

angles to its former course, receiving three important tributaries and several smaller ones on the east, but not a single permanent one from the west. The area of the Sierra drained by the San Joaquin is only about half that of which the Feather collects the surplus waters.

There are several large mountain lakes in California, some of which are of pure and fresh water, while others are alkaline, being without any outlet. The finest of these is Tahoe, which lies on the very summit of the Sierra, and at an elevation of about 6200 feet. It has a length of about twenty miles, and is 1500 feet deep, its water being extremely pure, as it contains only three grains of solid matter to the gallon. The overflow of this body of water passes off by the Truckee River, and enters Pyramid Lake, where it "sinks," or disappears by evaporation. Clear Lake is another beautiful sheet of water, in the Coast Ranges, and about the same length as Lake Tahoe, but much narrower and more irregular in shape. Owen's Lake is the "sink" of Owen's River, and is about eighteen miles long. Mono Lake is the sink of the streams rising in the Sierra between Mount Dana and Castle Peak. It is about fourteen miles long, and nine wide, and lies at an elevation of about 7000 feet above the sea-level. There are several other large alkaline lakes in Lassen and Modoc counties, which receive the drainage of the eastern slope of the Sierra, within the limits of the State. Death Valley is the sink of the Amargosa River, and it has evidently been once an extensive lake, although now only a mud-flat in ordinary winters, and a dry, alkaline, desert plain in summer. All these lakes and depressions show very plainly, by the terraces which surround them, that the water was formerly much more abundant, and stood at a higher level than it now does.

North of the parallel of 40°, where the Coast Ranges and the Sierra unite, and the Great Valley disappears, the country is extremely rough and very thinly inhabited. The seven counties which are included within the region north from the head of the Sacramento Valley to the State line had in 1870 a population of only 19,269, and they had all lost in numbers during the previous decade. The counties of Lassen, Siskiyou, and Modoc, which are embraced in the north-eastern corner of the State, are chiefly covered with volcanic plains, very dry and barren, lying between precipitous, although not very lofty, ranges. The waters of this region have no drainage to the sea. These three counties, with an area as large as that of Belgium, had in 1870 a population of only 8175, or less than one to the square mile. The north-western corner of the State is also extremely rough and mountainous, and a large part of it quite uninhabitable. The ranges which intersect it, and which are known as the Siskiyou, Salmon, and Scott Mountains, seem to be geologically the continuation of the Sierra Nevada. They are from 6000 to 8000 feet in height; but they have never been accurately mapped, and very little is definitely known about them, although gold washings have been carried on for many years in some of the valleys bordering the Klamath River and its tributaries.

That portion of California which lies to the south and east of the southern insculcation of the Coast Ranges and the Sierra, comprising an area of fully 50,000 square miles, is also very thinly inhabited, with the exception of a narrow strip along the coast. Nearly all of San Diego and San Bernardino counties belongs to the Great Basin system, having no drainage to the sea. Los Angeles County, however, has within its borders some of the most fertile lands in the state. These form a strip about twenty miles wide along the coast; the north-eastern half of the county on the other hand, is extremely barren. The region lying east of the Sierra Nevada, and between the crest of that

range and the boundary of the State, chiefly divided between the two counties of Mono and Inyo, is also a very mountainous tract of country. Owen's River runs through it from north to south for a distance of 180 miles, emptying into the lake of the same name, lying at the south end of Owen's Valley, and with no outlet. Here the scenery is extremely grand, the valley being very narrow and the ranges on either side elevated from 7000 to 10,000 feet above the lake and river. The Inyo range, on the east, is quite bare and destitute of timber, and its summits are only occasionally whitened with snow for a few days during the winter, the precipitation being almost entirely cut off by the Sierra on the west. East of Owen's Lake are several parallel ranges of mountains; and beyond them, at a distance of about forty miles from the lake, is Death Valley, which is about 150 feet below the sea-level. The name was given in allusion to the fate of a party of emigrants, who perished here, many years ago, from thirst, and perhaps starvation. Between Owen's Lake and Death Valley are the Panamint Mountains, which have lately been the scene of considerable mining excitement. A portion of the extreme southern part of the State in San Diego County is also below the sea-level. Here is a depressed area of fifty miles in length, the width of which is unknown; in its lowest part it is over 300 feet beneath the level of the sea. Dry Lake occupies the greatest depression of this area at the entrance to the Coahuila Valley.

