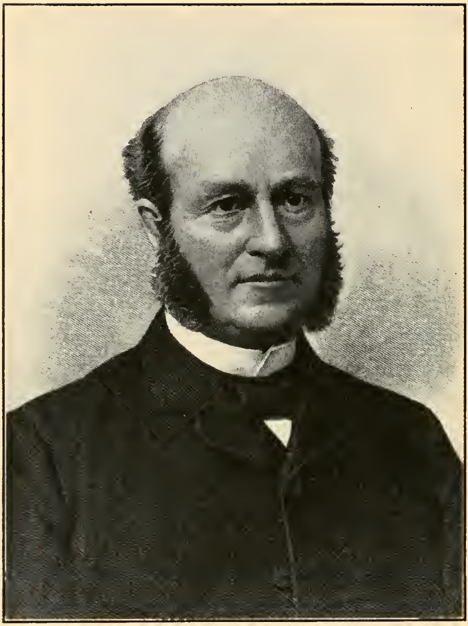
HISTORY OF CALIFORNIA



History of California

SPECIAL ARTICLES

EDITED BY

ZOETH SKINNER ELDREDGE

New York
The Century History Company

DARIUS OGDEN MILLS

Born at North Salem, New York, September 5, 1825; died at Millbrae, Cal., January 3, 1910; came to California in 1849 and went into business in Sacramento. He soon opened a bank there under the firm name of D. O. Mills and Company, still in existence as the National Bank of D. O. Mills and Company. After retiring from the Bank of California in 1877 he removed to New York, though retaining his large interests in California.

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VOLUME FIVE

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INTRODUCTION TO THE FIFTH VOLUME

THE special articles in this volume will give some idea of what California is, what her citizens have done, and what they may reasonably be expected to do to increase the sum of human knowledge and to promote the welfare and happiness of the people.

It is hard to understand Spain's long neglect of California after the voyages of Ulloa, Cabrillo, and Vizcaino, after Francis Drake sailed his *Golden Hinde* up the coast and proclaimed the sovereignty of Queen Elizabeth, leaving with the Indians a portrait of their queen in the form of a sixpence nailed to a post at Point Reyes. It was not until the advent of the Russians on the northern coast nearly two hundred years later, combined with the attitude of the English cabinet, that Spain awoke to the necessity of protecting her rights. And even in this Spain's action was feeble and lacking in vigor; so much so that navigators of other nations marveled that she could maintain herself in California with so small an armed force. As Gessler raised his hat on a pole for all to do it reverence, so Spain planted in California the royal standard of Castile and Leon, as if she expected the sight of it to overaw all who contemplated invasion or insult.

Spanish rule in California came to an end in 1821 on the establishment of the Mexican republic, and the Mexican title was extinguished in 1848 by the Treaty of Guadalupe Hidalgo. Seventy years ago barefooted friars were pushing from mission to mission, converting the heathen, while the ranchero prince, with his cattle on a thousand hills, entertained all comers with magnificent hospitality. The exports of California consisted of a few cargoes of hides and a little grain. Today what a change! The annual products of the orchards and vineyards alone amount to $100,000,000, while another hundred million dollars is taken from the earth in metals and in mineral oils. The country that was said by early travelers to be unfit for cultivation was for many years the largest exporter of wheat of any state in the union.

Along with the development of material wealth is the progress of education and the cultivation of the arts and sciences. And what of the Californian! In him is concentered the romance and chivalry of Spain, the glory of England, the energy and valor of the empire builders; he dwells in the Terrestrial Paradise,* and the fruits and flowers of the earth are his.

> "He made him ride on the high places of the earth,
> That he might eat the increase of the fields;
> And he made him suck honey out of the rock,
> And oil out of the flinty rock;
> Butter of kine, and milk of sheep,
> With fat of lambs,
> And rams of the breed of Bashan, and goats,
> With the fat of kidneys of wheat;
> And thou didst drink the pure blood of the grape."

Zoeth S. Eldredge

San Francisco, May, 1914.

*When Columbus sailed on his fourth voyage, in which he hoped to pass through what we now know as the Isthmus of Panama, and sail northwestward, he wrote to his king and queen that thus he should come as near as men could come to "the Terrestrial Paradise." (Edward Everett Hale in *Atlantic Monthly* for February, 1864, cf. also, *Las Sergas de Esplandian, Seville*, 1510.)

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George Hamlin Fitch ("California Books and Authors") is a newspaper man, and since 1880 has been Night Editor and Literary Editor of the San Francisco Chronicle. He was born in Lancaster, New York, in 1852; was educated in the public schools of San Francisco, Fort Edward Institute, New York, and Cornell University, class of 1875; from 1878 to 1879 was Assistant City Editor of New York Tribune. Mr. Fitch is the author of "Comfort Found in Good Old Books," "Modern English Books of Power," "The Critic in the Orient" and "The Critic in the Occident."

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Crittenden Thornton ("History of the Laws of California") is a lawyer of high standing in San Francisco. He was born in Eutaw, Greene county, Alabama, in 1849; was educated at the City College of San Francisco; has practiced his profession in Nevada and for the past thirty years in California.

Orson F. Whitney ("The Mormons in the History of California") known in Utah as Bishop Whitney, was born in Salt Lake City in 1855; son of a pioneer of 1847; was educated in the public schools and in the University of Deseret, now University of Utah; has been newspaper reporter and editor, Chancellor of University of Deseret, 1886-90; Professor of Theology and English, Brigham Young College, 1896-97; Assistant Church Historian, lecturer, preacher, etc.; member of City Council; City Treasurer; Chief Clerk of House of Representatives, Utah Legislature; member of Constitutional Convention; State Senator; has published "Life of Heber C. Kimball," "History of Utah," and other works.

Edward James Wickson ("The California Fruit Industry") is Professor of Horticulture in the University of California. He was born in Rochester, New York, in 1848; was graduated at Hamilton College, 1869, with degree A. B.; A. M., 1872; has been connected with the Department of Agriculture of University of California since 1891; was one of the organizers of the State Horticultural Society and is its secretary; is the author of "California Fruits and How to Grow Them," "The California Vegetables in Garden and Field."

Charles G. Yale ("Mining in California") is Statistician, U. S. Geological Survey. He was born in Jacksonville, Florida, in 1847; was educated in the public schools of San Francisco and the City College, graduating in the class of 1870; studied chemistry, assaying, etc., under Professor Thomas Price; has had field experience as assayer, miner, and millman; was for many years mining statistician, U. S. Mint at San Francisco, and the California State Mining Bureau; for twenty years editor Mining and Scientific Press of San Francisco, mining editor of other San Francisco papers, correspondent of Engineering and Mining Journal of New York, and a large contributor to U. S. Mint reports, State Mining reports, census reports, and to various mining and other publications, and is today perhaps the best authority in California on mining matters.

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OUTLINE OF THE GEOLOGY
OF CALIFORNIA

CALIFORNIANS may well be proud of the geologists that have contributed to science in this field, for there are some great names among them, names as highly honored in the scientific centres of Europe as in America.

PRINCIPAL WORKERS IN GEOLOGY IN CALIFORNIA

The pioneer work was done by the geologists of the Pacific Railroad survey in the early fifties, William P. Blake, Jules Marcou and Thomas Antisell. Blake was a keen-sighted, practical geologist whose work still stands as a model for accuracy. Marcou was a brilliant but hasty and erratic generalizer, who dared to make a geologic map of the state at a time when the geology had not yet been outlined. Antisell was a patient and plodding student who laid the framework of our *knowledge* of the geology of the Coast ranges. Associated with them, although he was never in California, was T. A. Conrad, the greatest authority on the Tertiary paleontology of America.

Immediately after them, and still among the pioneers, came John B. Trask, our first state geologist, whose name we are still proud to commemorate in the many species named after him.

Then came the golden age in the great geological survey conducted by J. D. Whitney and William M. Gabb, in the sixties. We are still proud that the greatest geologist of his time in America should have honored California by making it the field of his scientific studies during this decade. Gabb, too, was a genius of the first rank, and would have become one of the foremost among American men of science had he not been cut off by premature death. With this survey, too, were associated Clarence King, W. H. Brewer, and Leo Lesquereux, famous in other lines of activity. It is peculiarly fortunate that in a new and difficult region, men of such high attainments ahould have laid the foundation.

After this period came genial Professor Joseph Le Conte, whose deep philosophy and charming simple expression of it, and whose lovable personality brought additional glory to California.

A marked increase in scientific activity came in the eighties and early nineties, through the investigations of the United States Geological survey, represented by George F. Becker, Joseph S. Diller, Waldemar Lindgren, F. H. Knowlton, and Henry W. Turner, whose masterly delineations of the intricate geology of the Sierra Nevada, and especially of the gold belt, have won the admiration of the scientific world. Associated with them in deciphering the geology of the Coast ranges was William H. Dall, the world's greatest conchologist, who has given so liberally of his stores of learning in unraveling our Tertiary paleontology and making known the wealth of mollusks in our living fauna.

The modern era begins in the opening of the nineties with the coming of Andren C. Lawson and John C. Branner to the state. They, with their associates, have begun the superstructure, and have made great steps toward deciphering the physical history of California.

No history of the geology of California would be complete without the name of Harold W. Fairbanks, who is inseparably connected with the study of physical geography in our region. John C. Merriam's wonderful discoveries of fossil mammals, and his masterly philosophic discussions of the extinct animals that swam in our seas and roamed over our lands, have become world famous. And Ralph Arnold has added a new chapter to our history in his careful stratigraphic and paleontologic studies that have made our Tertiary and Quaternary faunas known everywhere.

There are few regions in the world where the records of geologic history are more complete than in California, for every major division is represented by marine sediments, and many of them also by continental deposits. This is made possible by the geographic position between two ancient and persistent bodies of water, the Pacific ocean, and the Great Basin sea, which alternately encroached on what is now California, each one supplying that part of the record which the other omitted. The Pacific ocean still washes the western shore of California, now encroaching, now retreating; but the Great Basin sea is long since dead, and would be buried, were it not for the later uplifts that rear its old sediments in the mountain ranges of the desert region.

Great Basin Sea. The older portion of the geologic record, from the Cambrian to the top of the Middle Jurassic, has been preserved chiefly in the sediments of the Great Basin sea, while during those ages that part of California which was afterward covered by the Pacific ocean was either above water, or has had its sediments so much metamorphosed that their age is not positively determinable.

The Great Basin Sea of Paleozoic and early Mesozoic time covered approximately the area of the Great

Basin of the present age, sometimes more, and sometimes less, dwindling away gradually from the noble expanse of the Carboniferous Sea to the shrunken remnant in early Mesozoic time. This basin at all times was directly connected with the Pacific ocean, by a broad passage to the northwest; and during a part of the Paleozoic, especially during the period of the Coal Measures, it was joined to the Mississippian Sea. At all other times it was exclusively western, and the marine Triassic and Jurassic history of the United States is its peculiar property. It has played very much the same part in the geologic history of North America as the ancient Mediterranean or Tethys did in the history of Europe, though on a much smaller scale, since it was epicontinental, and not intercontinental. The Cambrian, Silurian, and Devonian sediments of California are mere fragments of little area, representing only a small part of the entire time of those ages. The Carboniferous, however, is fairly complete, all three major divisions being fully represented by marine faunas. The Triassic period is well represented, the Upper Triassic of California being the standard for this epoch in America, and comparing very favorably with the rest of the world in the richness of its faunas, and the completeness of the record. The Jurassic section of the Great Basin sea is the most complete in the United States, having portions of each stage, but it is fragmentary, the faunas being poorly preserved and scanty. It is not comparable with the Jurassic record of Alaska and British Columbia, and nowhere approaching that of South

America. With this epoch the marine column of the Great Basin ends abruptly, as the sea was obliterated at the beginning of the Cordilleran revolution.

Pacific Record. The marine record of California from the bottom of the Upper Jurassic through the Quaternary was kept exclusively by the Pacific ocean. This was divided between two provinces, or areas of sedimentation, the Sierra Nevada, and the Coast ranges, but the distribution was not balanced. The Pacific province is one of the great geosynclines, with sediments approximating seventy thousand feet in thickness, and undergoing subsidence more or less continuously, though spasmodically, from the Triassic onward, interrupted by great periods of orogenic activity. This is a part of that grand structural feature of the continent of which the Great valley, the Gulf of California, the Willamette valley, and Puget sound are remnants.

The recognizable Paleozoic and early Mesozoic sediments are confined to the Sierra Nevada, while the Cretaceous and Tertiary strata are most complete in the Coast ranges. The Sierran record is fragmentary, the formations being incomplete, separated by great unconformities, including great masses of tuffs and igneous rocks, and showing evidence of important recurring orogenic and volcanic activity.

The Coast range province, too, showed this same phenomenon in its Paleozoic and early Mesozoic sediments, but from the bottom of the Cretaceous to the middle of the Miocene conditions were more uniform, indicating moderately quiet advance and retreat of the sea, with minor unconformities, smaller masses of igneous intrusives, and outpourings of surface lavas. The Coast range revolution, about the middle of the Miocene epoch, broke the monotony of this history, and for a time there was much mountain-making activity. Minor outpourings of lava occurred along the coast, while farther to the northeast the Columbian lava flood overwhelmed an area of about two hundred thousand square miles, and the rejuvenation of the Sierra Nevada was beginning.

The Cretaceous section of the Coast ranges is more complete than that of any other single province in America. It lacks only the uppermost portion, and shows a variety of conditions not seen anywhere else, from the boreal faunas of the Knoxville to the tropical faunas of the Horsetown and Chico epochs, with fossil floras interbedded in every formation.

The Tertiary marine section of the Coast ranges is not only the most complete in America, but also more complete than that of any other single geographic region in the world. Every minor division is fully represented by marine faunas, and most of them have freshwater beds intercalated, with fossil plants and freshwater animals.

The Quaternary marine section of the Coast ranges is the most complete that has been described, for this is almost the only known region where there has been much post-Quaternary orogenic activity. In nearly all other regions the Quaternary sediments are still buried under the oceans in which they were deposited.

ROCK-FORMING AGENCIES OF CALIFORNIA

Igneous Rocks. A large part of the surface of the state, a little less than one-half, is made up of igneous rocks. Of these the most important group consists of deep-seated granitic rocks, granites, grano-diorites, diorites, and gabbros, compounds of feldspars and ferro-magnesian minerals, such as hornblendes, pyroxenes, and mica. The greatest of these batholiths is the great igneous mass of the Sierra Nevada, making up the bulk of that mountain chain. Smaller batholiths of similar character are in the Sierra Madre range, the White Mountain range, the Klamath mountains, and in the Santa Lucia mountains.

Associated with the deep-seated granitic rocks in nearly all these regions there are numerous dyke-rocks, similar in chemical nature to the parent masses, but showing only a small surface area.

A second group is composed of basic intrusives, chiefly peridotites, now largely changed to serpentine, rich in olivine and other ferro-magnesian minerals. These cover great stretches in the Coast ranges, where they are largely of Franciscan age, older than the Cretaceous; they also form less extensive masses in the Sierra Nevada.

A third group is composed of dark lavas, mostly andesites and basalts, surface flows from volcanoes. These are chiefly of Tertiary age, Miocene, and, together with the less important rhyolite lava flows, they cover broad areas in northeastern California, and smaller patches in all the other mountain regions of the state. The flows in northeastern California are a part of the Columbian field, and probably came from fissure-eruptions. The others came from ordinary volcanoes, though in most cases the volcanic cones are long since destroyed. Mt. Shasta and Lassen Peak are the two grandest volcanoes of the state, the southern extension of the Cascade range, still preserving their ancient form and some feeble remnants of their old-time activity.

Inorganic Sediments. The greater part of the surface of California, a little more than half, is made up of sediments. These are of two groups, (1) inorganic, and (2) organic.

The inorganic sediments are far greater in thickness and areal extent, sandstones and shales, derived from the decay of crystalline rocks. The quartz and undecomposed feldspars furnished the sand grains, and the decomposed feldspars furnished the clay for the shales. The sandstones of California are remarkable for the large quantity they contain of undecomposed fragments of minerals derived from the igneous rocks, so that they are more often arkose and greywacke than true sandstones.

Thick beds of aluminous shales, now largely changed to slates, are found in the Carboniferous and Jurassic rocks of the Sierra Nevada, and to a less extent in the Franciscan formation of the Coast ranges. The Auriferous slates also form the surface rocks of considerable areas in the Klamath mountains.

Less altered shales are extensively developed in all the later formations of the state, from the Lower Cretaceous upward, although not on such a grand scale as in the older periods.

The greatest individual mass of sediments in California is formed by the Quaternary and Pliocene fluviatile deposits of the Great valley. This mass is about four hundred miles long by fifty in width, and is several thousand feet thick in the middle, thinning out toward the edges, surpassing the enormous mass of Tertiary sediments. These valley deposits have been bored to a depth of three thousand feet, without reaching bed-rock, but there are too few deep borings for an estimate of the average thickness to be possible.

A second great mass of clastic sediments is seen in the Tertiary sandstones of the Coast ranges which extend nearly the entire length of the state, and have a total thickness of about fifteen thousand feet, although not all of this at any one place. A remnant of this series is seen along the western flank of the Sierra Nevada in the marine and brackish-water Ione formation, and the upland equivalent is seen in the Auriferous gravels.

A third great mass of sandstones is found in the Cretaceous of the Coast ranges, where a thickness of about thirty thousand feet was deposited. This thickness surpasses by far that of the Tertiary sandstones, but the areal extent is much less. These, too, overlapped on the foot of the Sierra Nevada.

Smaller masses of sandstone, now largely changed to quartzite, are seen in the early Mesozoic and Paleozoic formations of the Sierra Nevada and Coast ranges, but nowhere forming extensive surface areas.

On the western flank of the Sierra Nevada, throughout the gold belt, there are in the late Paleozoic and in the late Jurassic thick beds of tuffs, or volcanic ash, now altered to greenstone schists. These in places have a thickness of several thousand feet, but do not form considerable areas of the surface rocks.

Organic Sediments. These do not make much of a figure on the areal map of the state, but play a large part in its economic history. They are limestones, siliceous shales, and plant accumulations in the form of coal or lignite.

The limestones are entirely of organic origin, with the exception of some smaller occurrences of late spring deposits, or calcareous tuff, which, however, are large enough to be used in the manufacture of cement.

The great masses of limestones are confined to the Paleozoic and early Mesozoic, though as late as the middle of the Jurassic period there are some large beds of limestone. They are formed of ground up shells, corals, and foraminifers that lived in quiet, clear waters, but are now largely crystalline, most of the evidence of their organic origin having been destroyed in the great mountain-making revolutions that have passed over them. The formation of limestone on a large scale in California was confined to epochs that we know from other evidence were warm, and also to epochs when sheltered, clear seas covered portions of the state. In such seas corals and foraminifers abounded, and the evidence of their rock-forming activity is still visible in the coral reefs of the Paleozoic and Triassic, and the Fusulina limestone of the Carboniferous.

From the middle of the Mesozoic up to the Eocene it was still warm enough at times for reef-building corals, and foraminifers to have flourished in the seas of California; but the warm epoch of the Middle Jurassic was a time of igneous activity, and during the Cretaceous there was too much sand and mud poured into the water for these organisms to find a favorable habitat.

Limestones, at least in part formed by corals, have a thickness of several thousand feet in the Cambrian of Inyo county, but the areal extent is unknown. The Devonian of Shasta and Siskiyou counties shows coral reef rock to the thickness of several hundreds of feet, of small area. These are all surpassed in the great masses of Carboniferous limestone, of the White mountains, the western flank of the Sierra Nevada, and the Klamath mountains, where the lenticular beds sometimes attain a thickness of two thousand feet.

The Santa Lucia limestone, in the Coast ranges, of doubtful Paleozoic age, also occur in large beds, amounting to several hundred feet in thickness, now changed to marble.

The Upper Triassic of Shasta and Plumas counties has lenses of limestone in places four or five hundred feet thick, forming important topographic features, and largely formed by the agency of corals.

The Franciscan series of the Coast ranges has similar limestone masses of lenticular form, amounting in places to a few hundred feet in thickness, and wholly destitute of fossils, except a few traces of foraminifers.

The Cretaceous lacks limestone beds, except a local accumulation of shell limestone in the Knoxville formation of Colusa county, where a thickness of only a few feet is developed.

The Eocene of the Santa Cruz mountains has some thin beds of limestone, and the Miocene of Santa Barbara, San Luis Obispo, and Orange counties has shell limestone amounting to as much as fifty feet in thickness. With the exception of these local occurrences there are no limestone masses in the marine beds of California from the middle of the Jurassic to the Quaternary, the Jurassic and Knoxville being characterized by thick beds of shale, and the other formations, from the Horsetown up, by enormous beds of sandstone.

Siliceous Organic Sediments. Among the most remarkable features of the stratigraphy of California are the thick beds of siliceous organic sediments. In the Monterey shale of the middle Tertiary in the Coast ranges such sediments are extensivey developed, and in places reach a thickness of five thousand feet. These are not shales in the ordinary sense, for they are chiefly organic in origin, the remains of microscopic diatoms and radiolaria. Similar deposits are known also in the Eocene of the middle Coast ranges, but on a smaller scale. These organic siliceous shales are of great economic importance, for they have furnished nearly all of the petroleum of California.

Similar masses of siliceous organic sediments are known in the Coast ranges in the Franciscan formation, of the earlier Mesozoic, but they are no longer shales, rather hard, flinty rocks, with the organic matter long since removed, and the fossil tests of radiolaria almost entirely destroyed, so that the rocks now show little resemblance to organic sediments.

In the Mother Lode region of the Sierra Nevada there are somewhat similar chert masses, in beds supposed to be Jurassic in age. These too are probably of radiolarian origin. In the Middle Triassic of Shasta county a series of siliceous shales almost without sand grains, and about two thousand feet thick, likewise was probably formed partly from the shells of siliceous organisms.

The Lower Carboniferous and the Devonian of Shasta and Siskiyou counties also contain many hundreds of feet of fine-grained so-called siliceous shales that are probably, at least in part, metamorphosed organic sediments. Shells of diatoms and radiolaria are extremely rare in all these older beds, but organic silica is very soluble, and even a slight degree of metamorphism destroys the delicate tests, and thus obliterates the evidence of their origin.

Gold Deposits of California. The gold deposits of California, which have added in the last sixty years considerably more than a billion dollars to the world's wealth, lie principally in the gold belt of the Sierra Nevada. They are of two sorts, vein or lode deposits, and Auriferous gravels. The lode deposits are in quartz veins in the metamorphic auriferous slates and associated igneous rocks; they are deep seated chemical deposits formed by the hot waters that permeated these rocks in the periods of mountain making activity and great intrusions of granitic masses in the time preceding the Cretaceous age. They still continue and will continue for many years to be a great source of wealth to our state.

The Auriferous gravels are sedimentary deposits laid down by the ancient Tertiary rivers that won their golden freight from the wear and tear of the gold quartz veins of the old mountain highland during the long period of erosion that lasted throughout the end of the Cretaceous and early part of the Tertiary periods. The accumulation is still going in the modern bars of streams in the gold belt, though not on such a grand scale as in the Tertiary rivers.

Coal Deposits. During the Eocene epoch plant remains accumulated to a considerable extent in the swamps of the old embayment of California, especially along the western flank of the Sierra Nevada near Ione, the Coast range island area of the Mt. Diablo region, and in the middle Coast ranges of Monterey, San Benito, and Fresno counties. These leaf beds have since been compacted into lignite, and in a few places into true coal.

Chemical Deposits. In Kern, San Bernardino, San Diego, and Inyo counties there are extensive chemical precipitates of salt, soda, potash, borax, and gypsum, concentrates from the old lakes and salt pans of the arid region, from Tertiary up to the present. The areal extent is not large, but they are scattered over enormous stretches of country, and are of great present or prospective economic importance. Outranking all the other chemical deposits in abundance and importance the petroleum of California, distilled by natural processes from the organic siliceous shales of the Tertiary, has come to the front, and in recent years has surpassed gold as the most characteristic product of the "Golden State."

Most Important Events in the Geologic History of California. In early Cambrian time sedimentation began in the eastern part of California on the western shores of the Great Basin sea, and kept up, almost without interruption, until the middle of the Jurassic. During this long period the greater part of the state appears to have been above water, although during the Santa Lucia epoch (Paleozoic?) calcareous sediments were laid down in the Coast ranges, and during the Carboniferous the Great Basin sea spread westward and southward over much of the region of the Sierra Nevada. In the Permo-Carboniferous, California, although remote from the center of activity, felt the effects of the Appalachian revolution, for an uplift began along the axis of the Sierra Nevada, manifesting itself in great outpourings of volcanic tuffs, which now are preserved as greenstones, showing by their marine fossils that they were deposited in the sea. Further west, the calcareous sediments of the Santa Lucia mountains were raised above the sea and changed into marbles and schists.

The Appalachian revolution restricted, but did not obliterate, the Great Basin sea, nor did it confine the relentless advance of the Pacific ocean, for during the Jurassic marine sediments were laid down along the Coast ranges, and along the sides of the Sierra. The Franciscan series has preserved this record in the Coast ranges, and the Mariposa formation in eastern California.

The Cordilleran revolution began in the Great Basin sea in the middle of the Jurassic, when that body of water, after many vicissitudes, finally went dry, and has never since been covered by salt water, although in later ages Tertiary and Quaternary lakes have been scattered over its dead basin.

This elevation culminated, in late Jurassic time, in the upturning, and metamorphism of the Triassic and Jurassic sediments of the Sierra Nevada, and the Franciscan beds of the Coast ranges. Since that time the Sierra Nevada has been above the sea, subjected to continuous erosion, and there we see the deeper results of metamorphism. The Coast ranges, on the other hand, have been buried under the later Cretaceous and Tertiary sediments, and the deeper products of metamorphism are little exposed. The crystalline schists of the Coast ranges are evidences of rather shallow hydrothermal metamorphism, while the great masses of thoroughly altered rocks and auriferous veins of the Sierra Nevada show the deep-seated action in that region. This explains the fundamental difference between the metamorphic rocks of the two areas, where the phenomenon was contemporaneous, and the rocks affected were similar in the beginning.

During this epoch along the west coast, from Oregon to Lower California, there was much igneous activity, and great masses of serpentine are now seen throughout the Coast ranges, the results of alteration of the peridotite dykes that were intruded into the Franciscan sediments.

It is probable, also, that the Cordilleran revolution was something more than a mere orogenic disturbance, for it marks a change from the warmth of the Middle Jurassic, with its cycads and reef-building corals, to the cooler epoch of the Upper Jurassic, with its scanty boreal fauna. The Middle Jurassic was of tropical type, from Mexico to Alaska, and uniform up to Franz Joseph Land. The Upper Jurassic, on the other hand, was of Boreal type from the Arctic region down as far as California, and for a short epoch in the Portland these conditions extended down as far as Mexico.

After this mountain-making epoch near the close of the Jurassic, the sea again encroached on the uplifted area, and the Knoxville sediments were laid down on the western border of the Coast ranges. The lower Knoxville beds contain a fauna closely related to that of the Mariposa, still with Jurassic types of *Aucella*, and with the same poverty of other animals. But the upper Knoxville beds, while still retaining reminiscenses of the Boreal region in *Aucella* and a few other forms, show a preponderance of life characteristic of more favorable conditions. *Aucellas* of northerly habit mingle with cephalopods that did not belong in the Boreal region, and on the nearby land cycads abounded.

With the opening of the Horsetown epoch, the revolution of faunas and floras was complete, the climate had become tropical, and swarms of *Trigonia*, *Nautilus* and *Ammonites* like those of India and eastern Africa occupied the shallow seas of northern California. These beds were deposited only in a narrow strip from Shasta county down to the neighborhood of Mt. Diablo, the rest of the state being above water.

While the Paleozoic and the earlier part of the Mesozoic were characterized by the formation of immense masses of limestone, and the Jurassic and the Knoxville by the deposition of thick beds of shale, the middle Cretaceous inaugurated a sandstone-forming era, which lasted through the entire Tertiary.

During the Upper Cretaceous Chico epoch the climatic conditions and faunal geography remained unchanged, but the sea encroached still further on the land, reaching the foot of the Sierra Nevada, where, in Butte county, the unaltered and slightly tilted sandstones of the Upper Cretaceous may be seen resting upon the upturned, metamorphosed and eroded rocks of the backbone of California.

By the end of Cretaceous time the subsidence and erosion of the western part of the continent had almost established a connection between the Pacific Gulf in California and Oregon with the old Mediterranean sea of the Mississippi valley. The intervening isthmus not covered by salt water was worn down to base-level and wide expanses of flats were covered with marshes, which eventually formed coal, preserving a very similar flora from the outliers of the Mississippi valley almost to the Pacific coast. These coal-forming conditions reached far up into Alaska, where almost under the Arctic circle types of plants flourished that, to-day, could not live in the open north of Mexico.

In Eocene time the climatic and geographic conditions remained the same as in the Upper Cretaceous, but the sea had encroached still further on the land, and the base-levelling of the backbone of the continent was more complete. The aged rivers began to deposit their loads of sediments, beginning the formation of the Auriferous gravels, the first great source of wealth of the Pacific coast.

Tropical conditions still prevailed up as far as Alaska, and coal was still formed abundantly where vegetation is now scanty. If a geologist in western America had first named the geologic systems, the Eocene would have received the name "Carboniferous," for most of the coal on the west coast belongs to that epoch. During the Eocene, also, a temporary connection was established between the Pacific and the Atlantic basins, for in California and Oregon the Atlantic "fingerpost of the Eocene," *Venericardia planicosta* is found along with Pacific types.

Before the Miocene epoch this Atlantic connection had ceased, and the faunas of the later Tertiary were wholly of the Pacific type. The lower Miocene was still warm, for we find in its fauna a *Nautilus* still persisting, and other genera now found only in southern waters. Quiet accumulation of sediments with abundant organic remains, diatoms and radiolaria, was going on in the Coast range region. From these the petroleum, which has added so much to the wealth of California, was afterwards distilled, in the great disturbance that took place after the close of the Monterey epoch of the Miocene.

The vast outpouring of the Columbian lava flow, which covered an area of more than two hundred thousand square miles, including the northeastern part of California, occurred about the middle of the Miocene, and the Coast range disturbance was probably a local phase of the same revolution.

In the upper Miocene the climate was no longer subtropical, but warm-temperate and moist, like that of the states bordering the present Gulf of Mexico.

Marine animals like those of our time abounded in the waters, but along with them were some southern forms. And on the land elms, walnuts, hickories and laurels flourished, indicating a temperate, rainy climate, moister if not milder than that of today in the same region.

In the Sierra Nevada in this epoch there were large rivers, not running swiftly in deep cañons, as they do now, but winding slowly down low grades, overloaded with sediments, the Auriferous gravels. These dead rivers, which must have run on a low plain not far above sea-level, are now found high up in the Sierra Nevada, with their channels buried deeply under later lava flows, and warped by later orogenic movements.

In the Pliocene the warm-temperate types of plants have disappeared temporarily, and the salt-water faunas, too, show a change for the worse. The fresh-water Pliocene lake beds also show the influence of a cooler climate, for while many of the fossil mollusca are the same as species now existing in that region, others that are still living are now found only in the Klamath mountains.

Now the land had begun to encroach on the sea, and the shore was receding westward. The whole west coast was rising, and the salt waters no longer reached to the foot of the Sierra Nevada, nor even to the great valley. But the elevation was not uniform, for valleys in the Coast ranges that had been cut during the Miocene were filled with sediments during the Pliocene, which was made possible by local subsidence along the coast. The immense deposits of the great valley belong partly to this epoch, and partly to the

Quaternary, but they are wholly of fluviatile origin. These gravels and silts have been bored into to the depth of three thousand feet in the middle of the great valley, and still bed-rock was not reached.

During the Pliocene the Sierra Nevada was elevated again, and the rejuvenation of the streams carried the sediments out of the mountains to the flats of the valley floor, piling up the gravels and clays now known as the Tulare formation. California of that time was very much like California of today, with a great mountain range on the east; in the middle a long, broad valley, low-lying, and covered in many places by fresh-water lakes; and on the west, a long, low narrow mountain range. On the submerged narrow coastal plain, and in troughs parallel to this range, were laid down the marine Pliocene sediments.

About the close of the Pliocene, and in early Quaternary, the elevation of the west coast continued, causing deep cañons to be excavated by the vigorous streams, in the Sierra Nevada, and in the Coast ranges. This epoch has been called by Professor Le Conte the Sierran epoch. The results of this erosion are still seen in the deep cañons, the most striking scenic features of the Sierra Nevada, but those of the Coast ranges are now seen only on hydrographic charts, for they are now buried two or three thousand feet under the ocean. This shows that in early Quaternary time the coast stood two or three thousand feet higher than now. The record of that time is purely one of events, for the sediments that were laid down in the bordering sea are now covered by the ocean, and the region that is now above sea-level stood too high for much deposition. The Sierran epoch corresponds to the pre-Glacial or Ozarkian epoch of the eastern states.

Increasing cold accompanied the period of elevation, and this culminated in the Glacial epoch, in which the Sierra Nevada was covered by a continuous sheet of ice. The ice made its way down sheltering cañons to places that are now 3,500 feet above sea-level, but which then stood several thousand feet higher. This means that in the Glacial epoch the climate of California was very similar to that which now prevails on the Olympic peninsula in Washington, for in that region glaciers still come down to 6,000 feet above the sea, the climate is cool and rainy, and the forests consist almost entirely of conifers.

During the period of elevation the Channel Islands off the coast of southern California were connected with the mainland, allowing mammoths to make their way across on dry land. The channel was then a gulf, not unlike the present Gulf of California, and has been called the Santa Barbara gulf.

After the Glacial epoch had passed, there came another era of subsidence, but this time on a small scale, affecting only the immediate shore-line, which stood for a time from three to seven hundred feet lower than now. During this period were accumulated the marine San Pedro beds, known chiefly in the Santa Barbara gulf. At first the water was a little colder than at present, allowing marine life now characteristic of Puget sound to flourish as far south as San Pedro. Then it became warmer, and, for a short time, species that today cannot live north of Lower California made the Santa Barbara gulf their home. This history is remarkably like that of New England, where a warm Champlain epoch of depression followed the Ice Age.

After the San Pedro epoch there came on the west coast a renewed elevation, causing the streams to terrace the alluvial deposits that had filled the lowered valleys in the preceding epoch. This, too, has its counterpart in the Terrace epoch of New England. This time has left us no marine record, but only terraces on the streams, and along the shore.

The last phase in the physical history of the west coast is the recent subsidence that allowed the sea to encroach on the river valleys, forming the Bay of San Francisco, and other bays along the coast. This has been going on almost into modern time, for Indian shell mounds, apparently made by the same race that still exists in California, have been flooded by the continued subsidence of the Bay of San Francisco.

It is remarkable and little appreciated that the physical history of the Pacific coast should be so like that of the eastern coast of America. On both sides we have the pre-Glacial, Sierran or Ozarkian, elevation of the land, and erosion of deep cañons; the southward advance of the glaciers; the Champlain, or San Pedro, subsidence and amelioration of the climate; the Terrace elevation and moderate erosion; and the recent subsidence that made the fiords of New England and of Puget sound, the gentler bays of California and Oregon on the west, and the sounds of the Atlantic states on the east. On both sides of the continent submerged cañons run out to sea, marking the course of drowned rivers of early Quaternary time, now forming channels of navigation, making possible the maritime commercial centers of the east and the west.

SYNOPSIS OF QUATERNARY HISTORY OF CALIFORNIA

<table>
<tr><td>Recent</td><td>Subsidence epoch of Golden Gate and other bays</td><td colspan="4">Invasion of Golden Gate River System by tide water and formation of the harbors of the west coast. This subsidence has been going on until very recent time, for Indian shell mounds around the Bay of San Francisco are partly flooded.</td></tr>
<tr><td rowspan="4">Quaternary</td><td>Terrace epoch</td><td>Terrace</td><td colspan="3">Period of uplift and scouring out the channels filled during the San Pedro epoch, forming terraces in the fluviatile sediments of San Benito valley, and nearly all the valleys of the Coast range. The youngest (lowest) terraces of the San Pedro truncate the upper San Pedro beds and are later than they. The older (higher) wave-cut terraces of the west coast probably date back to the Sierran epoch.</td></tr>
<tr><td>Upper San Pedro</td><td rowspan="2">Champlain</td><td rowspan="2">Epoch of depression along the coast
Coast stood 300-700 ft. lower than now</td><td>Warm water marine fauna</td><td rowspan="2">Epoch of filling pre-existing valleys with gravels and other fluviatile sediments. Seen in the Salinas valley, Santa Clara valley, San Benito valley, and the great valley.</td></tr>
<tr><td>Lower San Pedro</td><td>Cold water marine fauna</td></tr>
<tr><td>Sierran epoch. Probably longer than all the rest of the Quaternary</td><td>Glacial
Pre-Glacial</td><td colspan="2">Period of elevation of the west coast, forming the great cañons off the Sierras and the submerged cañons of the coast. A period of no marine sediments (now exposed). In part contemporaneous with the Glacial epoch, for the glaciers of the Sierra Nevada came down some of the cañons.
The west coast then stood about 3,000 ft. higher than now, as shown by the submerged Monterey Bay cañon at a depth of 3,000 ft.</td><td>The principal terracing along the coast took place at this time, and also the Channel Islands were connected with the mainland, as shown by the Santa Rosa Mammoth.</td></tr>
<tr><td>Pliocene</td><td>Merced Beds</td><td></td><td colspan="3">Period of depression and filling of troughs with marine Pliocene sediments, and formation of great Pliocene lakes above sea-level.</td></tr>
</table>

ANCIENT CLIMATES OF CALIFORNIA

It may be thought that I am trespassing upon the province of the Weather Bureau, but, in fact, the ancient climatology of California belongs to the field of geology. There is preserved in the geologic record a climatic record going back untold millions of years, telling us of a time when the climate of California really was what we now claim it to be, when all the stories we tell our eastern friends would be true.

Mesozoic Climates of the West Coast. Since corals are wholly unknown in the Lower Triassic, and since the flora of that epoch is as yet little known, it is not possible to determine the temperature of either the land or the water. It is, however, certain that the oceanic temperature in India, in western America and in northern Siberia, was the same, for there is a remarkable similarity of the cephalopod faunas in all three regions.

It is also known that in the Permian and the Lower Triassic a dry climate prevailed over large areas, for products of desiccation, such as gypsum and saline deposits are common in many parts of the world, and even in regions that are now rainy, as in western Europe.

In the Upper Triassic there are great limestone masses and coral reefs in the Alps, the Himalayas and in California, with many species common to the three regions. Certainly the epoch of the *Tropites subbullatus* fauna was tropical up as far as Shasta county, California, for there reefs of Astræidæ are extensive. We may even be justified in assuming that the isotherm of 74° F. extended that far north. Indeed it probably extended up to southern Alaska, for the same coral reef fauna is found there in the Upper Triassic beds.

After the formation of the coral reefs in northern California and Oregon the facies changed suddenly from limestones to clay shales, and with this came an abrupt change in the marine fauna. The Indian types of cephalopods disappeared entirely, and in their stead came in a fauna of which the home seems to have been the Boreal region. *Pseudomonotis ochotica* was the commonest species in this fauna, and was widely distributed around the North Pacific. It has also been found as far south as Peru, on one side, and down to the equatorial part of the Indian ocean on the other. This wide dispersion does not necessarily mean a lowering of the oceanic temperature during this epoch, for this species may have lived in deep water, and therefore could easily find uniform temperature from the equator to the Arctic region. But the sudden change of facies and impoverishment of the fauna over such an enormous area are suggestive. A slight drop in temperature below 68° F. would account for it.

The last epoch of the Triassic, the Rhætic, has no marine faunas anywhere in America, but the flora, with its abundant cycads, is widely distributed in both the northern and the southern hemisphere. Coal deposits are common in this epoch, and this points to a very uniform and mild climate far beyond the present temperate zones.

At the opening of the Jurassic period we find a Mediterranean marine fauna established in western America; this same fauna also extended from the equatorial regions to Alaska, so that we are without evidence as to climatic zones, and can only infer that the temperature was uniform.

