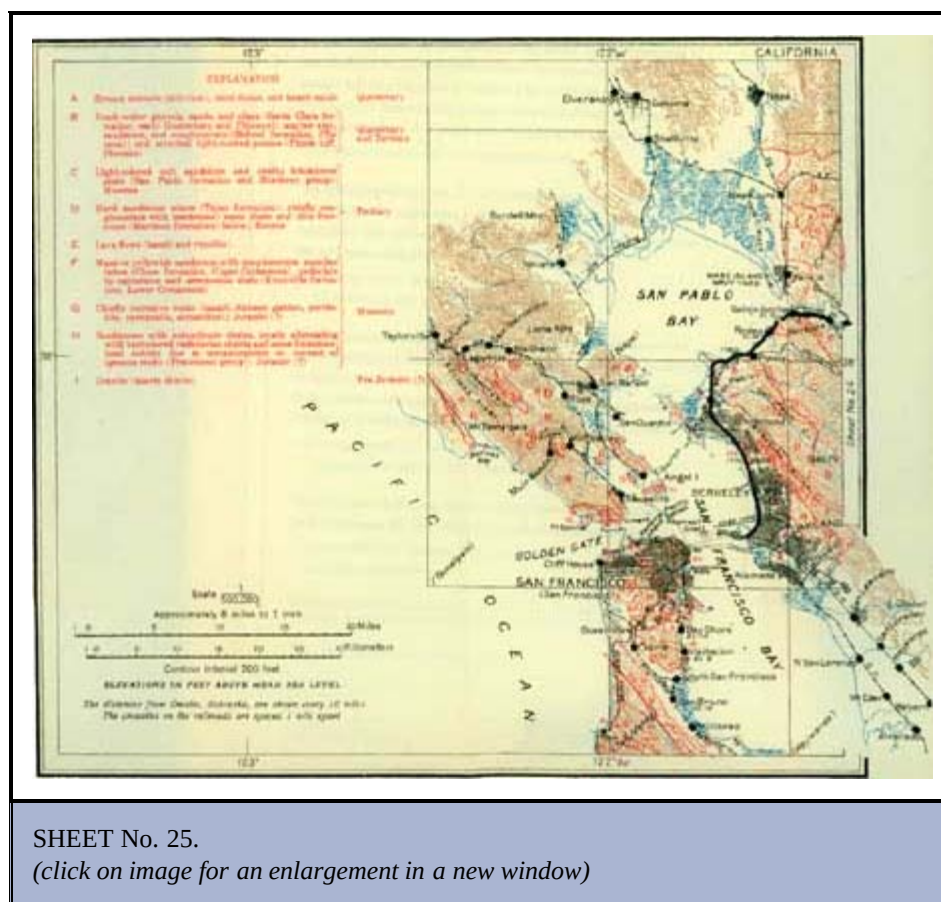
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Port Costa.

Elevation 11 feet.

Omaha 1,750 miles.

Port Costa (see sheet 25, p. 224), the western ferry terminus, is a shipping point, particularly for grain, which comes from the extensive grain-producing district in the valley¹ and is here loaded into ocean-going vessels. A long line of galvanized-iron grain warehouses may be seen on the water front.

¹Agriculture in California had its beginning in wheat raising, and wheat was long the State's greatest crop. Its production steadily increased until about 1884, to over 54,000,000 bushels annually. The levelness of the great grain fields of the valley led to the utilization of combined harvesters, steam gang plows, and other farm machinery of extraordinary size and efficiency. Recently, however, fruit growing has become a more important industry than grain farming. In the value of its fruit crop California leads all the other States.

On leaving Port Costa the train skirts the south shore of Carquinez Strait, where the steep bluffs offer many good exposures of folded sedimentary rocks. The first rocks seen are Upper Cretaceous (Chico) sandstone and shale. The rocks have a moderately steep westward dip and trend almost directly across the course of the railroad, so that as the train proceeds successively younger formations are crossed. At Eckley, a short distance beyond Port Costa, brick is manufactured from the Cretaceous shale. At Crocket is a large sugar refinery. Mare Island, across Carquinez Strait, is the site of the United States navy yard, which, however, is not readily discerned from this point. The Cretaceous shales and sandstones continue to Vallejo Junction and a little beyond.