There are many fine points in the scenery of California, some of which have already become well known from the descriptions of pleasure-travellers who have flocked to the State from all parts of the world. The granite pinnacles and domes of the Highest Sierra opposite Owen's Lake; the snowy cone of Mount Shasta, rising 10,000 feet above the adjacent plains; the lovely valleys of the Coast Ranges, with their peculiar vegetation,—all these have their charms; but the point which is most attractive of all is the Yosemite Valley. This is situated in the Sierra, about 150 miles in a direct line, a little south of east, from San Francisco. Its elevation is 3950 feet above the sea, and it is hemmed in by cliffs varying from 2000 to 3000 feet in elevation. The principal features of the Yosemite, and those by which it is distinguished from all other known valleys, are—first, the near approach to verticality of its walls; second, their great height, not only absolutely, but as compared with the width of the valley itself; and finally, the small amount of talus or *débris* at the base of these gigantic cliffs. The waterfalls in and about this valley are also of wonderful beauty and variety. Those of the Yosemite Creek, which descend from the cliffs on the north side, are most remarkable for their height, which is, in the whole, not less than 2600 feet, but divided into three parts, with one vertical fall of 1500 feet. The Nevada and Merced Falls of the Merced River, which flows through the whole length of the valley, combine great height with a large body of water, and are wonderfully grand. The Half Dome is one of the most striking features of the Yosemite, its elevation being 4737 feet above the bottom of the valley, with an absolutely vertical face of 1500 feet at the summit, turned towards the Tenaya Fork of the Merced, above which it rises. The scenery of the cañon of the Tuolumne River, which flows parallel with the Merced, a few miles further north, is also extremely picturesque, and remarkable especially for the great number and variety of the cascades which occur at short intervals in the deep gorge, the walls of which are bare and almost vertical precipices, in places more than a thousand feet high. The river, which is not much less than a hundred feet wide, falls 4650 feet in a distance of twenty-two miles. A few miles farther down, the narrow gorge opens out into a beautiful valley, in many respects a wonderful counterpart

of the Yosemite, although inferior to it in grandeur. This is called the Hetch-Hetchy. Above the Yosemite Valley the scenery of the High Sierra is very attractive, immense conical knobs or domes of granite being a prominent and very characteristic feature of this and other portions of the Sierra. Mount Dana, a little over 13,000 feet in height, dominates over the region above the Yosemite; and from its summit, which is quite easy of access, a magnificent panorama may be had of the Sierra Nevada, with Mono Lake, nearly 7000 feet below, spread out like a map, and beyond it the lofty, and, in some instances, snow-clad ranges of the Great Basin, while several well-formed and very large volcanic cones are seen just to the south of the lake.

Climate.—The climate of California presents many features of interest, differing considerably from those obtaining in the Eastern and Mississippi Valley States, which have furnished a majority of the immigrants to the Pacific coast and Great Basin. There can be no doubt that emigration to California has, especially within the past few years, been greatly stimulated by the desire of people at the East to escape the sudden changes, the intense heats of summer, and the bitter colds of winter, which characterize the climate of the whole country east of the Rocky Mountains.

The climate of California is very different in different parts of the State, according to distance from the ocean, situation with reference to the mountain ranges, and altitude above the sea-level. But there are certain peculiar features which obtain all over the State. In the first place, the division of the year into two seasons—a dry and a rainy one—is the most marked general characteristic of the Californian climate. But, as one goes north, the winter rain is found to begin earlier and last longer; while, on the other hand, the south-eastern corner of the State is almost rainless. Again, the climate of the Pacific coast, along its whole length, is milder and more uniform than that of the States in a corresponding latitude east of the mountains. Thus, we have to go as far north as Sitka, in latitude 57°, to find the same mean yearly temperature as that of Halifax, in latitude 44° 39'. And in going south along the coast, we observe that the mean temperature of San Diego is six or seven degrees less than that of Charleston and Vicksburg, which are nearly in the same latitude as San Diego, and situated, one on the Atlantic, the other on the Mississippi River. But, in addition, we notice that the means of summer and winter are much nearer the mean of the year in California than in the east. Thus, comparing Washington and San Francisco, we have—