In the Middle Jurassic reef-building corals lived in the waters of the Great Basin sea, and their remains are quite common in Plumas county, California, but in that province they formed no reefs, for the waters were not clear, and much disturbed by the deposition of volcanic ash. Abundant cycads, a tropical group of palm-like plants, lived on the land in California at this time, adding their testimony to the warmth of the climate. This same Middle Jurassic marine fauna extended up to Queen Charlotte islands, and to southern Alaska, in the latter place with cycads interbedded with the salt-water fossils. Here, as was often the case, the cycads extended some distance north of the corals, a coral reef with Astræidæ being known in this epoch on Queen Charotte islands, in 53° N. lat., while cycads occur as far north as 57° N. lat. In this same epoch the northern limit for coral reefs in the Atlantic region was 53° N., in southern England, while the other invertebrates and cycads ranged up to 80° N. lat. A mild climate must have extended up nearly to the pole.

The Upper Jurassic of California shows a sharp contrast to the preceding epoch; its marine fauna is scanty, and what little there is belongs to the Boreal type, the *Aucella* fauna, which is characteristic of Russia, northern Siberia and Alaska. For a short time this fauna ranged down into the edge of the tropics in Mexico. This does not mean that the climate was cold, but merely that the temperature was lower than that at which reef-building corals and the other sensitive invertebrates could flourish. In the Lower Cretaceous we find the same Boreal type still persisting as far south as middle California. But here, as in the Upper Jurassic, the evidence is conflicting, for cycads are known in both formations.

In the Lower Cretaceous epoch there was a sharp contrast between conditions on the Pacific and those on the Atlantic side of America. In the Atlantic waters coral reefs extended as far north as Texas, while no corals at all are known in the Pacific waters of America in California. In the Upper Cretaceous, on the other hand, coral reefs extended to Ensenada, Lower California, lat. 31° 30′ N., while in the Atlantic waters they did not reach so far north. In other words, the Pacific waters on the western side of America became warmer in Upper Cretaceous time than they were in the preceding epoch, while in the Atlantic the conditions were reversed, as was the case also in southern Europe, where coral reefs extended much further north in the Lower Cretaceous than they did in the Upper Cretaceous.

The change in faunal geography in western America about the middle of the Cretaceous period is very remarkable. The Knoxville epoch had a Boreal fauna, while with the opening of the Horsetown epoch the facies changed rather abruptly, and an Indian fauna came in. Swarms of ammonites of Indian type occupied the shallow marginal sea, showing at least a great change in geographic connections, if not in climate. It has been suggested by the writer that the opening of the Bering sea passage during the Mariposa epoch of the Upper Jurassic and the Knoxville epoch of the Lower Cretaceous would account satisfactorily for the change of facies and the lowering of the temperature at that time. The closing of this passage near the end of the Knoxville epoch explains the change of facies from the Boreal to the Indian type of fauna, and also the accompanying rise of oceanic temperature on the coasts of western America.

The favorable conditions, inaugurated in the middle of the Cretaceous, continued throughout the Chico epoch, during which coral reefs extended up to Ensenada, Lower California, N. lat. 31° 30′, and a warm climate prevailed even in Alaska. Reef-building corals extended up to the middle of California, but they formed no reefs, since there were no stretches of clear sheltered waters in which they could flourish.

Neozoic Climates of the West Coast. The Eocene climate of the west coast was nearly the same as that of the Upper Cretaceous. The marine deposits have numerous molluscan genera that are now confined to the tropics, and on the land palms abounded in California, Washington and Alaska. No reef-building corals of this age are yet known anywhere on the west coast, and it is probable that the marine temperature was slightly below that necessary for their existence in this region. The climate of the coast, from California to Alaska, was probably very much like that of the states bordering the Gulf of Mexico. There today many tropical molluscan genera are found in the waters, and on the marginal coastal plain there is a mixture of palms, deciduous trees and conifers. This is just what we find in the fossil Eocene flora of California and Puget sound; laurels, figs, sycamores, chestnuts, elms, liquidambar, oaks, palms and sequoias lived together. From this association we should infer that the climate of the west coast was no longer tropical, but subtropical, and very rainy.

The middle Tertiary faunas are very like the present in the association of genera, and the flora on the land agrees with this. The palms have disappeared, but laurels still occur. It is probable that the climate of the upper Miocene had about the same temperature as that of the present in California, but it had, apparently, a much greater rain fall, or one much more evenly distributed.

The Tertiary flora of the west coast was immensely richer than the present. No elm, liquidambar, nor true laurel lives wild on the west coast now, and many other types that flourished here are gone. The impoverishment of the present tree flora of California, as compared with that of the Tertiary, has been ascribed to volcanic activity, but this is absurd. In the first place the great extinction of the old types took place in the lowering of temperature near the end of Eocene time, while the era of great lava outbursts on the west coast was after the middle of the Miocene. The climate continued to cool off in the Pliocene, as is shown by the northern types of mollusca that then ranged as far south as Los Angeles, and by the fresh-water lake deposits of middle California, which contain a fauna at present confined to the Klamath region of northern California and southern Oregon. The flora of the Pliocene in California is very scanty, composed largely of willows, alders and conifers, very much like that of the Olympic peninsula in Washington.

The constantly decreasing temperature throughout the Tertiary is sufficient to account for the reduction of the flora. The tropical and finally the warm-temperate types were killed off locally, and such as were confined to this region were wholly extinguished. Some of the forms that lived in more favored regions to the south returned after the Glacial epoch. But most of the region to the south of California is not favorable to the extensive growth of forests, and many of the types have never returned to California, except when brought in by man.

In the early Quaternary there were extensive ice-sheets in the Sierra Nevada, and probably the climate of the sea-coast was cool. The glaciers came down the slopes to a line that is now about 3,500 feet above sea-level; it is thought, however, that California stood considerably higher than now, and that conditions here were more like those of the present on the Olympic peninsula.

After the Glacial epoch was past the climate became warmer, and many mollusca crept slowly up the coast, from the warm waters of Lower California. This southern type reached as far north as Santa Barbara in the upper San Pedro epoch of the Quaternary, during which time the sea probably had a temperature as warm as it now is on the shores of Lower California.

This warming up of the west coast was no mere local phenomenon, for the same thing occurred at the same time on the eastern coast of America, when a warm-water fauna ranged up to the Champlain district. And also in Europe the climate after the Glacial epoch was, for a little while, warmer than it is at present. After the San Pedro epoch on the west coast, and the Champlain in the east the climatic conditions became approximately what they now are, although it may well be that the Terrace epoch had a larger rainfall than that of the present.

In the foregoing pages it will be noted that during all the known Paleozoic the west coast enjoyed a warm and probably tropical climate, with some suggestion of a northward march of the isotherms, reaching a culmination in the Upper Carboniferous. There is then some indication of a southward recession of the isotherms in the Permian, and a renewed northward advance in the Lower Triassic. This continued until the middle of the Jurassic, but the farthest north was never again reached in the Pacific waters.

In the Upper Jurassic and the Lower Cretaceous another considerable southward recession of the isotherms is indicated, followed by a renewed northward advance in the middle of the Cretaceous. But this advance did not reach so far north as that of the Middle Jurassic. The Eocene epoch shows the temperature of the west coast nearly holding its own, but with a probable slight reduction. The Miocene climate had grown considerably cooler than that of the Eocene, and by the Pliocene it was already rather cold as far south as California. The early Quaternary climate was probably even colder than the Pliocene, for there we have the local ice-sheets in the high mountains of California. The post-Glacial amelioration of climate is as distinct here as it was in eastern America, and in Europe, and probably as short-lived. Middle and late Quaternary time was probably much longer than we have been accustomed to consider it, and there have doubtless been considerable fluctuations in our climate in that period, but we have as yet been unable to decipher these in the geologic record of the west coast.

Jas. Perrin Smith

SOME GENERAL FEATURES OF THE CALIFORNIAN FLORA

CALIFORNIA extends from north to south through almost ten degrees of latitude, represented on the Atlantic coast by the distance from Newport to Savannah, and in the interior of the continent from Chicago to Natchez. The climatic conditions between the northern and southern extremes of these eastern states bring about floras so different that they are always treated separately. The flora of California is generally considered an entity, though besides the same difference in latitude there is added a greater difference in humidity, the north having a very heavy rainfall and the south almost none; and there are even greater extremes in altitude from mountains more than fourteen thousand feet above the level of the sea, to valleys below its level.

From east to west the state is roughly divided into the maritime region; the coast mountains with hot, dry valleys separating the many ranges and peaks; the Sierra Nevada whose lofty summits are never free from snow; the great San Joaquin and Sacramento valleys; and lastly the deserts south and east of the Sierra Nevada which belong to similar regions in Nevada and Arizona. These different sections north and south across the state result in as many floras as there are peaks, ranges, valleys, or deserts, each with endemic species and peculiar features, yet all more or less typically Californian.

The botanist who comes to California from other parts of the United States has the happiness of beholding a new world of plants when he first sees the Californian flowers during the period of greatest luxuriance. Even those cosmopolitan tramps—the weeds—show many unfamiliar species which have been brought from southern Europe or even the western coast of South America during the days of Spanish dominion when the missionaries established agriculture and fostered commerce. Among the native flowers so many strange genera occur, even some new families, and scarcely a single species identical with any found elsewhere.

Environment is most essential in determining the character of any flora, and the chief factors are humidity, which depends generally on situation, and altitude, and soil constituents. However, environment is not all, for there are deeply interesting problems not yet satisfactorily solved which concern the origin. These bring the student to the study of the fossil floras of the past ages and to a broad comparative survey of the floras of the whole world. In order to really comprehend one flora, its relation to others must be considered. To illustrate: The occurrence of the California nutmeg tree (*Torreya Californica*) belonging to the yew family, is paralleled by another species in Florida and two in Japan and China, but none elsewhere. The tree mallow (*Lavatera assurgentiflora*) which is commonly planted around vegetable gardens as a wind break by the Italians of the San Francisco bay region is a native of the islands off the coast of southern California. There are three other species, one in each of the islands, San Benito and Guadalupe and one in the Coronado islands; but neither on the mainland of California nor elsewhere in North America is there another species indigenous. To find them we have to go to the Canary islands and the Mediterranean region. Sometimes geology fills in the gaps as illustrated most conspicuously by the sequoias or redwoods. Their fossils are found in many parts of the northern hemisphere indicating a former wide distribution and many species as contrasted with the two species now living in California, peculiar to this state and restricted in range. *Sequoia sempervirens* does not grow far from the coast, being bounded by the limit of the sea fogs, while *Sequoia gigantea* is found in scattered groves through the Sierra Nevada only. All such species closely related in form but remotely separated in time or place, undoubtedly indicate wide-spread distribution in the remote past, with conditions becoming unfavorable for continuance except in isolated regions. This may also explain endemic species found isolated and numbering comparatively few individuals. The most notable examples are the Santa Lucia fir (*Abies bracteata*) which is found in a few cañons in the Santa Lucia mountains in Monterey county; the weeping spruce (*Picea Breweriana*) restricted to the high mountains of Trinity and Siskiyou counties and the adjacent mountains of Oregon; the Torrey pine (*Pinus Torreyana*) found near San Diego and on the island of Santa Rosa; the Monterey cypress (*Cupressus macrocarpa*) indigenous to the coast of Monterey bay, though now widely cultivated; the Monterey pine (*Pinus radiata*) with a range slightly more extended and having a variety on the island of Santa Rosa with only two needles in a sheath instead of the three of the typical form. Examples might be continued indefinitely; for wherever these isolated species occur they are accompanied by other species in different families also endemic. The species of manzanitas (*Arctostaphylos*) which grow in the vicinity of the Monterey cypress and pine are not found elsewhere, and probably a third of the flora of the Monterey bay region is endemic.

The division of the year in California into the wet and dry season gives rise to a preponderance of annuals during the period of most luxuriant vegetation, representing a bewildering number of species varying from their relatives often by such minute points of difference as to show the process of evolution now going on. Many genera are apparently in a state of transition. Well defined species mean that the links have not survived; intergrading forms are those links. One of the best examples of such a transitional genus is the *Eschscholtzia* or Californian poppy. Some botanists divide this into more than a hundred species and others consider all to be forms of one. The clovers, lupines, hosackias, in the pea family; castilleia, orthocarpus, and pentstemon in the figwort family are other transitional genera. Many of the genera that are typically Californian show a similar lack of definition and a similar difference of opinion among botanists. The extremists are popularly known on the one side as the splitters and on the other as the lumpers. Some system is necessary for convenience, names are essential if we are to deal with these forms in any way, but it can be readily understood that in placing limits where there are none, the personal equation is so strong that agreement seems impossible. These problems give added fascination to the study of the Californian flora. What fills the evolutionist with delight and satisfies his theories, bewilders the systematist, brings him to despair or keeps him forever interested trying to solve the riddle of creation.

In spring the whole country is a beautiful flowery land except where man has usurped the soil for his crops, his flocks and herds, and his habitations. The annuals come up in masses, in colonies, one species often monopolizing the ground by millions of individuals over one area, another species over another, each giving its color to the landscape so that its identity can be known so far as the eye can see. They all quickly disappear when the rainy season ends, leaving their sleeping seeds to reproduce the same conditions the next year. When the first rains arrive in the fall they usher not winter but spring. Almost at once the brown hills and valleys, seemingly dead but full of dormant life, become a misty green which deepens with each succeeding rain. The myriads of sprouting seedlings have produced this miracle of a new world. The color of the winter landscape in California is a rich, luxuriant green, instead of snowy white; more species are in bloom at Christmas than in August. Of course, on the high mountains arctic and boreal conditions prevail and the higher peaks and valleys are buried for many months in snow.

It must not be thought that all the hills and valleys of the lower elevations are brown during summer. Immense areas of dense evergreen shrubby growth known as chapparal cover the hills of both the coast mountains and the Sierra Nevada. It consists of species of oak, ceanothus, manzanita (*Arctostaphylos*), yerba santa (*Eriodictyon*), azalea, rhododendron, vaccinium, gaultheria, pickeringia, chemisal (*Adenostoma*), toyon (*Heteromeles*), styrax, tree poppy (*Dendromecon*), pitcher sage (*Sphacele*), golden plume (*Ericameria*) and many more that are less common or conspicuous. From a distance these hills seem velvety in their verdure but at close range the chapparal is almost impenetrable. This dense covering of shrubs is of the greatest importance in conserving the rainfall and they are all protected from the drought and heat of summer by various devices that are also characteristic of desert plants. Each of the dominant species of this chapparal has its own time for bloom and were it not for the variability of the rainy season one could tell the month or perhaps even the week of the year by the prevailing color of the chapparal. All of one kind will be in bloom at once and they are often massed together. The different species of *Ceanothus* are the painters of blue, purple, and white; the manzanitas pink and white; the chemise white which later turns brown; the toyon white in summer, brilliant red in winter. The berries of the toyon are to Californians what holly is in other places, the chief decoration at Christmas.

The forests, too, are always green, the great primeval forests for which the Pacific coast is renowned. The deciduous trees are so few that they scarcely give color in autumn or show bare branches in winter.

In passing from the seashore to the summits of the highest mountains, belts of vegetation appear, each marked by its own peculiar trees and shrubs. These zones are neither parallel nor well defined and can be outlined only in a general way. There is always an area where the zone-marking species overlap.

Along the sea-beach where the plants grow in salt impregnated sand and are bathed by the salty spray of the ocean, they have many of the same characteristics as the plants that grow in the alkaline deserts of the interior, namely, fleshy foliage, prostrate habit of growth, great root system, and salty sap. Even the same genera are represented, such as *Abronia*, *Atriplex*, *Sucæda*, *Franseria*, and so forth. The species are, however, different. Among these maritime plants are some cosmopolitan species, *Cakile edentula*, *Convolvulus Soldanella*, *Mesembryanthemum æquilaterale*, suggesting artificial distribution, probably by sea birds.

The bluffs that generally rise along the coast are often a tangled mass of plants growing thickest in the neighborhood of springs which are common on such bluffs. Here are several shrubs with berries, such as the blackberry, salmon berry, thimble berry, huckleberry, gooseberry, currant, salal, garrya, myrica, twinberry, dogwood, rose, besides some willows, various shrubby composites and tall, rank umbellifers. Along the northern part of California these form thickets and are of similar species even to Alaska. In the southern part the species are different and not so dense, related to Mexican and desert species.

Above these bluffs are the grassy hills and valleys devoted to pasturing. Even when these hills are brown and dry in summer, the herbage is full of nourishment, natural hay cured by the heat of the sun so that all its sweetness is preserved. How well do these brown hills set off the evergreen trees that are scattered here and there, sometimes carved and dwarfed by the wind, as are those at the tree limit on the high mountains. How green these pastures are during the winter but in spring most beautiful, a kaleidoscope of color from the flowers growing everywhere.

Along the streams and the lower edges of the inner hills rise the forests. These forests in northern California are the home of many splendid trees, chief among all being the redwood (*Sequoia sempervirens*). Associated with this will be found the douglas spruce (*Pseudotsuga taxifolia*), the California nutmeg (*Torreya californica*), the different oaks (*Quercus Kelloggii*, *Garryana*, *lobata*, *agrifolia*, *chrysolepsis*, *densiflora*), the maple (*Acer macrophyllum*), box-elder (*Negundo californica*), the laurel or bay (*Umbellularia californica*), the incomparable madroña (*Arbutus Menziesii*), the wax-myrtle (*Myrica californica*), the ash (*Fraxinus oregana*), the elderberries (*Sambucus glauca* and *callicarpa*), the buckeye (*Æsculus californica*). Many of these trees have a much wider distribution, extending into the Sierra Nevada and growing at a much greater altitude. Above the forests and running into them through shrubby forms of these same trees come the chapparal covered slopes. Alders and willows frequent the lower part of the streams and away from the coast the sycamores also protect the water courses by their shade. Where the coast mountains rise to high peaks of from four to six thousand feet, pines appear, also incense cedar and other species of similar elevations of the Sierra Nevada. They both catch the moisture from the high winds that carry vapor across the coast mountains to the Sierra Nevada. The eastern slope of the coast mountains and the western side of the Sierra Nevada are very hot and dry in summer as are also the great valleys stretching between. Except in the vicinity of streams or occasional areas where oaks abound, the verdure is all gone in summer but reappears in winter, and in spring it is a flowery paradise everywhere.

In the higher mountains of the Sierra Nevada and a few peaks of the coast mountains the different zones are well marked by species of pines and firs. On the hot, dry foothills are the digger pine (*Pinus Sabiniana*) and the blue or white oak (*Quercus Douglasii*), also *Quercus Wislizeni*, an evergreen oak; higher up we find the yellow pine (*Pinus ponderosa*) accompanied by the black oak (*Quercus Kelloggii*), still higher is the zone of the sugar pine (*Pinus Lambertiana*) and with it we find the incense cedar (*Libocedrus decurrens*), Jeffreys pine, related to *Pinus ponderosa*, the white fir (*Abies concolor Lowiana*) and the giant redwood (*Sequoia gigantea*). Still higher are the red fir (*Abies magnifica*) which grows even to timber line, the mountain pine (*Pinus monticola*) the foxtail pine (*Pinus Balfouriana*) and the hemlock spruce (*Tsuga Mertensiana*). This last comes pretty close to timber line on some mountains where *Pinus albicaulis* forms wind-carved ridges and clumps like dense hedges. The tree commonly known in California as the tamrac is really a pine (*Pinus Contorta Murrayana*) which loves to grow circling the meadows where snow lies long and the streams head. It is a widely distributed species in several varieties and in the Rocky mountains is known as the lodge-pole pine. In the southern part of the state where the mountains do not rise so high and run east and west instead of north and south, some different species are found, as *Pinus monophylla*, *Pinus Parryana*, *Pinus Coulteri*, and *Pseudotsuga macrocarpa*. Between the extreme south and the extreme north of California the zone marking species have a great difference in altitude, for as one goes to the arctic regions the vegetation of the loftiest peaks of the southern mountains is similar in character and even in some species to that at the very sea level.

The desert flora is related to that of Mexico and is full of queer plants not found elsewhere. The best represented families are the *Compositæ* with a great many genera, the best known being the sage brushes (*Artemisia*); the rabbit brush (*Chrysothamnus*); *Chenopodiaceæ* with species of *Atriplex* or salty sage; *Polygonaceæ*, species of *Eriogonum*, *Chorizanthe*. There are many kinds of grasses, also of cactus. The *Leguminosæ* have most beautiful trees, the palo verde or *Parkinsonia*, the mesquites or *Prosopsis*, and the daleas which are all shrubs except *Dalea spinosa*. The yuccas belong to the lily family and the agaves to the amaryllis family. Indeed, many of the desert species are of surpassing beauty in flower and most of them are armed with thorns or spines. It is a wonderful experience to see the desert blooming after a plenteous rainfall. Never shall I forget the ocotilla (*Fouquiera splendens*) as I saw it in the spring on the edge of the Colorado desert in San Diego county. The stems of this plant rise in groups of single stalks and grow to a height of six to ten feet. Before the rains they are gray and bare except for the most awful thorns that completely cover the stems. After the rain these thorns become hidden beneath the delicate green leaves and the summit of the tall stems are glorified by great clusters of the most brilliant red flowers. For miles these groups of wonderful plants are scattered over the desert accompanied by different kinds of cactus, daleas, krameria, ephedra and others not so noticeable. On the Mojave desert the most conspicuous species is the tree yucca, a fantastic tree with spreading branches entirely bare except for the tuft of dagger-shaped leaves at the ends. It has a weird appearance in keeping with the desolate country over which it is spread. Where water flows during the rainy season, the desert willow, a peculiar tree related to the catalpa, the arrow-wood (*Pluchea borealis*), the mesquites (*Prosopsis pubescens* and *juliflora*) together with real willows (*Salix*), cotton woods, and sometimes the walnut.

Insular floras have a great value in the light they have thrown on the evolution of species. It was from the study of such floras and faunas that both Darwin and Wallace discovered the Law of Evolution. The Californian islands that lie off the coast from about Santa Barbara southward are full of interesting suggestions. They have not been so long separated from the mainland to lose all connection but not only do they have peculiar endemic species but where they have similar species each island will often show some slight variation from the species on the other islands and also from what grows on the mainland. A few conspicuous examples will illustrate. The Lyonthamnus is a peculiar tree found only on these islands, belonging to the rose family, but with some characteristics of the saxifrage family. The species as it grows on Santa Catalina island has simple leaves; on Santa Rosa and Santa Cruz islands the leaves are compound, each leaflet resembling a simple leaf of the Catalina species.

The holly-leaved cherry (*Prunus ilicifolia*) common on the hills of the mainland from northern to southern California has a related species on Catalina island having leaves without the prickly edge, much larger flowers and fruits, forming a fine, large tree. To number or list the endemic species of each of these islands would be quite unsatisfactory because of the great difference of opinion that would arise over specific lines.

It has been possible in this brief survey of the botanical features of California to merely touch upon the interesting features. To fully describe and explain at length would make a book of good size. While it is incomplete in so far as details go, yet the main points have, I think, been touched upon so as to give the average reader some knowledge of the character of one of the most interesting floras of the whole world.

Alice Eastwood

THE FAUNA OF CALIFORNIA

ONE of the most fascinating phases of the polychrome science, biology, is that aspect dealing with the adjustment of a fauna or a flora to the physical character of its habitat. Men nowadays commonly think of earth, air, water as passive matter and brush them aside into the category we call "inanimate nature." Birds sing, squirrels bark, flowers bloom; but mountains, rivers, and deserts live and breathe only in the imagination of the sentimental poet or of the superstitious barbarian. As one's horizon of appreciation widens, however, he sees things in the large, his vision reaches over areas of continental magnitude and extends through almost incalculable time. He sees in operation, forces which remain unnoticed through the briefer periods that can be measured in the pulse beats we call generations. He sees the world of organic things take shape and change that shape in response to environmental influence almost as though the physical in nature were the animate thing and organisms the insensate warp and woof plastic to its touch. The materialistic attitude toward nature is measurably tempered by this time and space vision and a faunal biologist sees the animate appear almost as a garment woven upon the inanimate. The robe is wondrously fitted to the form beneath it, displaying rather than hiding its contours, thrown into ample and luxuriant folds over the deep, quiet places, only to be drawn tense and spare over the points of highest tension; perhaps a bit sun-bleached or worn in spots of severe attrition and exposure, but maintaining an oriental splendor in deeper folds. Figures of the original pattern may in some places have completely disappeared, in others, simply mellowed or been enriched. So at times it almost seems that earth were alive and we its mere clothing. To the real naturalist, be he technical or otherwise, seeing with the larger vision the fauna of California, the wonder of this biological garment, its varied texture, its infinite range of coloring, yet withal its orderly conformity to law, cannot but appeal most forcefully.

The state of California embraces within its borders as great if not a greater variety of vertebrate animals than does any one of her sisters in the union. No less than 530 distinct races of birds and 337 species of mammals have been listed by the Museum of Vertebrate Zoölogy at the State University from this commonwealth. Of freshwater and littoral marine fishes, an equally imposing number has been recorded by the Zoölogy department of Stanford University. Reptiles and Batrachians have been too imperfectly surveyed to afford positive census as yet while invertebrates teem in such myriad numbers as to almost discourage the cataloging.

The great array of species thus listed from California is due not solely to the immense area involved but is attributable to a peculiar combination of many and widely diverse environmental factors. These factors include such important ones as great range of latitude, of elevation, of temperature, of humidity, of insolation. There extend throughout the length of the state great parallel ranges of mountains with at least one transverse barrier; there are partly disconnected peaks, there are continental islands and deep submerged valleys close inshore; there are unrelated river systems draining blindly into desert sinks. The whole country is geologically young, there have been recent and varied changes in its topography. There was never a general ice cap over the entire surface in glacial times to level off organic inequalities with the planing down of its physiographic contours. Under such conditions a biological monochrome is impossible. It is a commonly accepted bionomic principle that variety of conditions or rapid change in conditions will be reflected in the faunal fluctuation of the region involved, hence nature has here followed a logical course in weaving for herself a coat of many colors and California is rich in organic species.

Were the earth a sphere of unvaried surface from pole to pole, then would distance from the equator probably constitute the chief if not the only factor governing the distribution of its organic life. A species would assume position to north or to south in that temperature zone congenial to it until there resulted the phenomenon of species distributed in uniform bands along the parallel isotherms or lines of equal temperature throughout the earth. In the large, such zones do exist roughly outlined upon the continents despite the diversity of surface. Students of geographic distribution recognize in North America the so-called Sonoran Zone roughly coincident with the area of the United States lying between the Tropical Zone of Mexico and Central America to the southward and the Boreal Zone of Canada and Alaska to the northward. Latitude will thus be seen to constitute an important determinant in the distribution of species. California extends in its greater dimension over more than ten degrees of latitude, a distance here sufficient to traverse the entire Sonoran Zone. Her southern boundary lies at its southern isotherm, her northern counties reach beyond its northern isotherm into the Boreal Zone which is here deflected southward by the west American mountain systems.

The state, possessed of such great range of latitude, is then in a position to attract within its borders a number of forms from neighboring zones both to north and to south of her. Hence we find crossing our southern borders from Mexico a host of animal forms, some just peeping in as it were and others pushing further to the northward well into the center of the state. Scott's oriole, Arizona hooded oriole, Texan cardinal, vermillion flycatcher all are migratory forms capable of crossing such topographic barriers as intervene, yet, though coming north only in the warm season from the Tropical Zone they stop n the southern counties of the state. The zebra tailed lizard, the chuckawalla, the iguanid lizard, *Dipsosaurus*, the banded gecko are nonmigratory forms diffusing north from the deserts of Mexico into our southeastern corners where they find a congenial climate. At the opposite extreme from these gentlemen of fervid tastes we find in the northern counties of California the ruffed grouse, evening grossbeak, wolverine, otter, marten, and fisher, all of them forms we share with our Canadian neighbors to the northward. Back and forth for varying distances up and down the state, these organisms pass either in seasonal migration or in the slower course of species diffusion, each finding his environmental setting there to flourish.

In many respects comparable to the effect of longitude upon organic life is the influence of elevation above sea level. East and west continental life zones dependent in the main upon temperature find counterpart locally in the abrupt mountain ranges of the west. Within a score of miles one may pass from Lower Sonoran to Upper Sonoran, thence through Transition to Boreal at the summit of the range. California is rich in mountains and the ranges trend in the main parallel with the meridian. The Sierra Nevadas of the eastern border of the state rise to the height of perpetual snow and their north and south direction causes them to become a pathway for the southward diffusion of boreal forms such as the leucosticte, cross-bill, sierra grouse, Mount Whitney coney, marmot and wolverine. In the vicinity of San Francisco bay the western golden crowned kinglet occurs in winter at practically sea level. In Los Angeles county it is seldom if ever noted below an elevation of five thousand feet. This little visitor from the cold Boreal is thus able to pass the entire length of the state, climbing farther and farther into the mountains as he comes south and so escaping the scorned mildness of the warmer Sonoran Zone which laps like waves higher and higher along the flanks of the range until in southern California, its warmer airs wash across the ridge through the east and west passes and break the mountain chain into a number of biological islands of the Boreal. Upon these isolated peaks there appear thus segregated, larger or smaller patches of a more northern biota entirely surrounded by animals and plants distinctive of the south. Mount Whitney, Mount Piños, Mount San Gorgonio, and Mount San

Jacinto constitute such "islands" comparable to the southern end of the Andes trailing off into an archipelego in the antarctic sea.

Flanking the somewhat abrupt western base of the Sierra Nevada from Shasta to the Tehachapi, through the major part of the length of the state, shielded from the cool sea-winds by the Coast range immediately to the west, warm, dry, and level, there lies the great interior valley of the Sacramento and San Joaquin drainage basins. Here cradled between two great ranges of mountains, is a region of low elevation, great flatness of contour and of sluggish drainage, the wheat field of California. This great valley, so broad that its limiting ranges fade into the haze of drowsy weather or recede as vertical walls of white-capped blue on crystal days, gives the impression of limitless expanse and offers to animals and plants of plains loving nature, a congenial habitation. One or two residual bands of the once abundant antelope and a few of the vanishing dwarf elk still roam its open stretches protected by a rigorous state law which brands their killing a felony. Along its willow and cottonwood bordered water courses occur the wood-dwellers of the lower Sonoran, finding here a pleasant highway upon which they venture well into the northern part of the state. Along this tempered path goes that incarnate spirit of semi-tropic moonlight, the mocking bird. The anomalous road runner, a cuckoo with long legs and degenerating wings, his heritage of tree-dweller foot only slightly adjusted to the swift coursing habit, finds here a hot open country with abundant lizard and grasshopper diet quite to his fancy.

Shallow, ephemeral, and often alkaline lakes accumulate quickly on the level valley floor to form ideal haunts for such migratory southern gentlemen as the black necked stilt and the fulvous free duck. Bell's sparrow and the kangaroo rat, dwellers in sage and sand, find homes in the low marginal foothills while out over the plain from spurs of the Coast range sails the great California condor going easily fifty miles to breakfast on the once elk and antelope populated plains of this great level basin, the valley of the Sacramento and the San Joaquin.

The second great mountain mass, the Coast range, is less positive as a biological factor than is the Sierra Nevadan system. Elevations are less pronounced, continuity is less perfect, slopes less steep, and the vertical projection of life zones, in consequence, less perfectly defined. There are no perennial snows, no upper timberline, no hanging gardens in high glacier meadows, no crag-set lakes to attract the nesting water fowl, no roof gardens of tamarak and aspen groves. Nor are there at the other extreme any sun browned deserts at their feet such as cling about the skirts of Whitney, San Gorgonio, and San Jacinto. The system does, however, suffice to shut off from the west the wheat field of the interior valley and, among its broken spurs, to cradle a host of smaller patches of fertile garden. Where its western slopes do not drop sheer into the sea it serves to define fragments of a discontinuous coastal plain. In some of the enclosed pockets to the southward occur isolated colonies of the apparently disappearing yellow billed magpie. Here, too, is probably the last intrenchment within our borders of the California condor, unique in the northern hemisphere in point of size and equaled elsewhere in the world only by the great condor of the Andes.

At their northern end these broken coastwise mountains serve to bring well within our borders the northwestern Humid Belt, a biological area stretching down the coast from British Columbia practically to the San Francisco region. Being cool throughout the year, shaded by fog and clouds, watered abundantly and timbered in accordance, this area tempts southward such cold proof Canadians as the chestnut backed chickadee and Nuttall's sparrow. The dark coastal form of the wren tit is here segregated from the pale colored inland phase which ranges from Shasta county to Mexico in the Sonoran. The plumed quail, the coast jay, a dark colored species of that peculiar isolated rodent, the swellel, not to mention a host of smaller mammals—all help to characterize this well defined area.

South of the San Francisco region small pockets of the coastal area quite apart from the northwestern Humid Belt, harbor distinctive forms of wren tit, song sparrow, and chickadee, while up and down the whole disjointed coastal plain migrates that little salt-marsh creeper, the Bryant sparrow.

At its southern end the Coast range divides in the Santa Barbara region into two general masses. While one portion turns inland, the other continues southward from Point Conception out to sea as a now partly submerged peninsula evidenced by the group of peaks known as the Channel Islands. These islands are separated from the mainland of southern California by the Santa Barbara Channel, an ancient gulf comparable to the Gulf of California, until in recent geological time, it established a northern outlet by washing across the old peninsula in the vicinity of Santa Barbara. When this important event took place there were left marooned on the resultant chain of islands a number of forms of life some of which, though probably added to from time to time by various contributions from the mainland, have come to be distinct and characteristic of their insular habitats. Among the birds thus segregated are the San Clemente house finch, the island horned lark, San Clemente towhee, island shrike, Santa Cruz jay, San Nicolas rock wren and others. No less than four distinct races of gray fox occupy as many separate is lands of the group. The ground squirrel and white footed mouse add to the distinctiveness of the insular fauna by contributing each a modified subspecific form.

That subdivision of the southern Coast range mentioned above as passing inland from the region of Santa Barbara may now very properly claim our attention. This mountain mass thrusts itself well to the eastward, its spurs coming to lie in an east and west direction. In southern Kern county it meets with a westward spur of the Sierra Nevada and the two fuse to form the transverse barrier of the Tehachapi, an obstacle of such magnitude that two great competing railways must needs smother a mutual enmity to such degree as will permit their using a common track, the only feasible route yet surveyed over this great divide. Up its either side labors a great state's internal traffic only to lower itself cautiously and with almost equal effort down the serpentine loops of the opposite slope.

No less than the geographer does the biologist find this transverse wall of intense interest. Long before it could hamper the as yet unborn commercial activity of the rising human animal, it had proven an influence in measurably retarding the movements of the lower organisms. As a result of this insulating effect we are able to recognize south of this barrier the so-called San Diegan region, which is a well defined faunal island reaching from Santa Barbara on the north well down into northern Mexico. To the north and east of this area lie high mountains and beyond the mountains, deserts. Moat and battlement could not effect a more perfect barrier to ancient castle than does this combination of desert-girt mountains through which the three narrow passes of Newhall, Cajon, and San Gorgonio offer the only gateways. Within this warm, sheltered orchard garden bordering the sea and so sharply contrasted with the northern Humid Belt we find such forms as the Anthony towhee, Bryant cactus wren, and black tailed gnatcatcher. With them pushing south into Mexico goes a little beach comber, the large billed sparrow. Into this same area is now unfortunately intruding along the lines of railway through the three narrow passes that feathered Ishmaelite, the English sparrow. The San Bernardino kangaroo rat, the tawny gopher, San Bernardino grasshopper mouse, and the Xantus night lizard help to define this very interesting faunal area.

And now lastly our attention turns to the desert—the southeastern corner of the state—that part which it is said "God forgot." A wonder place, it holds the biologist in an unbreakable hypnosis. Here there is run within a score or two of miles, the entire gamut of biological changes from Boreal to Tropical. Here there are displayed some of nature's most fascinating phenomena of adaptation to an austere environment. In late August, at an elevation of more than eleven thousand feet one may walk over the snow packs of San Gorgonio peak out to the edge of things and look down into the pit of North America, sunken in clinker bare walls to a depth of nearly three hundred feet below the level of the Sea. Again one may stand at the margin of the shallow, brackish lake formed by runaway waters of the Colorado river empounded at the bottom of this pit and, here subject to a temperature suggestive of the veritable pit, he may look from barren, sterile, alkali lands to creosote and salt bush belt, thence to sage and oak belt, on up through various conifer belts, and finally to barren summit so near that it seems almost to overhang. With the eye one thus passes rapidly from desert with an annual rainfall of practically zero to snow covered peaks with nestling lakes and marshy meadows in the high hung valleys; from the sterility of heat and salt to the barrenness of cold and snow. What a condensation of biological areas! What endless interest when we learn that there occurs in each zone a specially adapted fauna and flora!

A popular concept of the desert makes of it a place wholly waste and devoid of life. One does not see how life can exist without water, the desert is a place without water, hence a place without life—a very simple conclusion from a seemingly unchallenged premise. In this premise, however, lies the fundamental error. The desert is not waterless except by comparison with more favored spots. It may not rain this year but next year it probably will or else the year following. Some plants readily wait a year for a drink and are then content with a very scant sprinkling. They have developed during long ages of adjustment the power of rapid drinking through extended root systems spread just beneath the surface. Water thus acquired in time of meagre rainfall is almost indefinitely retained by means of thickened cuticle and minimized leaf surface. Seeds of more ephemeral flowers may lie hidden in the sand for several seasons before a rain comes sufficient to germinate them. They then leap into life, maturity is attained, seeds ripen on the drying stem from which the leaves have already withered, the brief life cycle is run within the few weeks of favorable condition, seeds drop into the shifting sand, and another long wait is in order. Where there is seed there is to be found the attendant procession of interdependent forms—ant, beetle, lizard, bird, rodent, snake, coyote, vulture—and the desert is alive. Leagues out on the Mojave desert from Barstow, away from water on surface or in substratum, the writer found Gambel quail, cañon wren, sage sparrow, Say phoebe, mocking bird, kangaroo rat, jack rabbit, coyote, leopard lizard, scaled lizard, desert tortoise and unidentified insects.

About the Salton Sink on the Colorado desert there is an abundance of birds, mammals, and reptiles. No species is more distinctive of such environment than is that elusive songster, the Leconte thrasher, a bird with all the sweetness of song that the mocking bird possesses yet with too much originality to plagiarize as does that arch rascal. In similar haunts with Leconte thrasher occur the cactus wren, sage thrasher, and Gambel quail. About the natural oases and now readily adopting the artificial thickets of the irrigated ranches, is the desert song sparrow with much of the color from his speckled coat seemingly struck inward to enrich his joyous song till it surpasses that of his darker coastwise relative, the San Diego song sparrow. The flooding of the great Salton Sea and the distribution of water over the land by artificial means has attracted gulls, terns, pelicans, cormorants, rails, ducks, cranes, meadow larks, marsh blackbirds, and a host of other forms appearing most incongruous in the greater environment of the desert. Only a step out from these oases, however, the antelope chipmunk, zebra tailed lizard, desert rattlesnake, and desert tortoise help to remind one that the "desert primeval" is very much alive.

From the foregoing discussion it is evident that California because of her infinitely varied topography and consequent segregation of faunas, will hold for the student of species distribution an intense and unending interest. Here the great questions of adjustment to environment continually confront him. Why is the coast wren tit dark and the pallid wren tit from the interior some shades lighter? If forced to occupy an arid region would the coast form become bleached or remain dark? Why do they not intermingle? The valley quail goes out from the San Diegan region through San Gorgonio pass to the desert's edge, the Gambel quail comes in from the desert through the same pass to the edge of the more humid San Diegan; each species stops at the gate, as it were, and looks through at the, to him, unpromising land on the opposite side; they mingle amicably here for a space but neither goes down into the domain of the other. Why do they respect the invisible barrier? It must be a matter purely of preference as each species occupies the same ecological position and on this common border of their habitats the two mingle without visible antagonism. How does the desert rodent live his whole life through without knowledge of water and subsist, as captive specimens have done for years upon food no more succulent than dry bird seed? What is the immediate derivation of species of fish now dwelling in streams that empty into the "dead seas" of blind drainage systems? How did the Boreal faunas of our isolated mountain peaks become stranded upon these Arrarats as though once borne on a flood tide of cold now ebbed away from them? Science is confronted with a multitude of such questions many of which bid fair to remain long unanswered. The field naturalist joining hands with the experimental biologist, may solve in the near future some of these problems, still for a long time to come California cannot but appeal to the student of speciation as a land of opportunity.