On the southeast side of San Pablo Bay, near the west end of Carquinez Strait, there are wave-cut terraces and elevated deposits of marine shells of species that are still living. These terraces and deposits do not show south of San Pablo Bay, and therefore seem to indicate the recent elevation of a block including only a portion of the shore around the bay. This block probably includes the Berkeley Hills and a considerable territory to the east, perhaps even extending to Suisun Bay.

Vallejo Junction.

Elevation 12 feet.

Omaha 1,754 miles.

From Vallejo Junction a ferry plies to Vallejo (val-yay'ho), which is on the mainland opposite the navy yard, and from which railroad lines extend into the rich Napa and Sonoma valleys. Santa Rosa, the home of the famous Luther Burbank, is in the Sonoma Valley. Vallejo was named from Gen. Mariano Guadalupe Vallejo, who played a prominent part in the early history of California. It was the capital of the State from 1851 to 1853. Beyond Vallejo Junction Carquinez Strait begins to open out into San Pablo Bay.¹

¹The section along the shore of San Pablo Bay between Vallejo Junction and Pinole (see figs. 19 and 20, on sheet 25, p. 224) includes six of the most widespread divisions of the sedimentary series in the Coast Range region of California. The formations or groups represented are the Chico (Upper Cretaceous), Martinez, (Eocene), Monterey (earlier Miocene), San Pablo (later Miocene), Pinole tuff (Pliocene), and Pleistocene. The only large divisions of the middle Coast Range sequence not represented are the Franciscan (Jurassic?), Tejon (Eocene), and Oligocene, all of which are found within a few miles to the east and south.

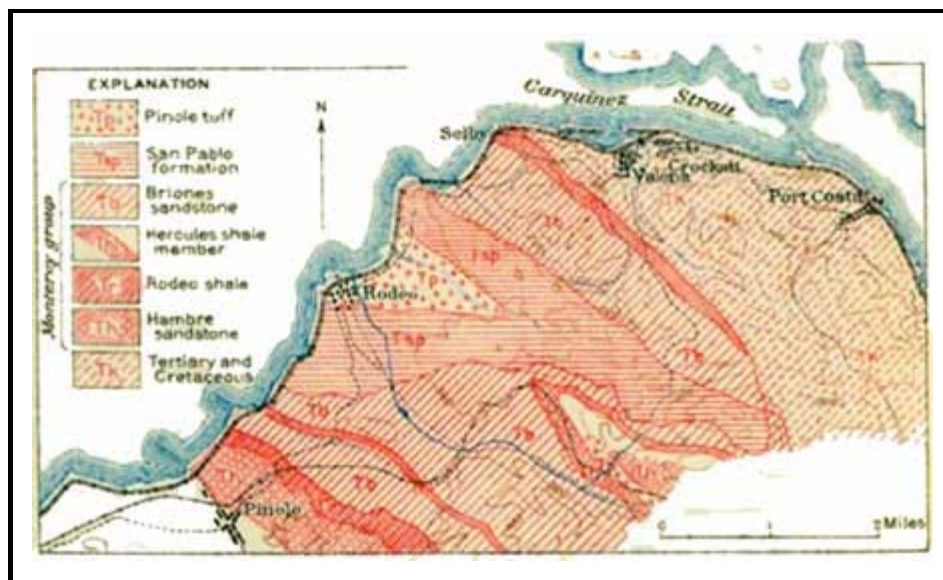


FIGURE 19.—MAP SHOWING GEOLOGIC FORMATIONS ALONG THE SOUTH SHORE OF SAN PABLO BAY.

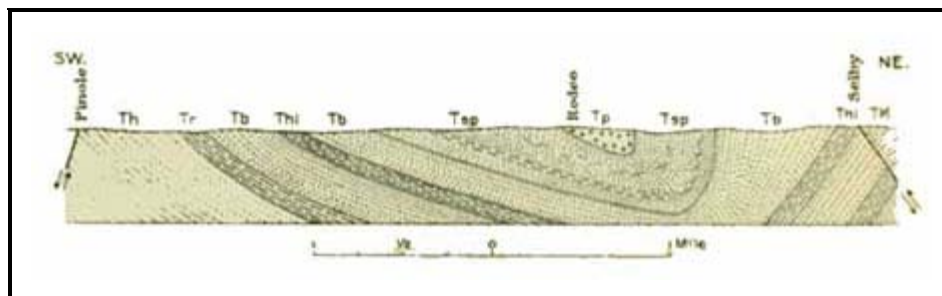


FIGURE 20.—SECTION SHOWING STRUCTURE ALONG THE SOUTH SHORE OF SAN PABLO BAY.