	Mean of Year.	Mean of Summer.	Mean of Winter.
San Francisco,	56	60	51
Washington,	56.07	76.3	36.05

This condition of things is not so marked as we advance into the interior of California; but everywhere in the state the winters are comparatively mild, and the heat of summer is much less disagreeable in its effects, because the air is exceedingly dry and the evaporation proportionately rapid. The climate of San Francisco is indeed wonderfully uniform; and the bracing, cool air which sweeps in from the ocean during the afternoons of the summer, although not favourable to persons with weak lungs or sensitive throats, is the very breath of life for those who are in vigorous health. One great drawback to the enjoyment of the delightful climate of California, however, is the dust of summer, which seems, until one becomes accustomed to it, quite unbearable. A more serious difficulty in this State is the extreme variability in the amount of rain which falls from year to year; and this uncertainty is something which must always be present in the mind of the farmer

as likely seriously to influence his future. Some years are so dry that the crops are almost an entire failure, except directly on the coast, or where artificial irrigation is practised; other years are so wet, that serious inundations occur. During the interval from 1850 to 1872, the yearly rain-fall ranged, at San Francisco, from 7.4 inches to 49.27 inches. In going southward from San Francisco, the mean rain-fall decreases along the coast, and at San Diego it is only about 10 inches. At Fort Yuma it is a little over 3 inches. In the Sierra the annual precipitation increases as we rise in altitude; it is almost entirely in the form of snow at elevations greater than 6000 or 7000 feet; and this snow, as it melts during the summer, furnishes a store of water of immense importance to the State, supplying, as it does, the numerous ditches or small canals, which have been built, in connection with great reservoirs high up in the mountains, for supplying the miners, and which are more and more utilized for agricultural purposes, as the placer-mining claims cease to be worked. As there is no fall of rain or snow of any consequence on the Sierra during the summer, the accumulated stock of the previous winter melts gradually, and after a succession of dry seasons, it almost entirely disappears from the summits of the range. If, on the other hand, two or more rainy winters follow each other, the crest retains a large amount of snow to add to the next year's stock. The climatic conditions are such, however, that there are no true glaciers formed anywhere in the Sierra, although the traces of former ones are everywhere visible along the highest part of the range. These ancient glaciers once covered the summits and extended quite low down in some of the valleys,—notably in that of the Tuolumne, where the ice-flow may once have been from thirty to forty miles in length. The walls of the Hetch-Hetchy Valley are beautifully scored and polished by former glaciers, which once entirely filled the upper portion of this grand cañon. The nearest approach to a glacier which at present exists in the Sierra is to be found on Mount Shasta, on the north side of which, and almost at the summit, are large masses of ice having many of the characteristics of the genuine glacier.

The winds of California are, during the summer, exceedingly regular in their movement. As the interior becomes heated by the sun, the air rises, and a current of colder air rushes from the sea to take its place. Wherever there is an opening, therefore, in the Coast Ranges down to the level of the sea, there the wind will blow through it fiercely during the hottest part of the summer day, towards the interior. Thus, in going from the Bay of San Francisco towards the mountains, or up either the Sacramento or the San Joaquin Valley, the wind will be with the traveller. In fact the current spreads out fan-shaped from that point, and reaches far up from the ocean. A very strong wind and cool and bracing weather at San Francisco are indications of exceptionally hot days in the interior. At night the breeze slackens, and usually ceases altogether, a light mist often enveloping the city of San Francisco. At the same time, the cooler air draws gently down the mountain slopes, in opposition to its direction during the day. In the interior, the days, in summer, are extremely warm, the thermometer sometimes rising to 120° in the shade, and 160° or 170° in the sun. The farther one goes from the Bay of San Francisco, the hotter it becomes. At night, however, the radiation is rapid, and the temperature falls, so that a warm covering is almost always needed. The south-eastern corner of California is exceedingly dry, and has a very high temperature. At Fort Yuma the mean of the year is 76°, and the heat in summer is almost intolerable, the thermometer ranging above 90°, sometimes for weeks, both by night and by day. Among the peculiarities of the Californias this is not one of the least striking, that, as one