Diverse as is the topography of the state there prevails over the major part of its large area a factor which at first glance would be considered a leveler of inequalities. That factor is what is known to the meteorologist as the Franciscan climate. The year is biseasonal; practically all the rainfall comes within the five months from November to April, and by far the greater portion is precipitated within three of these months. The winters are warm and the summers practically rainless for seven months consecutively and the summer temperature away from the coast may become quite high. The effect of such a climatic condition upon the fauna of the state is noticeable in several different ways. In regard to their activities, one will notice among the mammals of the Sonoran a marked absence of hibernation and a very positive tendency to estivation. The ground squirrels and the pocket gophers display locally such a tendency. They often lie quietly through the hottest, driest part of the year with no sign of activity at least upon the surface. As soon as the rains have moistened the earth sufficiently to green the hills over, the work of these pestiferous rodents is resumed in force.

Another noticeable effect of the climate is to increase the resident population of birds. Many kinds which are elsewhere migratory will remain within the state's borders throughout the year, performing slight geographical migration or only the vertical migration up and down the mountains. The breeding season is prolonged. Several small species like the humming birds, finches, and the mocking bird may begin breeding in February and continue till October. Amphibians and lizards are active in December and January since the ponds never freeze sufficiently to drive their myriad population into refuge in the mud. Insects produce a greater number of broods per season since every month of the year has its flowers.

A further effect of the long period of unbroken sunshine is to bring about a sharp contrast between the north facing and the south facing slopes in even moderately broken country. On south facing slopes the sun lies long and lies warm. The moisture is drunk away in summer faster than the roots of perennial plants can burrow to deeper strata, hence we find on such exposures at lower elevations, only a growth of annuals and xerophytes which give place on higher elevations to the dwarfish chapparal or elfinwood. On the other hand, the shaded north facing slope may be wooded to the very crest of the divide. Damp, shady and cool, its perennial thickets offer lodgement to forms in sharp contrast to the open sunny exposures of the opposite tilt. On the one side the meadow lark, on the other side the song sparrow; on the one, the ground squirrel, on the other, the wood rat. Great tongues of the Sonoran Zone may run far up along the sunny side of a large valley to far overlap the downward reach of the Transition Zone along the opposite side. In such fashion do the larger biological areas become checkered into a smaller and smaller pattern of intermingled faunas until the observer, according to his lights, is either oppressed by the seeming tangle of forces at play or else he tingles with enjoyment of the orderly conformity of it all to simple and readable law.

To the student of things as they are, there very naturally and altogether properly comes the question as to how they were. Things have not always been so; everything changes even to men's ideas of the truth. Hence have we come to realize that the world today is a product not of special and instantaneous creation, but of long existing and still operative forces. Slow indeed has been the change, hence its tardy recognition. The period of human record is often spoken of by geologists as being but a mere flash light, an instantaneous impression of the earth and her creatures. Man-made history is too young to record any progress in events geological, yet the present proves to us that such change has been and still is going on. We are forced to concede that mountains are born, yet born to die; that great inland seas may prove but ephemeral things; that climate no less than topography is subject to fluctuation.

In view of the intimate relation existing between the creature and its habitat one might expect the same law of mutability to hold true in biology. We find such to be the case as regards the nature, the abundance, and the distribution of any organic form. We are unable, with some possible exceptions, to see any great modification of a species in nature during the period of human record. Most of the observable changes in distribution and in numbers have been, alas, of a destructive nature. To the question of how and whence the appearance of species, paleontology alone can contribute indisputable evidence. As history stands to economics so does paleontology stand to biology and neither student of present conditions can intelligently deal with his varied problems without an appreciative consideration of the salient points, so far as recorded, in the development of those conditions. It cannot then prove amiss in this discussion if mention is made of some of the horizons of chief interest in the vertebrate paleontology of California.

Within the limits of the state there are known a goodly number of bone bearing horizons. These beds are of different geological age, and represent a diversity of method of accumulation, hence they include a considerable range of fauna. The great Triassic limestone deposits of Shasta county are primarily marine and from them come the Shastasauridæ, a primitive family of Ichthyosaurians which have contributed materially to our understanding of the relationships of that group of highly specialized reptiles. We share with our easterly neighbor, Nevada, this interesting family which until their very recent discovery in like strata of Europe were unknown except from the Sierra Nevadan limestones. Great whale-like creatures, they swam in an ancient Triassic sea whose calcareous bottom mud was later upheaved to form in part the Sierra Nevadan system. The immense mountain building blocks of limestone thus formed retain still the bones of these great creatures as hieroglyphics, readable to the appreciative eye as though scratched upon Chaldean tablets of kiln dried clay. The original anatomical interest in these primitive ichthyosaurs has been supplemented since the discovery of related forms in Europe, by an additional interest which appeals especially to the student of geographical distribution, an interest hinging upon their synchronous occurrence in points so widely separated upon the earth's surface.

Human history affords instance of some very ancient parchments from which the original record was supposedly erased by the mediæval historian in order that narrative of his own time might be inscribed thereon. These parchments, preserved to modern times, have thus born a dual record—a tale within a tale. So has it been with the great lenses of the Shasta limestone. Percolating waters have in several cases dissolved out extensive caverns in the upheaved blocks of the Triassic sea bottom; these caves engulfed, during Pleistocene time, the remains of mammals, birds, reptiles, and fishes; drainage lines changing, the mouths of the caves became closed and the second record was sealed away from harm in these perfect catacombs. In recent time, some hundreds of thousands of years of cañon cutting has again opened the bone bearing cavities and the modern scientific explorer reads the second inscription on these tablets of time hardened mud. Potter Creek, Samwel, and Hawver Caves are such repositories which have yielded interesting Pleistocene remains especially of mammals and birds. Two mammalian species especially characteristic of these cave deposits are *Euceratherium* and *Preptoceras*, hoofed forms showing affinities with several living ruminants including the now arctic musk ox. An elephant, a mastodon, a camel, a bison, two horses, the gigantic bear, *Arctotherium*, and the long clawed ground sloth, *Megalonyx* appear among the fifty or more mammals listed from these caves. Eighteen species of birds have been determined from the same deposits, a list which affords a dual interest, first because fossil birds are of such rarity that most of the species are for the first time recorded as fossils and second because several of the species have their nearest living relatives now confined to more southern latitudes.

An interesting deposit of Miocene strata occurs in the Mojave desert near Barstow. The nature of the accumulation is such as to indicate an extensive lake bed, the waters of which persisted for a considerable length of time. About this body of water there roamed great numbers of little three toed horses, *Merychippus*, the dimunitive deer-antelope, *Merychodus*, and two species of camel-like creatures, a large and a small one. The nature of this fauna is distinct from that of other

Pacific coast faunas and shows its nearest relationships to lie with the plains-dwelling faunas of the Miocene east of the Rocky mountains.

The marine Miocene of the coastal region is rich in fossil whales but as yet little has been done in the determination of this material. There also occur in these beds associated with the teeth of sharks, the remains of that aberrant creature, *Desmostylus*, which has so long puzzled scientists as to its affinities. Molluscan remains from upper Miocene beds indicate a climate cooler than at present prevails in the region.

Perhaps the most remarkable deposit of fossil vertebrates in the west and certainly the one which has seized upon the interest and the imagination of popular and scientific readers alike, is that unique horizon, the Rancho La Brea asphalt. The manner of accumulation and preservation of remains; the perfectness of specimens; the wide range of species represented; the seemingly limitless amount of material; the remarkable completeness with which the Pleistocene fauna of the region is probably represented—all conspire to make these beds a wonder place to any one who visits them. Only a few minutes out from the business center of Los Angeles and a stone's throw aside from one of the splendid interurban boulevards, the locality attracts a procession of visitors from every class of society and every aspect of interest.

Deep down in the Miocene strata of this locality lie great beds of oil-impregnated sand, the tapping of which has afforded a great measure of California's monetary wealth. Earth shifting disturbances caused, in the geological ages following the Miocene, an upfolding and a consequent cracking of the overlying strata—a condition which as early as Pleistocene time established chimney-like connection between these buried oil sands and the surface above. Rock pressure and the expansive force of natural gases brought to the surface greater or lesser quantities of the crude oil which accumulated about the mouths of these chimney-like vents. With the slow upbuilding of the surrounding surface by process of soil formation, these oil accumulations built up likewise, now widening out, now encroached upon by the adjacent soil, until we discover them today as irregular but sharply defined lenses reaching in some cases beyond the depth of twenty feet below the present surface.

The natural oil of the Los Angeles oil fields is asphaltic in its base and even when freshly discharged is heavy and viscid. Exposed to the air it becomes under process of natural distillation a more and more tenacious tar-like residuum which, even in shallow accumulations is capable of entangling and holding animals which may blunder into it. In summer a surface accumulation of this material in natural depression may become covered by a thin film of dust blown over it from the adjacent soil surface until the dangerous tar pool appears as innocent as any other part of the open plain. In winter the rain water accumulates in the same natural depressions as does the oil. The result is that a stratum of relatively clear water comes to overlie and perfectly conceal the sticky mass. The land of little rain thus tempts the mammal or bird to destruction by its greatest desideratum, water.

Let the imagination play but for a moment upon such a set of conditions—the innocent looking pitfall in dry weather; the water-baited trap tempting the thirsty after brief showers; the live-baited trap resulting in either case as the helpless victim seeks his liberty; finally the carrion-baited trap for the scavenger; a trap always set, always baited, always operative, universally tempting, insatiable. Not a pleasing picture is drawn by this excursion of the imagination, but to the investigator coming a millenium afterward and finding these remains sealed away in the perfect asphaltic preservative, what a picture of the local Pleistocene fauna is revealed!

Perhaps no method of entombment recognized by the paleontologist could be more impartial in its capture and preservation of species. Hence the study of the fossil fauna of Rancho La Brea brings forth many interesting observations. The richness of fauna in that age of mammals, the Pleistocene, is beautifully evidenced by the presence of mammoth, mastodon, ground sloth, camel, bison, horse, deer, bear, saber-toothed tiger, lion, puma, wolf, and others to the extent of more than fifty species. Associated with these powerful mammals were equally unusual birds. The great *Teratornis*, a raptorial bird larger than any other known flying bird living or extinct, tore with its immense eagle-like beak an unsavory sustenance from the dead bodies of these huge mammals. With him at the ignoble banquet were four species of true condors, the smallest equalling in size the living Andean condor. Attracted and ensnared by the same trap were six species of eagles instead of the meagre two we now boast in this region. Wading birds and swimmers were attracted by the surface pools of rain water or else in the half light were led to mistake the mirror surface of freshly outpoured oil for water and left their remains immortalized in the mud which gripped and held them. A turkey-like peacock inhabited the near by thickets and came to drink his destruction at the margin of such pools. Turtle doves, blackbirds, meadowlarks, flickers, owls, road runners, and a varied crew of other forms totalling sixty species, fell, at one time or another, as prey to this deceptive snare of ever ready bird lime.

A little careful work with a fine pointed instrument in the now cheesey matrix, a bath in gasolene, drying in sawdust, and a final polishing with soft cloth turns these specimens into dark stained, lustrous bronze, bearing even the most delicate imprint of their former clothing of muscle and ligament. The studious eye of science, reading these traces, clothes the whole in living semblance and the animals of Rancho La Brea are called to resurrection.

In this horizon, again, the relationships of the birds point to a withdrawal of their immediate descendants toward the southward. The eagles, the storks, the vultures, the caracara, the peacock have left their nearest living relatives in Mexico, Central America, and South America.

According to the evidences of paleontology the ground sloths without question, had their origin in South America and wandered thence northward into the United States; the bison and elephants came southward from Alaska where some land connection had let down the bars between this and the Eurasian continent;

Horses, camels, and saber tooths probably grew up with the country; lions and bears came with the elephants from the north, while the peccaries developed with us, then went south to Mexico and later diffused back into the Sonoran of Texas. These records of ancient animal migrations, coupled with the present phenomena of horizontal and vertical distribution show an effect as of successive wave upon wave of biological impetus moving now north, now south, swirling and eddying across the changing face of the country, stranding some species, washing away others, scouring a pathway for still others, till our flash light of this great sea of forces, the instantaneous view we call the present, reveals the fauna of California, clothing her in a rich and varied robe of many colors.

PARTIAL LIST OF AUTHORS CONSULTED

Grinnell, J. Various papers in the University of California Publications, Department Zöology and in Condor magazine.

Merriam, C. H. The Geographic Distribution of Life in North America, Smithsonian Report, 1891.

Merriam, J. C. Various papers in the University of California Publications and in Science.

Miller, L. H. Various papers in the University of California Publications and in Condor magazine.

Swarth, H. S. Various papers in the University of California Publications and in Condor magazine.

Willett, G. Birds of the Pacific Coast of Southern California, Cooper Ornithological Club, Pacific Coast Avifauna No. 7.

Loye Miller

THE CLIMATE OF CALIFORNIA

THE climate of a country is determined primarily by geographical latitude, by proximity to large water areas, by the topography, by prevailing drift of the lower or surface air and by storm frequency. In California there are five well marked factors operating to control climatic conditions. Of these perhaps the most important is the prevailing drift of the surface air from west to east, common to temperate latitudes, but marked in this section of the American continent. In this great aerial stream are the lesser currents induced by the eddies and counter-eddies familiarly known as "lows" and "highs." It has been found that these disturbances for the most part drift east along a line north of California and this is the chief reason why the weather in general is less changeable than in regions nearer the storm tracks or paths of greatest storm frequency. Again, the proximity of the Pacific Ocean, a great natural conservator of heat, serves to prevent marked temperature changes. Ocean currents also exert a certain influence, their effect in the main being to cool the surface air and facilitate cloudy condensation, thus promoting the formation of fog. Finally the diversified topography of the State determines what may be called local climates. The prevailing flow of air is from the west to the east, that is from the sea to the land. During the day hours as a rule this flow is increased; but during the night hours, the wind velocities are diminished. In the general drift we find the cause of the strong westerly winds so characteristic of the California coast. Charts of wind direction formerly issued by the Weather Bureau but now by the Hydrographic Office show with much detail the frequency and intensity of the wind for all parts of the coast. From the 55th parallel to the 30th the winds are chiefly northwest. In summer between latitudes 35°N and 40°N winds are distributed as follows: west to northwest, 75 per cent; north to northeast, 4 per cent; east to southeast, 3 per cent; south to southwest, 3 per cent; and calms, 15 per cent. In winter the winds are southeasterly, and southerly gales are frequent. Nevertheless, northwest winds are not infrequent as is shown by the following: west to northwest, 30 per cent; north to northeast, 18 per cent; east to southeast, 17 per cent; south to southwest, 22 per cent; and calms, 13 per cent.

It is because of this general motion of the air from west to east that the climate of west coasts is less severe than the climate of east coasts. If the circulation of the surface air were reversed, the Atlantic coast and the middle portion of the country would have less variation of temperature and the climate would be in many respects milder than that which now exists. On the other hand, the climate of the Pacific coast, and especially of California west of the Sierra Nevada, would lose much of its present equability. The winters would be rigorous and the summers very warm.

The mean annual temperature of the Pacific near the California coast is 13°C, 55°F. The prevailing winds therefore blow over a surface that is warmer in winter and cooler in summer than a land surface would be. The temperature amplitude of all the coast stations is consequently small compared with that of the interior. During the summer months the mean temperature of the water is about 15°C, 60°F. The diurnal change in the temperature of the water is small. During the winter the mean temperature of the water is about 10°C, or 50°F. Interesting comparisons of water-surface temperatures, air temperatures and currents may be found in the Ocean Charts referred to above. One point however should be noted in connection with air temperature at sea, and that is that observations are made close to the water surface and do not represent the air conditions at a height of several hundred feet.

In the diversified topography of the state, we have another important factor in determining local climates. The state has a mean length of nearly eight hundred miles and an average width of two hundred miles. Its area is 155,980 square miles, or a little less than a hundred million acres. The coast line corresponds in position with that portion of the Atlantic coast extending from Boston to Savannah. There are very few rivers, and in both orography and hydrography there is little resemblance to the Atlantic seaboard. The coast line has a mean annual temperature ranging from 10°C, 50°F to 15°C, 60°F, while on the Atlantic coast the temperature ranges from 8°C, 47°F to 20°C, 68°F. In July the isotherms run almost north and south on the Pacific coast, while on the Atlantic coast they conform to the parallels of latitude. In the winter the difference between the mean temperature of the interior of California and the coast amounts only to about 3°C, 5°F, but in the summer the difference is marked, amounting in general to 11°C, 20°F.

Orography plays an important part in controlling the movement of the surface air. The prevailing westerly winds, wherever allowed access to the interior through gaps in the Coast Range, modify and practically control the temperature. On the other hand, when the movement of the surface air is from the north or northeast, there are marked föhn effects due to the passage of the air over the mountains and thence down into the valleys. One of the most trying climatic features of California is the so-called "norther" or hot wind, caused by dynamic compression of rapidly moving air. Northers occur in the great valley chiefly during May, June and July. Their occurrence is associated with the presence of high pressure over Oregon and Idaho and a deepening of the usual summer low over the valley of the Colorado. Under such conditions, afternoon temperatures rise to 43°C, 110°F, or even higher.

In the southern portion of the state there are winds of similar formation known locally as Santa Anas.

In all these cases the air has been dynamically heated and dried in its passage from the Great Basin southwest or south over the Sierra Nevada and thence down the western or southern slopes. The velocity of the wind sometimes exceeds ten meters per second (twenty miles an hour), and as much dust is carried, the conditions created are generally disagreeable.

During December and January under certain pressure distributions there are well-marked föhn effects in the counties south of the Tehachapi. Afternoon temperatures will exceed 80°. Morning temperatures, however, are low, owing to intense radiation.

We thus have the same pressure distribution resulting in cool nights and warm afternoons.

STATE DIVISIONS

For convenience in discussing the data, the state has been divided into five sections, bearing some relation to the principal watersheds. These divisions are:

Northwestern California
Northeastern California
Central California
California south of the Tehachapi
California east of the Sierra Nevada

NORTHWESTERN CALIFORNIA

This includes the coast counties north of the bay of San Francisco, also the Coast Range counties west of the Sacramento watershed. Beginning with Del Norte and the western half of Siskiyou counties, the district extends south including Humboldt, Trinity, Mendocino, Lake, Sonoma, Napa, and Marin counties. The four last named constitute a subdivision, known locally as the Bay counties. There are four small valleys in this subdivision, known as the Russian River, Sonoma, Napa, and Vaca Valleys.

The Coast Range runs north and south through the entire district and climatic conditions vary greatly within short distances, owing to the diversified topography.

The coast line is bold and rugged. There are many projecting headlands, the best known of which is Cape Mendocino, latitude 40°30′N. The well-known Point Reyes, latitude 38°11′N, longitude 122°51′W, is formed by a westward projection with a hook to the south, thus making an open roadstead, known as Drake's Bay. Francis Drake anchored here in June, 1579.

There are few harbors in the 290 nautical miles.* The following table gives the distance in nautical miles of the chief headlands:

San Francisco to Point Reyes	33 miles
Point Reyes to Point Arena	67 miles
Point Arena to Cape Mendocino	98 miles
Cape Mendocino to Eureka	23 miles
Cape Mendocino to Point St. George	78 miles

The Coast Range extends in a nearly north and south line the entire length of the district. The St. Helena Range is the best known of the several minor ranges. Mount St. Helena, elevation 4,600 feet, is situated at the intersection of Napa, Lake, and Sonoma counties. In the northern portion of the district there are many peaks exceeding six thousand feet. The range is there locally known as the Trinity mountains. Farther west are the smaller ranges known as the Scott mountains, Salmon Alps; and to the southwest the South Fork mountains and Elk Ridge. The Siskiyou mountains of Oregon extend southward into California.

The various ranges mentioned form watersheds for numerous small rivers. The streams of the eastern slope of the Coast Range drain into the Sacramento. In the north the Klamath river, and its tributary, the Trinity, drain the four northwestern counties, emptying into the Pacific ocean. The Eel River drains the Mendocino and Lake sections, flowing northwestward.

*A nautical mile is a minute of an average great circle. It is 800 feet (244 meters) more than a statute mile.

There are comparatively few lakes in this Section, the only one of any size being Clear Lake, in the center of Lake county.

The most noticeable climatic features of the coast district are the moderate temperatures, the frequent fogs and the high winds. The climate of the interior, *i. e.*, of the valleys back from the coast, is entirely different, as will be shown later. Few extreme temperatures are recorded, the highest temperature at Eureka being 29.6°C, 85.2°F on June 6, 1903, and the lowest, 6.7°C, 20°F, January 14, 1888. A good idea of the small temperature range is obtained from the statement that the mean of the maximum temperatures for a period of ten years at Eureka was 14°C, 57°F and the mean of the minimum temperatures, 9°C, 47°F. The evenness of temperature is due to two factors, viz: the proximity of the ocean, and the prevailing movement of the air in these latitudes from the ocean to the land.

The winds are, as stated above, generally west, but during the winter months, owing to the approach of barometric depressions from the north, high southeast winds occur. These winter storms, known locally as "southeasters," are the most important climatic features of this section. Heavy rains accompany these storms. During the summer months there are but few disturbances. The west winds, however, in the summer months blow steadily during the afternoon hours. Occasionally during the months of April, May and June these west or northwest winds reach high velocities. In a paper entitled "Some High Wind Records on the Pacific Coast," in the *Monthly Weather Review*, February, 1908, McAdie and Thomas give records covering high velocities obtained with northwest and southeast winds. On February 25, 1902, at Point Reyes, for two hours the velocity varied from 40 to 45 meters a second, 90 to 100 miles an hour, with an extreme velocity of 46 meters a second, 103 miles an hour, or a mile in thirty-five seconds. Again, on March 1, during a severe southeast gale there is a record of one mile in a little less than thirty seconds; and for five minutes, including the time of the extreme velocity, the miles averaged less than thirty-four seconds, or at the rate of 48 meters a second, 107 miles an hour. From May 15th to 20th, 1902, high northwest winds prevailed along the entire coast. At Point Reyes light, for the forty-eight hours ending midnight, May 18th the average velocity of the wind was 32 meters a second, 72 miles an hour. For the last twenty-four hours of this period the average velocity was 35 meters a second, 78 miles an hour, for the last twelve hours, 84 miles, and for the last six hours, 88 miles. The greatest wind movement recorded in any one hour was 164 kilometers, 102 miles. The maximum velocity for the storm was 49 meters a second, 110 miles an hour, at 8:50 p. m., May 18, and the extreme velocity 120 miles, at 8:38 p. m. The record of the whole period is complete and legible and of the 7,565 kilometers 4,701 miles shown, only 27 kilometers, 17 miles are interpolated, owing to the fact that the anemometer cups were carried away and this interval elapsed before a new set of cups could be put in place. The feat was performed by W. W. Thomas, at a time when the wind was blowing at the rate of 41 meters a second, 91 miles per hour.

The writer has found a reference on the old forecast charts at San Francisco to a record of 48 meters a second, 108 miles an hour from the southeast at Cape Mendocino, on January 22, 1886, at 7 A. M. There was also a note that a maximum velocity of 64 meters a second, 144 miles an hour from the southeast occurred at Cape Mendocino, on January 20, 1886.

In the paper referred to above can be found wind records for San Francisco, Point Lobos, Mount Tamalpais, Point Reyes, and a number of interesting accounts of the velocities experienced at sea by masters of various steamships and sailing vessels.

The month of May is as a rule the month of maximum air movement. A good illustration of the duration and strength of this northwest wind is afforded by the following table, showing velocities during May, 1903:

WIND MOVEMENT FOR MONTH

Stations in California	Total for month	Average daily	Greatest in 24 hours	Greatest hourly movement
Point Reyes Light........	24,072	776	1,673	88
Mount Tamalpais........	16,871	544	1,189	78
San Francisco............	10,040	324	517	34
Point Lobos..............	15,431	498	929	60
Southeast Farallon.......	17,331	559	1,185	58

A distinctive feature of the coast climate is the sea fog. The fog belt extends along the entire coast. During summer afternoons the depth of the fog stratum varies from 30 to 518 meters, 100 to 1,700 feet. Frequently the lower level of the fog stratum is 30 meters, 100 feet, or less above the sea or ground surface. Experiments in the vicinity of Mount Tamalpais indicate an average summer afternoon temperature of 27°C, 81°F, for the levels 2,300 feet, 700 meters, and above. At saturation this would mean over 11,000 grains weight of moisture per thousand cubic feet of space. The temperature at sea level is about 13°C, 55°F. At saturation this would mean nearly 4,900 grains of moisture per thousand cubic feet of space. The condition is therefore entirely different from some of the well-known fog formations on the Atlantic coast, where warm water supplies the necessary vapor, and fogs form when the north or northwest winds of lower temperature than the water favor condensation.* Kite experiments indicate that at the 1,000-meter, 3,280-foot level on summer afternoons there is a moderately strong flow of air from east to west. It would seem as if the heated air of the great valley, or some portion of it, moved seaward above the level of the incoming or east flow of the surface draught.

The climate of the counties back from the coast is, as previously stated, entirely different from the coast climate. These inland valleys are sheltered from the ocean winds and show a marked difference in temperature amplitude, and in humidity. While on summer afternoons the coast sections are cool and foggy, the interior sections are warm, dry, and with little wind stirring unless the wind is from the north, in which case it may be strong. A fair idea of the climate of the interior may be obtained from the records of the station at Upper Lake, kept by Charles Mifflin Hammond, coöperative observer, for a period of more than

*There are, of course, other fog formations where warm south winds blow over cool water surfaces.

twenty-five years. A temperature of 43°C, 109°F has been recorded once, July 31, 1909, and temperatures of 41°C, 105°F several times during midsummer months. The lowest temperature ever recorded was 9°C, 16°F, on December 18, 1908.

NORTHEASTERN CALIFORNIA

This section includes the northeastern counties, lying east of an imaginary line through the foothill section of the Coast Range and south to a line drawn from the northern side of San Francisco bay to Lake Tahoe. The counties in the district are Solano, Yolo, Sacramento, Placer, Nevada, Sutter, Colusa, Butte, Sierra, Plumas, Lassen, Shasta, Modoc, and the eastern portion of Siskiyou, Tehama, and Glenn. Practically it is the watershed of the Sacramento river and its tributaries. This is the principal river of California. The following note relating to the hydrography of the section is taken from a publication of the Weather Bureau, "Climatological Data of the United States by Sections" (Bulletin W) Data, Section 15:

"The portion of the drainage basin above Red Bluff, California, extends from the Trinity Mountains on the west to the Warner Mountains, near the California-Nevada state line, on the east. The watershed on the west from the Trinity Mountains is comparatively narrow, being only from ten to thirty-five miles in width, and furnishes a very small portion of the discharge of this river; but from the east, Pit River, which is the most important tributary, drains a large area extending about 120 miles east from Sacramento River between Mount Shasta on the north and Lassen Peak on the south. The greater portion of this basin is composed of lava and shows other evidence of volcanic activity, such as volcanic cones and craters. Nearly all the streams tributary to

Pit River have their origin in large springs, many of which discharge several hundred second-feet. The most important tributary of the Pit is McCloud River, draining the southeastern slope of Mount Shasta. It derives its waters principally from the melting of the snow on the high elevations of this mountain. The western portion of the watershed extending along the Trinity Range is well timbered, as is also that portion of the drainage area in the Sierra Nevada lying between Mount Shasta and Lassen Peak. Farther east, however, there is little or no forest covering, and the country is used extensively for pasturage."

The most prominent feature of the section is Mount Shasta, elevation formerly given as 14,380 feet, recently (1914) changed by the U. S. Geological Survey to 14,168 feet. The height generally given in atlases, school geographies, railway folders, etc., namely 14,444 feet is not correct. Shasta is one of the three great peaks on the Pacific coast south of Alaska, namely Mount Whitney, (14,502), Mount Ranier (14,408), and Mount Shasta.

South of Shasta lies Lassen Peak, elevation 3,184 meters, 10,437 feet. To the east and north is a large area extending to the Warner mountains with an average elevation of from four to five thousand feet. The most prominent peaks in this range are, Bidwell, 2,606 meters, 8,551 feet; Fandango, 2,392 meters, 7,848 feet; Cedar, 2,532 meters, 8,308 feet; Warren, 2,846 meters, 9,668 feet; and Eagle, 3,025 meters, 9,934 feet.

In the area between the Cascade Range and Warner Range are numerous lakes, of which the best known are Lower Klamath, Tule, Clear, and Goose lakes.

It is of some importance to understand clearly the orography of the district in order to obtain a better comprehension of certain well-marked climatic features. It is essentially a district of local climates, one in which marked differences are found in short distances and where the general air drainage system is modified by surface conditions. The terms northern and southern do not apply in describing the climate of this section, because the isotherms run north and south. Thermal conditions depend largely upon elevation and the sheltering influence of the mountains. A more appropriate classification of climate is that generally adopted by horticulturists, in which there are three general divisions, viz: valley, foothill and mountain. Professor E. J. Wickson, in the opening chapter of his book "California Fruits," aptly says:

"In climatic conditions affecting horticulture we have in California almost an epitome of the whole United States, with added climatic characters peculiarly our own."

In the summer months the general movement of the air is from the south. This is due to the prevailing westerly winds of these latitudes, so noticeable along the coast. The Coast Range acts as a barrier to the eastward flow of the air, and from observations made with kites and the study of the motion of the lower clouds it would appear that the surface current from the west during summer months is comparatively shallow and indeed is hardly noticeable above the 1,000 meter, 3,280 feet level. Some of this surface wind passes freely through the gap in the mountains, *i. e.*, through the Golden Gate, and is deflected north in the Sacramento valley. This constitutes the well-known south wind felt nearly every summer night and which materially moderates the heat of the valley.

During the long summer, mid-day, and afternoon temperatures are high. There is, for example, during the month of July, a difference of 8°C, 15°F, or more in the mean temperature of Sacramento and San Francisco; and a difference of 13°C, 25°F, between the mean temperature of San Francisco and Red Bluff. The temperatures are: San Francisco, 14.6°C, 57.3°F; Sacramento, 22.5°C, 72.5°F; Red Bluff, 27.8°C, 82.1°F. There are probably few localities in the world where there exists so marked a gradient in surface temperature. During the winter months the differences are less marked and there is practically the same temperature at the northern and the southern end of the valley. The following figures give the mean temperature for January: San Francisco, 9.7°C, 49.5°F; Sacramento, 7.6°C, 45.6°F; Red Bluff, 7.4°C, 45.4°F. The higher temperature at San Francisco is to be explained as due chiefly to its proximity to the ocean, the same cause operating also to give the lower temperature in midsummer.

The rainfall is rather evenly distributed, and on the same level the distribution both as to intensity and frequency is comparatively uniform. There is however a marked difference in the amount of rainfall at stations close together but differing in elevation. The amount of rain increases as one goes from the floor of the valley through the foothill section and up the mountain side, reaching a maximum at a height of about 2,000 meters, 6,560 feet. The records of the stations along the line of the railroad from Sacramento to Summit, covering a period of thirty-six years, show a steady increase in the quantity of rain caught by the gages of about

1cm., 0.4 inch, for every 11 meters, 36 feet, rise in elevation. The rate of increase is greatest about the 1,000-meter, 3,280-foot, level and becomes negative above the 2,000-meter, 6,562-foot level. At these high levels, however, much of the precipitation falls in the form of snow, and it is possible that with our present methods of reduction true values have not been obtained.

VARIATION OF RAINFALL WITH ALTITUDE

In the *Monthly Weather Review*, July, 1911, Charles Lee gives numerous diagrams showing the rate of increase of precipitation with elevation in various parts of California. Three sections of the Sierra Nevada are charted, the first known as the Central Pacific group, extending from Sacramento to Truckee; second, the Mokelumne section, extending from Stockton to Carson lake, about fifty miles south of the first group, and third, the Tuolumne group, extending from Merced to the southern end of Walker lake. The Fresno section then would constitute a fourth group, one still farther south. From all of them it appears that there is a definite increase in precipitation with elevation up to 1,500 meters, 5,000 feet, decreasing steadily above this. The average rate of increase is 8.5 inches, 215 millimeters, per 300 meters, 1,000 feet, 300 meters, up to 1,500 meters, 5, 000 feet.

East of the Sierra crest precipitation decreases rapidly with decrease in altitude, maintaining a constant rate to the 1,500-meter, 5,000-foot level and a decreasing rate below this elevation. The distance and precipitation curves conform to the profile in general shape, except that their maxima are west of the topographic crest, occupying the same relative position with respect to the Great Valley as the 1,500-meter, 5,000-foot level. They have a tendency to become horizontal over the level portion of the profile, to rise over western slopes below the 1,500-meter, 5,000-foot contour, to fall over western slopes above this, and to fall over eastern slopes. In other words, the general slope of the country seems to have more to do with the amount of precipitation than does altitude.

CENTRAL CALIFORNIA

The portion of California included under this head is bounded on the north by a line drawn from San Francisco to Lake Tahoe; on the east by the Sierra Nevada; on the south by a line drawn from Point Conception south of Bakersfield and including the Fern watershed; and on the west by the Pacific.

The most prominent features are the bay of San Francisco, that portion of the great valley known as the San Joaquin, and the coast valleys, embracing the Santa Clara, the Salinas and other smaller valleys.

The bay of San Francisco is one of the great harbors of the world. While there is a continuous water passage from the Pacific ocean to the delta formed by the Sacramento and the San Joaquin rivers, the bay is locally considered as embracing only the central and southern portions of the water surface; the northern portion being known as San Pablo bay, which in turn is distinguished from Suisun bay lying to the east and connected with the former by the Straits of Carquinez. The length of the bay proper, in a northwest and southeast line, is about forty-two miles; and the width varies from five to thirteen miles. At mean tide the area of the bay, exclusive of San Pablo and Suisun bays, is about four hundred and fifty square miles. The combined areas amount to about nine hundred square miles. The bay is connected with the Pacific Ocean by a narrow water passage varying in width from one mile to three miles and about six miles long. This is known as the Golden Gate. The city of San Francisco lies on the southern side of the Golden Gate, occupying the end of the peninsula, which is here about seven miles wide. The area occupied by the city amounts to about fifty square miles.

The climate of San Francisco is so out of the usual that it has attracted general attention.* There are certain noticeable features, such as the fogs and the low temperatures in midsummer, which are not found in such marked degree elsewhere. The climatic features of this city follow.

SUMMARIZED CLIMATIC DATA FOR SAN FRANCISCO

1. The monthly and annual mean temperature of the air. Jan., 49.2°; Feb., 51.3°; March, 52.1°; April, 53.8°; May, 55.7°; June, 56.3°; July, 56.4°; Aug., 57.0°; Sept., 59.1°; Oct., 58.5°; Nov., 55.2°; Dec., 50.2°; the annual, 56.6°.

2. The extent of the mean diurnal range of temperature for each month. Jan., 9.8°; Feb., 11.0°; March, 11.6°; April, 12.9°; May, 12.2°; June, 13.3°;

*See McAdie, *Climate of San Francisco*, U. S. Weather Bureau Bulletin 44, 1913. Reed, W. G., *The Rainfall of Berkeley, California*, Univ. Calif. Publ. Geog., 1913, *Vol. I, No. 2, pp. 63-79.*

July, 12.2°; Aug. 11.3°; Sept., 13.1°; Oct. 13.6°; Nov., 11.4°; Dec., 9.8°. Annual, 11.8°. The greatest diurnal range, Jan., 24°; Feb., 25°; March, 27°; April, 33°; May, 35°; June, 43°; July, 31°; Aug., 38°; Sept., 41°; Oct., 33°; Nov., 26°; Dec., 22°. The greatest diurnal range for the entire period, 1871 to 1911, 43°. This occurred on June 29, 1891. The maximum was 100° and the minimum 57°.

3. The mean temperature at two specific hours, namely, the early morning and mid-afternoon. At 6 a. m. the mean temperature is, Jan., 46°; Feb., 48°; March, 49°; April, 50°; May, 51°; June, 52°; July, 53°; Aug., 54°; Sept., 55°; Oct., 55°; Nov., 52°; Dec., 47°; annual, 51°. At 3 p. m., Jan., 53°; Feb., 56°; March, 57°; April, 59°; May, 60°; June, 61°; July, 61°; Aug., 62°; Sept., 64°; Oct., 64°; Nov., 60°; Dec., 54°; annual 59°.

4. The extreme limits or total secular range of the mean temperatures of the individual months: Jan., 54.8°-46.2°; Feb., 56.8°-47.8°; March, 57.2°-48.9°; Apri 58.2°-51.6°; May, 59.8°-52.6°; June, 62.4°-55.4; July, 61.6°-55.6°; Aug., 61.8°-56.4°; Sept., 64.6°-57.6°; Oct., 64.2°-56.6°; Nov., 59.0°-53.1°; Dec., 54.0°-47.0°.

5. The mean of the monthly and annual extreme temperatures and the resulting non-periodic range. Jan., 8.6°; Feb., 9.0°; March, 8.3°; April, 6.6°; May, 7.2°; June, 7.0°; July, 6.0°; Aug., 5.4°; Sept., 7.0°; Oct., 7.6°; Nov., 5.9°; Dec., 7.0°. The warmest year in 1890, with a mean annual temperature of 57.9°. The coolest year was in 1893, with a mean annual temperature, 54.3°, or an annual range of 3.6°.

6. The absolute highest and lowest temperatures that occur within a long interval of time. The absolute highest since 1871 is 101° on September 8, 1904; and the lowest 29° on January 15, 1888.

7. The mean variability of the temperature as expressed by the differences of consecutive daily means: These data are based upon records carrying six years, 1906 to 1911: Jan., 2.0°; Feb., 1.8°; March, 2.7°; April, 3.2°; May, 2.4°; June, 2.4°; July, 2.1°; Aug., 2.0°; Sept., 2.9°; Oct., 3.5°; Nov., 2.3°; Dec., 2.0°; for the year, 2.5°.

8. Mean limit or date of frost in spring and fall and the number of consecutive days free from frost.

During the past twenty years there has been no date when the minimum temperature of the air as officially recorded fell as low as 32°. Light frosts occur during the winter mornings, but no damage results.

9. The elements of solar radiation as measured by optical, chemical and thermal effects. No data available.

10. The elements of terrestrial radiation as measured by radiation thermometers. No data available.

11. Temperature of the ground at the surface and to a depth of one or two yards. No data available. Records of street temperatures are obtained by a kiosk in Union Square park and also on Montgomery street, near California street. In general the range is greater than the official exposure gives. Temperatures 2° to 3° higher are recorded in the afternoon and 3° or 4° lower in the early morning.

12. The monthly means of the absolute quantity of moisture in the atmosphere: Records covering one year, May, 1911, to April, 1912, give the following mean vapor tension, as determined from bi-hourly observations: Jan., .306 inch; Feb., .299; March, .266; April, .274; May, .290; June, .328; July, .365; Aug., .362; Sept., .364; Oct., .340; Nov., .283; Dec., .234; annual, .309 of an inch.

13. The monthly means of the relative humidity. The means as determined from 8. a. m. and 8 p. m. observations for 20 years, 1891 to 1910, are:

	a. m. %	p. m. %	mean %
January	87	75	81
February	86	72	79
March	85	70	77
April	80	69	74
May	86	71	78
June	89	77	83
July	92	82	87
August	93	79	86
September	88	73	80
October	86	71	78
November	85	71	78
December	84	73	78
Annual	87%	73%	80%

14. The total precipitation, by monthly and annual sums. The annual precipitation, period 1850 to 1911, is 22.71 inches. The seasonal precipitation, *i. e.*, from July 1st of one year until June 30, succeeding year, covering the seasons from 1849-50, to 1911-12, is 22.58 inches. The monthly amounts are Jan., 4.94;

Feb., 3.60; March, 3.35; April, 1.65; May, 0.72; June, 0.15; July, 0.02; Aug., 0.02; Sept., 0.30; Oct., 1.02; Nov., 2.55; Dec., 4.56.

15. The maximum precipitation per day and per hour. The heaviest precipitation on any one day occurred Jan., 28-29, 1881, from 11:08 p. m. 28th to 11:08 p. m. 29th, amount 4.67 inches. The next greatest 24-hour rainfall occurred on September 24, 1904, when 3.58 inches fell. The heaviest hourly rainfall occurred on September 23, 1904, 0.97 of an inch fell. In two hours 1.29 inches fell and in 16 hours and 15 minutes, 3.58 inches fell.