In the San Pablo Bay section all the formations below the Pleistocene are included in a syncline, on the northeast side of which the strata are nearly vertical, but on the southeast side the dip of the beds is lower. The Pleistocene beds rest horizontally across the truncated edges of the Miocene and Pliocene. The aggregate thickness of the sediments in the San Pablo Bay section is not less than 8,000 feet. With the exception of the Pliocene and a portion of the Pleistocene, all the formations are of marine origin. A portion of the Pinole tuff was certainly deposited in fresh water. The Pleistocene beds were deposited under varying marine, estuarine, and fluvial conditions.

Fossil remains are found in all the formations of the San Pablo Bay section, and at least six distinct faunas are represented. Very few specimens have been procured in the Chico near the line of the railroad, but abundant fossils are found in the same formation a few miles to the east. The Martinez fauna is represented in the cliff opposite the Selby smelter. The Monterey and the San Pablo contain abundant remains. The fresh-water fauna of the Pinole tuff is represented by molluscan species. Leaves and remains of vertebrates are also present. The Pleistocene shale contains abundant marine shells of a few species, with mammal bones representing the elephant, horse, camel, bison, ground sloth, antelope, lion, wolf, and other forms.

The dark Cretaceous shales near the railroad station at Vallejo Junction are soon succeeded by brown shales and massive sandstones belonging higher in the Cretaceous system. The contact between the Chico and the Martinez (Eocene) beds is in a fault zone cut by the railroad tunnel a short distance west of Vallejo Junction. Just beyond the tunnel the contact between the Martinez and the Monterey (Miocene) is clearly shown in a high cliff to the left, opposite the Selby Smelting Works, where the buff-colored Monterey sandstones and shales rest with marked unconformity upon the black Eocene shales. Near the contact the Eocene shale is filled with innumerable fossil shells of boring Miocene mollusks. The Monterey beds are extraordinarily well exposed in the cliffs to the left, and immediately beyond the contact, where they consist of fine buff shales with shaly sandstones and thin bands of yellow limestone.

After leaving these cliff exposures the train passes Tormey station, crosses a little swamp, and approaches a tunnel cut into vertical cliffs of massive gray sandstone; this is the type locality of the San Pablo formation (upper Miocene). The refining plant of the Union Oil Co., at the east end of this tunnel, is located on the upper part of the San Pablo beds. Vertical beds

of massive tuff immediately west of the oil refinery represent the lower part of the Pinole tuff. Beyond these beds the train crosses another swamp and enters a cut in which white volcanic ash beds of the Pinole tuff dip at a relatively low angle to the northeast. This change in dip shows that these beds are on the southwest side of the San Pablo Bay syncline, the axis of which passes through the swamp area. Resting upon the tilted ash deposits in this part of the section are horizontal beds of Pleistocene shale.

Rodeo.

Elevation 12 feet.

Omaha 1,757 miles.

The name Rodeo (ro-day'o), meaning "round-up," indicates that the station so called was formerly a cattle-shipping point. Beyond Rodeo the train enters a series of cuts. Near the station are exposures of massive tuffs close to the base of the Pinole tuff. Beyond this point the San Pablo (Miocene) appears, with low dips to the northeast. In the sea cliffs on San Pablo Bay a few yards from the railroad are excellent exposures of the Miocene capped by Pleistocene shale. At Hercules, where there are large powder works, the railroad cut is in broken shale of the Monterey group, the same beds that were seen near the Selby smelter, on the northeast side of the syncline. Beyond Hercules the railroad passes over Monterey shale to the town of Pinole (pee-no'lay, a Spanish term used by the Indians for parched grain or seeds), where the Pinole tuff is in contact with the Monterey and is covered by a thick mantle of the Pleistocene shale. In the cuts southwest of Pinole the rocks exposed are all either steeply inclined Pliocene tuffs or horizontal Pleistocene beds.

Pinole.

Population 798.

Omaha 1,760 miles.

At Krieger, where the tracks of the Santa Fe route may be seen approaching the bay front from the south, is a so-called "tank farm." The oil-storage tanks, which belong to the Standard Oil Co., are beyond the Santa Fe line. Beyond Sobrante station is Giant, another powder factory, and beyond that are pottery works which obtain clay from Ione, in the Sierra Nevada. The bay shore near Oakland is largely given over to industrial uses, on account of its facilities for rail and water transportation.

San Pablo.

Elevation 30 feet.

Omaha 1,765 miles.