leaves the Sacramento and San Joaquin plains, and travels into the mountains, it becomes quite perceptibly warmer, at least for the first 2000 or 3000 feet of ascent. Thus, the mean temperature of the year at Colfax, 2400 feet above the sea-level, was, for 1871, 1°·6, and for 1872, 1°·4 higher than that of Sacramento, which is only 30 feet above the sea. As high up as 8000 or 10,000 feet the days in summer are comfortably warm, and even on the high peaks of the Sierra, at 12,000 or 13,000 feet of altitude, at mid-day it is usually so warm that an overcoat is not needed. At night, however, at these elevations, it is almost always so cold that frost occurs, although occasionally it is very warm all night long, even at as great an altitude as 8000 feet. It adds very much to the pleasure of travelling in the High Sierra that the weather is, by day, almost all summer long, delightfully mild and clear, and without rain; so that one of the greatest discomforts to which tourists are exposed in Switzerland and most other regions of pleasure-travel is here entirely unknown.

Geology.—The geological structure of California is comparatively simple, although the extreme paucity of fossils in the rocks of the gold region for a long time rendered it impossible to ascertain the age of the auriferous belt. It is also true that, for similar reasons, the formations which make up the main body of the Coast Ranges were not easily made out. A geological survey was authorized by the legislature in 1860, and continued, with occasional stoppages, until 1874. In the published volumes and maps which have been issued in the course of this work, almost all that is known with accuracy in regard to the geology and mineral resources of the State may be found.

The Sierra Nevada first claims attention, as being the dominating range. It has a central core or axis of granitic rock, which forms almost the whole body of the range in its southern portion, diminishing in width as it is followed towards the north. All the higher points of the Sierra, in its most elevated portion, are of granite. Farther north there are a few high peaks of metamorphic rock, and many of the summits are capped with volcanic materials. Flanking the granite is a very heavy mass of slaty metamorphic rocks, commonly known as the auriferous belt of the Sierra. This consists chiefly of argillaceous, chloritic, and talcose slates, with a great variety of other metamorphic rocks in smaller amounts, and some large, apparently isolated patches of limestone, which succeed one another in the line of direction of the axis of the range. The strike of the slates is usually parallel with that of the axis of the range, and their dip is, in general, at a high angle towards the east. Low down in the foot-hills, sandstones of Tertiary and Cretaceous age occur in considerable quantity. From the Stanislaus River towards the south, these strata are Tertiary, and they form quite a broad belt on White River and Pose Creek. On the American River, and north of it, the Cretaceous rocks are occasionally well developed and full of organic remains. All these beds rest in almost horizontal position on the upturned edges of the auriferous slates, showing that the elevation and metamorphism of the chain of the Sierra took place previous to the Cretaceous epoch. These beds are of marine origin; but there are very extensive masses of sedimentary materials higher up in the Sierra which are fluvial and fresh-water deposits, and they are associated with great quantities of volcanic detritus and solid lava which has evidently come down from the higher portions of the chain. The eruptive materials do not usually lie where they were ejected, but seem to have been carried far from their original position by currents of water, as they are made up, in great part, of rolled or brecciated masses, and are interstratified with gravels and finely laminated clays. These latter often contain impressions of leaves and whole trunks of trees, usually