16. The number of days having .01 of an inch of precipitation, including dew or frost. The mean number of rainy days, period 1850 to 1911, Jan., 11; Feb.; 10; March, 11; April, 6; May, 4; June, 1; July, 0; Aug., 0; Sept., 2; Oct., 4; Nov., 7; Dec., 11; for the year, 67.

17. The percentage of rainy days in each month or the probability of a rainy day. Jan., 35%; Feb., 36%; March, 35%; April, 20%; May, 13%; June, 3%; July, 0; Aug., 0; Sept., 7%; Oct., 13%; Nov., 23%; Dec., 35%; for the year, 18%.

18. The number of days of snow with the depth and duration of the snow cover. Snow falls rarely in San Francisco. In the period of 41 years, 1871 to 1911, snow has fallen on 13 different dates. The greatest depth was 3.5 inches on December 31, 1882. The snow seldom lasts more than three hours. The longest duration was over night.

19. The dates of earliest and latest snowfall: The earliest date was December 31st and the latest, March 3d.

20. Dates of earliest and latest hail: The earliest hail fell in October and the latest in May. Hail-storms are infrequent. In 20 years, 1891 to 1910, 56 hail-storms occurred. Forty-two of these occurred in December, January, February and March. None occurred in June, July, August and September.

21. Data regarding thunderstorms. Thunderstorms are rare, in a period of 20 years there have been 28 storms, eight of which occurred in one year. December is the month of maximum frequency. The storms are of short duration and feeble intensity. Damage from lightning is trivial.

22. The amount of cloudy sky, expressed in decimals. The period 1891 to 1910, Jan., 5.2; Feb., 5.0; March, 4.8; April, 3.8; May, 4.0; June, 3.3; July, 3.8; Aug., 4.2; Sept., 3.6; Oct., 3.4; Nov., 3.9; Dec., 4.4; annual, 4.1.

23. Percentage of cloudiness by monthly means for three or more specific hours of observation. Data not available.

24. Thickness of the cloud layer or the amount of strong sunshine as shown by candle sunshine recorder. Data not available.

25. Number of foggy days or total number of hours of fog. The number of foggy days recorded in period from 1891 to 1910, with one year missing, is 450, or an average of 24 days per year.

26. Number of nights with dew, also the quantity of dew. No records of nights with dew have been kept and there are no instruments for recording the amount of dew. In the afternoon and night fogs are accompanied by more or less condensation on the streets. This wetting is particularly noticeable on the south sidewalks, during the summer months from 6 p. m. until 9 a. m.

27. The monthly means or total wind velocities or estimated wind force. Period 39 years, 1872 to 1910, except December 40 years, and April and May, 1906, portions of month: Jan., 5,282 miles; Feb., 4,990; March, 6,563; April, 7,260; May, 8,416; June, 9,118; July, 9,494; Aug., 9,047; Sept., 7,156; Oct., 5,792; Nov., 4,649; Dec., 4,952; annual, 82,704 miles.

28. The frequency of winds from the eight principal points of the compass, and the frequency of calms. Jan., N., Feb., W.; March, W.; April, W.; May, W.; June, W.; July, W.; Aug. W.; Sept., W.; Oct., W.; Nov., W.; Dec., N.; annual, W. There are few calms and these occur chiefly in the winter months.

29. The frequency of winds for each hour of observation and the diurnal changes. The most frequent direction at 1 a. m. is W.; 2 a. m., W.; 3 a. m., W.; 4 a. m., W., changing to S.W.; 5 a. m., W-S.W.; 6 a. m., W.-S.W.; 7 a. m., W.-S.W.; 8 a. m., W.-S.W.; 9 a. m., W.-S.W.; 10 a. m., W.; 11 a. m., W.; Noon, W.; 1 p. m., W.; 2 p. m., W., 3 p. m., W.; 4 p. m., W.; 5 p. m., W.; 6 p. m., W.; 7 p. m., W.; 8 p. m., W; 9 p. m., W.; 10 p. m., W.; 11 p. m., W.; midnight, W. The diurnal changes are most noticeable during the

winter months. In January the wind is south, from midnight until noon, veering to northeast from 1 p. m. to 3 p. m. and then becoming northwest. In February, the same change can be noticed except that the northeast winds begin at 9 a. m. and northwest at 1 p. m. During the late spring, the summer and fall the winds are steadily west. In November a shift to the south begins at 7 a. m., changing to northeast at 10 a. m., northwest at 1 p. m., and west at 3 p.m. In December the winds are light and variable from 1 a. m. until 3 p. m., mostly northeasterly. At 4 p. m. and through the balance of the day the winds are northwest.

30. Meteorological peculiarities of each wind direction, or the respective wind roses for temperature, moisture, cloudiness and rainfall. The north and northeast winds are accompanied by a higher temperature in the summer and fall and lower temperature in winter. These winds are accompanied by low vapor content or dry weather, little cloudiness and light rainfall if any. The east, southeast, and south winds are accompanied by rising temperature, increasing moisture, considerable cloudiness and rainfall. The rain beginning some hours after the commencement of the wind. The southwest winds are accompanied by moderate temperature, much moisture, cloudiness and rain. The west and northwest winds are accompanied by a fall in temperature, moisture above the normal, much fog and little rainfall.

31. The mean annual barometric pressure. At sea level the annual pressure, mean of 38 years, 1873 to 1911, is 30.027 inches (762.5 millimeters), 1017 Kilobars.

32. Total evaporation, daily and monthly, or some equivalent factor, such as the depression of the dew-point, combined with the velocity of the wind. Data not available.

33. Variations in the gases contained in the atmosphere. Data not available.

34. Impurities in the atmosphere, such as the number of dust particles and especially the number of spores or germs of organic life. No data; but it is known that large amounts of carbon and sodium chloride exist in the air within a few hundred feet of the ground. The impurities are largely due to imperfect combustion. Large quantities of smoke escape into the lower air. Fortunately the strong west winds carry the smoke and fog eastward over the water surface.

35. The proportions of ozone, peroxide of hydrogen and nitric acid. No data.

36. The electrical condition of the atmosphere. No data.

37. The sensation experienced by the observer, such as mild, balmy, invigorating, depressing, and other terms used to express the effect of the weather upon mankind. The climate is not mild or balmy; but rather invigorating, as a strong breeze from the sea stimulates. It may also be noted that the moderate temperatures are conducive to sleep and rest, especially during the summer. In this respect San Francisco differs from many of the great cities of the world. There is practically no period of the year when heat in any way interferes with the regular routine of life.

38. The number of storm centers that pass over a given locality, or the storm frequency, monthly and annually. Comparatively few storms pass over San Francisco. During the summer months the mean path of storm movement is far to the north. During the winter months the relative frequency is three storms per month although in nearly every year there is a winter month without any marked disturbance. The spring months average two storms per month, the duration and intensity decreasing as the season advances.

39. Frequency of severe local storms. High southeast or southwest winds occur frequently during the winter months. During other months winds seldom reach a velocity of 40 miles. The relative frequency of severe local storms in which the winds exceed 50 miles an hour is about two each winter season. In the past 20 years there have been three occasions when the wind reached 60 miles or more, namely, November 30, 1906, 64 northeast; March 1, 902, 60 south; December 23, 1892, 60 southeast.

40. The duration of twilight. There is less twilight than the normal for cities in latitude 37°to 38°, because summer afternoon fogs obscure the sky.

41. The blueness or haziness of the sky. The skies are seldom as blue as in the mountain section. There is considerable haziness. Occasionally after a prolonged southeast storm, the air is remarkably pure and the visibility excellent.

42. The number and extent of sudden change from warm to cold or moist to dry weather and *vice versa.*

There are few sudden changes, and the climate is on the whole one of the most equable in the United States. The temperature range is small and the only marked changes occur during the periods of high temperature. Under such conditions the temperature falls suddenly in the afternoon of the second or third day, the wind changing to the west and the fog coming in from the sea.

43. In addition to the above we may add the one general factor of air drainage, or ventilation. San Francisco is one of the best ventilated cities in the world. A glance at the table of mean hourly wind velocities will show that there is a steady supply of fresh air, air from the ocean; and during the summer afternoons or in other words when most needed, the supply is greatest. This strong surface draught removes impurities, prevents stagnant conditions of the air, and the existence of poisonous gases. It also prevents colonization of mosquitoes.

The effect of the moderate temperature, high and nearly uniform amount of water vapor and excellent ventilation undoubtedly contribute to health.

One other fact should be noted, namely that there is little if any loss of sleep during the night hours. It is seldom if ever too warm during the summer nights and on the other hand seldom too cold for comfort on winter nights.

SAN JOAQUIN VALLEY

Regarding the general climatic features of the San Joaquin valley, it may be said that the precipitation is lower than might be expected. There is a practically rainless period from May to September. In some seasons there are afternoon thunderstorms in the foothills and occasional light rains. The seasonal rainfall amounts to about ten inches in the central portion of the valley, and of this less than half an inch falls during the months of June, July, August, and September. The month of greatest rainfall is December, with an average of less than two inches. Notwithstanding the somewhat limited rainfall, the valley and foothill regions constitute the chief agricultural sections of the state. Apricots, cherries, almonds, walnuts, peaches, pears, plums, grapes, figs, and olives are grown most successfully. Citrus fruits of all kinds flourish in the foothill section. It may also be pointed out that this is the only section of the United States in which raisin-making is carried on.

The summer afternoon temperatures are exceedingly high. At Fresno a maximum temperature of 46°C, 115°F has been recorded; and temperatures of from 38° to 43°C, 100° to 110°F are not unusual in the midsummer months. Owing to intense radiation the diurnal range of temperature is large, the difference between the extremes frequently amounting to 20°C, 40°F, or more. During the winter months the temperature falls to the freezing point or below. The lowest temperature recorded at Fresno was 7°C, 20°F, on January 17, 1888. This was the coldest weather ever experienced in this section. Frosts occur frequently during the winter months; the first killing frosts occurring about the beginning of December, and the last about the end of March.

The prevailing winds are from the north and occasionally they are strong and do damage, especially during the first part of June when the wheat is about ready for harvest. The summer days are as a rule cloudless. During the winter months, under certain pressure distribution, a low-lying land fog forms during the night and morning hours. This stratum of ground fog is not very deep, often not exceeding 30 meters, 100 feet, and is confined chiefly to the river courses and bottom lands. The foothill sections are for the most part above these winter fog belts.

SALINAS VALLEY

The next largest valley in central California is the Salinas valley, which lies west and southwest of the San Joaquin. Beginning at the mouth of the Salinas river, on the southern side of Monterey bay, the valley extends southeastward through Monterey and San Luis Obispo counties, nearly one hundred miles, with an average width of ten miles. On the west side of the valley the Santa Lucia range rises with an average altitude of 1200 meters, 4000 feet. On the east side, the valley is bounded by the various minor ranges forming the western boundary of the San Joaquin.

The coldest month is January and the warmest July. In the central part of the valley the mean annual rainfall is less than 400 millimeters, 15 inches. There are years, however, when the amount exceeds 500 millimeters, 20 inches, and, on the other hand, there have been two years in a period of thirty-seven when the annual rainfall did not exceed 175 millimeters, 7 inches. Both of these were unusually dry years in California. The rainfall is fairly well distributed for agricultural purposes. In the summer months strong north winds prevail; but from November to March the prevailing wind is south.

The city of Salinas has a mean annual temperature of 13°C, 56°F. The highest temperature recorded was 36°C, 96°F, and the lowest 7°C, 20°F.

The Santa Clara valley lies between the Santa Cruz mountains on the west and the Mount Hamilton range on the east. The prevailing westerly winds, intensified by the formation of the Golden Gate, are deflected up the Santa Clara valley as strong north winds. There are well-marked differences in temperature and rainfall between the valley and the coast. The mean annual rainfall at San Francisco is about 600 millimeters, 23 inches, and at San José about 400 millimeters, 15 inches. In other words, in going south a distance of fifty miles there is a steadily decreasing rainfall, amounting to about eight inches in the distance named. The Lick Observatory is situated on Mount Hamilton at an elevation of 1,283 meters, 4,209 feet above sea level. The station is about fourteen miles east of the city of San José. The mean annual precipitation is about 800 millimeters, 32 inches, or nearly double that of the floor of the valley. Rain falls in every month of the year on Mount Hamilton, but the summer rains are limited to light showers. More than half the annual rainfall occurs between December and March.

San José, the county seat of Santa Clara county, and most prominent city in the valley, lies fifty miles south of San Francisco and about eight miles south of the lower end of San Francisco bay. The elevation varies from 24 to 30 meters, 80 to 100 feet above sea level, but within a few miles from the center of the city the foothills rise to heights exceeding 300 meters, 1,000 feet. The general movement of the air is from the north, and the valley is somewhat sheltered from the strong westerly winds prevalent on the coast. Summer fogs are not carried over the western hills, but hang in beautiful cascades along the ridge. There is a marked difference in the amount of bright sunshine during summer afternoons between the valley, especially that portion near San José, and San Francisco. Low winter fogs sometimes occur, but as a rule do not last long.

The mean annual temperature of the lower end of the valley is 14°C, 58°F. The coldest month is January, with a mean temperature of 9°C, 48°F, and the warmest month, July, mean temperature 67°. The highest temperature recorded is 40°C, 104°F, and the lowest temperature —8°C, 18°F.

CALIFORNIA SOUTH OF THE TEHACHAPI

This division embraces Santa Barbara, Ventura, Los Angeles, Orange, Riverside, San Diego, Imperial, and San Bernardino counties. The section is bounded on the north by the Sierra Madre, on the east by the Colorado river, on the south by Mexico and the Pacific, and on the west by the Pacific. The most important section is the San Gabriel valley. The principal city is Los Angeles, situated in a valley of the same name. The center of the city was originally eighteen miles from the ocean; but recent extension of the city's boundaries to include San Pedro makes the city a seaport. Within a distance of sixty miles there are many smaller cities and towns, of which may be mentioned Pasadena, Riverside, Redlands, and San Bernardino. The mountains to the north rise abruptly and form a wall varying from 1,500 to 3,000 meters 5,000 to 10,000 feet in elevation. Some of the best known peaks are Mount Lowe, elevation 1,042 meters, 3,420 feet, Mount Wilson, 1,770 meters, 5,800 feet, and San Antonio, commonly known as "Old Baldy," 3,070 meters, 10,080 feet. These can be seen from elevated places in the valley. On the eastern side lie the San Bernardino mountains, with an average elevation exceeding 1,800 meters, 6,000 feet. Some of the best known peaks in the range are San Bernardino, 3,075 meters, 10,360 feet and San Gorgonio, 3,196 meters, 11,485 feet, locally known as "Old Grayback," the highest peak in southern California.

The southern half of the whole district is drained by the Santa Ana river, which has its source in the San Bernardino mountains, traversing San Bernardino valley and breaking through the Santa Ana mountains between Rincon and Yorba, after which it is diverted for irrigation in the comparatively level lowlands around Orange, Santa Ana, Anaheim and Fullerton. The northern portion is drained by the San Gabriel river, which rises near the backbone of the Sierra Madre and flows westerly through various canyons, reaching lower levels near Azusa. It then flows southerly through the San Gabriel valley and the Los Angeles valley, emptying into the Pacific Ocean in a delta east of Long Beach. A third stream is the Los Angeles river, formed by a number of small creeks uniting east of Los Angeles and entering the Pacific west of Long Beach.

The topography favors a drainage of the air from the mountains seaward at certain hours and a return flood, or movement of the surface air from the sea inland at certain other hours. In other words, the conditions are extremely favorable for the development of air streams which reverse their direction at least twice in each 24-hour period.

In general the lower air flows to the southwest during the night and early morning hours and to the northeast during the afternoon hours. During the winter months when areas of high pressure pass over the Great Basin, the surface air apparently moves south, crossing the northern flank of the Sierra Madre and descending with some momentum into the great valley. The wind movement is particularly marked in the vicinity of the mountain passes, a good illustration being near Cajon Pass, 1,165 meters, 3,823 feet. During these so-called "northers," also locally known as Santa Anas, the temperature rises and the humidity falls. The existence of a low pressure area south of the valley of the Colorado seems to intensify the condition. Heavy frosts occur as a rule after a period of boisterous north wind; and are undoubtedly traceable to the displacement of the warm air of the valley by air that is not quite so warm, but remarkably dry and comparatively free from dust. During the stillness of the morning hours and before the return flow of air from the sea can be effective, the soil, which in places consists principally of river wash, coarse sand, and gravel, or else a light sandy loam, loses heat rapidly by radiation through the dust-free dry air; and it is not unusual on January mornings to have temperatures of about —3°C, 26°F in the orange orchards. At many points, especially in the lower lands, care must be taken to protect oranges and lemons from both the fall in temperature and the rather rapid rise which occurs about eight o'clock in the morning.

SAN DIEGO

In the extreme southwestern portion of the general division lies San Diego, located on the bay of the same name. The city is the oldest one on our Pacific coast. Weather records have been maintained for a period of sixty-two years. The climate of the city is described in detail elsewhere.* In general the rainfall is light, seldom exceeding 250 millimeters, 10 inches; and over eighty per cent of the amount falls between October and March. There is, however, a much heavier rainfall in the mountains to the northeast, and the annual rainfall at an elevation of 1,000 meters, 3,280 feet amounts to 1,500 millimeters, 60 inches. On the eastern slopes of the mountains the precipitation diminishes rapidly. In the Colorado desert, particularly that portion known as the Salton desert, the annual rainfall does not exceed 75 millimeters, 3 inches. There is, therefore, a marked variation in rainfall within comparatively short distances. It is worth noting that the heaviest rainfall for a short period, in the United States occurred in the form of a cloud burst in this section. On August 12, 1891, according to Archibald Campbell, coöperative observer, there fell at Campo, 409 millimeters, 16.10 inches during a storm of the "Sonora"

*Carpenter, Ford L., *The Climate and Weather of San Diego, California,* published by the San Diego Chamber of Commerce, 1913.

type. In the *Monthly Weather Review* for October, 1906, a description of this particular storm and other "Sonoras" is given by Campbell. The date, however, is incorrectly given as August, 1890, and the rainfall did not all occur within twenty-four hours. The twenty-four-hour rainfall was 292 millimeters, 11.50 inches. In a period of about eighty minutes 292 millimeters, 11.50 inches fell, so far as can be ascertained.

IMPERIAL VALLEY

The Salton Sink is a portion of an ancient lake, and it has been proposed by William P. Blake, who discovered the Salton Sink, that the original lake be named Cahuilla, as distinguished from the Salton Sea or present body of water, which does not rise to the ancient lake level, just as Salt Lake, for example, is known to be the remnant of the greater lake Bonneville. The area of the Salton Sea during its most recent period of expansion, 1907-8, was about four hundred square miles. The surface is approximately sixty meters, two hundred feet below mean sea level. Previous to the flooding the lowest point of the sink was 91.4 meters, 273.5 feet below mean sea level.

The valley lies to the south of the sea, extending to the Mexican line, and contains approximately half a million acres of highly fertile land, sloping gently from the south. The Colorado river about sixty miles east is tapped at several points, and a supply of water for irrigation purposes thus provided. The valley has now substantial agricultural interests. Cotton is one of the chief products of this section. Brawley, Imperial, El Centro, Holtville, and Calexico are incorporated towns.

The climate is one of high afternoon temperature and extreme dryness during the summer months. During 1911 the highest temperature recorded at Brawley was 45.5°C, 114°F on July 30th, and the lowest 20°F on December 24th. The annual mean temperature was 21.2°C, 70.2°F, the monthly mean for January, 54°F, and for July, 32.2°C, 90°F.

The rainfall at Calexico during 1911 amounted to 34.3 millimeters, 2.35 inches, distributed as follows: January, 11.9 millimeters, 0.47 inch; February, 22.1 millimeters, 0.97 inch; March, 3.3 millimeters, 0.13 inch; July, 8.4 millimeters, 0.33 inch; and October, 11.4 millimeters, 0.45 of an inch. As a rule little rain falls from the storms of the north Pacific. During the period from July to October occasional heavy rains occur in connection with the Sonora type of storm. The winds are mostly northwesterly in winter and easterly in summer.

During the overflow of 1907, when the Colorado river broke through an improperly built headgate and reached the Alamo and New rivers, thence flowing north into the Salton Sea, there was much discussion as to the effect which the newly formed or rather increased area of water would have upon the climate of the section, particularly in the matter of rainfall. Many held that there was an increase in rainfall, cloudiness and relative humidity. In the *Monthly Weather Review* for December, 1906, Professor A. J. Henry discusses the problem and comes to a decision in the negative.

OWENS VALLEY

There is a section of California lying east of the Sierra Nevada and north of the Sierra Madre to which the general name of Owens valley has been given, because of the lake and the river of the same name. The valley is about a hundred miles long, with an average width of twenty-five miles. The northern end has an elevation exceeding 1,200 meters, 4,000 feet, and the slope is to the south. The Owens river, from which the city of Los Angeles obtains its supply of water, is fed by a number of mountain streams, due to the snows of the high sierra. While the water of the river is fresh, the water of Owens lake into which it empties is too saline for potable purposes. The river channel lies close to the base of the Inyo mountains, which bound the valley on the east. Detailed description of the character of the valley floor, the run-off of the various streams, and the amount of water in the soil can be found in various papers published by the engineer corps of the Los Angeles Aqueduct.* Reference may also be made to papers in the *Monthly Weather Review* for January, 1910, by Charles H. Lee and A. B. Wollaber.

The best-known town in the section is Independence where weather records have been kept, but not continuously, since 1865. This section of the Great Basin has been known for many years as "the land of little rain."

*See annual reports of the Bureau of the Aqueduct L—a Branch of Public Works. Lee, C. H., *Water Resources of Part of Owens Valley, California,* U. S. Geol. Survey Water Supply paper 294, 1912.

At Independence, elevation 2,098 meters, 3,907 feet, the mean seasonal rainfall is 88.4 millimeters, 4.48 inches; at Bishop, 1,361 millimeters, 5.36 inches.

DEATH VALLEY

This valley lies partly in California (southeastern portion of Inyo county) and partly in Nevada (southern portion of Nye county).

A few years ago this portion of the old Great American Desert was accessible only by teams from Goldfield, Nevada. Now, however, the Tonopah and Tidewater Railroad traverses the section formerly dreaded, and in 1912 a coöperative station was established at Greenland Ranch, a few miles southwest of Ryan, which in turn is four miles southwest of Death Valley Junction on the Tonapah and Tidewater Railroad. Self-recording instruments for obtaining records of temperature and humidity are being installed and continuous records are now available.

The name Death Valley is given to this section because of the loss of a party of emigrants in 1849 and subsequent numerous deaths of prospectors. During the summer months afternoon temperatures frequently reach 49°C, 120°F. As in other portions of the desert, however, the nights are generally cool. The valley is below sea level, the lowest point thus far determined being 177 meters, 280 feet below.

Alexander McAdie

THE INDIANS OF CALIFORNIA

THERE are few types of mankind lower and more degraded in their native condition than the California Indians, and yet few that have exercised so profound an influence on the history of a civilized state as this aboriginal race. So tamely and completely have they given way to the superior white, that their survivors drag out an obscure, hardly known, and insignificant existence today on the fringes of the industry and prosperity to which they barely contribute. Yet all the earliest history of California revolved about them, and its entire pre-American period was shaped by Indian relations. Had the California natives been warlike raiders, or shrewd aggressive traders like so many others, the Spanish occupation of the state would have been first delayed and then run a far different course; the discovery of gold might have been postponed for years; and the rush of the Argonauts, the filling up of the land, its Americanization and development, with the attainment of its present status, would have been achieved under widely different conditions from those which the actual history reveals.

When Cabrillo in 1542 first sailed up the coast of California, almost simultaneously with the entry on the lower Colorado river of Alarcon, he found the Indians simple, poor, friendly, and approachable. Forty years later that remarkable mixture of buccaneer and gentleman, free-booter and patriot, Sir Francis Drake, added to his feat of being the first Englishman to circle the globe, the glory of being the earliest member of that nationality to explore the Pacific coast, and of leaving a record of the first English church service read on soil of what is now the United States—as commemorated by the impressive Prayer Book Cross surmounting a height in Golden Gate Park in San Francisco.

Drake spent a month and a half repairing his ship the *Golden Hind* in a harbor long believed to have been San Francisco bay, but now almost certainly identified as the inlet near Point Reyes known as Drake's bay. Like a prudent general, he built a fort for his little company; but his subsequent experiences proved this precaution needless, for the neighboring Indians, who came in great numbers, were so far from being hostile or even suspicious, that they regarded the English as gods, and offered them food and presents in sheer reverence and good faith.

The British hero has left a most interesting and exact account of his aboriginal worshipers. His descriptions of their feathered pendant-decorated baskets, strings of wampum, net-work bags, feather crowns, method of greeting, and devotions, accord exactly with the implements and customs of the tribes of today. Even the one or two words that he mentions from their language can be identified in idioms that still survive, and we know now that his native friends belonged to the coast division of the great Miwok family—a group of Indians that even in recent decades roamed over the slopes of Mount Tamalpais and dug shell fish along the estuaries of the Marin coast.

For nearly two centuries after Drake, California and its Indians remained almost unknown. Now and then the coast was touched, as by Vizcaino early in the following century; but little contact was achieved, and of that there remains slight record. With the suppression of the Jesuit missions in Baja California, and the handing over of their establishments to the Dominicans, while Alta California was allotted as a virgin field to the Franciscans, the real history of our California, and the first chapter in the story of the relations of its Indians with the race that was thereafter to dominate them, opens. In 1769 Junípero Serra blessed the site of San Diego, to be followed in two generations by the foundation of twenty other missions extending north to beyond San Francisco.

These church establishments, founded solely on account of the Indians, and in their behalf, determined the location for all time of San Francisco, San Diego, Santa Barbara, San Rafael, and other cities. They contained for many years the principal wealth of the territory; and their activities, more than anything else, shaped the course even of civil developments until the secularization in 1834. At first, indeed, the governmental administration was intended as little more than an arm of support for the propaganda. Only gradually, as the period of American annexation was approached, did political and economic considerations of the laity begin to overshadow the interest of the church in her dusky, simple-minded converts.

It is remarkable, and a tribute to the peace-loving nature of the Indians, how small a military force the vice-regal government of New Spain found it necessary to maintain in protection of the missions and their tempting wealth. Fifteen men not infrequently constituted the garrison of a presidio whose mission enclosed from a thousand to two thousand Indians, without counting their wild relatives who roamed at large. Such ease in maintaining order and rule has not been encountered by Europeans in their settlement of any other part of America, and reveals the sluggish, tractable character of the original Californians in its best aspect. Ninety thousand Indians were baptized, from first to last, at the twenty-one missions. More than a third of this number were to be found at any given moment, for a long duration of years, in their establishments.

For two centuries, including the whole of the California mission period, the Apache kept the Spaniard out of Arizona and parts of New Mexico, and terrorized time and again extensive tracts in Chihuahua and Sonora; yet the collective numbers of the various Apache tribes, in the heyday of their renown, probably never reached ten thousand. The retardation of the civilization and development of California, if this state had been afflicted with desperate raiders of the calibre of the terrors of the Southwest, is obvious; the events of '49, and of subsequent years, would have spelled a far different chapter of history from that which we now read.

On the whole, the Indian converts of the Franciscans in California seem to have been fairly satisfied with their new life. Regular and abundant meals, the possession of clothing, the excitement of occasional fiestas, a secure and even life, unquestionably compensated for a loss of personal liberty and the moderate amount of labor required of all. The prohibition of their native religious practices must indeed have seriously pained some of the older men, whose only recourse lay in a secret and stinted performance of their rites. It is known too that now and then stirrings of the natural human desire for untrammeled freedom agitated them; occasional escapes of bands are recorded. But a deputation of loyal Indians, armed with ropes, and led by a few soldiers, was always sufficient, if inaccessible mountain tracts were not too near, to bring back the recalcitrants in short order. True revolts hardly occurred, except for an attack on San Diego Mission in its early days, and an abortive uprising of the neophytes of the missions in what is now Santa Barbara county in 1824. One father exchanged his life for the blood and crown of martyrdom on the former of these occasions; and four white men, including, however, neither missionaries nor soldiers, were killed in the latter episode; but there is no record that even half a dozen soldiers suffered death in the occasional little campaigns and bloodless operations of more than fifty years.

The missionaries have at times been charged with the employment of compulsion toward their converts. Corporal punishment was in use. Discipline, while not severe, was unrelaxing, and obedience enforced, where moral superiority failed, by recourse to strength of arm. These are undoubted facts. But it is unfair to judge the eighteenth century by the standards of the twentieth, or to expect to find in the relations of a few civilized people with a fifty-fold more numerous native population, the social and legal equalities of a long settled community all of one race. Above all, the Franciscans were clearly actuated in the main only by motives of the Indians' welfare. They were saving their souls; and if in so doing, they held the

Indians strictly to duties that would both support them in comfort and decency and would maintain the establishments, they acted with economic wisdom and advanced the cause of civilization as well as the interests of their faith. Despots on a small scale Junípero Serra or his followers may well have been; but they surely were benevolent despots, and, what is more yet, disinterested. They gathered no profits themselves from their converts' labors. The mission lands and improvements were merely held in trust for the Indians, as they might be for children or wards. Such a course has been and is impossible under the democratic institutions of our federal government; but there is no doubt that had it been feasible, and applied, the Indian problem of the United States would have been handled with greater satisfaction, disposed of more quickly, and met on the whole with more fairness, than has actually been the case.

The Mexican government, too, although moved by animosity against the missions as religious establishments, planned decently for the Indians when its act of secularization was enforced in 1834. The mission lands were to be divided and allotted in severalty to the Indians, or sold for their benefit. This scheme unfortunately was entirely theoretical. In its execution, frauds were sometimes perpetrated upon the Indians, at the instance and for the benefit of the resident Spanish Californians. Where the Indians actually did receive their due in land, it was soon neglected and entirely abandoned, or passed in one way or another out of their possession into that of their more thrifty Caucasian neighbors. The prediction of the Franciscans was soon verified. The Indians were as yet incapable of proper independence or self-support in a civilized community, and a few years found them homeless, in abject poverty, scattered, and rapidly dying out, except where more fortunate bands had returned entirely to the old wild life.

Although low in the scale of advancement, ignorant of the art of agriculture, and for the most part of that of pottery making, without knowledge of construction in stone, and lacking in the picturesque totemism as well as the aggressive fighting spirit of more easterly and northerly tribes, the California Indians as a body displayed several notable peculiarities.

Their considerable numbers contrast with the scantiness of population in most other regions of North America. The earlier guesses of three quarters of a million are obviously wild. The more recent estimate of two hundred and sixty thousand made by a careful student, must also be regarded as too high. But even the most conservative figures place the number of the aboriginal Californians at from one hundred thousand to one hundred and fifty thousand. This is a light population compared with that which the state enjoys today, but it bulks heavily in view of the fact that according to the closest computations the total number of Indians in all America north of Mexico at the time of discovery was less than half the number of human souls at present in California. With a twentieth of the area of the United States, California, for all the deserts along its eastern border, held one-eighth the native population of the entire country. This superior density not only reflects the easier climatic conditions and geographical advantages; it also proves a social condition of comparative peace and quiet for many centuries before the coming of the white man.

Even more exceptional than the numbers of the Golden State Indians, was the diversity of their languages. One hundred and thirty-five dialects were spoken between the Oregon and Mexican boundaries. About a third of these idioms have become extinct, through the dying away of the tribes that knew them; the remainder survive in the mouths of from one to eight hundred souls each. Nor were these dialects all mere minor variations of one common mother tongue. Twenty-one or twenty-two groups or families were long ago made out, among which the totality of idioms could be properly distributed; and so different were these groups that their number remained undiminished, and they stood unimpaired before comparisons, for thirty years. It is only in immediate recency that prolonged analysis has finally succeeded in demonstrating the underlying similarities of several of these twenty-one families, and thus proving them akin. Even at that there remain six or eight groups, each composed of from one to fifty dialects, which are so dissimilar to one another that a separate origin, thousands of years ago, must be ascribed to each class.

Tribal divisions were even more numerous than tongues; but closer scrutiny reveals that in almost every case what were at first called tribes are in reality nothing more than villages, or "rancherías," as, following Spanish usage, they are still generally called.

In the absence of any federative principles or higher organization, these independent rancherías were the ultimate political units, and in one sense the tribes, of the California Indians. Of such village communities, each with its own chief, and each free to conduct war or negotiate peace at the will of its own members only, there must have been about one thousand in California.

A number of tribes in the larger sense, that is, groups of villages linked by similar speech, identical customs, and generally a common purpose, can however be distinguished; and of these, a mention of the more important may be worth while.

About San Diego, and named after its mission, were the San Diegueños, or, in Indian parlance, the Kamia, a group much less tractable than most others. To their east, on the Colorado river, dwelled their kinsmen the Cocopa, the Yuma, and the Mohave, even more renowned for a warlike spirit, and the only tribes in the state whose men today still wear their hair long. Following the coast northward, one encountered in the vicinity of the next three missions the San Luiseños, the San Juaneños, and the San Gabrielinos, the former still flourishing, the latter two virtually extinct. All of these were members of the great Shoshonean family, and distant relatives, in the remote past, of the renowned Aztecs of Mexico. In the Colorado desert were the Cahuillas, and north of them the Serranos, or "mountaineers." Still other Shoshonean tribes extended across the great Mohave desert past Death valley, and skirted the eastern flank of the Sierra Nevada, in part occupying also the higher portions of this great range, as far north as Oregon. These included the Chemehuevi and other Southern Paiute offshoots; the Kawaiisu; the Tübatulabal of Kern River; the Panamint, Koso, and Mono, identifiable by their names; and the Northern Paiute.

The great Chumash group ranged from Ventura to San Luis Obispo, and from Santa Cruz Island to Tehachapi. The Spaniards spoke of them as the "Indians of the Channel" of Santa Barbara, and reckoned them as more intelligent, polished, and wealthy than the other tribes of California. Mission life was quickly fatal to them, however, and scarcely a dozen survive. A group of unknown name, usually called "Salinan" from their habitat, have vanished almost as completely, while the Esselen, a little tribe of the coast south of Monterey, became totally extinct forty or fifty years ago. Still farther north, from Monterey to San Francisco, and inland to Mount Diablo, were numerous squalid and interrelated bands, many of whose local village names have been preserved, but for whom there is no generic name beyond the Spanish "coast-men," Costaños, corrupted into Costanoan in technical book English. A century and a third of contact with the superior race has proved fatal to this group also, and it is as good as gone.

In the interior the scythe of civilization began later to mow its harvest, and more numerous representatives remain. The great valley of the San Joaquin, from Stockton to Bakersfield, with much of the adjacent foothill territory, was the possession of the most widely spread of all the indigenous stocks, the Yokuts, whose name, like that of many other divisions, means nothing more than "people" in the original. Forty or fifty subdivisions were once comprised in this great group, the designations of some surviving in modern geographical terms: Chowchilla, Kaweah, Tache, Yokohl. The Sierra foothills from the Merced to the Cosumnes river were occupied by the Miwok, a much broken family, offshoots from which were found also in Marin and Lake counties. North of them, from Eldorado to Plumas counties, were the Maidu—also "the people"—while Lake Tahoe and adjacent tracts east of the great watershed belonged to the Washoes, a tribe of Nevadan rather than Californian affiliations and outlook.

The entire west side of the Sacramento valley, from Suisun Bay to Mt. Shasta, was occupied by the Wintun, with their southern branch the Patwin, an intellectually superior tribe, it appears, for from them nearly all their neighbors seem to have borrowed many of their religious institutions. Across the river from them, in Tehama and Shasta counties, were the Yana or Nozi, a dreaded and vindictive little people, whose stubbornness caused them to suffer greatly at the hands of the whites, and who were distinctive in many of their habits, especially in the remarkable peculiarity of possessing different dialects for their men and women.

On Pit river roamed the Achomawi; on Hat creek the Atsugewi; to the north, from Tule Lake into Oregon, the Modoc, a small tribe whose temporarily successful resistance to the federal soldiery in 1873 has made them famous; and in Siskiyou county the Shasta, whose name is perpetuated by that of the snow clad peak.

The Pomo were the dominant group of Sonoma, Lake, and Mendocino counties, populous, renowned for their surpassingly fine basketry, and still in their old haunts. Their northern neighbors, the Yuki or "enemies," were ruder, warlike, and of peculiar interest because both their speech and their physical type are unique. In a broken chain from Mendocino to Del Norte counties dwelled the Kato, Wailaki, Mattole, Chilula, Hupa, Tolowa, and others, all members of the great Athabascan family—original relatives, as evidenced by their language, of the far distant Apache and Navajo and of the still more remote Dene of Alaska.

In Humboldt county, finally, were three small but populous units, diverse in speech but similar in customs, and superior in the general level of their life and institutions to probably all the other aborigines of the state, except the before-mentioned Chumash. These were the Wiyot, the Yurok, and the Karok.

"Diggers" is a name that has been indiscriminately applied to nearly all these groups, until today it is in the estimation of the public at large the specific tribal name of the California Indians. Nothing, however, is more meaningless, and even misleading than this term. It was used originally, more as a derogatory designation than anything else, of the Shoshoni, Bannock, and other tribes of the Great Basin region, who eked out a scanty living in a half desert habitat by digging roots. So expressive of contempt, however, was the name, that it was readily extended, in 1849 and the days following, to the rude and passive natives of California, whenever a more fortunate Caucasian felt himself called on to give way to his feelings toward a people who were "best dead, anyway." The multiplicity of Indian divisions in California, and the lack of proper tribal designations for most of them, made the term a convenient one, even for those who did not share such sentiments; and it soon established itself in usage. It is, however, as unspecific in denotation as "Indian" itself; resembling in this respect the familiar "Siwash" of farther north on the Pacific coast—another term which is frequently but erroneously thought to be tribal in its force.

The name "Digger" is moreover misleading, since roots formed only an insignificant element in the food of the California aborigines. The staple was nearly everywhere the acorn, which was not only obtained in abundance, but, when leached by warm water of its tannic acid, is thoroughly nourishing and palatable. Seeds of grasses, sages, and herbs probably came next; then, according to location, either fish or shell-fish, or rabbits, squirrels, and other small game. Deer, elk, or antelope provided food only irregularly; and roots and berries were no more important. Lizards, snakes, snails, slugs, honey, yellow-jacket larvae, grasshoppers, caterpillars, and angleworms, were all relished by some tribes; but others refrained from these delicacies, and added to the list of tabooed foods the flesh of certain animals, which, like the bear, were thought to be too human for consumption, or, like the coyote and eagle were reverenced for the part they were believed to have had in the creation of the world. Dog meat, a tid-bit among eastern tribes, was everywhere in California thought to be the deadliest of poisons. Agricultural products, mostly corn, beans, and squashes, were raised and used only by the Yumas and Mohaves of the Colorado river bottom lands.

The food, and therefore the mode of life, of the prehistoric ancestors of our modern California Indians, was undoubtedly substantially the same for thousands of years past. This can be asserted confidently from the abundance of stone mortars and pestles—the typical acorn and seed crushing implements—which have been found at all depths of the soil, and in all parts of the state in countless numbers; in fact, are the utensils characteristic of the archeology of California. Other types of stone ware, arrow-points, knives, charmstones, sinkers, and so forth, occur; but these also have survived into the life of the modern natives in identical shapes; so that it is clear that there has been no significant evolution nor even retrogression in the customs and life of the indigenes during a long time past. Stone axes, for instance, stone war-club heads, and stone structures, all familiar to the antiquarian of the East or the Southwest, are completely wanting from the lowest as well as the highest relic-bearing strata of California; and are equally lacking from the life of the most recent generations.

Along the coast, especially on the ramified shores of San Francisco bay, numerous conspicuous landmarks of aboriginal occupation remain: the shell heaps. These moundlike deposits, representing the gradual accumulation of the food refuse of populations whose largest article of diet was shell-fish, are piled up, in some cases, to a height of thirty and thirty-five feet. Nearly all have their bases submerged from two to ten feet below present sea-level, proving a gradual submergence of the land—a deduction confirmed by geologists on other grounds—and, since such subsidence is normally very slow, indicating a long lapse of time since these sites first began to be occupied. Clam, mussel, and oyster shells, with an admixture of ash, pebbles, and earth, occasional lost or broken implements, and considerable numbers of human burials, make up the body of these "kitchen-midden" mounds; and it is interesting to note that each species of shell is most frequent in those deposits which were accumulated along the particular reaches of shore where the living mollusk of the same variety flourishes most abundantly today. The oyster beds of the immemorial past lay where they still lie.