Beyond Giant the foothills retreat from the bay shore and the railroad enters the broad lowland on which the cities of Berkeley and Oakland are built. Near San Pablo, in the vicinity of San Pablo and Wildcat creeks, there is a gravel-filled basin. Many wells sunk in this gravel may be seen near the tracks, and from them a municipal water company and both railroads obtain water. West and southwest of San Pablo station a line of hills shuts out a view of San Francisco Bay. These hills constitute the Potrero San Pablo, so called because, being separated from the mainland by marshes, they were a convenient place in which to pasture horses during the days of Mexican rule, when fences were practically unknown. The hills are made up wholly of sandstone belonging to the Franciscan group.¹ On the other side of them are wharves, warehouses, and large railway shops belonging to the Santa Fe system. From that side also the Santa Fe ferry plies to San Francisco.

¹The rocks of the Franciscan group comprise sandstone, conglomerate, shale, and local masses of varicolored thin-bedded flinty rocks. The flinty rocks consist largely of the siliceous skeletons of minute marine animals, low in the scale of life, known as Radiolaria, and on this account they are known to geologists as radiolarian cherts. All the rocks mentioned have been intruded here and there by dark igneous rocks (diabase, peridotite, etc.), which generally contain a good deal of magnesia and iron but little silica. The peridotites and related igneous rocks have in large part undergone a chemical and mineralogic change into the rock known as serpentine. Closely associated with the serpentine as a rule are masses of crystalline laminated rock that consist largely of the beautiful blue

mineral glaucophane and for that reason are called glaucophane schist. Schist of this character is known in comparatively few parts of the world, but is very characteristic of the Franciscan group. It has been formed from other rocks through the chemical action known as contact metamorphism, set up by adjacent freshly intruded igneous rocks. The Franciscan group is one of the most widespread and interesting assemblages of rocks in the Coast Ranges.

Richmond.

Population 6,802.

Omaha 1,767 miles.

Richmond, on both the Southern Pacific and the Santa Fe lines, is becoming a busy shipping, railroad, and manufacturing point, on account of the congestion of the water front of Oakland and San Francisco. The hills on the east side of the track, known to old Californians as the Contra Costa Hills, but now often referred to as the Berkeley Hills, rise steeply from the plain. The most conspicuous summit from the West is Grizzly Peak (1,759 feet), but Bald Peak, just east of it, is 171 feet higher. The hills are generally treeless on their exposed western slopes, although their ravines and the eastern slopes are wooded.¹

¹The geologic structure of these hills is rather complicated. Along their southwest base, between Berkeley and Oakland, is a belt of the sandstones, cherts, and schists belonging to the Franciscan (Jurassic?) group and characteristically associated with masses of serpentine. Overlying the Franciscan rocks are sandstones, shales and conglomerates of Cretaceous, Eocene, and Miocene age. These in turn are overlain by tuffs, fresh water beds, and lavas of Pliocene and early Quaternary age. The general structure of the ridge east of Berkeley is synclinal, the beds on both sides dipping into the hills. The upper part of Grizzly Peak is formed chiefly of lava flows of Pliocene age.

Beyond San Pablo and Richmond the rocks of the Franciscan group outcrop in low hills. At Stege the railroad is still close to the shore of the bay. Between this place and the hills is one of the suburbs of Berkeley known as Thousand Oaks. The traveler can get here an unobstructed view out over the bay and through the Golden Gate. Mount Tamalpais is on the right and San Francisco on the left. Just to the left of the Golden Gate the white buildings of the Exposition grounds can readily be distinguished if the day is at all clear. At Nobel station a little wooded hill of Franciscan rocks stands close to the railroad on the left. Beyond Nobel an excellent view may be had of the hilly portion of the city of Berkeley.

Berkeley.

Elevation 8 feet.

Population 40,434.

Omaha 1,772 miles.

West Berkeley station, also known as University Avenue, is in the older part of the city of Berkeley, and the center of the city is now almost 2-1/2 miles back toward the hills. Berkeley was named after Bishop Berkeley, the English prelate of the eighteenth century who wrote the stanza beginning "Westward the course of empire takes its way," by those who chose it as a site for the University of California. One of them, looking out over the bay and the Golden Gate, quoted the familiar line, and another suggested "Why not name it Berkeley?" and Berkeley it became.