silicified, as well as bones of land and aquatic animals. The character of these fossil remains indicates that the formation is of late Tertiary age, and it may be considered as Pliocene. Although the crest of the Sierra is frequently crowned by large masses of volcanic materials, there are no indications of present activity along the range, and only occasionally can remains of ancient crateriform openings be seen. In Plumas County, however, and especially in the neighbourhood of Lassen's Peak, there are several solfataric areas and well-formed cinder cones, some of which exhibit very marked appearances of recent action. From here northward, volcanic masses cover more and more of the higher regions, and almost the whole of the north-eastern corner of the State is exclusively occupied by rocks of this character. Lassen's Peak (10,577 feet) and Mount Shasta (14,440 feet) are both extinct volcanoes, and the latter has, near its summit, hot springs and indications of solfataric action. The auriferous slates of the Sierra contain occasional fossils; and, in quite a number of localities, these have been found in close proximity to well-marked and productive veins of quartz, which are now, or have formerly been, extensively worked for gold. These fossils are of Jurassic age, and no Silurian or Devonian forms have ever been discovered anywhere in the Sierra. In Plumas County, Triassic fossils have also been discovered, but only in one locality of limited extent. These are, however, identical with species belonging to the Alpine Trias, which have been found in large quantities, and in numerous localities, on the eastern side of the Sierra, and which prove that this interesting group of rocks has a wide distribution on the Pacific side of the continent. The limestone belt, already mentioned, appears to be entirely destitute of organic remains, except in the extreme northern part of the State, where, in one or two localities, it has been found to contain well-marked carboniferous types. Farther south, this rock has become much metamorphosed, and is in many places converted into marble, while its organic remains appear to have become entirely obliterated.

The Coast Ranges are made up almost entirely of Cretaceous and Tertiary marine strata, chiefly sandstones and highly bituminous shales. The Cretaceous rocks occur from the Cañada de las Uvas northward along the east side of the Coast Ranges, gradually occupying more and more space in a northerly direction. After passing the Bay of San Francisco, this formation makes up nearly the whole mass of the mountains, which grow more elevated and rougher towards the north, the rocks being much metamorphosed and broken by granitic intrusions. In the vicinity of Clear Lake (latitude 39°) there is a belt of volcanic materials, accompanied by hot springs, and solfataric action, crossing the ranges from east to west. The Coast Range mountains have been much disturbed, and in part elevated during the most recent geological epoch, as large masses of strata of Pliocene age are found in various localities to have been turned up on edge; but volcanic activity seems to have been more general and continued to a later date in the Sierra than in the Coast Ranges. Some of the granitic masses along the shores of the Pacific are more recent than the Miocene Tertiary, as strata of this age have been uplifted and turned up on edge by the protruding granite. Indeed, everything in the Coast Ranges points to great geological disturbances as having occurred at a very recent date. Among the illustrations of this condition of things, the changes produced by earthquakes in modern times may be cited. Like all the rest of the Pacific coast, California is liable to these disturbances, and this circumstance has undoubtedly had considerable influence in retarding the settlement of the State. No year has been known, since the conquest of the country by the Americans, so disastrous as were the spring

and summer of 1812; the destruction of life at that time would probably have been large if California had been as thickly settled as it now is. During the whole of May of that year the southern part of the State was violently agitated, and the disturbances continued with more or less severity through the entire summer. So frequent and violent were the shocks that the people abandoned their houses and slept on the ground. In September the missions of San Juan Capistrano and La Purisima were destroyed, and thirty or forty persons killed at the first-named place; also a considerable number at Purisima, but how many was never ascertained. At Santa Barbara a tidal wave rushed into the interior; but the inhabitants, having observed the previous recession of the sea, had fled to the adjacent high ground, and thus escaped destruction. In the year 1808, in the months of June and July, there were numerous shocks at the Presidio of San Francisco. On the 8th of October 1865 the whole region adjacent to the Bay of San Francisco was violently disturbed, and many buildings thrown down, while hardly one of brick or stone within the city itself escaped injury; but few lives were lost, although great alarm was felt. Since that time there has been no severe shock having its focus near the coast; but in 1872 the whole Sierra Nevada, and the adjacent State of Nevada, were most violently shaken, the centre of the shock having been along the axis of the range, from which the waves were propagated east and west with about equal velocity. Immense quantities of rock were thrown down from the granite pinnacles in the Highest Sierra. The small settlement of Lone Pine, in Owen's Valley, at the east base of the mountains, was completely demolished, and between twenty and thirty persons killed. Luckily the heaviest part of the shock was limited to a region hardly at all inhabited, so that the destruction of life was insignificant in comparison with the extent and violence of the disturbance. Lighter shocks continued to be felt, for two or three months after the first severe one, through the whole extent of Owen's Valley. The extinct or dormant volcanoes, of which there is a fine group midway in the valley between its two extremities, showed no signs of being affected by this exhibition of the seismic forces. There are in the Coast Ranges long and very straight fissures in the rocks, which have been produced by earthquakes in modern times; and these have, in some instances, been accompanied by changes in the relative level of the ground on each side.