The most careful computations of the size of the larger mounds as compared with the habits of life of their builders, and the geological subsidence, have led to an estimate of a lapse of at least three thousand years since these spots were first inhabited. This is not an antiquity so great as some parts of the world can boast. But it is interesting to reflect that San Francisco was inhabited, though but by primitive ancestors of Indians, when Solomon built his temple and Troy was sacked.

Shell beads have been discovered in many of these remains of the past, and indicate a use of money similar to that of the more recent tribes. The California Indian was notably avaricious. Military glory meant little to him; but the rich man was chief. For so many strings of shell money, one could buy himself a wife; for double the amount a woman could be secured who was of high caste, that is, descended from a wealthy family; and her husband's children would be of equally lofty social reputation. At the same price a murder could be compensated for in blood money. And when no such practical uses were necessary, the strings of shells still gave eminent prestige by their mere possession.

The religion of the Indians was far more complex than might appear at first sight. Innumerable ceremonies filled their days. At birth, at puberty, and at death, rites were performed; marriage alone was no sacrament. Among many tribes the young men went through a long and formal initiation before they could participate in sacred matters; but once admitted, they were thenceforth members of secret societies which almost suggest our Masonic orders.

Mourning ceremonies were even more spectacular, because public, and were accompanied not only by endless wailing and by long preachments, but by wholesale destruction of property in memory of the deceased.

The souls or "hearts" of the dead were supposed to never perish utterly, though a disagreeable fate might be in store for them if some religious ritual remained unfulfilled. Wickedness, however, was not believed to be punished except in this life, so that good and bad together went to the same shadow land, where food furnished itself and eternity was spent in dancing and festivities.

The legends of the various tribes evince a higher power of primitive speculation than might be anticipated in view of their being largely animal tales. Some of the traditions accounting for the origin of the world are not without a lofty strain in all their grotesqueness, and the solution of the ever-recurring problem of good and evil is at least attempted. The origin of death, for instance, is explained in many tribal legends in a form which lacks the moral element of the Biblical account, but resembles it in presupposing a time in the first beginning of the world when the ancestors of the human race were immortal, and in recounting that it was an error of some one that was responsible for the introduction of death into the scheme of things. In many legends the someone is stated to have been Coyote, who, not necessarily evil minded, but mischievous, heedless, and vain, is believed to have constantly tried to remodel the universe according to his own ideas. Sometimes, as when he stole fire, or sunlight, for the good of mankind, he was a benefactor; on other occasions, as when he released a flood, started a world conflagration, or chose perpetual death in place of the alternative of constantly renewed youth, his pranks and arrogance resulted as disastrously as the plottings of his Satanic counterpart, the Biblical serpent.

American contact has resulted in much the same status for the interior and northern tribes as Spanish influence had achieved for their brethren of the southern coast two generations earlier. The Indians lost their land, sickened, died like flies, and in the half-state between civilization and savagery in which they found themselves, were hard put to it to maintain themselves at all. The state government did nothing for them, except occasionally to authorize as militia such parties of settlers as might organize for the chastisement or wiping out of an obnoxious band of natives. Sometimes the settlers had ample provocation; sometimes the first just complaints came from the Indians, who, obtaining no hearing or redress, inflicted the retaliation which they thought called for, but which usually only brought still greater misery on their heads. The local history of California, in part still unwritten—and perhaps best so—is dotted with examples of individual and wholesale outrages of this sort during the fifties and sixties. In most instances it is perhaps impossible to decide who was most to blame; but in the end it was inevitable that the Indians, as the weaker party, suffered most. The conquerors had no great glory to gain; the events themselves are half forgotten, the scars they struck nearly effaced; and it seems wisest to draw the veil over this chapter of the state's history.

The national government, however, possessed both precedent and machinery for handling the Indian situation in the days of the pioneers. That it did not do so was inexcusable. Had the local tribes been warlike and predatory, had they inflicted exemplary injury on those who deprived them of their lands and often of their sustenance, a cry would have gone up that would soon have been hearkened to in Washington. But the settlers were schooled in self-reliance, and arranged difficulties to suit themselves; and the Indians had no spokesman before the great father.

Such attempts as the United States made to deal with the Indian problem were extraordinarily inefficient, and more feeble than in any other portion of the country. Bands of the most diverse origin and speech, divided by age-long antipathies, were assembled by commissioners and persuaded to assent to treaties which they did not understand and to cessions of land to which they laid no claim. In many instances the treaties were never ratified by the Senate, with the result that the Indians were dispossessed and received not even a pretence of a return. Such reservations as were arranged for, were mostly established without consideration of the customs, abilities, and enmities of the various tribes, and without provision for their support. The Indians kept running off; and finally most of these futile attempts were abandoned. In all California only four reservations continued to be maintained, counting the scattered little tracts of southern California hill land as one, as in effect they are; and these four contain arable land sufficient for the decent self support of possibly one-fourth of the shrunken present day population. With all the tremendous decrease of the last sixty years, California still ranks fifth in the number of its Indians—16,000; and yet no western state contains so little reservation land, in proportion to its area. A belated attempt was made in the last ten years to remedy the earlier oversights and neglect, congress voting some two hundred thousand dollars for the purchase of homes for homeless California Indians. This amount, wisely spent, has relieved some acute suffering; and has had the salutary moral effect of making the Indians feel that they were not being dealt only injustice.

In the main, however, they long ago solved their problem for themselves—by work. Not the steady, directed labor of the white man with an ambition and a future, it is true; but at least enough to show good intent and capacity, to keep themselves alive, and to earn a fair measure of respect from those of the dominant race who know them best. Hop-picking, fruit-gathering, haying, sheep-shearing, and general ranch work, more frequently for hire than on their own account, are their commonest occupations and in these they are sought. Such labors, performed in shabby civilized clothes, are not portrayed in cinematograph films and do not lend much color to romance. The California Indian therefore occupies a far less conspicuous place in the public mind than his showier and more imposing brother of the east. But he has made greater progress on the road to civilization; and substantially he already is, though but in an humble way, a useful, satisfactory, and willing member of the community and nation.

A. L. Kroeber

LAND TITLES IN CALIFORNIA

TO understand the land system of California it is necessary to go back to the colonization of the country. The establishment of missions in remote provinces was a part of the colonial system of Spain, and hence when the king ordered the military occupation of the province it was determined to establish three missions therein: one on the bay of San Diego, one on the bay of Monterey, and one at a point between to be selected by the expedition and to be named in honor of San Buenaventura, the good *doctor serafico* of Saint Francis and one of his successors as minister-general of the order. These missions were to be under the protection of presidios and others were to follow until the reduction of California was complete. The new establishments flourished and rapidly augmented their number until they extended from San Diego on the south to Sonoma on the north, occupying the whole territory of the coast, except the presidios of San Diego, Santa Barbara, Monterey, and San Francisco, and the three pueblos of Los Angeles, San José, and Branciforte; the limits of one mission forming the boundary of the next. After a time the governors began making grants of land to individuals—mainly retired soldiers, but these grants were made subject to the claims of the missionaries who held the land in trust for the use of their wards, the Indians. These grants were but few in number, and usually at a distance from the mission establishments within whose jurisdiction they fell. The consent of the priests was not always given. It was no part of their policy to promote colonization. In addition to the difficulty of obtaining land, trade with the colony was not permitted and the settler had no market for his product. Therefore it was that beyond a few retired soldiers California had practically no settlers. The missions grew and flourished but immigrants would not come notwithstanding the inducements of pay and rations offered. Colonel Costansó, the engineer who had come with Portolá in 1769, was sent to California in 1794 to investigate conditions and ascertain the reason for the lack of progress in the settlement of the country, and reported that the mission plan of colonization was a failure; that after many years the missions still remained in charge of the priests and mission guards; that there was a lack of population, and no ship owners on the coast. There were no inducements to the farmer and stock raiser, for no trade was permitted with either foreign or Spanish ships other than the regular transports.

Notwithstanding the liberal gifts of land, pay, rations and privileges granted to settlers in the three pueblos founded, only about thirty families could be obtained, and the rest of the *pobladors* consisted of retired soldiers and the descendants of soldiers.

There has been much misunderstanding in regard to the title to lands occupied or claimed by the missions. These lands did not belong to the church nor to the mission establishments as corporations. The absolute title to the land was vested in the crown, and the Indians were recognized as the owners, under the crown, of all the land needed for their support. All the missions in California were established under the direction and mainly at the expense of the government, and the missionaries there never had any other rights than to the occupation and use of the lands for the purpose of the missions, namely: to prepare the Indians that they might, in time, take possession of the land then held in common. This done, the missions were to be made pueblos and the missionaries returned to their convent. There never was any misunderstanding in regard to this principle, least of all on the part of the missionary priests, and it was understood that the missions existed at the pleasure of the political authority. On the 17th of August, 1773, the viceroy, Bucaréli, wrote to the comandante of California, as follows:

"When it shall happen that a mission is to be converted into a pueblo the comandante will proceed to reduce it to the civil and economical government, which, according to the laws, is observed by other pueblos of this kingdom; then giving it a name and declaring for its patron the saint under whose memory and protection the mission was founded."

The right, then, to remodel these establishments and convert them into towns and villages, subject to the known policies and laws which governed settlements of that description, we see was a principle of their foundation; the missions were disposable at the will of the crown or its representatives. This view of their purpose and destiny fully appears in the tenor of the decree of the Spanish cortes of the 13th of September, 1813, which provided: "That all the new reduciones y doctrinas of the provinces beyond sea which were in charge of missionary monks, and had been ten years subjected, should be delivered immediately to the respective ecclesiastical ordinaries, without resort to any excuse or pretext, conformably to the laws and cedulas in that respect." Also:

"That the missionary monks should discontinue immediately the government and administration of the property of the Indians who should choose, by means of their ayuntamientos, with intervention of the superior political authority, persons among themselves competent to administer it, the lands being distributed and reduced to private ownership in accordance with the decree of 4th January, 1813, on reducing vacant and other public lands to private property."

It was contemplated that in ten years from their foundation the missions should cease; that within that period of time the Indians would be sufficiently advanced in Christianity and the arts of civilized life to assume the position and character of citizens. Yet sixty-five years rolled by and found the missionary monks still in the government and administration of the property of the Indians, in possession of twenty-one great mission establishments, raising annually one hundred and twenty thousand bushels of wheat, maize, and other grains, ornamented and enriched with plantations of palm trees, bananas, oranges, olives, and figs, orchards of deciduous fruits, fertile vineyards, and in addition, vast herds of self-moving or live stock, valued, at current rates, three millions of dollars, and bringing enormous annual returns upon its aggregate amount, while thirty thousand Indians lodged in the mission buildings and contributed their labor to the production of this wealth.

In 1833 the Mexican congress ordered the secularization of the missions and in 1834 Governor Figueroa issued a reglamento providing for the distribution and management of their property.

After Mexico achieved her independence trade relations with the outside world were established and there soon came a demand for land, though not many grants were made until after secularization of the missions was begun. In 1824 the Mexican congress had adopted a liberal decree for the settlement of her provinces. Lands were to be granted to all who could make use of them, with preference for Mexican citizens, without distinction, except only that due to private merit and services rendered to the country. Comandantes of presidios made grants in the neighborhood of their presidios and alcaldes granted pueblo lots. The larger grants were made by the governors, and on a liberal scale. A square league (*sitio*), 4,438.56 acres, was the unit, and of these eleven (48,824.16 acres) could be granted to one individual. The theory of the eleven leagues was: one league of irrigable land (*tierra de regadio*), four superficial ones of land dependent on the seasons (*de temporal*), and six superficial ones for the purpose of rearing cattle (*de abrevadero*). The unit of the large grants was called a *sitio de ganado mayor*—a place for large cattle.

The instructions of Viceroy Bucaréli of 17th August, 1773, to the comandante of California relative to the reduction of a mission to a pueblo, also authorized the granting of lands either in community or individually to the Indians of the missions, to settlements of white persons, and to soldiers who should marry Indian women. Under this reglamento the first private land grant in California was made November 22, 1775, to Manuel Butron, a soldier of the Monterey garrison, in virtue of his military service and in right of his wife, Margarita, a daughter of the mission. It was for a piece of land one hundred and forty varas* square.

With the secularization of the missions and the development of trade came a great demand for land. To obtain a grant, the first proceeding was an application or petition to the governor, praying for the grant, specifying usually the quantity of land asked and designating its position, with some descriptive object or boundary, and also stating the age, country, and vocation of the petitioner, together with a rude map or plan of the required grant, called a *diseño*, showing its shape and position with reference to other tracts or to natural objects. Many of the later petitions, however, did not contain a *diseño*. The request was then referred to the proper authorities for information concerning the applicant and the land desired, called an *informe*, and if all was favorable, the grant was made by the governor in form, or by writing on the margin of the application "Let the title issue." The papers (*expediente*) were fastened together and transmitted to the territorial diputacion where they were entered in the record, a copy of all made and filed in the archives and the original delivered to the grantee for his protection, and constituted his title. There was no public or authorized surveyor in the country and there were not any regular surveys made of grants. The conditions of occupation with a certain amount of live stock and of building on the land within a year were generally added, and the grants usually contained a direction that the grantee should receive judicial

*A vara is 33 inches.

possession of the land from the proper magistrate (usually the nearest alcalde), and that the boundary of the tract should be designated by that functionary "with suitable landmarks." The latter injunction was usually more honored in the breach than in the observance. The reglamento of Felipe de Neve, governor of California, approved by the king, 24th of October, 1781, provided that each settler of a pueblo (*poblador*) should receive a *solar* (house-lot) of one hundred varas square and four *suertes* of two hundred varas each, for planting, together with the free use of the *dehesas* (pasture lands) and the rights of montes and aguas—the woods and waters. Each pueblo had, for the accommodation and use of future population, her *ejidos*—vacant suburbs or common lands—comprising, with the solares, suertes, etc., the four square leagues provided each pueblo of the Indies by decree of Philip II. The law of 1824 also provided for grants to *empresarios* or contractors, for colonies, but so far as I know none were granted. The McNamara grant (of 3,000 leagues), which did not go through, was the only attempt of this character.

Towards the end of Mexican rule the scramble for land was very great. It was believed that the loose bond which held California to Mexico would soon be broken and it was understood that the United States intended to acquire the province through the filibustero method. The opinion was freely expressed by the American newspapers that California would soon be United States territory; yet notwithstanding this, lands were freely granted to such Americans as complied with the requirements of law. In few cases were all the formalities of the law complied with, for land was cheap and the people and authorities indolent and careless. Sometimes there was no diseño, no informe of local officials, and no approval by the assembly. Boundaries were but vaguely described and occasionally, not at all. A grant would be made for so many leagues at a place indicated by name; or for a certain area "poco mas o'menos" (a little more or less) between defined natural bounds; or for a fixed extent to be located within certain larger bounds, the surplus being reserved.

As the Americans came in before and after the conquest they found large portions of the best lands occupied by Mexican grantees. This was, in the eyes of many of them, all wrong. As American citizens they were entitled to land. The big Mexican grant was to them an abomination. What right had any man to claim fifty thousand acres of land? Hadn't they fought for the country, and hadn't the Mexican grants lapsed with the conquest? At least many of them acted upon that principle, and associations of squatters were formed and adopted laws granting to each member the right to preëmpt one hundred and sixty acres of any land that was vacant, or what they chose to consider vacant.

In 1849, Henry W. Halleck, captain of engineers and secretary of state, reported to Governor Mason the condition of land titles in California, in which he found that many of the provisions of law regarding the granting of lands had not been complied with and expressed the opinion that some of the alleged grants were forged or antedated.

In July, 1849, William Carey Jones, an adept in the Spanish language and a lawyer skilled in Spanish colonial titles was commissioned by the secretary of state to proceed to Mexico and to California and procure information as to the condition of land titles in California. Jones went first to California, by way of Panama, and after careful and searching examination of land matters proceeded to the city of Mexico. His report dated April 10, 1850, is a model of clear, concise statement of conditions. He found that much of the coast country, lying west of the Sacramento and San Joaquin valleys and south of Sonoma was covered with private grants, but he was convinced that when the country was surveyed extensive and valuable tracts would be found remaining after leaving to every grantee all that his grant called for; besides which was the vast region north of Sonoma, the valleys of the Sacramento and San Joaquin, and the gold region of unknown extent along the foothills of the Sierra Nevada. "The grants in California" the report says, "I am bound to say, are mostly perfect titles; that is, the holders possess their property by titles that, under the law which created them, are equivalent to patents from our government; and those which are not perfect—that is, which lack some formality or some evidence of completeness—have the same equity as those which are perfect, and were and would have been equally respected under the government which has passed away. Of course I allude to grants made in good faith, and not to simulated grants, if there be any such, issued since the persons who made them ceased from their functions in that respect." The report says that any measure calculated to discredit, or cause to be distrusted the general character of the titles in California, besides the alarm and anxiety which it would create among the ancient population and among all present holders of property, would also retard the substantial improvement of the country. The commissioner suggests an authorized survey of the grants would be sufficient to protect the interests of the United States and all classes of Californians, the government reserving the right to take legal steps against suspicious titles.*

In March, 1851, Congress passed a bill, introduced by W. M. Gwin, to settle land titles in California. It provided for a board of three commissioners before whom every claimant under a Spanish or Mexican title must, within two years, present his claim with the documentary and other evidence on which he relied. Either party might appeal to the district court and from its decision to the supreme court. All lands for which claims were rejected or not presented were to be regarded as part of the public domain. Benton earnestly opposed the bill, protesting against the plan of a commission as a violation of the spirit of the treaty of Guadalupe Hidalgo, and declaring that to oblige the Californians to defend their titles before three tribunals would amount to confiscation instead of the promised protection.

The board organized in December, 1851, in San Francisco and opened its sessions in January, 1852.

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*According to the Geological Survey the land area of California is 99,898,880 acres, of which 20,000,000 acres is arable land. The Spanish land grants covered about 8,500,000 acres.

With the exception of one term in Los Angeles in 1852, the sessions were held in San Francisco until the final adjournment in 1856. In all, 813 cases were presented; 612 claims were confirmed; 178 were rejected, 19 discontinued, and 4 were still pending in 1880, twenty-nine years after the passage of the law, according to the official report to the 24th session of the California legislature.

The ninth article of the treaty of Guadalupe Hidalgo provides that Mexicans who remained in the ceded territories of New Mexico and California and became thereby citizens of the United States should be "Maintained and protected in the free enjoyment of their liberty and property." All the tribunals before whom the Californians were required to prove their titles were to be governed in their decisions by this treaty, the law of nations, the laws, usages, and customs of the government from which the claim was derived, the principles of equity, and the decisions of the supreme court of the United States, so far as they were applicable. That substantial justice was ultimately done, so far as the validity of the grants was concerned, can hardly be denied, but just the same, the Californians lost their lands in the process of defense, as Benton stated would be the case if the land commission bill passed. The injustice of requiring a proprietor who had been in possession for ten, twenty, or thirty years, whose right was well known and had never been disputed, to appear before a court whose proceedings were strange and whose language was unknown to him, and produce the documentary proof of his title—documents he may have lost, or perhaps never had—

will be readily understood. His opponent was the powerful United States of America who could and did employ the most astute lawyers to fight him, and who took advantage of every petty technicality and legal quibble to defeat his claim. To such an extent was this carried as to cause severe strictures from the supreme court. Says Justice Grier (United States vs. Johnson): "Nor is it a part of the duty of council representing the government to urge microscopic objections against an honest claimant, and urge the forfeiture of his property for some oversight of the commissioners in not requiring proof according to the strict rules of common law." Justice Field in United States vs. Auguisola says: "The United States have never sought by their legislation to evade the obligation devolved upon them by the Treaty of Guadalupe Hidalgo to protect the rights of property of the inhabitants of the ceded territory, or to discharge it in a narrow and illiberal manner. * * * They have desired to act as a great nation, not seeking, in extending their authority over the ceded country, to enforce forfeitures, but to afford protection and security to all just rights which could have been claimed from the government they superseded." Justice Swayne in United States vs. Moreno says: "A right of any validity before the cession was equally valid afterwards, and while it is the duty of the court, in the cases which may come before it, to guard carefully against claims originating in fraud, it is equally their duty to see that no rightful claim is rejected. No nation can have a higher interest than the right administration of justice."

Such opinions illustrate the lofty integrity of the supreme court and add lustre to the names of those who composed it.

By questioning the title the law made the land hard to sell and the owner in order to raise money for taxes, support, and defense was obliged to part with a good portion at a fraction of its value, and thus vast tracts fell into the hands of lawyers and speculating land sharpers. The result concentrated in a few hands a great part of the agricultural lands and worked great detriment to the development of the state, while to the individual Californian the result was disastrous. If the land commission decided in his favor, the government agent usually appealed to the district court and thence to the supreme court at Washington; the struggle for "protection" lasting anywhere from five to twenty-five years and long before a final decision was reached the once wealthy proprietor was a beggar. The case of Mariano Guadalupe Vallejo will illustrate this. In the early forties General Vallejo was the richest man in California. A man of magnificent proportions, handsome, proud, and dignified, he was a ranchero prince, living on his great estate, and entertained all visitors to California with unbounded hospitality. A warm and consistent friend of Americans, he advocated their cause in spite of the abominable treatment he received at the hands of the Bear flag party. In his History of California (MS) he testifies that his grant of the rancho of Petaluma was not finally confirmed until 1875, after he, tired of fighting squatters and lawyers, had given up his rights to the land. His claim to Rancho Nacional Soscol was rejected by the supreme court on the ground that he had bought it from the government—that the governor had no power to sell public land. He could give it away for nothing but could not exchange it for food and clothing for his soldiers; a most unjust ruling. In this case Justice Greer, dissenting, said: "I cannot consent, by my silence, that an inference should be drawn that I concur in the opinion just delivered. I cannot agree to confiscate the property of some thousand of our fellow-citizens who have made purchases under this title and made improvements to the value of many millions, on suspicion first raised here as to the integrity of a grant universally acknowledged to be genuine in the country where it originated. * * * This government has bound itself by a solemn treaty to respect all just claims which the citizens of California held at its date. I shall not comment on the good faith with which this obligation has been observed, or whether it was acting in good faith to these new citizens to compel every owner of a grant or title under Mexico to enter into a long and expensive litigation beginning at home and ending here; a litigation, too, with one who paid no costs, while it was ruinous to the claimant, who, if he retained one-half for himself, when successful, was considered fortunate. Instead of protecting their possessions, they were, in many instances, left a prey to squatters and champertous attorneys. * * * In a country where land had no value, where it was freely given to all who asked, without money and without price, in amounts not to exceed fifty thousand acres, it will be supposed that there were few cases to be found where the government could raise money by the sale of it. This is, perhaps, the only case to be found where such a sale has been made. The laws of 1824 and 1828 were colonization laws; they regulated grants of land made for this purpose. * * * This sale to Vallejo was not a colonization grant nor were the regulations of 1824 and 1828 applicable to it. * * * That there was a sale by the governor of California for a consideration paid, when the governor could find no other way to raise funds for the support of the government is satisfactorily proved. It was a matter of general notoriety at the time. The copy of a letter from the governor to the grantee accompanying the title is found among the archives. * * * But we are about to forfeit the title on the ground that the governor, though he might give away land to any amount, had no authority to sell it for money. It is assumed that because there was a special power given by statute to grant to colonists, therefore he had no other power. This court has frequently decided that the authority of a governor to make such a grant will be presumed from the fact that he did make it and that it lay upon those who deny the power to prove the want of it. * * * If this treaty is to be executed in good faith by this government why should we forfeit property for which a large price has been paid to the Mexican government, on the assumption that the Mexican government would not have confirmed it but would have repudiated it for want of formal authority? Vallejo was an officer of the army, high in the confidence of the government. His salary as an officer had been in arrears. In a time of difficulty he furnished provisions and money to the government of the territory. How do we know that

Mexico would have repudiated a sale of 80,000 acres as a robbery of its territory, when any two decent colonists having a few horses and cows, could have 100,000 for nothing?

"I believe that the Mexican government would have acted honestly and honorably with their valued servant, and that the same obligation rests on us by force of the treaty.

"Now that the land under our government has become of value these grants may appear enormous; but the court has a duty to perform under the treaty which gives us no authority to forfeit a bona fide grant because it may not suit our notions of prudence or propriety.

"We are not, for that reason, to be astute in searching for reasons to confiscate a man's property because he has too much. Believing, therefore, that in the case before us the claimant has presented a genuine grant for a consideration paid, which the Mexican government would never have disturbed for any of the reasons now offered for confiscating, I must express most respectfully, my dissent."

I have quoted at some length from the opinion of this great jurist because his argument seems to me to be unanswerable. In 1863 congress, by special act, provided that actual purchasers under the Vallejo title should have the preference to enter the land at one dollar and twenty-five cents an acre. The grant covered the towns of Benicia and Vallejo.

Thoughout the long period of litigation the squatter influence was very great. They elected legislatures, senators, and congressmen; judges and court officials;

THE DISEÑO OF THE SAN ANTONIO RANCHO

Granted by Don Pablo Vicente de Sola, Governor of California, to Sergeant Luis Peralta, August 18, 1820. The grant was by metes and bounds and was for 11 leagues (44,800 acres) in what is now Alameda county, covering the sites of Oakland, Alameda, and Berkeley.

Mexico would [illegible] a title of 80,000 acres as a [illegible] of the [illegible] two dozen colonists having a few horses and cows, could have 100,000 for nothing.

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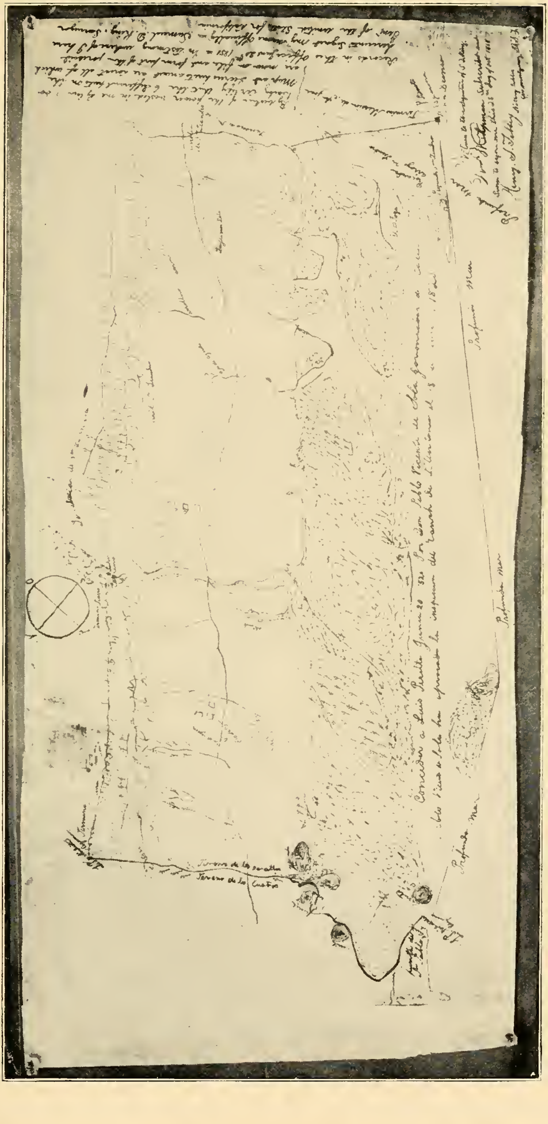
Throughout the long period of litigation the squatter influence was very great. They elected legislatures, senators and congressmen; judges and court officials;



they formed a secret league and sometimes opposed an armed force to legal ejectment. At San Antonio (East Oakland) a mounted cannon in the plaza with its squad of armed men was pointed out as the evidence of title by which they held the land, and to such an extent were the operations of the squatters carried that Domingo Peralta was arrested, put in jail, and made to pay a heavy fine for attempting to drive some trespassers off his property.

The working of the land law of 1851 was oppressive and ruinous. Seven-eighths of the claims submitted to the commissioners were valid and genuine titles, yet as a rule the proprietors lost all their possessions in the effort to save them. Their lawyers took immense fees in land and cattle. They became immensely wealthy while their clients were reduced to poverty. They were also in some cases, accused of aiding and abetting the plundering of their clients. A noted case in point is that of the San Antonio Rancho, granted in 1820 to Luis Peralta, a sergeant of the San Francisco presidio. This grant was for eleven leagues; it covers the sites of Berkeley, Oakland, and Alameda, and was, perhaps, the most valuable grant made in California. In 1842, Don Luis divided the property among his four sons and confirmed the division in his will of 1851.* The story of this grant is a long one and I intend some day to write it up. Squatters occupied the rancho, killed the Peraltas' cattle and "preëmpted" their land. A false survey was made cutting off some seven thou-

*Land granted to citizens was not subject to execution for debts of grantee; was descended from father to son, and involved feudal liability such as bearing of arms, etc. Land was seldom granted to women.

sand acres of redwood timber and all of the water front. The diseño of the original survey, by Lieutenant Martinez of the San Francisco presidio, shows the lines on the bay running to deep water (*profunda mar*) at the island of Yerba Buena, and those on the north to the summit of the Sierra de Contra Costa. The patent was never given to the Peraltas until after the death, not only of Don Luis but of his four sons. Their lawyer, now a very old man, is still living. His wealth is estimated at seven millions. The descendants of the original proprietors are living in poverty.

Not only were the Californians stripped of their property but they were robbed of their good name. "Give a dog a bad name and hang him." Unjust and cruelly false statements were made concerning the Spanish citizens, their government, their officials and all pertaining to them, until the Americans, with the prejudice of the Anglo-Saxon against the Latin race, came to look with suspicion on everything that was Mexican and some even believed that a Mexican had no rights that an American was bound to respect. Nor was this prejudice restricted to Americans living in California. In the case of the United States vs. Argüello, Justice Daniel said: "It can hardly admit of a rational doubt in the mind of any man who considers the character of much of the population of the late Spanish domain in America—sunk in ignorance, and marked by the traits which tyranny and degradation, political and moral, naturally and usually engender—that proofs, or rather statements, might be obtained, as to any fact or circumstance which it might be deemed desirable or profitable to establish."

What a statement for a learned justice of the supreme court of the United States to make concerning a people of whom he knew little outside the statements of those who wished to despoil them!

The Honorable Jeremiah S. Black, attorney-general of the United States, in a report to the president in 1860 on California Land Titles, says: "The archives thus collected furnish irresistible proof that there had been an organized system of fabricating land titles carried on for a long time in California by Mexican officials; that forgery and perjury had been reduced to a regular occupation; that the making of false grants with the subornation of false witnesses to prove them, had become a trade and a business."

In a series of letters published by William Carey Jones, the writer severely criticised the attorney-general's statements and theories, exposed with skill and fairness some of Black's blunders and false pretensions, and said: "If the matter shall ever be strictly examined, it will be found that the various acts of congress in relation to the claims to land in California, and the way that those acts have been administered, have had the effect in a large degree to substantiate what is false and discredit what is true." There is no doubt that many simulated grants were presented to the commission and in such a way as to deceive the very elect. The American occupation, and in particular, the discovery of gold, had made the land valuable, and in ignoring testimony regarding years of undisputed and notorious occupation, as was done in many cases, the government opened the door to fraud. All sorts of claims never before heard of were presented for confirmation; the testimony of Mexicans of the lower sort was used to strengthen bogus grants, and some well known and prominent Americans found the graves of their reputations in the land commission and in the United States district court. The astute attorney-general and the learned jurist should not have limited their strictures to men of Spanish blood.

The land act by unsettling land titles and causing ceaseless litigation worked disaster to California. Had the genuine grants been promptly confirmed and patented large tracts of the best lands would naturally have been sold in small divisions to settlers. As it was, the estates passed for the most part into the hands of speculators. Had the recommendations of Jones for the prompt survey and patent of well-known valid grants been followed, it would have been well for the country. The doubt, uncertainty, retarded progress, litigation, with its legacy of hatred, destruction of property, and bloodshed, resulting from the operation of the law would have been avoided. Josiah Royce says of the land act: "The devil's instrument it proved to be by our friendly coöperation, and we have got our full share of the devil's wage for our use of it."*

*Royce, *California, p. 469.*

Zoeth S. Eldredge

THE "MORMONS" IN THE HISTORY OF CALIFORNIA

THE activities of the "Mormons" or Latter-day Saints in the history of California, antedate for the most part the admission of this commonwealth into the American Union. For this reason I have chosen to take a larger view of the subject than one suggested by existing boundary lines. California, up to February, 1848, was a Mexican province, comprising the present states of California, Nevada, and Utah; here named in the order of their elevation to sovereignty. Any important happening, therefore, within that general area, prior to the time when it was ceded by Mexico to the great republic, may properly be regarded as an event connected with the history of the Golden State. In fact, the period might be extended to September, 1850, when divisional lines were drawn by congress, the territory of Utah organized, and California admitted into the Union; the boundary between these two sections of the original domain being fixed in the Sierra Nevada.

BRANNAN AND THE "BROOKLYN"

The first "Mormons" to set foot upon the coast of California, came by sea from New York, around Cape Horn, to the Bay of San Francisco. This was in 1846. They sailed on the ship *Brooklyn*, leaving New York early in February, and landing at Yerba Buena (now San Francisco) on the last day of July. They numbered two hundred and thirty-five men, women, and children, and were under the leadership of Samuel Brannan. The company was well supplied with farming implements, mechanics' tools, and all the equipment necessary for a new settlement, which they proposed to found somewhere on the Pacific coast. These colonists, who were probably the first American sea-faring immigrants to reach California, carried with them a printing press, type, paper, and other materials, with which they afterward published "The California Star," the second newspaper established in the province. Brannan in New York, had edited a paper called "The Prophet," published in the interest of the Latter-day Saints. He and his associates put up a printing office, and issued a copy of the "Star," within fourteen days. The company settled on the San Joaquin river, where they plowed, put in crops, and built houses of adobe, or sun-dried brick.

A MODERN EXODUS

The departure of the *Brooklyn* company from New York was incidental to a general westward movement on the part of the Church of Jesus Christ of Latter-day Saints, commonly known as the "Mormon" Church, which was then in its sixteenth year, and had its headquarters at Nauvoo, Illinois, on the east bank of the Mississippi river. Prior to the exodus from Illinois, the Church had migrated successively from three other states of the Union: namely, New York (where it had its origin), Ohio, and Missouri. The removals from Missouri and Illinois were compulsory, resulting from religious and political differences between the Latter-day Saints and other inhabitants of those states.

In Illinois the Saints had prospered for a season, purchasing lands, building cities, establishing schools and newspapers, erecting a temple, sending missionaries

BRIGHAM YOUNG

Brigham Young, born at Whitingham, Vermont, June 1st, 1801, joined the "Mormon" Church at Mendon, New York, in 1832, and became its leader at Nauvoo, Illinois, in 1844. He directed the exodus, or western migration of his people, and from July 1847, when he entered Salt Lake Valley, to the day of his death, August 29, 1877, the life of this famous Pioneer forms the backbone of the history of Utah, the State that he founded.

through the United States, to Canada, and to Europe, and starting thence a stream of emigration that has done much to people, with the bone and sinew of Great Britain, Scandinavia, and other countries, the region of the Rocky mountains. The significance of this emigrational movement, from the "Mormon" point of view, is the gathering of scattered Israel, in fulfillment of ancient prophecy—a step preparatory to the second coming of the Messiah. In and around the city of Nauvoo, these proclaimers of a new gospel dispensation gathered to the number of about twenty thousand. Then came a repetition of their former painful experiences. Joseph Smith, the founder of the Church, born at Sharon, Vermont, December 23, 1805, fell a victim to mob violence at Carthage, Illinois, June 27, 1844. His brother, Hyrum Smith, was slain at the same time.

This double tragedy, supplemented by the fiercest kind of opposition, including house-burnings and other depredations, brought about the exodus from Illinois, and the pilgrimage into the wilderness. That exodus had been contemplated by Joseph Smith, who, shortly before his death, had begun to plan for the removal of the Church into the great west. He had even organized an exploring expedition to the Rocky mountains, designated by him as the future home of his people. The execution of the project fell to his successor, Brigham Young, and the men surrounding him.

The Latter-day Saints began to leave Illinois about the first of February, 1846. Many of them crossed the frozen Mississippi on the ice. Most of their wagons were drawn by oxen, and some were driven by women and children. Moving slowly, and founding temporary settlements along the way, about the middle of June the first companies reached the Missouri river, and encamped at Council Bluffs, on the Pottawattamie Indian lands. There was no city—only the Bluffs, where Indian chiefs sometimes met in council. The Missouri river was then the frontier of the nation, and the migrating "Mormons" were upon the threshold of the wilderness, the extreme western fringe of civilization.

Beyond lay the broad plains where the savage red man roamed. Farther on were the snow-capped summits of the Rocky mountains; and farther still, the sun-burnt valleys and dry plateaus of "The Great American Desert," renamed by Frémont "The Great Basin," and separated from the Pacific coast by the towering Sierra. West of that rocky barrier the land was fertile, sloping down to the sea; but eastward, for many a weary league, it was a waste, almost treeless and waterless.

The only white occupants of this arid, rock-ribbed wilderness were a few rough mountaineers, living in lonely log forts, with their Indian wives and half-breed children, hunting the bear, trapping the beaver, trading with the natives, and acting as guides for emigrant trains or chance travelers to or from the western ocean. Several thousand Americans had settled among Spaniards and Indians along the Pacific coast, but none had settled here—Salt Lake valley, with its environs, was a spot desired by none, shunned by all.

This desolate inter-mountain region belonged to Mexico, and was part of the province of Upper California, distinguished by its title from Lower California, the peninsula still bearing that name. Eastward there was another Mexican province—New Mexico—which included Arizona. North of these provinces was Oregon, including Washington, Idaho, and other parts. Oregon was a bone of contention between the United States and Great Britain, both countries claiming it. Such was the posture of affairs in the west at the period of the Mormon exodus.

Just before the beginning of that movement, an agent of the Latter-day Saints, acting under instructions from President Brigham Young, went to the city of Washington, to solicit governmental aid for his people. No gift of money or of other means was asked—only employment in freighting provisions and naval stores to Oregon, or to other points on the Pacific. The agent, Jesse C. Little, who seems to have presented his petition after the exodus began, stated that many of his co-religionists had already left Illinois for California, and that thousands of others, in the United States and in the British Isles, would go there as soon as they were able.

Let me here interject that Upper California, or that part of it in the region of the Rocky mountains, became the theme of a "Mormon" hymn, sung on both sides of the Atlantic, during the period of the early settlement of the Great Basin.

President Polk received Little kindly, and promised to do what he could for the homeless people. War was then pending between the United States and

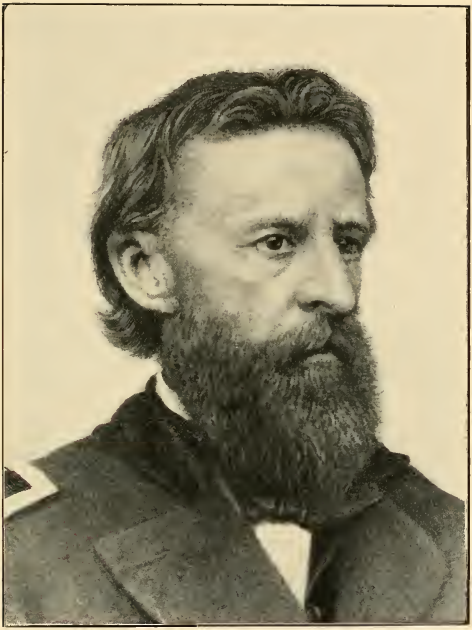
Mexico, and in April of that year hostilities began on the Texan border. By this time the "Mormon" vanguard was well on its way across Iowa, heading for the Missouri river. After the victories of Palo Alto and Resaca de la Palma, won by General Zachary Taylor on the ninth and tenth of May, it was decided to strike the enemy at three points simultaneously: General Taylor to continue operations along the Rio Grande; General Scott to invade Mexico from the Gulf coast; and General Stephen W. Kearny, with a third army, to march overland and capture the Mexican provinces in the west. A portion of Kearny's force was to be recruited from the "Mormon" camps on the frontier. Five hundred able-bodied men were to be called for, or given the privilege of volunteering in their country's cause. They were to unite with the Army of the West at Santa Fe, and march to the Pacific coast; the term of enlistment being twelve months.