The University of California was founded in 1868. It is one of the largest State universities in America, including besides the regular collegiate and postgraduate departments at Berkeley the Lick Observatory, on Mount Hamilton; colleges of law, dentistry, pharmacy, art, etc., in San Francisco; the Scripps Institution for Biological Research, at La Jolla, near San Diego; and other laboratories for special studies elsewhere. It is a coeducational institution and had a total enrollment for 1914-15, not including that of the summer school, of 6,202. The members

of the faculty and other officers of administration and instruction number 890. The university buildings at Berkeley are beautifully situated and have a broad outlook over San Francisco Bay. Their position can readily be identified from the train by the tall clock tower. Another prominent group of buildings occupying a similar site just south of the university grounds is that of the California School for the Deaf and the Blind.

Just before reaching Oakland (Sixteenth Street station) the train passes Shell Mound Park. The mound, which is about 250 feet long and 27 feet high, is on the shore of the bay close to the right-hand side of the track. It is composed of loose soil mixed with an immense number of shells of clams, oysters, abalones, and other shellfish gathered for food by the prehistoric inhabitants of the region and eaten on this spot. The discarded shells, gradually accumulating, built up the mound. Such relics of a prehistoric people are numerous about the bay, for over 400 shell mounds have been discovered within 30 miles of San Francisco. The mound just described is one of the largest, and from excavations in it a great number of crude stone, shell, and bone implements and ornaments have been obtained. The mounds evidently mark the sites of camps or villages that were inhabited during long periods, for the accumulation of such refuse could not have been very rapid. Archeologists who have studied the mound say that it must have been the site of an Indian village over a thousand years ago, and that it was probably inhabited almost continuously to about the time when the Spaniards first entered California.

Oakland.

Elevation 12 feet.

Population 150,174.

Omaha 1,774 miles.

The first stop in the city of Oakland is made at the Sixteenth Street station, about 1-1/2 miles from the business center of the city. Oakland is the seat of Alameda County and lies on the eastern shore of San Francisco Bay directly opposite San Francisco. Its name is derived from the live oaks which originally covered the site. It is an important manufacturing center and has a fine harbor with 15 miles of water front. Visitors to Oakland should if possible take the electric cars to Piedmont, from which a fine view may be had of San Francisco, the bay, and the Golden Gate. This view is especially good at sunset. A walk or drive to Redwood Peak takes the visitor past the former home of Joaquin Miller, author of "Songs of the Sierras" and many other familiar poems, and affords equally fine views.

Leaving the station at Sixteenth Street, the train skirts the west side of the city and runs out on a pier or mole 1-1/2 miles long. This is the end of the "overland" part of the route, for the rest of the journey must be made on the San Francisco ferries. The distance across the bay is 4 miles, and the trip is made in the ferryboats in about 20 minutes. In crossing the bay the traveler sees Goat (or Yerba Buena), Alcatraz, and Angel islands to the right, Mann Peninsula beyond them, and the Golden Gate opening to the west of Alcatraz.

Goat Island lies close to the ferry course across the bay. Like most of the other islands in the bay, it is owned by the Government. On the nearest point there is a lighthouse station, and below it the rocky cliff is painted white to the water's edge. Just to the right of this is the supply station for the lighthouses of the whole coast from Seattle to San Diego. Behind this station is the United States naval training station, of which the officers' quarters may be seen on the hillside and the men's quarters near the larger buildings below. At the extreme northeast point of the island is a torpedo station, where torpedoes are stored for use in the coast defense.

On Alcatraz, the small island west of Goat Island, is a United States disciplinary barracks, and on Angel Island, north of Alcatraz, are barracks and other military buildings, a quarantine station, and an immigrant station.

Few people in viewing the Bay of San Francisco think of it in any other way than as a superb

harbor or as a beautiful picture. Yet it has an interesting geologic story. The great depression in which it lies was once a valley formed by the subsidence of a block of the earth's crust—in other words, the valley originated by faulting. The uplifted blocks on each side of it have been so carved and worn by erosion that their blocklike form has long been lost. Erosion also has modified the original valley by supplying the streams with gravel and sand to be carried into it and there in part deposited. The mountains have been worn down and the valley has been partly filled. Possibly the valley at one time drained out to the south. However that may be, at a later stage in its history it drained to the west through a gorge now occupied by the Golden Gate. Subsidence of this part of the coast allowed the ocean water to flow through this gorge, transforming the river channel into a marine strait and the valley into a great bay. Goat Island and other islands in San Francisco Bay suggest partly submerged hills, and such in fact they are.

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Last Updated: 28-Mar-2006