Mining.—California was for many years chiefly known to the world as the region where gold was obtained in extraordinarily large quantities. The excitement occasioned by the discovery of the precious metal was very great throughout the United States, and this and the finding of an equally important auriferous region in Australia, only two or three years later, produced an immense effect on the commerce of the world, stimulating emigration in a way never before dreamed of. The existence of gold had long been known in California, and washings had been carried on in the southern part of the country, near the San Fernando Mission, for several years, having commenced there as early as 1841. No discovery had been made, however, which attracted much attention, or caused any excitement, previous to the occupation of the country by the Americans. In January 1848, a piece of native gold was picked up in an excavation made for a mill-race on the South Fork of the American River, at a place now called Coloma. It was several months, however, before the number of persons brought together by this discovery had become large; but, by the end of December, washing for gold was going on all along the foot-hills of the Sierra, from the Tuolumne River to the Feather, a distance of 150 miles. The first adventurers came from Mexico, the South American coast, and even from the Sandwich Islands. The

excitement extended to the eastern Atlantic States in the course of the autumn and winter succeeding the discovery; and, in the spring of 1849, the rush of emigration across the plains, and by way of the Isthmus of Panama, commenced; and it was estimated that 100,000 men reached California during that year, among whom were representatives of every State in the Union. The emigration to the land of gold was continued, with but little abatement, during the three succeeding years; but the excitement fell off in a marked degree in 1854, at which time there was a decided reaction throughout the United States in regard to mining matters. The Californian discoveries had given rise to a general search for metalliferous deposits in the Atlantic States; and this had been followed by wild speculations, a great deal of money having been sunk in opening new mines, and in attempting to develop old ones which had never yielded anything of value. How many miners were actually at work in California at the time of the greatest excitement can only be a matter of conjecture. It is generally believed that not less than 50,000 men were engaged in mining for gold at the close of the year 1850. Those who had good opportunities for observing think that there were as many as 100,000 at work in 1852 and in 1853. At the time of their greatest productiveness, the yield of the Californian gold washings reached about sixty-five millions of dollars in value a year; this was from 1850 to 1853. If there were 75,000 miners actually employed at this time, the average amount obtained must have been fully \$8 a day per man. The average is thought by many to have been as high as \$20 a day during the year following the first discovery. At this time the diggings for gold were chiefly along the rivers. These were "flumed,"—that is, the water was taken out of the natural channel by means of wooden flumes,—and the accumulations of sand and gravel in the former beds were washed. All the small "gulches" or ravines leading down the sides of the steep and narrow valleys, or cañons, were worked over, either with or without the aid of water. These were the first and richest "placers," and in them the precious metal was most unequally distributed. Those who first got hold of the rich bars on the American, Yuba, Feather, Stanislaus, and the other smaller streams in the heart of the gold region, made sometimes from one to five thousand dollars a day; these rich spots were chiefly very limited in area, and after one was worked out, it might be days or weeks before another was found.

During the year 1851 the miners, not finding any longer room for employment on the river-bars, began to extend their "prospecting" to the higher ground, and it was not long before it was discovered that the so-called "high gravels"—that is, the detrital deposits of Tertiary age—contained gold, although the quantity was so small that washing it in the ordinary way was not profitable. This led, in 1852, to the invention of the "hydraulic process" of working the auriferous detritus, the idea of which is due to E. E. Matteson, a native of Connecticut. This process has now received an immense development, successive improvements having been made in the method and the machinery for applying it, until the results have become indeed wonderful. The "sluice" which is used with it, and, in fact, in all gold-washing in California at present,—almost without exception,—is also a Californian invention. Previous to its introduction, first the "rocker" and then the "tom" were employed. During the first years of the Californian excitement there was much wandering about within the State and in the adjacent territories in search of new "diggings," the miners seeming to have the fixed idea that somewhere an auriferous centre or focus would be found, vastly richer than any thing previously discovered. They were an excitable body of men, and frequently left