THE MORMON BATTALION

The first intimation had by the "Mormon" leaders respecting this purpose of the government, was the appearance at Mt. Pisgah, one of their temporary settlements in Iowa, of an army recruiting officer, Captain James Allen, who issued a circular, making known the wishes of General Kearny concerning the troops to be raised. Allen then went on to the Bluffs, to confer with President Young and other leading men of the Church. Coming at such a time, without warning, and embodying a proposition so different from the one submitted by Agent Little at Washington, the call created at first some consternation. A force of team-

COLONEL COOKE

Colonel Philip St. George Cooke, U. S. A., a native of Virginia, born in 1809, was graduated from West Point in 1827, and saw service in Illinois and in Kansas before the Mexican War, during which he commanded the Mormon Battalion in its march from Santa Fe into Southern California. During the Civil War he fought for the Union; was retired in 1873, after forty-six years of continuous army service, and died March 20, 1895.



sters, with wagons to freight stores and supplies, was one thing; a battalion of five hundred fighting men was quite another. In the midst of an exodus rife with dangers and hardships, the services of that number of able-bodied men could ill be spared.

But there was no hesitation. "You shall have your battalion, Captain Allen," said President Young, "and if there are not young men enough, we will take the old men; and if they are not enough, we will take the women;" a touch of grim humor tempering the sternness of the resolve. Colonel Thomas L. Kane, U. S. A., who came with Agent Little to the Bluffs, in his account of the enlistment of the battalion, summarized the incident thus: "A central mass meeting for council, some harangues at the more remotely scattered camps, an American flag brought out from the store-house of things rescued and hoisted to the top of a tree-mast, and in three days the force was reported, mustered, organized, and ready to march."

The date of enlistment was the 16th of July. Five hundred and forty-nine persons, including several families of women and children, who went with their husbands and fathers, composed the Mormon battalion. The five companies were commanded, respectively, by Captains Jefferson Hunt, Jesse D. Hunter, James Brown, Nelson Higgins, and Daniel C. Davis. The volunteers were equipped at Fort Leavenworth, and marched thence to Santa Fe, which town had already surrendered to General Kearny.

At Santa Fe, by the general's order, Colonel Philip St. George Cooke, of the regular army, took command of the battalion, which then began its arduous march across the dreary plains and rugged mountains of New Mexico, into southern California. Their route was by way of the Rio Grande, the Gila, the Colorado, and the San Pedro. They tramped, from the Missouri to the Pacific, a distance of over two thousand miles, pioneering much of the way through an unknown wilderness. Colonel Cooke said of this achievement: "History may be searched in vain for an equal march of infantry." Short rations, lack of water, with excessive toil in road-making, well-digging, and forced marching, caused much suffering, some sickness, and several deaths in the battalion. Even before reaching Santa Fe, many were disabled and prevented from going farther. These invalid detachments—less than one hundred men, with most of the women and all the children—were put in charge of Captains Brown and Higgins, and ordered to Pueblo, now in Colorado. The main body, including four or five women who accompanied their husbands, pushed on to the Pacific coast, arriving near San Diego late in January, 1847.

General Kearny, by a more direct route, had reached the coast some time earlier, though with only a few men, having disbanded most of his force on learning that California was already in possession of the United States; Colonel John C. Frémont, the explorer, aided by Commodores Sloat, Montgomery, and Stockton, and the American settlers of Sacramento valley, having all but subdued the country before Kearny arrived. Cooke's command had driven out the Mexican garrison of Tucson, but they had no other opportunity to engage the enemy. Their most exciting experience was a "battle with the bulls," on the San Pedro river, where they were attacked by an army of wild cattle, and narrowly escaped dispersion, if not destruction, from the fierce horns and hoofs of the innumerable horde.

Fort-building and garrison service were the principal occupations of these volunteers during their remaining months of service. They were quartered at San Diego, San Luis Rey, and Los Angeles, and performed their duties in such a manner as to call forth the commendation of the United States officers, and at the same time to win the good will of the conquered Californians. While in garrison they were permitted to accept outside employment, offered them by civilians in the towns where they were stationed. They made and burnt the first bricks in San Diego, and probably in all California. A squad of the battalion men served as General Kearny's escort, when, in May, he set out for Washington, accompanied by Colonel Frémont, the latter charged with insubordination, for refusing to recognize the general's authority.

In July, at the expiration of their year's term of enlistment, the battalion was honorably discharged at Los Angeles. There, at the urgent request of Governor R. B. Mason, Kearny's successor as military commandant, eighty-one of them rëenlisted, and were ordered back to garrison San Diego; their comrades setting out to rejoin their families or friends, left upon the far away frontier. Some of these discharged soldiers were next heard of in connection with the California gold discovery.

Governor Mason, in his report to the adjutant-general, September 18, 1847, said: "Of the services of the battalion, of their patience, subordination, and general good conduct, you have already heard; and I take great pleasure in adding that as a body of men they have religiously respected the rights and feelings of this conquered people; not a syllable of complaint has reached my ear of a single insult offered or outrage done by a Mormon volunteer. So high an opinion did I entertain of the battalion, and of their special fitness for the duties now performed by the garrisons in this country, that I made strenuous efforts to engage their services for another year."

Henry G. Boyle, one of the volunteers, gives to history the following items of information: "I think I white-washed all San Diego. We did their blacksmithing, put up a bakery, made and repaired carts, and, in fine, did all we could to benefit ourselves as well as the citizens. We never had any trouble with the Californians or Indians, nor they with us. The citizens became so attached to us, that before our term of service expired they got up a petition to the governor to use his influence to keep us in the service. The petition was signed by every citizen in the town."

THE UTAH PIONEERS

The original enlistment of the battalion had caused the postponement of a project formed by the "Mormon" leaders before reaching the Missouri river—namely, the sending of a company of pioneers to explore the Rocky mountains and look out a home for the main body of their people. Had it not been for that enlistment, Upper California would have been penetrated by the founders of Utah as early as the summer of 1846. Owing to the postponement, they did not enter Salt Lake valley until a year later.

From the east to the Pacific coast, there were three routes of travel, two of them by sea. One doubled Cape Horn, one crossed the Isthmus of Panama, and the third was from the frontier over the plains. Westward travel on the overland route usually started from Independence, Missouri, the main outfitting point on the frontier. Most of the emigrants traveled in companies for mutual aid and protection. The regular route was up the Platte river, along the Sweetwater, and through South Pass, now in Wyoming. West of this point, those going to Oregon would turn north, while those bound for California would follow Bear river, skirt the northern shore of the Great Salt Lake, and then cross the country to the Sierra Nevada.

The people at Council Bluffs, after the departure of the battalion, crossed to the west side of the Missouri, and built, by permission of the Omaha Indians, the little town of Winter Quarters, now Florence, Nebraska. From that point the pioneers, about the middle of April, 1847, set out upon their journey to the Rocky mountains. They numbered one hundred and forty-three men, three women, and two children. Their leader was Brigham Young. The men were armed with rifles and small weapons, and a cannon was taken along to overawe hostile Indians. In their covered wagons they carried plows, seed grain, and a year's supply of provisions. They also took with them a case of surveyor's instruments, afterward used in laying out Salt Lake City. One of the party invented an odometer, to measure the distance traveled. In all there were seventy-two wagons, drawn by horses, mules and oxen. Mounted men were few. Most of the pioneers, like the emigrants who followed them, walked the greater part of the way, a distance of over a thousand miles. They were required to be watchful and prayerful, to sacredly observe the Sabbath, and respect the rights of the red men.

Most travelers to the west passed up the south bank of the Platte. The pioneers chose the north bank, and broke a new trail, now covered for hundreds of miles by the Union Pacific railroad. Streams too deep to ford were crossed by means of a leather boat, which served as a wagon box while traveling. Rafts were also used, made from cottonwood trees growing along the banks. Some of the streams were only about two feet deep, but at the bottom were beds of quicksand, dangerous to teams, and almost pulling a wagon to pieces. As a rule, the Indians—mostly Pawnees and Sioux—were friendly, though some of them set fire to the prairie, burning the grass needed by these travelers as feed for their animals, and ran off horses belonging to the company. As a means of protection at night, the wagons were corraled in a circle or an oval, with the tongues outside; a fore wheel of each wagon locked in a hind wheel of the one ahead. The stock were kept inside the enclosure thus formed. The prairie swarmed with buffalo, but the pioneers killed game only when they needed it for food. Now and then the skull of a dead bison, bleaching on the plains, served as a post office, in which to leave letters for friends who were following.

The pioneers crossed the Platte at Fort Laramie, a station of the Hudson Bay Fur Company, hiring for that purpose a ferry-boat, from a Frenchman in charge of the post. In the Black Hills they constructed a ferry of their own, and helped over the river at that point several companies of Missourians, bound for Oregon; receiving their pay in flour, meal, and bacon at eastern prices. At Laramie they were reinforced by a small party of "Mormon" emigrants from Mississippi.

West of the Rocky mountain "divide" they met Colonel James Bridger, builder and part proprietor of Fort Bridger, the second permanent trading post on the overland route. Bridger's "fort" was nothing more than a double log house, surrounded by a stockade of posts, driven into the ground. It was situated on a number of small islands, in Black's fork of Green river, where the colonel held lands under a grant from the Mexican government. He advised President Young not to settle in the Great Basin, until it had been demonstrated that grain could be raised here, and banteringly offered a thousand dollars for the first ear of corn that ripened in Salt Lake valley. Other mountaineers were equally pessimistic in their reports concerning this region.

Just before the pioneers crossed Green river, Samuel Brannan rode into camp, having come directly from the Bay of San Francisco. He, with two companions, had crossed the Sierra Nevada at Truckee pass, near the foot of which they had seen the bleaching bones of members of the ill-fated Donner party, a belated company of emigrants, caught in the heavy snows of the year before, thirty-nine of the original eighty-seven perishing. Brannan's purpose in meeting the pioneers was to persuade them to pass by the barren, forbidding region of the Great Salt Lake, and join him and his colony on the fertile slopes of the Pacific. He brought with him sixteen numbers of "The California Star," and the latest news from the battalion. He used every endeavor to convince President Young that it would be to the advantage of the Latter-day Saints to establish themselves on the western coast; but in this he was unsuccessful. The prospect painted by his eloquence had its pleasing features, but was not alluring to the sagacious leader, who had seen his people despoiled and driven, repeatedly, through sheer inability to hold their own against overwhelming odds, hostile to and arrayed against them. Until they became strong enough, not only in numbers, but in influence, through a proper understanding of their motives on the part of their fellow citizens, to defend themselves against further possible aggressions, it was better for them to seek isolation, and face the hardships and dangers of the desert. Moreover, their martyred prophet had predicted that they should become "a mighty people in the midst of the Rocky mountains;" and they proposed to stand by that prophecy and help on its fulfilment. "This is the place," said Brigham Young, indicating Salt Lake valley as the site for their first settlement, and Salt Lake valley was accordingly chosen for that purpose.

It was July 24, 1847, when Brigham Young arrived in view of the Great Salt Lake. Some of his followers had preceded him, and plowing and planting had begun two days before. It was difficult work, and more than one plowshare was broken in the hard sun-baked soil. To make the plowing easier, dams were placed in the mountain streams, and the ground well flooded. This was the beginning of irrigation in arid America, by men of the Anglo-Saxon race.

As a protection against hostile and thieving savages —Shoshones on the north, Utahs or Utes on the south— these settlers, and those who followed them that season, built a rude fort, in the form of a rectangle, thus forming the nucleus of Salt Lake City, the parent and model of hundreds of towns and villages now dotting the surface of the Great American Desert.

CRICKETS AND GULLS

From my History of Utah, I here reproduce, with slight revision, one of the early incidents in the pioneer colony:

"No event in Western history awakens more interest than the episode of the crickets and the gulls. It occurred when Salt Lake City, the earliest settlement in the Rocky Mountain region, was less than one year old. The so-called 'City' was not even a village at that time; it was little more than a camp, consisting of a log-and-mud fort, enclosing huts, tents, and wagons, with about eighteen hundred inhabitants. Most of these had come immediately after the Pioneers, who, with Brigham Young, their leader, arrived in July, 1847. President Young and others had returned to the Missouri River to bring more of the migrating people to their new home among the mountains, and those who remained here were anxiously awaiting the results of their first labors to redeem the desert and make the wilderness to blossom.

"Some plowing and planting had been done by the Pioneers upon their arrival, but the seeds then put in, such as potatoes, corn, wheat, oats, peas and beans, though well irrigated, did not mature, owing to the lateness of the season. The nearest approach to a harvest, that year, were a few small potatoes, which served as seed for another planting. It was therefore their first real harvest in this region that the settlers of these solitudes were looking forward to, at the time of the episode mentioned.

"Much depended upon that harvest, not only for the people already here, but for twenty-five hundred additional immigrants, who were about to join them from the far-away frontier. The supplies brought by those who came the first season had been designed to last only about twelve months. They were gradually getting low, and these settlers, be it borne in mind, were well nigh isolated from the rest of humanity. 'A thousand miles from anywhere,' was a phrase used by them to describe their location. They had little communication with the outside world, and that little was by means of the ox team and the pack mule. If their harvest failed, what would become of them?

"In the spring of 1848, five thousand acres of land were under cultivation in Salt Lake Valley. Nine hundred acres had been sown with winter wheat, which was just beginning to sprout.

"Then came an event as unlooked for as it was terrible—the cricket plague! In May and June these destructive pests rolled in black legions down the mountain sides, and attacked the fields of growing grain. The tender crops fell an easy prey to their fierce voracity. The ground over which they had passed looked as if scorched by fire.

"Thoroughly alarmed, the community—men, women and children—marshalled themselves to fight the ravenous foe. Some went through the fields, killing the crickets—but crushing much of the tender grain. Some dug ditches around the farms, turned water into the trenches, and drove and drowned therein the black devourers. Others beat them back with clubs and brooms, or burned them in fires. Still the crickets prevailed. Despite all that could be done by the settlers, their hope of a harvest was fast vanishing—a harvest upon which life itself seemed to depend.

"They were rescued, as they believed, by a miracle—a greater miracle than is said to have saved Rome, when the cackling of geese roused the slumbering city in time to beat back the invading

THE GULL MONUMENT

This monument, commemorative of the episode of the Crickets and the Gulls, the destruction of the former by the latter, and the consequent rescue of the first harvest sown in Salt Lake Valley, stands upon the Tabernacle grounds, in the heart of the Utah Capital. It was unveiled September 29, 1913. The monument was designed and executed by M. M. Young, a grandson of Brigham Young.

Gauls. In the midst of the work of ruin, when it seemed as if nothing could stay the destruction, great flocks of gulls appeared, filling the air with their white wings and plaintive cries. They settled down upon the half-ruined fields. At first it looked as if they came but to help the crickets destroy. But their real purpose was soon apparent. They came to prey upon the destroyers. All day long they gorged themselves, disgorged, and feasted again, the white gulls upon the black crickets, like hosts of heaven and hell contending, until the pests were vanquished and the people were saved. The birds then returned to the Lake islands, leaving the grateful settlers to shed tears of joy over their timely deliverance.

"A season of scarcity followed, but no fatal famine; and before the worst came, the glad people celebrated, with a public feast, their first harvest home.

"The gull is still to be seen in the vicinity of the Great Salt Lake. The wanton killing of these birds was made punishable by law. Rome had her sacred geese; Utah would have her sacred gulls, forever to be held in honor as the heaven-sent messengers that saved the Pioneers."

THE STATE OF DESERET

By the treaty of Guadalupe Hidalgo, signed February 2, 1848, the conquered Mexican provinces were ceded to the United States, and at the earliest practicable moment the white inhabitants of the Basin took steps toward the founding of a civil government, agreeable to the constitution and laws of their country. In February, 1849, a call was issued to "all the citizens of that portion of Upper California lying east of the Sierra Nevada Mountains," inviting them to meet in a political convention at Salt Lake City. The convention met on the fifth of March, and petitioned congress for the organization of a territory, to be known as Deseret—a word taken from the Book of Mormon, and signifying honey-bee. Pending action upon this petition, the convention organized the provisional government of the State of Deseret, the boundaries of which were the same as those of the proposed territory, embracing present Utah and Nevada, parts of Wyoming, Colorado, New Mexico, and Arizona, and a strip of sea-coast in southern California, including the port of San Diego. Subsequently congress was asked to admit Deseret into the Union as a state.

The people west of the Sierra Nevada having also set up a provisional government, it was proposed to secure the admission of Deseret and California as one state, with the understanding that they would afterward separate, and form two distinct commonwealths. President Zachary Taylor was said to favor this plan, which promised a solution of the slavery question in the newly acquired province, the inhabitants of which were to decide for themselves whether the state should be slave or free. Deseret consented to the proposed union, but with the understanding that the separation should take place at the beginning of the year 1851, when each state, with its own constitution, should become free, sovereign, and independent, without any further action by congress. Nothing came of the movement, however; California being unwilling to unite.

The building up of the State of Deseret went steadily on, though in the face of distressing conditions. Since the autumn of 1848 there had been almost a famine in the land. The scant harvest, resulting from the cricket plague and from drought and frost, had made the food question a serious one, and clothing and other necessaries were almost as scarce as breadstuffs. Nearly every man in the colony dressed in buckskin, and wore Indian moccasins. Those who had provisions put their families upon rations, while those who were without, or had but little, dug and ate sego and thistle roots, or cooked the hides of animals, to eke out their scanty store.

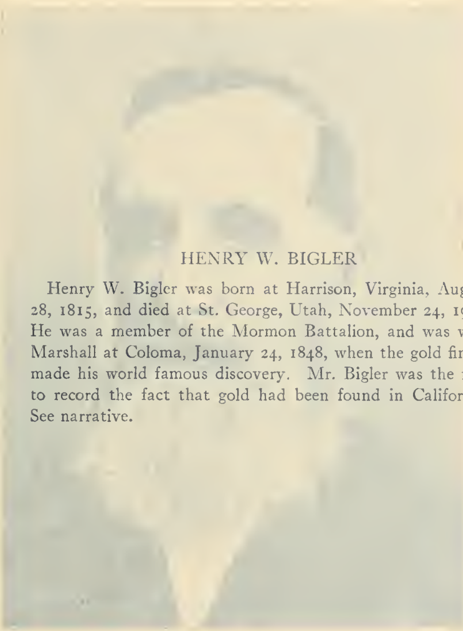
Relief came in a manner most unexpected—and here my narrative again touches the history of California proper.

THE GOLD DISCOVERY

It has already been shown how the Mormon battalion received its discharge at Los Angeles in July, 1847, and how the main body of the volunteers set out to rejoin their families or friends, in the Great Basin or on the Missouri frontier. My story now has to do with these returning soldiers. Pursuing at first a northwesterly course, they came to Sutter's fort, near the present city of Sacramento, where some of them found temporary employment. The main body, reaching Lake Tahoe, met Samuel Brannan, returning from Salt Lake valley after his ineffectual attempt to persuade the pioneers to locate their new home on the Pacific. Brannan gave a doleful account of the place they had chosen for a settlement, and expressed the belief that they would yet follow his advice, and remove to California. Subsequently the returning volunteers met Captain James Brown, of the Pueblo detachment, on his way to San Francisco, with power of attorney, to draw the pay due to his men from the government. Captain Brown delivered to the battalion men an epistle from the presidency of the Church, advising such of them as had no families to remain on the coast, work through the winter, and come on to "The Valley" with their earnings the next season. About half of them turned back, and quite a number rejoined their comrades at Sutter's fort, where they also secured employment.

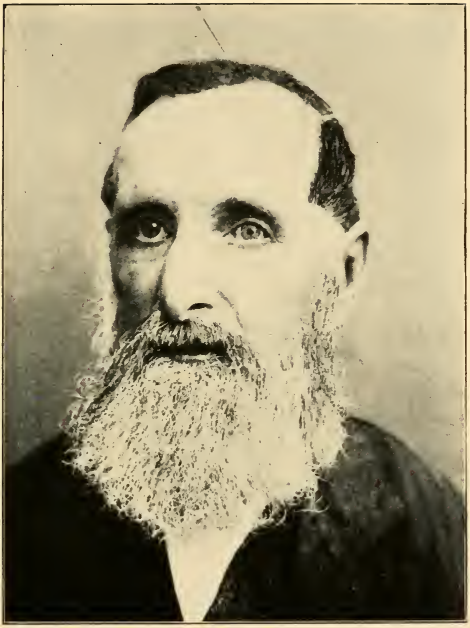
Among the mountains, in the little valley of Coloma, on the south fork of the American river, about forty-five miles east from the fort, a saw mill was erected for Captain Sutter, and after its completion the water was turned into the race, to clear away dirt and other debris, preliminary to a trial run. The stream having been shut off, Sutter's foreman, walking along the tail race, picked up from the bottom of the ditch a few yellow shining particles, about the size of wheat grains. These were assayed, and found to be gold. That foreman was James W. Marshall, famed as the discoverer of gold in California (January, 1848). But others, beside Marshall, were concerned in the event; "Mormon" picks and shovels had helped to bring the precious metal to the surface.

Henry W. Bigler, afterward of St. George, Utah, made what was probably the first record of the world-renowned discovery. The entry in his diary read as follows: "Monday, 24th. This day some kind of metal was found in the tail race that looks like gold." Six days later he wrote: "Our metal has been tried, and proves to be gold. It is thought to be rich. We have picked up more than one hundred dollars' worth last week." Associated with Bigler were Alexander Stephens, James S. Brown, James Berger, William J. Johnston, and Azariah Smith, all ex-members of the battalion. I give the names as they appear in James



HENRY W. BIGLER

Henry W. Bigler was born at Harrison, Virginia, August 28, 1815, and died at St. George, Utah, November 24, 1900. He was a member of the Mormon Battalion, and was with Marshall at Coloma, January 24, 1848, when the gold finder made his world famous discovery. Mr. Bigler was the first to record the fact that gold had been found in California. See narrative.



S. Brown's "Life of a Pioneer." Some of the richest gold finds on the American river were by these men and their comrades who took part in extending the area of the original discovery. "Mormon Island," in that river, became noted for its "diggings." A number of the battalion men, while working on Sutter's land, shared the results of their labors with him and his partner, Marshall, who furnished provisions and tools for the prosecution of the enterprise. Afterward the employes operated independently on claims of their own.

One of the most enthusiastic promoters of the gold excitement was our friend Brannan, who stirred San Francisco (at first indifferent) to a fever of agitation over the event. Coming down from Sutter's fort, where he had a store, he brought with him, as did others, gold dust and nuggets from the placers. "Gold! Gold! Gold, from the American River!" shouted Brannan, as he strode down the street, swinging his hat in one hand, and holding in the other a bottle of the yellow dust, which he displayed to the gaping crowds that gathered round him. Sight, reinforcing rumor, kindled a fire that could not be quenched; Brannan's paper, "The California Star," added fuel to the flame; and from the wild rush to the gold fields that followed, San Francisco was in some danger of being depopulated.

The excitement was not confined to California. It extended over the civilized world, and by sea and land eager souls from many nations hurried to the new El Dorado. Much of this emigration passed through Salt Lake valley. Here the tired gold seekers halted for rest, or to obtain supplies to enable them to reach their journey's end. Some had loaded their wagons with merchandise and supplies for the mining camps. Impatient at their slow progress, and hearing that other merchants had arrived by sea before them, they all but threw away the valuable goods they had freighted over a thousand miles. Dry goods, groceries, provisions, clothing, implements—in short, all that was needed by the poorly fed, half-clad community in the mountains, was bartered off to them at almost any sacrifice, so anxious were the owners to lighten their loads and shorten the time of travel. In this manner "the gold emigration," as it was called, greatly benefited the settlers in the Basin.

The "gold fever" infected some of the citizens of Deseret, and an influence had to be exerted by leading men to prevent too large an emigration from these parts. "We cannot eat gold and silver," said Brigham Young, to the people who had elected him governor. "Devote yourselves to agriculture, manufacture, coal and iron mining; establish those industries that lie at the basis of every state's prosperity; and let the gold and silver stay where they are, until the proper time comes to bring them forth and utilize them." Such was the substance of his advice. Despite all persuasion however, some were hurried away, overcome by the prevailing thirst for sudden wealth.

On the other hand, it is a remarkable fact that the battalion men who had been advised from Salt Lake valley to rejoin the main body of their people here in 1848, did so, notwithstanding the prevalent and constantly growing excitement over the gold fields that was beginning to sweep the coast lands like a cyclone. Preparatory to their journey to Deseret, they rendezvoused at Dutch Flat, a few miles from Coloma, and crossed the Sierra Nevada at or near the head of the American river. Three of their number, David Browett, Daniel Allen, and Henderson Cox, moving out ahead, were waylaid and killed by Indians. The others reached their destination in safety. Many of the *Brooklyn* company—perhaps most of them—also came on to "The Valley"; but Brannan, their sometime leader, remained in California.*

While deprecating the extravagance of the gold excitement, and averse to the premature opening of precious mines nearer home, Governor Young had no prejudice against mining as a vocation. Party after party of "Mormon" missionaries, on their way to the Pacific islands and to other parts, were counseled by him, as president of the Church, to work in the California mines long enough to provide themselves with means of transportation to their various fields of labor; and they acted accordingly.

Much of the gold mined in California found its way to Deseret, and served a timely purpose. Money was exceedingly scarce, and great inconvenience had resulted. Exchange and barter was the rule, clothing and furniture being paid for with cattle, wheat, or potatoes. Frequently little bags of gold dust were handed around, in place of dollars and cents. Subsequently, however, the dust was coined, and gold pieces, ranging in value from two and a half dollars to twenty dollars, were issued under the authority of the State of Deseret. These coins, of unalloyed virgin gold, were designed purely for local use, and as

*He removed to Mexico in 1880 and died there in 1889.—Ed.

soon as government money became plentiful, they were called in and disposed of as bullion to the federal mints.

THE TERRITORY OF UTAH

Congress denied Deseret's prayer for statehood, and organized the territory of Utah, California at the same time being admitted into the Union. Utah was bounded on the west by the state of California, on the north by the territory of Oregon, on the east by the summit of the Rocky mountains, and on the south by the thirty-seventh parallel of north latitude. This cut off the strip of sea-coast included in the proposed State of Deseret, but still left the territory an area of 225,000 square miles. The Organic Act, or act organizing the territory, was signed by President Fillmore on the ninth of September, 1850, but the news did not reach Salt Lake valley until late in January, 1851. Even then it did not come directly, or in an official way, but having been published in eastern papers, and carried across the isthmus and up to San Francisco, along with the tidings of California's admission, it was brought to Salt Lake City by Henry E. Gibson, a returning missionary.

While disappointed at the denial of their petition, and feeling that congress had been partial to the people of California, the citizens of Utah made the best of the affair, and were not without feelings of gratitude toward the administration, for its consideration in the matter of federal appointees. Brigham Young, who had been elected by the people governor of Deseret, became governor of Utah by presidential appointment, and three other prominent "Mormons," with about an equal number of non-"Mormons," were also commissioned to represent the general government in the territory. By this time western Utah had received its first settlers, and the beginnings of Carson county had been made. This part, about ten years later, was included in the territory of Nevada.

EVANGELICAL ACTIVITIES

The presence of many of their people, in a more or less scattered condition, on the Pacific slope, and a desire to extend their evangelical activities in that direction, determined the Church authorities at Salt Lake City upon the project of organizing a mission in "Western California," as the region beyond the Sierra Nevada was then called. For that purpose two of the "Mormon" leaders, Amasa M. Lyman and Charles C. Rich, were sent to San Francisco, the former in April, 1849, the latter in the ensuing October. Subsequently Parley P. Pratt, one of the original apostles of the Church, presided over the California and Oregon Mission, and was succeeded by George Q. Cannon, afterwards Utah's delegate in congress. In San Francisco, Mr. Cannon edited and published "The Western Standard," a paper founded by him in February, 1856.

THE SAN BERNARDINO COLONY

Just before the territorial government went into effect, the Church authorities decided to establish an outfitting post in southern California, with a view to facilitating their prospective emigration from the Pacific islands, and likewise from Europe, by way of Panama. The commission to secure a site for this purpose and plant a colony thereon, was entrusted to Messrs. Lyman and Rich. Concerning the project President Young says in his journal: "Elders Amasa M. Lyman and C. C. Rich, with some twenty others, having received my approbation in going to southern California, were instructed by letter to select a site for a city or station, as a nucleus for a settlement, near the Cajon pass, in the vicinity of the sea-coast, for a continuation of the route already commenced from this place to the Pacific; to gather around them the Saints in California; to search out on their route, and establish as far as possible, the best location for stations between Iron county and California, in view of a mail route to the Pacific; to cultivate grapes, sugar cane, cotton, and any other desirable fruits and products; to obtain information concerning the Tehauntepec route, or any other across the isthmus, or the passage around Cape Horn, with a view to the gathering of the Saints from Europe; to plant the standard of salvation in every country and kingdom, city and village, on the Pacific and the world over, as fast as God should give the ability."

Early in 1851 a company of nearly five hundred men, women, and children, from Salt Lake valley, crossed the southern desert, threaded the Cajon pass, and encamped at Sycamore Grove, on the west side of San Bernardino valley. There they remained, pending further explorations, and the selection of a site for a permanent settlement. From Utah they had passed over much of the trail since covered by the San Pedro, Los Angeles, and Salt Lake railroad, popularly known as "The Salt Lake Route." While tarrying at the

Grove, they established a school, taught by J. H. Rollins, afterwards assessor of San Bernardino county. The Los Angeles "Star" welcomed the colonists in these kindly words: "We learn that one hundred and fifty Mormon families are at Cajon pass, sixty miles north of this city, on their way here from Deseret. These families, it is said, intend to settle in this valley, and to make it their permanent home. We cannot yet give full credit to these statements, because they do not come to us fully authenticated. But if it be true that Mormons are coming in such numbers to settle among us, we shall extend to them, as good and industrious citizens, a friendly welcome."

The spot selected for a settlement was the site of the now flourishing city of San Bernardino. It was then a ranch, containing upwards of eighty thousand acres of land, for which the owners, the Lugo Brothers, who held it under a grant from the government of Mexico, were paid the sum of $77,500. The soil was rich, and water and timber were abundant. The ranch was described, for situation, as "about one hundred miles from San Diego, seventy miles from the sea-port of San Pedro, and fifty miles from Pueblo de los Angelos." The purchase was consummated on the twenty-second of September, some months after the arrival of the "Mormons" in the valley.

They at once went to work, making improvements, and by the tenth of December had built one hundred tenements, and projected a stockade fort, afterwards constructed, for protection against hostile Indians. They surveyed and fenced a field enclosing nearly two thousand acres of land, upon which plowing and planting immediately began. Then a wagon road was located from San Bernardino to San Diego. In March, 1852, a city was laid out, Lyman and Rich planting the center stake of the town site on "Temple Block"—now the public square of San Bernardino. The blocks were thirty-six rods square, and the streets five rods wide; a feature of beauty much commented upon at the present time. The town resembled, in this respect, Salt Lake City. In April a bowery was erected, also an adobe building, sixty by thirty feet in dimensions, with a good shingle roof. There public meetings were held, likewise day and Sabbath schools.

After founding their settlement, the colonists made a road to the forests of redwood, pine, and hemlock, eleven miles to the northward. Near the point where this road entered a cañon, the workmen found, at an altitude of two thousand feet, what are now the Arrowhead Hot Springs, one of the best sanitary resorts on the Pacific coast.

Later, municipal and county governments were organized, Daniel M. Thomas being county judge, and Andrew Lytle, mayor. There was also an ecclesiastical regime—a Stake organization, with Amasa M. Lyman as president, and other prominent men in the high council. Charles C. Rich was associated with Elder Lyman in the presidency, and after they left, David Seeley presided. William Crosby was bishop of San Bernardino ward or branch. These organizations were maintained during the six years that the "Mormons" resided there. What they accomplished in a material way is partly told in "The Western Standard" of December 27, 1856; the "Standard" reproducing its account from "The Los Angeles Star."

"During the past week," says the "Star," "we paid a visit to the city of San Bernardino. We were glad to find that considerable progress has been made in city improvements, since the period of our former visit. Several new stores have been erected, the old ones have been improved, and the number of persons engaged in trade considerably increased. The spirit of enterprise which characterizes the people of California is as observable here as in older and more populous communities.

"As yet, there is no Court House, the sessions of the courts being held in a large room of Bishop Crosby's Hotel. Neither is there a county jail, nor indeed much need for one. There are two schools well attended, and a third school house is being erected. In the school house, the services of public worship are held, according to the forms of 'Mormonism,' which is the prevailing religion of the people of the city.

"The Ranch of San Bernardino is laid off in lots of 1, 5, 10, 20, and 40 acres, the extent of the city being two miles square. The property is held by Lyman, Rich, and others, in trust, we believe, for the benefit of the Church. The condition of the mortgage on the ranch is such now, that a warranty deed is given to the purchaser for his land, which is fully released from all liabilities, thus giving encouragement to immigration and substantial improvement of the farms. In consequence, a large amount of fencing will be put up the coming year, should the mills be able to produce sufficient lumber for the purpose. This will depend on the nature of the season. An abundant rain will make the people prosperous. The population of the ranch has increased considerably during the past six months, amounting at present to about three thousand.

"Being desirous of obtaining information regarding the resources of the community, we applied to J. H. Rollins, Esq., the County Assessor, who very kindly furnished us with such statistics as were in his possession. From him, also, we obtained the report of the County Surveyor, an abstract of which we give elsewhere.

"From the Assessor's list we take the following account of the amount of stock cattle, from one year upward, including American yearlings and two-year-olds:

American cows	13,510
California cows, gentle	618
American oxen	230
American horses	174
California horses	1,383
Mules	229
Sheep	3,917
Goats	500
Hogs	437

"The amount of grain raised is as follows: Wheat 30,000 bushels, barley 15,000 bushels, corn 7,000 bushels, and some 200 bushels of oats, the potato crop being almost an entire failure on account of drouth. Garden vegetables are abundant otherwise.

"The amount of butter, cheese and eggs produced and sold to merchants in the city of San Bernardino is as follows: Butter 1,700 lbs., cheese 3,000 lbs., eggs 13,000 dozen. This is considered not more than one-half of the amount of these articles produced.

"There are in this county seven saw mills, six driven by water; and one steam mill (thirty-five horse power engine). One grist mill, with two pairs of French burrs, owned by Lyman, Rich, and Hanks. Also one at Jarupa, with one pair of French burrs, owned by Don Louis Roubideaux; and one at San Bernardino, owned by Charles Crismon, with which is connected a saw mill, and planing and sash machine. Also, in the same locality, is a steam distillery, which is owned by Charles Crismon, and is now in operation. Four of the above water mills have not been in operation since June last, from the dry season.

"In the San Bernardino Mountains there are two shingle machines, which have cut during the season 500,000 shingles."

The report of the surveyor of San Bernardino county, Arvin M. Stoddard, contained the following items:

"The ranch of San Bernardino is the finest in the County, and among the finest in the State. It is owned by the 'Mormons,' and under their management is becoming one of the most thrifty places in this portion of the State. The ranch is subdivided into five, ten, twenty, forty and eighty acre lots, which are sold to any person desiring to settle here, on reasonable terms; by which means it is fast progressing in the scale of agricultural improvements, having some of the finest land in the State upon which to operate. It bids fair to become celebrated as a fruit growing country; already has a large amount of different varieties of trees been imported from Oregon, which under proper culture thrive remarkably well. The grape also is beginning to be extensively cultivated, and at the present time the inhabitants are enjoying the fruits of their labors in some of the largest and best grapes that can be found in the State. For raising vegetables, this ranch is well adapted, and for grazing is not to be excelled by any."

The San Bernardino colony was maintained until the latter part of 1857, when, owing to prospective trouble between the territory of Utah and the general government—trouble caused by false reports, and happily averted without bloodshed—the "Mormon" missions in the west were discontinued, and all "Mormon" colonizing work outside of Utah abandoned; most of the people moving back to their former homes.

THE CALIFORNIA MISSION

Many years elapsed before there was again any considerable number of Latter-day Saints within the state of California. During the latter part of the eighties, Elders J. W. Pickett and Mark Lindsay, who had removed from Utah to the coast, were directed by President Wilford Woodruff, then head of the Church, to call on the Nethercott family in Oakland, they having written, requesting that missionaries be sent to them. As the result, several members of that family were baptized. The Nethercotts had a friend, Norman B. Phillips, in the south end of the state, and through the instrumentality of Elder Lindsay, this man and his wife also came into the Church. Phillips afterwards labored as a missionary in Oakland and in Sacramento. These were the beginnings of the present-day California Mission.

The first regularly called missionary in this field was Elder John L. Dalton, who, from 1892 to 1894, labored in the north, bringing together quite a number of men and women who had drifted away from the Stakes of Zion in the Rocky mountains. Dalton was followed by A. S. Keller, and H. B. Williams, also from Utah; and these missionaries, by George H. Maycock, J. D. Cummings, Nels Johnson, and Ezekiel Blodgett.

In January, 1894, Doctor Karl G. Maeser, superintendent of Church schools for the Latter-day Saints, was at the Midwinter Fair, in charge of the Utah exhibits. He was made president of the California Mission, and directed the holding of its first conference in San Francisco. Dr. Maeser returned home in August of that year, and then came Elder Charles J. Nethercott, appointed with his family, to do missionary work in and around Oakland, his early home.

Meanwhile two of the leading men of the Church, Elders Francis M. Lyman and Brigham H. Roberts, had been laboring strenuously in southern California, principally among old members of the body. They reorganized the San Bernardino branch, and visited

San Francisco, Los Angeles, and San Diego, holding numerous meetings, and everywhere giving new life and impetus to the mission.

Its third president was Henry S. Tanner, under whom, from 1894 to 1896, the work grew apace. The San Francisco and Los Angeles conferences were organized by him, and the work opened up in the larger cities of the state. President Tanner was assisted by capable men, one of whom, Ephraim H. Nye, became his successor. Elder Nye was released in April, 1901.

Among the Utah visitors to California at the time of the Golden Jubilee—January, 1898—were Henry W. Bigler, James S. Brown, Azariah Smith, and William J. Johnston, sole survivors of the party who were with Marshall, the gold finder, half a century before. They went as honored guests of the Society of California Pioneers, to participate in the celebration, and were conspicuous as "Companions of Marshall" in the procession of the memorable Twenty-fourth, the fiftieth anniversary of the famous discovery. That same year, on the second day of September, Wilford Woodruff, President of the Church of Jesus Christ of Latter-day Saints, died in San Francisco, while seeking rest and recuperation on the coast. His first counselor, President George Q. Cannon, died at Monterey, April 12, 1901.

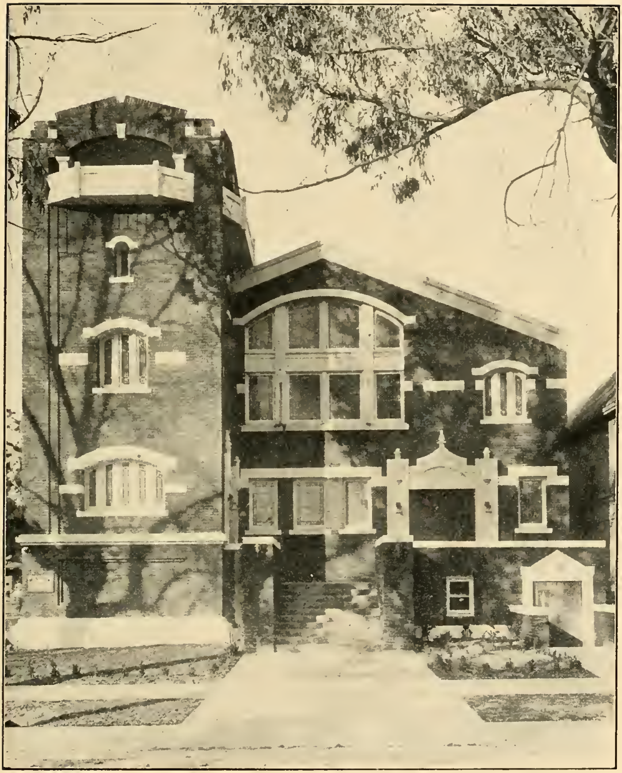
The California Mission is now presided over by Elder Joseph E. Robinson, and during his administration it has increased both in territory and in membership, some of its branches extending into Arizona. During the summer of 1912 four thousand Latter-day Saints were expatriated from Mexico, on account of brigandage and war. About six hundred of these remained within the territory of this mission. In 1901 it comprised four branches, with three subdivisions, aggregating about seven hundred souls. It now has twelve branches and three wards, with about thirty-five hundred names on its records.

The California Mission has grown in prestige and power from the beginning. Its headquarters are at Los Angeles, where there is a thriving branch, with subdivisions at Long Beach and Ocean Park. The Gridley branch numbers nearly eight hundred souls. They have built a fine social hall, valued at $3,500, and a church valued at $11,000, with real estate valued at $1,500. The crowning event in the history of the mission, up to the time of this writing (January, 1914), is the erection at its headquarters, 153 West Adams street, Los Angeles, of a splendid brick chapel, with art windows, and front embellished with Utah oolite; the entire structure costing $25,000. The interior is appropriately furnished with hardwood pews and chairs and has a beautiful baptistery, with Sabbath school auditorium and class rooms. Two other buildings have been erected on the same block—one for the accommodation of the mission president and his family, the other for the office force and traveling missionaries. The Los Angeles chapel was dedicated by the present head of the Church, President Joseph F. Smith, in May, 1913.

Orson F. Whitney

THE LOS ANGELES CHAPEL
(Latter-day Saints)

This structure fronts on West Adams street, Los Angeles. It was built by the Latter-day Saints between December 9, 1912, when ground was broken, and January 7, 1913, when the corner stone was laid. The chapel was dedicated May 4, 1913.



CALIFORNIA'S MINING HISTORY

THE mining history of California virtually began in the year 1849, although gold had been discovered before that time and had attracted the attention of the whole world. During the summer of that year, however, it is estimated that no less than fifty thousand people started overland for California and probably as many more left the seaports of the eastern states for the same destination and with the same object in view—to dig for gold. This rush continued for several years and resulted in the establishment of camps, villages, towns and cities throughout the mining regions of the state, most of which are still in existence, although in many the population is much scantier and is devoted to other pursuits, as the diversified interests of the state gradually became known and utilized. But it was the gold miners who settled California and brought about its early development. California has well earned and deserves its title of the "Golden State." Since 1849 and up to the end of 1913 it has produced, in gold alone, the vast sum of $1,587,694,320. The entire United States production of gold since 1792 (including that of California) has been $3,451,915,000, so that the single state of California has produced within about $276,000,000 of as much as all the gold derived from Alaska, Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington, and the southern and scattering states. In other words, all the other twenty-five gold-producing states of the union combined have only yielded about $276,000,000 more than the single state of California in a period of one hundred and twenty years.

In the sixty-five years during which gold mining has been carried on in the state the average production has been $24,426,066 per annum, equal to an average monthly production for the consecutive seven hundred and eighty months, of $2,035,505.

It is to be noted, moreover, that California is still the leading gold producer among all the states of the union, and there is still a larger number of producing gold mines than in any other state. Gold is being mined yet in thirty-one of the fifty-eight counties of California. With the exception of the few years when the Cripple Creek region of Colorado was yielding largely, California has always been the leading producer.

Among other mining states of the union, California has, as a gold-producing region, the distinction of holding the record on all counts. It has made by far the largest aggregate yield; made the largest output in any single year; made the highest annual average, although its mines have been worked for sixty-five years; kept the lead as a gold-producer the greatest consecutive number of years; has the largest number of gold mines; pursues the greatest number of varied branches of gold mining; has the widest distribution of its gold deposits; has the largest area of auriferous gravels; and the deepest gold mines.

As to the distribution of the gold deposits alone, aside from their varied forms, it may be stated that California reaches through nine and a half degrees of latitude, and between the extreme northwest and southeast corners the direct distance is seven hundred and seventy-five miles while the width is from one hundred and forty-eight to two hundred and thirty-five miles.

Along the Sierra Nevada and its foothills, and the northwestern Coast range, and the southeastern desert region, in the tier of counties extending from one end of the state to the other, there is not a single one without its gold deposits in one or more forms.

Gold is mined in the highest part of the Sierra Nevada, the foothills, the valleys, and on the beaches bordering the ocean. Even in the wastes of the Mohave and Colorado deserts are many productive gold mines. The gold is taken from quartz, placers, seam diggings, pockets, river, hydraulic, drift, ocean beach sand, by dredging, wing-damming, sluicing, dry-washing, and other forms of mining. In one county there are gold mines being worked at elevations of 9,000, 11,000, 13,000, and 13,500 feet, while in the same county gold is being taken out at places over two hundred feet below the level of the sea. At the Kennedy mine, Amador county, at an elevation of 1,500 feet, they are mining at the bottom of a vertical shaft 3,896 feet deep or 2,396 feet below sea level. It may be thus noted that the gold deposits extend over a longitudinal area of seven hundred and seventy-five miles, a lateral area of an average width of one hundred and ninety-one miles (or extreme width of two hundred and thirty-five miles) and a vertical range of 15,896 feet.

The climatic conditions in all except the very highest ranges are favorable to continued work the year round and even there the deep quartz mines keep in operation for twelve months. In some of the foothill and upper valleys, the men work in their orange and olive orchards and vineyards during one season, and drift under them for gold at another season. It is to be noted that today the three great gold-dredging fields of the state are at points where citrus fruits first ripen—Oroville, Marysville, and Folsom. The county producing the most gold is a foothill county, and the next in rank a valley one, neither in the snowy mountains. The leading producer of gold is a quartz mining county, and the one next in order gets its gold from the auriferous gravels by the dredging system in the midst of orange and olive orchards and vineyards.

It seems rather odd, in view of the facts to the contrary, that there is a prevalent impression that gold mining in California is almost a thing of the past, and that there is no other mining worth considering. Yet, the state continues to produce more gold than any other in the union and, with the value of all its mineral substances combined exceeds annually the output of any state west of the Mississippi river. Indeed, it stands fifth in rank among all the states in value of its mineral products. In the past fifteen years there has been a gradual annual increase in value of total mineral substances until in 1912 the total yield was valued at $92,837,374. This greatly exceeds the gold product of the banner year of 1852 when the yield from the placers was $81,294,700. At the present time gold and petroleum combined represent about sixty-five per cent of California's mineral output, the petroleum alone being about forty per cent of the total output of the entire United States.

Nearly all who hastened to California in the early pioneer days came with the expectation of getting a harvest of gold in a few months and returning to the "States." But they soon discovered that the precious metal was not to be gathered at the grass roots, but had to be dug for, and not every piece of ground in the country contained gold. Morever, the work of getting out the gold was not easy even for those who found where it was. Probably less than half of those who succeeded in reaching the mines engaged in the actual business of mining. The working miners had to be provided with necessities and soon merchandizing and other industries sprang up on all sides. With very few exceptions the multitudes who came to mine, knew nothing whatever of the business. They did not even know what were the favorable places to look for the gold until shown by others who had preceded them.

The pioneers were all placer miners, working surface deposits only. The pick, pan, rocker, sluice, and long tom comprised their appliances; the gulches, ravines, shallow gravel deposits, river beds and bars, the source of their gold. In these places nature had, by a system of concentration extending over countless ages, stored the gold set free by the erosion of the rocks, and washed out of the buried rivers of the past, and it was found in nuggets, coarse grains, and fine particles. Worthless surface soil had to be removed to get at shallow gravel deposits, or small shafts sunk to reach it. In many places cuts were made in the bedrock and the gravel shoveled into ground sluices. Always the gravel or sands had to be washed to recover the gold and in many places water had to be brought in by ditch or flume for this purpose. For many years an enormous yield of gold was maintained from these sources. Gradually, however, as was to have been expected, the richer areas available for this kind of mining were narrowed, as ground was worked out, and then attention was turned to other sources of gold supply.

Finding, as the miners of those days did, these surface auriferous deposits only at certain points, they began to look for the sources of the placer gold. This led to the search for quartz veins, and also for the large bodies of auriferous gravel which were contained in the hills of the mining region. In time deeper gravel deposits were found and opened and quartz veins or ledges were discovered and developed.

The first radical departure from the then known methods of gravel mining was made about the end of 1852 by E. E. Mattison, a miner at Yankee Jims, Placer county, who conducted water through a small ditch to a pressure box and from that carried it through a canvas hose, with a tin nozzle, discharging it under pressure against the gravel bank. By means of this primitive but epoch-making device the gold-bearing gravel and dirt was washed by the water into and through sluices and riffle boxes much faster than men could possibly handle it. This was the first attempt at hydraulic mining, a system which has been put in use in all parts of the world. The same plan has been adopted in railroad construction or where large bodies of earth had to be removed and where water under a high head was available, and was found specially useful in certain parts of the work on the Panama Canal, the "giants" or nozzles and other mechanical equipment having been made in California for the canal contractors. Not long after Mattison's invention (which was never patented) iron and steel pipes were substituted for canvas hose and massive giants or nozzles, some as large as eleven inches in diameter were used, through which large volumes of water under immense pressure were thrown against the gravel banks. Hundreds of miles of canals and ditches were dug, great reservoirs were formed, flumes built, and pipe lines laid at enormous cost. It was estimated that when hydraulic mining was at last prohibited by law in certain portions of California, over $100,000,000 was invested in that branch of the gold mining industry alone, and that the annual gold yield from that source was from eight to ten millions of dollars.

In certain places the early-day miners who worked the shallow gulch placers followed the pay gravel up to the head of the stream and would often find that the gravel would continue under a capping of hard lava which covered the hill-top. In other places isolated hills or ridges were seen to be topped with rich beds of auriferous gravels. These places were usually high above the present streams. It was soon determined that these gravel deposits were in the beds of ancient buried or "dead" rivers. The finding of these Tertiary gravels, was, like the first important discovery of gold, the result of chance rather than by any preconceived theory or systematic plan of exploration.

The gravels in these dead rivers occupy deep water-worn channels, once the beds of broad and swiftly-flowing streams. Careful studies have later been made of these ancient rivers, made possible by the long-continued work of the drift miners, and a large part of them has been mapped, and their courses generally traced, showing that the periods when these streams existed and were active was of great length, and that there were numerous rivers, at different heights. Most of them are now covered with a heavy lava capping. Where the lava-cap has been eroded or cut across, the gravels are exposed and may be mined by the hydraulic system; but where the lava cap remains, tunnels, sometimes several thousand feet in length, must be cut to tap the actual river channel, when the deposit is worked by the "drifting" system. After the bedrock tunnel through barren material has reached the gravel of the ancient river channel, the miners prepare to "drift" up the gravel channel proper. The auriferous gravel is blasted and dug out, only the lower portion, near the bedrock, being mined, and this is removed to the outer air where it is washed on washing floors, or where cemented, is first crushed in mills with light and rapid-dropping stamps.

The gravel channels in these old dead rivers are often a thousand or more feet in width, varying the same as modern streams. But only the richer portion of the gravel may be mined profitably and this "pay lead" is generally near the center of the old channel and at its lowest point where the water had cut the deepest into the rock. Pay leads of one hundred to one hundred and fifty feet are of average width, but some are three hundred or four hundred feet. The gravel runs from $2 to $10 per cubic yard. In some localities as at Iowa Hill in Placer county, the miners took out as high as $1,000 per lineal foot in mining up the channel in the center and for the full width of the pay lead.

Capital is required to develop and operate both drift and hydraulic mines and the ordinary miner cannot handle them alone. In drift mining the tunneling through bedrock to tap the gravel channel involves considerable initial expense before pay can be reached, and the ground must all be timbered in the tunnel and the mine. In hydraulic mining the necessary water rights, reservoirs, and water supply systems must be provided before any gravel may be washed. And in both cases the original cost of the mining ground must of course be considered. For many years past the federal government has prohibited hydraulic mines from operating anywhere in the drainage basins of the Sacramento and San Joaquin rivers, unless suitable steps are taken to restrain and impound the debris or tailings resulting from washing through the sluices such immense quantities of earth and gravel. This material used to enter the smaller streams and finally reach navigable waters of the main rivers, and farming and orchard lands along the banks were more or less damaged. At the time of this prohibition the hydraulic mining regions of the central portion of the state were almost depopulated, the mines closed down, and millions of dollars worth of mining and water property virtually confiscated and rendered worthless, either for use or sale.

In order to be able legally to operate a hydraulic mine in the drainage basins referred to, a permit must first be obtained from a federal commission of engineers, called the California Debris Commission, who supervise the plans and construction of the restraining works, dams, etc., and who close down the mine altogether if it be shown that damage is being done by its operations, even after the works are completed. Having to keep the debris behind the dams until fully settled, greatly restricts the amount of material which may be washed during a water season, so that the hydraulic mining industry is no longer as attractive for investment as formerly. In all other parts of the state except the drainage basins of the Sacramento and San Joaquin rivers, this kind of mining may be carried on without any restriction whatever as there are no navigable streams north or south of the central drainage basin referred to. The northwestern counties of Siskiyou, Trinity, and Humboldt are now the main hydraulic mining centers and many large and important mines continue to be operated. There are large areas of ground still available for this class of work in these counties which have not yet been developed, as the water supply systems are by no means to be compared with those formerly used in the central counties.

There are still some hundreds of known miles of the ancient buried rivers of California which have never been worked for gold, and there are many thousands of acres of exposed auriferous gravel suitable for hydraulicking, still waiting to be mined. An account of the origin and scope of the gravels, with maps, and descriptions of the mines and channels, etc., may be found in Professional Paper No. 73 of the United States Geological Survey, entitled "The Tertiary Gravels of the Sierra Nevada, California," by Waldemar Lindgren, the eminent geologist.

With the exhaustion of the open surface gold deposits, the day of the individual miner came to an end in California. Then both the character of the mining and of the mining population changed. It was no longer possible for the nomadic miner with a few simple tools, his own labor, and no technical knowledge or capital, to gather a fortune where nature had concentrated it for him in a few yards of earth or gravel. It became necessary to employ both capital and labor to carry on gold mining under the changed conditions. Ditches, flumes, and reservoirs had to be built for water systems for the hydraulic mines; long tunnels had to be run to tap the ancient gravel channels under the lava-capped divides; and shafts had to be sunk or tunnels run, and pumps, hoists, mill, and other machinery provided, before profit could be expected from the quartz mines.

The great body of miners then stopped working on their own account, and were employed on daily wages by companies organized to conduct the operations requiring investment. The miners gave up their nomadic habits and became permanent residents of the larger towns, taking steady employment in mines and hills, and this condition continues today. Naturally, however, there are numerous prospectors throughout the mining regions, as well as miners working their own "prospects" (undeveloped mines), but the majority of the mining population now work for the companies, where large operations are carried on.

This has resulted in building up permanent towns and villages in all centers of extensive operations, and many of these have all the appliances of modern civilization, with convenience of transportation, far different from the temporary mining camps of the early days.

The era of speculative mining common to newly settled regions has long since passed in California and the industry has for many years been conducted in as legitimate a manner as farming, manufacturing, etc., profits being sought from the products of the mines themselves rather than from fictitious and evanescent prices of stock. The stock exchanges have never been able to induce the gold miners to place the stock of their mines on the lists to be be dealt in by people who knew and cared nothing for the real value of the mines themselves, but only for possible profits from daily fluctuations of the stock.

It is a somewhat remarkable fact that long years after the superficial free-gold placer deposits were supposed to have been virtually exhausted, a new system of mining ground on or near the surface should have been put in practice which has made so marked a change in the industry that the gold yield from gravels has nearly reached that from the quartz mines. The system of dredging is one where improved modern appliances of a mechanical nature are utilized to handle vast quantities of auriferous material in a brief space of time, and then without the use of water under high heads, the necessity of tunnels or shafts, or the employment of much manual labor. Moreover, what is an important feature in this system is that it may be used on ground which has no "fall" or dump, is below the level of the neighboring streams, and had hitherto been mostly considered worthless for mining.

A pit is dug in the ground in which a very strong wooden or steel hull or scow boat is built, and the ponderous digging machinery is placed in this. A series of heavy steel digging buckets, some with as high a capacity as sixteen cubic feet each, revolve on endless chains around drums placed at the top and bottom of a heavy "ladder," digging out the material at the bottom of the pit and, at the top of the revolution dumping it into a hopper. Water under pressure is led into this hopper so as to disintegrate the material therein before it passes to the gold-saving apparatus below. The tailings or debris, from which the gold has been taken, passes continually out into the pond behind, the larger rocks, however, being elevated by a "stacker" to a pile outside the pond. The boat floats in water in the pit and as the dredge digs ahead, cutting out one end of the pit, the space behind is filled with the material which has been dug and washed in the sluices and riffle boxes on the boat. In effect the machine carries the floating space or pond around with it, digging a new space constantly, and filling in where it has already dug. Most of the machines are operated by electric power.

The largest machines now in use are capable of digging between 10,000 and 12,000 cubic yards of gravel daily, digging to sixty-five feet below the water line of the pond and piling rock, etc., forty feet above the water line. The largest machines have buckets of sixteen cubic feet capacity although many have buckets of five to seven cubic feet capacity each. The cobbles or water-worn rocks dug up with the gravel are separated from the dirt and piled up on the bank by the stacker, taken by power machinery to the large rock crushing plants owned by the dredging companies, and there crushed and sized for macadam road building, giving a good profit as a by-product of gold mining.

The principles of hydraulic mining have also been applied with effect in gold dredging. Where the gravel banks above water are at all cemented, two nozzles, one at each corner of the dredge, throw water under high pressure to disintegrate the material being dug by the buckets so it may be more easily mined.

This is a business requiring large capital, as good dredging ground is worth from $500 to $1,000 and upward per acre, and a dredge may cost from $100,000 to $360,000—the latter the cost of the most recent one with sixteen cubic feet buckets and all modern equipment. The cost depends on the size and capacity. The ground to be worked is prospected in advance by a system of drilling, so it is pretty closely known upon beginning operations what the gross output and profit may be on a given area of ground.

In gold mining by this most modern system the presence of paying gravel is not the only consideration. It is impossible to dredge areas which are suitable for either hydraulic or drift mining, or gravels carrying too many and too large boulders, or lying on hard or rough bedrock. Those too deep or too shallow may not be dredged, and there must be sufficient area in one place to warrant the construction of the expensive machinery. In places where the area of dredging ground is not large, only small machines are constructed.

The three points in the state where extensive dredging operations are carried on are in Butte, Yuba, and Sacramento counties where swift streams from the mountains and foothills, after having cut for ages through the older auriferous gravel systems, debouch upon the valley, spread out, from narrow channels to wide ones, and deposit the silt and fine gold. No coarse gold or nuggets are found in these places, that having been previously deposited further up the streams. There are other isolated places in the state where one, two, or three dredges of small size find profit in working limited areas. There are now sixty-five dredges, large and small, operating in California, and their annual gross output of gold is about $7,500,000 a year, which is far more than the yield of all other forms of placer mining combined. Since the first dredge was installed in California in 1899 the gold yield from this source to the end of 1912 has been in the aggregate $55,415,191.

At some places orange and olive orchards and vineyards as well as farms have been purchased by the dredge men and the ground mined for gold, and this has caused some complaint against them locally. The largest of the companies now, however, remove the rocks, level over the worked-out ground, and at once plant it in orchards and vineyards again, restoring, as far as may be, the ground to its original condition, minus the gold they have recovered.

Notwithstanding the combined output annually of the different forms of placer mining—dredge, drift, hydraulic, and surface claims—the quartz mines of the state continue to produce more gold than all these methods together. The deep or quartz mines now produce 56.14 percent of the gold and the combined placers 43.86 per cent. The dredges alone produce 37.68 per cent of all the gold, and 85.93 per cent of the placer gold.

The deep or quartz mines are yielding annually 2,640,000 tons of ore, including gold, silver, copper, lead and zinc ores. The gold mines predominate largely and are worked on a very extensive scale. Out of five hundred and thirty-two properties of this class productive in 1912, there were four hundred and seventy gold mines and the others produced more or less gold with their other metals. The siliceous ores derived from these four hundred and seventy gold mines amounted to 2,225,429 tons with an average value of $4.95 per ton in gold and silver and an annual average of all metals of $5.13 per ton. The average value of ores varies not only in different mines, but in different counties. For example, in Nevada county, where the veins are comparatively small, the average value in gold and silver from 270,000 tons of ore treated was $7.62 per ton. In Amador county, where the Mother Lode vein is quite wide, 673,498 tons of ore milled, yielded $4.11 per ton on the average. In some counties such as Sierra and a few others, where they have small veins, with more or less irregular pay ore, they sometimes obtain hundreds, and even thousands of dollars per ton from comparatively small quantities of ore.

In the earlier history of gold mining in California some very foolish and extravagant ideas prevailed in relation to the gold mines, and, as a result, numbers of mines were given up and people came to look on quartz mining as a risky business. It was found later that the fault lay more in the men than in the mines themselves and most of the old abandoned mines were subsequently reopened and put on a paying basis. The quartz mining industry of the state is today in a more satisfactory condition than it ever has been since its inception. The appliances for saving the gold have been greatly improved and are used carefully and intelligently. Every effort is made to gain as large a percentage of the gold in the ores as possible. It is now possible to work ores at a profit that twenty years or so ago were considered worthless. This has been brought about by the adoption of more economical methods in both mine and mill, increased knowledge of the proper way to treat ores, improvement in processes, and use of electric power instead of steam. The cyanide process, chlorination process, and canvas and slime plants now in use, play an important part in the ultimate saving of all the gold. There is now a certain reliability to quartz mining that it did not formerly possess, so that the industry has grown to large proportions mainly through local and individual efforts and the application of capital. At present most of the more prominent quartz mines are worked by companies, although some are operated by individuals; the latter being worked on a comparatively small scale.

At the quartz mines of the state there are now four hundred and eighty-three stamp mills and fifty-four roller mills, having two hundred and ninety crushers, 6,020 stamps, five tube mills, 1,334 concentrators, and fifty-six cyanide plants. The combined capacity of these mills is 24,381 tons of ore in twenty-four hours.

In the larger and older quartz mines considerable depth has been attained. The vertical shaft of the Kennedy mine in Amador county, is 3,896 feet deep, and the machinery is built for a depth of 5,000 feet. The Plymouth shaft is 2,000 feet vertical and in other mines in the same county, the Fremont has two inclined shafts one 1,550 and the other 2,200 feet; Keystone 2,220, Lincoln 2,050, Wildman 1,450, South Eureka 2,765, and Argonaut 4,000 feet on an incline. At

Grass Valley, the North Star, the most productive quartz mine in the state, has a shaft 5,000 feet on the incline and measures are being taken to provide machinery for sinking 5,000 feet additional. It is noteworthy that the two deepest mines named, the Kennedy and North Star, mined ore in 1913 as good as any they ever encountered in the upper levels. This is a source of great encouragement to owners of other properties which have not sunk to such depths.

Quartz mines are being worked in a great many counties of the state from Siskiyou on the north to San Diego on the south. Most of these are in the mountain, foothill, or desert regions; there being none of note in the valley counties. Several of the old mines in the Mother Lode counties, especially in Amador, have recently been reopened and unwatered after lying idle for twenty years or more. The shafts have been repaired and retimbered and operations to continue sinking resumed.

The space at command prevents any extended consideration of the quartz mining industry in any detail. It should be stated, however, that few new mines of importance have been discovered in recent years, mainly because active prospecting has almost ceased. The old time prospector is a thing of the past, not only in California, but in other states as well. The new men who have gone into mining are working for wages and few of them do any prospecting, while the old-timers who followed that occupation are growing fewer every year. Moreover, the government has set aside so much forest and other land as reservations, and so much is owned by railroad corporations and private persons, that the area in which prospecting may be carried on has gradually become smaller and smaller. This subject of the decline of prospecting has attracted the attention of the mining journals and mining men and has brought about considerable discussion without, so far, any satisfactory solution to the problem. Another thing, too, in connection with quartz mining and milling, is that the enforced eight hour law in both mines and mills, and the workman's compensation law, have entailed additional expenses which are burdensome not only to large properties but to small ones as well. And a matter of perhaps greater importance to the quartz miner is, that it is highly probable in the future the larger operators will have to impound the tailings or refuse from their mills, in the same way the hydraulic miners are compelled to do. This is a matter which has been impending for some time, but it was only in 1912 that the first steps were taken in that direction. An injunction suit involving several thousand acres of land was filed against several large mines in Amador county and a number of land owners. The charge was that the mining companies have allowed debris or tailings to accumulate in a certain creek to such an extent that the stream has frequently overflowed and inundated the surrounding territory. A compromise was effected so that the large mining companies would be exempt from litigation until December, 1914, if by that time they took steps to protect the property of the plaintiffs by restraining their tailings and not allowing them to enter the streams. The mining companies have purchased lands near their properties, and some of them have put up large tailings wheels to elevate the tailings and pass them to these lands so they might be impounded behind suitable dams away from the streams. This adds to the cost of the milling of the ores, of course. When it is recalled that the quantity of ores milled annually in the state runs from 2,000,000 to 2,225,000 tons it may be seen what damage might result in certain localities when all this material is allowed to pass into streams or spread where the waters carry it. In Amador county alone, where the first suit has been brought, the mills treat from 700,000 to 750,000 tons of ore a year, all the tailings of which (virtually the whole quantity) has been dumped for years into the creeks to pass on down to lands below when the winter storms filled the streams. It is not probable that mines with small mills will be affected by this matter, but in certain localities more or less damage may be done unless quartz tailings are impounded. It is a new thing for quartz miners to have to impound their tailings, as heretofore they have always let them run into small creeks or streams and be carried away.

Perhaps a few words should be said before closing this account of the gold mines of the state, of the ocean beach, or "black sand" mining for gold which is carried on, as it is somewhat peculiar and is only done elsewhere in this country on the coasts of Oregon, Washington, and Alaska. The sandy beaches at certain points on the coast line contain considerable gold in very fine particles, and this is found in the black sands, or magnetite, underlying in thin strata, the ordinary white or yellow. sands common to all ocean beaches. The constant erosion of the bluffs and banks of earth bordering the beaches, by the action of the waves, cuts them down, and the fine gold therein contained is concentrated with the heavy iron sands under the top layer of lighter sand. These beaches are worked intermittently, especially after winter storms when the overburden of ordinary beach sand has been washed away, leaving the heavier and more valuable sand behind. The black sands are dug up and washed in sluices or "toms" and the gold saved. Many beaches containing gold are known at widely separated points along the California coast. An important feature is that the black sands also contain considerable quantities of platinum and iridosmine, as well as other minor minerals. The sands of the ocean beach back of Golden Gate Park, San Francisco, contain more or less gold, but not in sufficient quantities to warrant mining them. At one period, many years ago, the discovery of exceptionally rich beach sands at Gold Bluff on the northern coast almost depopulated San Francisco, so great was the rush of people to locate claims. The first comers got hundreds of thousands of dollars in that locality as they found what had been concentrated for ages. The beaches renew themselves in gold every few years. When pay gold is found one year, it may be three or four years before the beach will pay again, and this depends largely on the severity of the winter storms which concentrate the sands.

As California has always been best known for its gold mining industry, and has been preëminent in that, most of the space reserved for this chapter has been devoted to that subject. But it is to be borne in mind that while the gold miners are still active, and still lead the other states of the union, other departments of mining have come to the front in later years. This is shown by the fact that the annual gold yield of the state is, on an average, about twenty million dollars, yet the total value of all mineral substances produced in California is now nearly ninety-three millions yearly. And it is worthy of note that the larger proportion of the values from mineral products have only been apparent in later years, long after the gold mines were at their highest point of activity. The state has proved that it is rich in mineral wealth aside from its gold and silver. Thus, in 1892 the total value of all mineral substances, including gold, was only $18,300,168, and in 1902 it was $35,069,195, while in 1912 the total value was $92,837,374. This is a wonderful showing for the last two decades, and it is not supposed that the highest point of production has yet been reached.

There have been found in California some seventy mineral substances which are valuable to mankind and between forty-five and fifty of these are now being commercially utilized to a greater or less degree. With some of the others arrangements are being made for utilization on the completion of the Panama Canal, when the heavier and more bulky substances may be shipped at a profit to points of consumption, but which cannot at present be mined profitably owing to high railroad rates from California.

It is not possible in this brief and condensed review of the mines of the state, to give space to consideration of minor minerals or even to show the conditions surrounding all of the important ones.

It is deemed proper, however, to make mention in a brief manner, of some few substances more or less peculiar to the state, or not found in other parts of the union, except in isolated localities or in quantities to make it profitable to mine them.

Borax, for example, is a substance which is produced in the United States only in California, the annual value of the output being from $1,250,000 to $1,500,000. All the product of recent years is from Colemanite ore, and not from superficial marsh deposits as formerly. The ore is mined principally in Inyo and Los Angeles counties, but some is also obtained from Ventura county. The main supply is from Inyo county where new deposits are about to be opened. A number of known deposits have not been, as yet, utilized. What ore is mined is shipped to New Jersey where it is refined into the borax of commerce.

Chrome, or chromic iron ore, is not produced elsewhere in the United States, California having furnished the entire domestic product since 1880. Formerly, during the era of sailing vessels, considerable was shipped around Cape Horn to the eastern states, but the long railroad haul and resultant cost prevents any great extension of this industry at present. It is used for chemical and metallurgical purposes, and for furnace linings, making hard tool steel, etc.

Outside of California no magnesite is mined in the United States. The domestic output, in value a little over a hundred thousand dollars a year, is consumed on the Pacific coast as it cannot be shipped east and compete with the imported material from Greece and Austria. Most of the California product is used in the manufacture of paper from wood pulp, although some is made into tiling, wainscoting, artificial marble, furnace hearths, fire-proof bricks, hard plaster, flooring, fire-proof building material, etc.

While platinum is found in other localities, California produces about ninety per cent of the domestic output annually. It is obtained mainly as a by-product in the gold dredging industry but some comes from the black sands of the ocean beaches and that from hydraulic and placer mining.

Quicksilver is another important mineral product in which California stands preëminent, the output annually being from eighty to eighty-eight per cent of the entire United States. Of twenty producing mines in the country seventeen are in California. Indeed, until Texas began making a small output in 1899, followed later by Nevada, California supplied the entire product of the United States as far back as 1850. The average annual production of the state for sixty-three years has been valued at $1,465,708, and the total yield of this substance in the state since 1850 has been 2,124,732 flasks of 75 to 76½ pounds each, valued in the aggregate at $92,275,695.

California is now the leading producer of petroleum among all the states, and yields from thirty-nine to forty per cent of the domestic product. The annual value is about $40,000,000. Pennsylvania and New York since 1859 have produced 736,205,000 barrels of forty-two gallons each, and California since 1876 has produced 542,888,881 barrels to the end of 1912. The California yield at present is from 86,000,000 to 90,000,000 barrels yearly and it is expected, if the proportion of the earlier months continues through the year, that the 1914 yield will exceed 100,000,000 barrels.

Vast quantities of natural gas have been allowed to escape in the state for many years, and have only been utilized in a few localities. But now active steps are being taken for its conservation and utilization at many points. Pipes have been laid to several cities of importance from the wells, and more are being built. The value of that used at present is about a million dollars yearly.

Twenty-five out of the fifty-eight counties of the state contain known coal deposits, a few of which have been mined, but most of them undeveloped. Almost all carry an inferior quality of lignite or bituminous coal.

Deposits of iron ore of varying size and quality are known to exist in thirty-one counties, but the annual production is nominal and is confined to the county of Shasta at present where ores are being smelted by electricity.

California was the earliest of the western states to make any important output of copper, beginning in the "foothill belt" of Calaveras county in 1862, but it was not until the discoveries of large deposits of ore in Shasta county in 1897, that the mining of the metal became of much importance. Up to the close of 1912 the total yield of the state had been 518,487,000 pounds, and the annual output of late years has been from 35,000,000 to 57,000,000 pounds, valued at from $5,000,000 to $7,000,000. The metal is very widely disseminated throughout the state but in only twelve counties is it being mined. The damages being done by the fumes from the smelting furnaces in which the ore is treated, have been the cause of much litigation and the resultant closing down of several of the more important plants. The question has not yet been definitely settled for which reason the copper mining industry of the state is not as prosperous as it would otherwise be.

Silver mining, as a separate industry has not been carried on for several years but some 1,500,000 to 2,000,000 ounces annually are produced, mainly from crude smelting ores of copper and lead, although considerable is also obtained with the gold from quartz and placer mining.

Lead mining, owing to the decline in value of silver, is no longer of much importance in California, but within the past few years some of the reopened old mines have resumed production. The mining of zinc is a comparatively new industry in the state, but the annual yield at present is about 5,000,000 pounds, all from Inyo county.

Many varieties of gems are produced in California, some of them peculiar to the state as far as this country is concerned. There is no definite value, however, for these native gems, as the demand is largely from the tourist trade, and exceedingly irregular. The principal gems mined are tourmaline, kunzite, turquoise, beryl, and hyacinth.

The stone industry of the state is very important and includes limestone, marble, granite, sandstone, trap rock, paving blocks, etc., there being upward of one hundred and fifty active quarries. California now stands sixth in rank among the states in quarry output.

To prove conclusively that California will long continue to be a great mining state, it is only necessary to say that, after sixty-five years work of production and exploration, there are now fifty-six out of the fifty-eight counties producing ore or mineral substances, and some counties as many as nine, ten, eleven, and twelve different ores.

In compiling statistics of mineral production of any given region the value of the products is fixed upon the refined or partly refined metals and is, of course, somewhat greater than the values of the ores from which they are obtained. The ores of precious or semi-precious metals, for example, are commonly complex mixtures of several metals and no quantities or values can be expressed until the contents are extracted in metallic form and become articles of commerce. For this reason the figures of mineral output of California for 1912 (the latest available complete statistics) are given under the respective headings of "raw" and "derived," according to the character of the substances named.

It is proper to note that a mining feature which will be of great importance to the agricultural industry of the United States has just commenced to be developed in California; that is the production of potash. The government has for some time been making deep borings in some of the western states in the hope of finding this important substance in commercial quantities. Meantime private enterprise has been making a similar search, and it has been found in large quantities, together with other valuable salts, in the floor of an ancient lake just south of the boundary line between

MINERAL PRODUCTION OF CALIFORNIA IN 1912
(U. S. Geological Survey)

PRODUCT	RAW		DERIVED	
	QUANTITY	VALUE	QUANTITY	VALUE
Asphalt, short tons	36,111	$ 92,139	213,220	$ 2,094,264
Borax, short tons	42,315	1,127,813	—	—
Briquets, Fuel, short tons	—	—	(a) (b)	(a) (b)
Cement, barrels	—	—	6,093,790	8,215,894
Chromite, long tons	201	2,753	—	—
Clay Products, short tons	102,520	(b) 139,919	—	5,912,450
Coal, short tons	10,978	23,601	—	—
Copper, pounds	—	—	33,451,672	5,519,526
Feldspar, short tons	(a)	(a)	—	—
Fuller's Earth, short tons	(a)	(a)	—	—
Gems and Precious Stones	—	—	—	45,330
Gold, Fine, ounces (Troy)	—	—	953,639	19,713,478
Gypsum, short tons	47,741	—	—	219,317
Infusorial Earth	—	—	—	(a)
Iron Ore, long tons	(a)	(a)	—	—
Iron, Pig, long tons	—	—	(a) (b)	(a) (b)
Lead, short tons	—	—	572	51,512
Lime, short tons	—	—	72,978	555,822
Magnesite, short tons	10,512	105,120	—	—
Manganese Ore, long tons	(a)	(a)	—	—
Mineral Paints, Natural Pigments, short tons	—	—	290	3,610
Mineral Waters, gallons sold	2,089,951	532,971	—	—
Natural Gas	—	1,134,456	—	—
Petroleums, barrels	86,450,767	39,213,588	—	—
Platinum, Fine, ounces (Troy)	—	—	603	19,899
Pumice, short tons	(a)	(a)	—	—
Pyrite, long tons	61,812	201,453	—	—
Quartz, short tons	(a)	(a)	—	—
Quicksilver, flasks	—	—	20,524	863,034
Salt, barrels	(a)	(a)	1,064,286	609,396
Sand and Gravel, short tons	2,189,432	518,516	—	—
Sand-Lime Brick	—	—	—	33,860
Silver, Fine, ounces (Troy)	—	—	1,300,136	799,584
Stone	—	(c)	—	c) 3,902,313
Sulphuric Acid (60° Baume), d, short tons	—	—	(a)	(a)
Talc, short tons	—	—	1,169	15,653
Tungsten (60° Concentrates), short tons	—	—	(a)	(a)
Zinc, short tons	—	—	2,173	299,846
Miscellaneous	—	40,835	—	1,112,817

Total Value, eliminating duplications $92,837,374

a Value included under "Miscellaneous."
b Value not included in Total Value.
c Stone sold rough included in derived product.

Inyo and San Bernardino counties, California, in the "desert region." Other and smaller dried up lakes in the same section of country have been found to contain the same commercial salines to a lesser degree. The government has withdrawn large areas of these lands so they would not fall into private control but used for the benefit of the nation at large.

The main and largest known deposit, located a few years ago under the mining laws by private parties, is the Searles or Borax lake. The deposit is on and near the floor of this ancient lake, the shore lines of which are still visible for many miles along the mountain side above the bottom. The area of the bottom is about 40,000 acres, and this has been acquired by a company which has built a railroad twenty-six miles long from Searles station to the lake deposit where an experimental plant has been erected. An investment of some $3,000,000 is required for the complete refining plant before the commercial salts may be placed upon the market. The depth of the bed in the bottom of the lake is from seventy to ninety feet and some of the material is in brine and some in solid form. From the numerous borings and chemical tests which have been made by the owners, it is estimated that this old lake bottom contains over 100,000,000 tons of sodium carbonate; 42,000,000 tons of sodium bi-carbonate; sodium biborate to the extent of 30,000,000 tons of commercial borax; and nearly 24,000,000 tons of potassium chloride. The quantity of common salt is almost incalculable. A plant for the manufacture of soda and soda ash has been built for some time, and efforts are now in the direction of the potash plant. At the present rate of expected to be enough in this single deposit to last many years thus freeing the country from the necessity of importing this substance from Germany as is at present the case.

Chas G. Yale.

A BRIEF HISTORY OF ASTRONOMY IN CALIFORNIA

ASTRONOMICAL history in California may be said to have begun with the arrival of George Davidson,* Assistant in the United States Coast Survey, in the summer of 1850,† to conduct the astronomical and magnetic departments of the Government's survey of the Pacific coast line. Davidson's first observing station was at Point Conception. Besides determining the latitude and longitude, and the variation and dip of the magnetic needle, he reported upon the best location for the proposed lighthouse at this most prominent and dangerous point on our western coast. During the first four years, other stations were occupied, successively, at Monterey, San Diego, Cape Disappointment (at the mouth of the Columbia River), Port Orford, Neah Bay (entrance to Puget's Sound), San Francisco (Presidio), and at approximately twenty minor points. Longitudes of the principal stations were determined from observed positions of the Moon with reference to surrounding stars (Moon culminations) and from the observed times of star occultations by the Moon, and the relative longitudes of minor stations were derived by means of transported chronometers.

A mass of information—astronomical, magnetic, topographic, hydrographic and general—collected by the various parties in the Coast Survey service, was

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*Davidson was accompanied by Assistants John Rockwell and James S. Lawson. Assistant R. D. Cutts, in charge of the triangulation and topographic services, came to California in the fall of 1850. Rockwell, Lawson and Cutts took prominent parts in the survey of the coast for many years.

†A preliminary survey, chiefly hydrographic, extending from Monterey to the Columbia River, was made slightly earlier by Lieutenant William P. McArthur, U. S. Navy, Assistant in the Coast Survey. Through devotion to duty on this survey, McArthur's health was impaired, and he died on December 22, 1850.

systematized and edited by Davidson in 1855, and published as a descriptive report of the West Coast, from Rosario Strait, Washington Territory, to the southern boundary of California, for the guidance of mariners.

The partial solar eclipse of May 26, 1854, was observed, with small telescopes, by Assistant Davidson at his Humboldt Bay station, by Assistant Cutts on Black Mountain (Loma Prieta), Santa Clara county, and by Professor James Nooney, Jr., at Benicia. The partial solar eclipse of March 25, 1857, was observed by Davidson in San Francisco.

The completion of a telegraph line to San Francisco, in connection with the Pacific railways, enabled the Pacific longitudes to be put upon a modern basis. From a temporary observatory set up in Washington Square, San Francisco, Davidson interchanged time signals with Harvard College Observatory on twelve nights between February 15th and April 4, 1869.

Expeditions conducted by Professor Davidson observed the total solar eclipses of August 7, 1869, at Kohklux, Alaska, and of January 11, 1880, on the summit of Santa Lucia mountain, California. The latter eclipse was also observed, at the same place, by Professor Frisbie of the U. S. Naval Observatory.

Acting under appointment from the general Government, Professor Davidson conducted expeditions to observe the transit of Venus across the Sun in Japan on December 8, 1874, and in New Mexico on December 6, 1882. Clouds vitiated the plans in Japan, but the 1882 transit was successfully observed by Davidson's party at Cerro Roblero, New Mexico, and likewise by some of Davidson's assistants at his observatory in San Francisco.

The transit of Mercury across the Sun was observed at Summit, in the Sierra Nevada, on May 6, 1878, by Assistant Colonna of the United States Coast Survey, and the transit of November 7, 1881, was observed by Professor Davidson's party at Yolo Base, Sacramento valley.

In the year 1860 George Madeira erected the first astronomical observatory in California, at Volcano, Amador county. The refracting telescope, of three inches aperture, was supplied with équatorial mounting and delicate clock-work motion. Madeira has recorded his discovery of the brilliant Comet 1861 II, in the late afternoon of June 30, 1861, only a few hours following its discovery in Europe.

It is a remarkable fact that the first research observatory planned for California, and indeed for the western half of the United States, was on a relatively large scale. James Lick's first deed of trust, dated July 16, 1874, appointed the following trustees:

Thomas H. Selby,	George H. Howard,
D. O. Mills,	James Otis,
Henry M. Newhall,	John O. Earl,

William Alvord.

The terms of the deed directed the trustees " * * * to expend the sum of seven hundred thousand dollars ($700,000) for the purpose of constructing and putting upon the land * * * the said lands being situated on the borders of Lake Tahoe, County of Placer, State of California—a powerful telescope, superior to and more powerful than any telescope ever yet made, with all the machinery appertaining thereto and appropriately connected therewith, or that is necessary and convenient to the most powerful telescope now in use, or suited to one more powerful than any yet constructed, and also a suitable observatory connected therewith.

"*Provided, however*, if the site above designated shall not, after investigation, be deemed by said Trustees, or a majority of them, to be a proper and suitable one on which to erect and maintain such telescope, then such Trustees, or a majority of them, shall elect a site on which to erect such telescope, but the same must be located within the state of California."

It was further directed that any unexpended balance of the gift should be invested and that the trustees should "devote the income thereof to the maintenance of said telescope and the observatory connected therewith, and make the same useful in promoting science."

The question, "What induced Mr. Lick to provide for a great telescope?" has never been satisfactorily answered; but there is no reason to doubt that he came to this determination without conscious suggestion from others. Early in 1873, he told Professor Davidson of his intention, and from that time until the summer of 1874, Davidson was his principal adviser on the subject. As Davidson has published, "James Lick originally intended to erect the observatory at Fourth and Market streets," San Francisco. He gained Lick's promise (not fulfilled) to make the bequest $1,200,000, to reduce the proposed diameter of the great refracting telescope from the impracticable one of seventy-two inches down to forty inches, and to locate the observatory at an altitude of 10,000 feet in the Sierra Nevada. Later, when Lick decided to locate in the low altitude of the

Coast range, Davidson "declined further conference with him." There can be no doubt that Davidson's advice was invaluable in giving a practical turn, at times when greatly needed, to Lick's plans; without it, the telescope might have been located at sea-level in the middle of the business district of San Francisco, or the entire proposal might have been wrecked on the rocks of impracticability; but on the score of altitude and other conditions affecting the location, the consensus of opinion amongst those who have used great telescopes and are experienced in the work of great observatories is to the effect that Lick's choice of a medium altitude was wise.

The trustees acted promptly in search of reliable information to guide them in securing a telescope "larger and more powerful than any yet made." Mr. D. O. Mills, president of the board, consulted with many astronomers in the Atlantic coast states in the summer of 1874. Professor Simon Newcomb was employed to visit European makers of telescopes and telescope glass, and his report on these subjects is dated March 4, 1875. Mr. Lick contracted a personal dislike for one member of the board and demanded his resignation. The other members considered this as unjust, and a menace to their usefulness, and the entire board resigned. In several ways this was a misfortune. To mention one way: Mr. D. O. Mills has told me that this first board recognized the insufficiency of Lick's gift, and that individual members of the board had definitely agreed amongst themselves to increase Lick's bequest, after his death should have occurred, by more than $2,000,000, principally to provide an endowment fund.

Mr. Lick's second deed of trust, dated September 21, 1875, appointed another board of trustees, and provided that the observatory, when completed, should be conveyed to the regents of the University of California and be known as the Lick Astronomical Department of the University of California.

A third Board of Trustees, consisting of:

Richard S. Floyd, President,
William Sherman, Vice-President
(died September 12, 1884),
Edwin B. Mastick, Treasurer,
Charles M. Plum,
George Schoenwald,

was appointed by Mr. Lick on September 2, 1876. Lick died on October 1, 1876. The third board built the observatory, with Mr. Thomas E. Fraser, Mr. Lick's confidential business man, as superintendent of construction. In the summer of 1875 Mr. Fraser examined Mount St. Helena, Mount Diablo, Loma Prieta, and Mount Hamilton* with reference to their fitness for observatory sites. In September, 1875, Lick proposed to the officials of Santa Clara county to construct his observatory on Mount Hamilton (altitude 4,209 feet), provided the county would build a first class road to the summit. The officials acted promptly, and a splendid road was completed in December, 1876, at a cost of $78,000. Legal complications following Mr. Lick's death were not settled until 1879, and active construction began in that year.

*Named for Reverend Laurentine Hamilton, of Oakland.

Land for the observatory site was obtained by grant of Congress (1,946 acres), by California Patent (511 acres), by gift of R. F. Morrow (40 acres), and by purchase (405 acres); total 2,902 acres.

Professor S. W. Burnham was invited to test the atmospheric conditions existing at Mount Hamilton by means of observations of double stars. This he did in the period August 17th to October 16, 1879. He concluded that, "so far as one may judge from the time during which these observations were made, there can be no doubt that Mount Hamilton offers advantages superior to those found at any point where a permanent observatory has been established. The remarkable steadiness of the air, the continued succession of nights of almost perfect definition, are conditions not to be hoped for in any place with which I am acquainted, and, judging from the published reports of the various observatories, are not to be met with elsewhere.* * * So far as there have been opportunities for judging, it is obviously an appropriate place for erecting and maintaining the telescope to be constructed under the Lick deed of trust, and required to be 'superior to and more powerful than any telescope ever yet made.'"

In 1879 Captain Floyd and Mr. Fraser consulted extensively, in Washington, with Professor Simon Newcomb and Professor Edward S. Holden, and the general plans then formed for the observatory were followed in all essential respects. These astronomers were, in fact, the scientific advisers to the three boards of trustees through their terms of office. In 1885 Professor Holden was appointed President of the University of California and director of the Lick

Observatory, on the understanding that he would fill the former office until the completion of the observatory and thereafter the latter office. The construction was finished in 1888, at a total expense of $610,000. A balance of $90,000 remained, in effect the nucleus of an endowment fund. The regents of the University of California assumed control on June 1, 1888, and the scientific staff entered upon its duties on that date.

The principal equipment provided by the Lick Trustees consisted of:

A 36-inch equatorial refractor, objective by Alvan Clark & Sons, mounting by Warner & Swasey. This instrument has also a photographic correcting lens of thirty-three inches aperture, figured by Mr. Alvan G. Clark. By placing the latter lens in front of the 36-inch objective, the telescope becomes a photographic instrument.

A 12-inch equatorial refactor, objective and mounting by Alvan Clark & Sons.

A 6½-inch meridian circle instrument, objective by Alvan Clark & Sons, mounting by Repsold.

Many smaller telescopes and other pieces of auxiliary apparatus.

Other important instruments were presented to the Lick Observatory in later years, as follows:

A 36¼-inch reflecting telescope, presented to the Lick Observatory in 1895 by Edward Crossley, Esq., of Halifax, England. The mirror was constructed by Sir Howard Grubb, and mounting by Dr. A. A. Common. The cost of a building to receive this instrument and the expense of transporting the instrument and iron dome from England were met by subscriptions from prominent citizens of California.

A 6½-inch comet seeker, objective by John A. Brashear, the gift of Miss Catharine Bruce.

A 6-inch photographic telescope, with objective by Willard and mounting by John A. Brashear, all the gift of Regent Charles F. Crocker.

A 5-inch telescope, with interchangeable photographic and visual objective, by Alvan Clark & Sons, the gift of Miss Floyd, daughter of Captain Floyd.

The Mills 3-prism spectrograph, the gift of Mr. D. O. Mills.

Delicate seismographs, the gift of Mr. William Randolph Hearst.

In order that the program of determining the radial velocities of the brighter stars might be extended over the entire sky, Mr. D. O. Mills provided funds in the year 1900 for a well equipped expedition to the southern hemisphere. The equipment included a 36½-inch 3-prism spectograph; a 2-prism spectrograph; a 1-prism spectrograph; an instrument shop; and other acessories. The D. O. Mills Observatory, administered by the Director of the Lick Observatory, is located on the summit of Cerro San Cristóbal, at an altitude of about 2,900 feet above sea level, in the northeasterly suburbs of Santiago, Chile. This important observatory was supported by Mr. Mills until his lamented death in 1910, and the support has been continued by his son, Mr. Ogden Mills.

Many auxiliary instruments, such as spectrographs, seismographs, clocks, chronographs, photometers, etc., have been purchased from time to time.

The directors of the Lick Observatory have been

Edward Singleton Holden,
June 1, 1888, to December 31, 1897,

James Edward Keeler,*
June 1, 1898, to August 12, 1900,

William Wallace Campbell,
January 1, 1901, to — —

Other astronomers on the staff have been

S. W. Burnham	1888–1892
J. M. Schaeberle	1888–1898
J. E. Keeler	1888–1891
E. E. Barnard	1888–1895
W. W. Campbell	1891– —
Henry Crew	1891–1892
R. H. Tucker	1893– —
C. D. Perrine†	1893–1909
R. G. Aitken‡	1895– —
W. J. Hussey	1896–1905
W. H. Wright‡	1897– —
H. D. Curtis‡	1902– —

The list of assistant astronomers includes the names of

A. L. Colton, Sebastian Albrecht,
J. H. Moore, R. E. Wilson,
R. F. Sanford.

*Died August 12, 1900.

†Beginning as secretary of the observatory and later promoted to positions of assistant astronomer and astronomer.

‡Beginning as assistant astronomer, with later promotion to position of astronomer.

Members of the staff have been detailed to take charge of the D. O. Mills Observatory in Chile, as follows:

W. H. Wright.......................1903–1906
H. D. Curtis........................1906–1909
J. H. Moore........................1909–1913
R. E. Wilson........................1913– —

The scientific staff has averaged: at Mount Hamilton, five astronomers, one assistant astronomer and two assistants; and in Chile, on the D. O. Mills foundation, one astronomer and two assistants.

The regents maintain three salaried University fellowships in the Lick Observatory, which are open to well-prepared graduate students who have decided to make astronomy or some of the closely related sciences the basis of professional careers.

The Martin Kellogg Fellowship in the Lick Observatory, endowed by Mrs. Louise W. B. Kellogg, widow of President Martin Kellogg, provides opportunity to one holder each year for advanced study and research under liberal conditions.

The efficiency of the Lick Observatory has been greatly increased by generous gifts of funds for special purposes from Regent Phoebe A. Hearst, Regent Charles F. Crocker, Regent William H. Crocker, Mr. D. O. Mills, Mr. Ogden Mills, and others; and by grants of funds from the Carnegie Institution of Washington, the National Academy of Sciences, and the American Academy of Arts and Sciences.

The results of researches have been published in various astronomical journals: in *Publications of the*

Lick Observatory, volumes I to X —; *Contributions from the Lick Observatory*, volumes I to V, discontinued; *Moon Atlas*, sheets 1 to 19; *Lick Observatory Bulletin*, volumes I to VII —; and in a few special volumes.

The investigational work of the observatory has been exceedingly fruitful. The great telescope has surpassed the expectations of those who planned it; and its energetic use throughout the whole of every good night in the quarter century of its existence has enriched astronomical science in unexpected ways. Lack of space prevents more than a brief reference to the leading discoveries made and results obtained, but the following list comprises those which will be of greatest interest to the general reader.

1. To the four bright satellites of Jupiter discovered by Galileo in 1610, the Lick Observatory has added three satellites. The fifth satellite was discovered by visual observations with the 36-inch refractor in September, 1892. It revolves around the planet once in 11 hours and 57 minutes, and is probably about one hundred miles in diameter. The sixth satellite was discovered by means of photographic observations made with the Crossley reflector in December, 1904. It revolves around the planet in 251 days, and is difficult to see. The seventh satellite was discovered with the Crossley reflector in January, 1905. Its period of revolution is 265 days, it has not been seen in the most powerful telescopes, and is known only from its photographic images.

2. Twenty-nine comets have been discovered. Nineteen of these were unexpected, and ten were periodic comets whose return had been predicted.

3. The first great successes in photographing comets and the Milky Way were made here. The unequalled Lick series of comet photographs has taught us more as to the structure, formation and dissolution of comets' tails than had been learned in all previous time.

4. About 4,400 double star systems have been discovered. These are stars which look single to the naked eye but which the telescope shows to consist in each case of two stars in mutual revolution around their center of mass. Many of the stars have been found to be triple, and a few of them quadruple. A systematic survey, extending from the north pole of the sky as far south as atmospheric conditions permit, including all stars down to the ninth visual magnitude, is nearing completion. It has been found that one star in every eighteen, on the average, is composed of two or more suns visible in the 36-inch refractor.

5. Irregularities in the motions of the first magnitude star *Procyon* had led the celebrated German astronomer Bessel, three-quarters of a century ago, to predict that *Procyon* had a companion sun revolving around it. This companion was discovered with the Lick telescope in 1896.

6. Spectrographic observations of stellar motions, made at Mount Hamilton and at Santiago, Chile, have shown that our Sun and its system of planets, satellites, etc., constituting the solar system, is traveling through space, with reference to the general stellar system, at a speed of about twelve miles per second. The direction of this motion, as determined by the spectograph, toward the boundary line between the constellations *Hercules* and *Lyra*, is in good agreement with previous ideas on the subject.

7. It is the prevailing belief of astronomers that the stars have been formed through the operation of evolutionary processes and that a study of their spectra enables us to arrange them approximately in the order of their effective ages. The blue stars are considered to be in early life, the yellow stars in middle life, and the red stars in old age. The Mount Hamilton and Santiago spectrographic observations of stellar motions have shown that stars effectively young are traveling slowly, middle-aged stars more rapidly, and old stars more rapidly still; that is, that the velocities of the stars increase with their effective ages. The average space velocity of the young stars is about eight miles per second, and of the old stars about twenty-two miles per second. Our Sun, which is middle-aged and traveling twelve miles per second, is one of the slow-moving stars of its class.

8. The observations made principally at Mount Hamilton and in part at Santiago, Chile, have established that those nebulæ known as planetary nebulæ are traveling through space, in various directions, with average speeds even higher than the average speeds of the stars. It had previously been supposed that these nebulæ represented a stage of existence antecedent to the stellar stage. The high velocities of these objects have created the opinion that they have more probably been formed from stars which have been overtaken by catastrophes, such as collisions with other celestial objects. The very extended nebulosity in *Orion*, on the contrary, is traveling with extremely low velocity, and affords no reason for changing the prevailing view that such nebulæ are representative of ante-stellar existence.

9. The North Pole Star was found to be a triple star, in 1899, by means of spectrographic observations. Two of its members are invisible in our largest telescopes. The bright star and one invisible companion revolve around each other in a little less than four days; and these two, forming a binary system, revolve around the center of gravity of themselves and the other invisible body in a period of fifteen years or more. The first magnitude star *Capella* was discovered to consist of two stars revolving around their center of mass in 104.1 days, the two nearly equal components being inseparable in our largest telescopes.

10. In the same manner about two hundred and fifty spectroscopic binary stars—stars apparently single in all telescopes but proved to be double by means of the spectrograph—have been found at Mount Hamilton and Santiago. It may be stated with absolute confidence, that one star in every four naked-eye stars, on the average, is in reality composed of two suns in mutual revolution around their center of mass; and there are good reasons for believing that observations to be made in the next decade will show at least one bright star in every three, on the average, to be double. Double suns have been proved to be so numerous by means of the spectroscope that the question is seriously discussed, "Is our solar system, consisting of one great star and many small planets revolving around it, in reality an average or prevailing type of stellar system, or does it represent an extreme type?"

11. A study of the orbits of spectroscopic binary stars has established that the component stars in a system whose spectrum indicates early age are relatively

very close together, requiring very short periods of revolution, and that the orbits are nearly circular. In systems whose spectra show them to be of greater and greater effective ages, the distances separating the components are successively greater, on the average, and their orbits are more eccentric. The observed facts on the subject are fully confirmative of existing mathematical theories of the evolution of double-star systems.

12. The Crossley reflecting telescope established for the first time the tremendous advantage of this form of telescope in the photography of certain classes of celestial objects, such as nebulæ, star clusters, etc. To possess reflecting telescopes became at once the ambition of many observatories and astronomers. Reflecting telescopes more powerful than the Crossley are now in use by, or under construction for several of the leading observatories. It is through the use of these instruments that some of the most striking advances of present day astronomy are made.

13. Before the Crossley reflector was in use about 10,000 nebulæ had been discovered at various observatories. A few dozens of these were known to be spiral in form. The Crossley photographs led to the discovery of many hundreds of additional nebulæ in the extremely small part of the sky covered by the photographs. It was a simple matter to calculate that certainly 120,000 and possibly half a million nebulæ await discovery whenever time can be spared for the Crossley reflector to undertake this work. These photographs led to the unexpected discovery that the majority of the nebulæ are of spiral form—undoubted evidence of their rotation.

14. The extensive series of photographs of the minor planet *Eros* and surrounding stars, with the Crossley reflector, led to a new and accurate determination of the distance from the Earth to the Sun.

15. The following total solar eclipses have been successfully observed by expeditions whose expenses were defrayed by the friends whose names are recorded:

1889, January, in northern California, by the University of California

1889, December, in French Guiana, by Regent Charles F. Crocker

1893, in Chile, by Regent Phoebe A. Hearst

1898, in India, by Regent Charles F. Crocker

1900, in Georgia, by Mr. William H. Crocker

1901, in Sumatra, by Mr. William H. Crocker

1905, in Spain and Egypt, by Mr. William H. Crocker

1908, in Flint Island, South Pacific Ocean, by Regent William H. Crocker.

On the basis of Regent Crocker's further generosity, an expedition is organizing to observe the eclipse of August, 1914, in Russia.

Numerous technical results concerning conditions existing in the outer strata of the Sun, in the solar corona, and in the Sun's surroundings were obtained at these eclipses, but reference must be limited to only three subjects.

(*a*) The extensive and unique set of large-scale photographs of the solar corona recorded for the first time the wonderful structure of the inner corona and furnished invaluable evidence bearing upon the question of the origin of the coronal streamers.

(*b*) The spectrographic results, combined with those secured by other institutions, have gone far to establish that the parts of the solar corona nearest to the Sun consist chiefly of incandescent particles and gases which radiate their own light to us, whereas the outer parts of the corona consist principally of small particles of matter which send us reflected and diffused sunlight.

(*c*) It had long been an eclipse problem to search for a planet or planets nearer to the Sun than *Mercury*, whose attractions upon *Mercury* were responsible for the unexplained discrepancies in the motion of that body. The Lick eclipse results are substantially final to the effect that no undiscovered bodies of appreciable size exist in that region. It is quite possible that small bodies will some time be found there, but they must be so small in combined mass as not to disturb the motion of *Mercury* appreciably.

16. It has been shown that the new stars appearing in recent years, that is, stars which suddenly shone out where previously no stars had been known to exist, have been converted into nebulæ, and later, in many cases, into extremely faint stars of apparently normal condition. As a consequence, the most probable theory of new stars is that they were originally so faint as not to have been included in star catalogues; that they later passed through extensive clouds of resisting materials such that the collisions on the star surfaces caused sudden increase in brilliancy; and, after passing through the resisting media, that they reverted slowly to their original state.

17. Many thousands of extremely accurate positions of the stars have been secured with the meridian circle.

The results, issued in three volumes, are important contributions to studies of the apparent motions of the stars on the surface of the celestial sphere.

18. Very extensive observations of double stars, comets, planets, and satellites have been made.

19. A large number of orbits have been computed for visual double stars, spectroscopic binary stars, comets and asteroids.

20. Extensive additions have been made to our knowledge of the spectra of nebulæ, comets, new stars, and stars of special interest; the results being of a higher order of accuracy than those previously obtained under less favorable conditions.

21. Important studies of the spectra of spiral nebulæ and star clusters were inaugurated.

22. An atlas of the Moon was made in the first years of the observatory's existence, on the basis of photographs obtained with the large telescope.

23. The motions of approach and recession of about 1,500 naked-eye stars, distributed over the entire sky, have been observed with the 36-inch refractor at Mount Hamilton and the D. O. Mills reflector at Santiago. These data have been utilized in the solution of many important problems concerning the stellar system. We have referred to some of the results in preceding paragraphs: The motion of the solar system through space is about twelve miles per second; certainly one bright star in every four, on the average, though appearing single in the most powerful telescopes, is in reality a double star; the velocities with which the stars travel through space are functions of their effective ages, the speeds increasing as the stars grow older.

These observations have shown, further, that the scale of the universe is about fifty per cent larger than former estimates had made it; that is, the brighter stars are, on the average, approximately fifty per cent more distant from us than we had thought.

24. Spectroscopic observations at Mount Hamilton and on the summit of Mount Whitney have shown that the atmosphere of *Mars* is of low density, probably much less dense at the surface of *Mars* than the *Earth's* atmosphere is at the summit of the highest peak in the Himalaya mountains. These observations have established likewise that the quantity of water vapor in the atmosphere of *Mars* above, say, a square mile of its surface, must be very slight as compared with the quantity of water vapor in the *Earth's* atmosphere above an equal area. In particular, these observations do not prove that *Mars* has no atmosphere and no water vapor; they merely prove that the quantities of these elements are relatively small as compared with the quantities of the same elements on the *Earth*.

James Lick's gift of a great telescope and observatory announced in 1874, and the frequent reports of progress made by the builders, created wide-spread interest in astronomy, especially in California. The many observatories, public and private, established in California in following years, owed their inception chiefly to this interest.

The Davidson Observatory, the personal property of Professor George Davidson, was erected in Lafayette Park, San Francisco, about 1879. It contained a 6.4-inch Clark refracting telescope, which was used to observe the total solar eclipse of 1880 on Santa Lucia Mountain, several partial solar eclipses, the 1882 transit of *Venus*, star occultations and comets, and to make drawings of the principal planets. In the late 1880's the question of variation of terrestrial latitudes was prominent, and observations at widely-separated stations were urgently called for. As a labor of love, Professor Davidson undertook the observations of latitude pairs of stars at this observatory. Between May, 1891, and August, 1892, he secured for this purpose 5,308 observations on 283 stars, and he made an additional series in 1893-4. His results were in good agreement with those obtained at European, Atlantic coast and Hawaiian stations. The Davidson Observatory was dismantled several years ago.

The Chabot Observatory, located in Lafayette Park, Oakland, was given to the city of Oakland by Mr. Anthony Chabot in the year 1883. It is under the control of the Oakland School Department. It has been used liberally for the instruction of students and public, by the first director, Mr. F. M. Campbell, and by the second and present director, Mr. Charles Burckhalter. The equipment consists of an 8-inch refractor, a 4-inch transit instrument, clocks, meteorological instruments, etc. Recognizing Director Burckhalter's ability and enthusiasm, the board of education in 1913 authorized the purchase of a 20-inch refracting telescope and accessories, to be mounted outside the city limits, for research duty.

The Berkeley Astronomical Department of the University of California is a strong factor in the history of astronomy in California. On the initiative of Professor Frank Soulé, head of the Department of Civil Engineering, the legislature of 1885 appropriated

$10,000 for the erection of a Students' Observatory on the University campus. The original equipment consisted of a 6-inch equatorial refractor, a 3-inch Davidson meridian instrument, sextants, chronometers, precision clock, spectroscope and other auxiliary apparatus. Several other small telescopes and suitable protecting buildings were added to the equipment in 1903-4. Instruction began in 1887, chiefly along the lines of engineering and geodetic astronomy. Dr. Armin O. Leuschner was asked in 1892 to conduct the astronomical courses, and a few years later he was placed at the head of the Berkeley Astronomical Department, as Director of the Students' Observatory. Coincident with the development of the teaching side, Professor Leuschner conducted research work on the theory of orbit determinations, and developed a process of his own, known as the "Short Method," which possesses great value. The inspiration radiated to his associates on the teaching staff and to the students through these investigations and their application to a great number of comet, asteroid, and satellite orbits, has been the chief factor in building up a great school of astronomy, both graduate and undergraduate. Director Leuschner's chief associate is Professor Russell Tracy Crawford. Cordial coöperation exists between the Lick and Berkeley astronomical departments of the University in all subjects of mutual interest. A considerable number of astronomers now holding important positions in various institutions of learning received their principal astronomical instruction and training in the Berkeley and the Lick astronomical departments of the University of California.

The observatory of the College of the Pacific was established in the year 1885, on the basis of gifts by Captain Charles Goodall and David Jacks. There are a 6-inch Clark equatorial, a 3-inch Davidson meridan instrument, and accessories. This observatory has the distinction of having turned the careers of two professors in the College of the Pacific, who were more or less incidentally placed in charge of the astronomical department, in the direction of practical astronomy: R. G. Aitken and H. D. Curtis, now astronomers on the staff of the Lick Observatory.

The observatory of Mills College, erected in 1887, is used for purposes of instruction. It contains a 5-inch refracting telescope whose lens, of English make, was presented by Reverend J. H. Wythe; a small transit instrument; an 8-inch reflecting telescope, also the gift of Mr. Wythe; and many minor items of equipment.

In succeeding years, privately-owned telescopes and observatories, on a modest scale, became quite numerous in California. It is not practicable to list them, but we may select for mention those belonging to and used by Reverend J. H. Wythe in Oakland, Mr. Charles Burckhalter in Oakland, Mr. William M. Pierson in San Francisco, Mr. F. G.Blinn near Oakland, and Miss Rose O'Halloran in San Francisco. In recent years Dr. Edward Gray of Eldridge, California, and Mr. E. L. Forsyth of Needles, California, have made commendable observations of variable stars with small telescopes. No attempt is made to list the many small telescopes in California, belonging to individuals and institutions, which have been used merely to "look through," in contradistinction to use for serious study or instruction.

The researches of Professor S. P. Langley, at the Allegheny Observatory, on the quantity and quality of the Sun's radiations to the Earth were seriously affected by our atmosphere, and especially by its water-vapor and dust contents. Langley felt that his results should be checked and extended by means of observations secured at both the base and the summit of a high mountain located in a pure and dry atmosphere, and in a latitude fairly far south to give high altitude to the noon sun. Mount Whitney, elevation 14,500 feet, the highest point of land in the United States, met all these conditions. The country on the east side of the mountain is so precipitous that the village of Lone Pine, only twelve miles away, is all but 11,000 feet lower than the summit; and the summer skies are remarkable for their purity and dryness. Through the generosity of Mr. William Thaw of Pittsburg a well equipped expedition, conducted by Professor Langley, who was assisted by James E. Keeler and others, occupied stations at Lone Pine (altitude 3,760 feet), at Mountain Camp (altitude 11,600 feet, on the floor of the deep gorge immediately west of Mount Whitney), and on the summit of Mount Whitney (altitude 14,500 feet), in the period July-September, 1881. The results bore importantly upon the question of the absorption of solar radiations in their passage through the Earth's atmosphere; but, while the atmospheric conditions were excellent, the full value of the summit station could not be utilized because of the lack of a protecting shelter for the observers.

The favorable opposition of *Mars* in August-September, 1909, led Director Campbell of the Lick

Observatory to plan for spectrographic observations on *Mars* and the Moon from the summit of Mount Whitney, to determine, if possible, the extent of the Martian atmosphere and of its water vapor. At the same time, Langley's successor, Mr. C. G. Abbot, Director of the Smithsonian Institution Observatory, desired to measure the heat radiation of the Sun from the summit of Mount Whitney. To enable both programs of observations to be carried through, the Smithsonian Institution built a three-room shelter of stone, steel and glass on the summit of Mount Whitney in July-August, 1909. The Lick Observatory expedition, equipped and supported by Regent William H. Crocker's generosity, secured the spectrographic observations of *Mars* as planned. The Smithsonian Institution likewise secured the desired observations of the Sun, in August and September, 1909. Mr. Abbot conducted another expedition to Mount Whitney in 1910, in continuation of the same research.

In the summer of 1913 a party under the leadership of Mr. A. K. Ångström, supported by the Smithsonian Institution, observed the intensities of nocturnal radiation from the Earth to the sky, and other radiation effects from the summit of Mount Whitney, from Lone Pine, and from an intermediate station. At the same time a party from the Weather Bureau, under the leadership of Mr. W. R. Gregg, observed atmospheric conditions above the summit of Mount Whitney with the help of captive balloons. Through the coöperation of the Weather Bureau and Director Abbot five sounding balloons, each carrying an automatically-recording pyrheliometer and auxiliary instruments, were sent up from the summit of Mount Whitney on five successive days. All five sets of instruments were recovered and their records were readable. One balloon carried the instruments to the height of 50,000 feet above sea level, where the result for the intensity of solar radiation was in excellent agreement with the results secured at low-level stations.

All of the recent expeditions to Mount Whitney were vitally indebted to Mr. G. F. Marsh, a public-spirited citizen of Lone Pine, who was the principal factor in constructing and maintaining the trail to the summit, under conditions difficult in the extreme.

The total solar eclipse of January 1, 1889, whose shadow-band extended east-northeasterly across northern California, in approximate latitude $+39°$ was extensively observed. There were well equipped expeditions from Harvard College Observatory at Willows, under the direction of Professor William H. Pickering; from Washington University Observatory at Norman, under Reverend Father Charroppin; from Carlton College Observatory at Chico, under Professors Pearson and Wilson; and from the Lick Observatory at Bartlett Springs, in charge of Astronomer James E. Keeler, assisted by Astronomer E. E. Barnard and other members of the staff. Many members of the Amateur Photographic Association of the Pacific Coast, under the direction of Professor Burckhalter, observed the eclipse phenomena successfully at Cloverdale, and many other amateur observers were located at other points. Clouds interfered with the work of several parties, but numerous excellent photographs of the corona and prominences were secured.

The interest in astronomical subjects existing among the public in California and adjoining states was revealed at the time of the eclipse, and the Astronomical Society of the Pacific was organized shortly after the eclipse occurred, in order to develop that interest. The energy and organizing ability of the first president of the Society, Edward Singleton Holden, gave widespread membership to the Society. Five meetings per annum are held on the average, and twenty-five octavo volumes of the Publications of the Astronomical Society of the Pacific have been issued. Early in the history of the Society, Mr. Peter Donohoe provided funds for awarding a bronze medal to the discoverer of each unexpected comet. Eighty Donohoe medals have been awarded to date. Mr. Alexander Montgomery gave the sum of $2,500 to endow the library of the Society. Miss Catharine Bruce endowed the Bruce Gold Medal, with a gift of $2,500. Bruce medals have been awarded under unique conditions to eleven astronomers in seven nations. Mr. John Dolbeer and Mr. William Alvord each bequeathed $5,000 to the endowment fund of the Society.

The summit of Mount Wilson, located a few miles northeasterly from Pasadena, altitude 5,886 feet, was occupied by a Harvard College Observatory party, under the direction of Messrs. E. S. King and Robert Black, from 1889 to 1891, as a part of the search, in both hemispheres, for an observing station possessing excellent atmospheric conditions. The principal instrument was a 13-inch equatorial refractor. Photographs were obtained of the major and minor planets, of the Moon and of other objects. The station "was then abandoned owing to the impossibility of getting at that time a title to the land."

In the late 1880's Mr. Spence of Los Angeles undertook to provide the University of Southern California with a 40-inch refracting telescope. The University's Year Book for 1890 stated:

"The Spence Observatory.—The crown disc for the 40-inch glass is now in Boston, and Mr. Alvan G. Clark is ready to begin the work of grinding and finishing this part of the glass. The flint disc is not yet complete but is being moulded by Monsieur Mantois of Paris, and will be ready to ship to this country some time during the winter."

Shortly following the publication of this statement Spence died, and the University authorities found that available financial resources did not justify them in proceeding further. In 1893 the discs of glass were purchased by Mr. C. T. Yerkes as the first item of equipment for the splendid Yerkes Observatory of the University of Chicago.

The observatory of Napa College, established about 1890, was supplied with an 8-inch Clark-Saegmüller refracting telescope. When this institution closed its career, about 1895, the telescope was purchased by Santa Clara College.

The observatory of Santa Clara College contains the 8-inch refractor described above, mounted in 1900; a 6-inch photoheliograph, mounted in 1907; a Hilger-Evershed 3-prism spectroscope; and auxiliary instruments. The Director, Father Jerome Ricard, S. J., observes the Sun in search of sun-spots and faculæ, to serve as the basis for his own long-range predictions of short-period changes in the weather of the Pacific states. It should be noted that Santa Clara College possessed a 4-inch telescope, with altazimuth mounting, as early as 1860.

The Lowe Observatory, constructed in 1894 by Mr. T. S. C. Lowe, on Echo mountain, a shoulder of Mount Lowe, north of Pasadena, belonged originally to the Mount Lowe Railway Company, later to the Pacific Electric Railway Company, and is now the property of the Southern Pacific Company. Its altitude above sea level is about 3,500 feet. The principal equipment consists of a Clark refracting telescope, aperture 16 inches. This instrument had been the property of Dr. Lewis Swift, in Rochester, New York, where he had discovered 960 nebulæ and nine comets. Coming to Echo mountain as the first director of the Lowe Observatory, in 1894, at the age of seventy-four years, Dr. Swift continued his searches during six years, adding 230 nebulæ and five comets to his discoveries. He resigned in 1900 and was succeeded by Professor E. L. Larkin, whose energies have been devoted principally to writing popular articles on a very wide variety of subjects.

The International Geodetic Association decided, in 1898, to establish four observing stations widely distributed in longitude, but on the same parallel of latitude (39° 08′ north), to make systematic observations of the same selected stars, as a basis for studies of the latitude-variation problem. These stations, located in Japan, Italy, Maryland, and at Ukiah, California, were identically equipped with "Zenith" telescopes of 4¼-

inch aperture. Later, the Russian government joined in the work by equipping and supporting a similar station on the Oxus River, and the Cincinnati Observatory which happens to lie in the same latitude, assumed a share. The Ukiah station has been in continuous existence, with the following observers:

Frank Schlesinger................1898–1903
Sydney D. Townley..............1903–1907
James D. Maddrill................1907–1912
William F. Meyer................1912– —

The observational data are sent to Potsdam, Germany for study by the Geodetic Association.

There is a small observatory at the Mare Island Navy Yard whose work is confined to time determinations. For many years the results were restricted to the needs of the navy and to dropping the time ball on Telegraph Hill (now on the tower of the Fairmont Hotel), San Francisco. In recent years the United States Navy, in California, as elsewhere in the United States, supplies accurate time signals to the Western Union Telegraph Company, which in turn distributes them widely as commercial matter. The officer at present in charge of the Mare Island time service, Professor T. J. J. See, has devoted his leisure most assiduously to the investigation of many important problems in theoretical astronomy and geology. His extensive volume, "Researches on the Evolution of the Stellar Systems," treats especially of the so-called capture theory of the origin of the planets and the satellites of the solar system.

The Mount Wilson Solar Observatory of the Carnegie Institution of Washington owes its inception to Professor Langley's recommendation, in 1902, that the Institution should establish and conduct a solar observatory at a very high altitude. It seems certain that Langley's proposal reflected his appreciation of Mount Whitney as an observing station. He had in mind a station considerably higher than the summit of Mount Whitney, in Mexico or South America. Other astronomical advisers of the Institution emphasized the scarcity of well equipped observatories in the southern hemisphere and the resulting arrears of astronomical knowledge as to the southern sky, and recommended that provision be made also for the suitable advancing of astronomy in the far south. The trustees of the Institution appointed a committee consisting of Director Lewis Boss, Dudley Observatory, Albany, New York, Director George E. Hale, Yerkes Observatory, and Director W. W. Campbell, Lick Observatory, to investigate these subjects more fully, and to consider the question of suitable sites for such observatories. The committee appointed Astronomer William J. Hussey of the Lick Observatory to test the atmospheric conditions on several mountains in southern California, at one station in Arizona, and at a few points in New South Wales, and to observe also the general conditions which would affect the administration of observatories in those localities. The committee reported, in 1903, in favor of a solar observatory, including a 60-inch reflecting telescope, to be located preferably on Mount Wilson, and of an observatory for the solution of certain definite and pressing problems, to be located at some point in the southern hemisphere as yet unselected.

In April, 1904, the Carnegie Institution made a grant of $15,000 to improve the trail to the summit of Mount Wilson, to mount, shelter and use a horizontal reflecting telescope loaned by the Yerkes Observatory, and to make further tests of the conditions on Mount Wilson (altitude 5,886 feet). Dr. George Ellery Hale was appointed director of the Mount Wilson Solar Observatory. In December, 1904, a further grant of $150,000 was voted for construction and maintenance during the year 1905. These and similar grants up to the present time amount to approximately $1,500,000. About two-thirds of this sum has thus far been expended on equipment, including the construction of a very difficult road from the foot to the summit of the mountain, and the remaining third for maintenance and salaries.

The principal instruments on Mount Wilson are as follows:

A 60-inch reflecting telescope, equipped with secondary mirrors for converting it into the Newtonian and Cassegrain forms; with a variety of spectrographs adapted to the brightness of the stars under investigation; and with other auxiliary apparatus.

A horizontal reflecting telescope, aperture 24 inches, focal length 60 feet, fed by means of coelostat mirrors, and supplied with spectroheliographs, etc., for detailed study of the Sun's structure. A mirror of 145 feet focal length is also available to adapt the scale of the solar image to the atmospheric conditions and to the requirements of the problem in hand.

A "tower telescope," in which the coelostat mirrors on the top of a tower receive light from the Sun and send it vertically down through a lens, aperture 12 inches and focal length 60 feet, to form an image near the surface of the ground, at the top of a "well." The well, 30 feet in depth, contains spectrographs mounted vertically in such positions that their slits, at the top of the well, are in the focal plane of the lens on the summit of the tower.

The tower telescope just described proved so advantageous that a similar telescope, 150 feet high, supplied with a well 75 feet deep, suitably equipped with coelostat mirrors, lenses and spectrographs, was constructed in 1910. The lens on the tower supplies an image of the Sun about 17 inches in diameter, and the large-scale spectrograph in the well enables exceedingly minute details of the solar image to be subjected to powerful analysis.

In 1906 Mr. John D. Hooker of Los Angeles gave to the Mount Wilson Solar Observatory the sum of $45,000 to provide the principal mirror of a 100-inch reflecting telescope. The Carnegie Institution accepted the gift, and assumed the obligation of providing the telescope mounting, dome, and auxiliary apparatus, and of maintaining it in use.

A unique feature of the Solar Observatory consists in the maintenance of a physical laboratory, whose principal function is to assist in the interpretation of phenomena observed in the Sun and stars; in contrast, more or less sharply defined, with the policy of other observatories in leaving many problems of interpretation for solution by existing physical laboratories. The physical laboratory of the Solar Observatory is extensively equipped with the most refined and powerful instruments of their class, and has been exceedingly fruitful of results.

The mountain station is used to secure the astronomical observations, nearly all of which are photographic. The photographs are measured, the computations are made, and the results are studied and prepared for publication, in Pasadena, where the administrative offices, measuring and computing bureaus, the physical laboratory, and the extensive shops for the manufacture of instruments are located.

A second departure from existing practice consists in the manufacture of essentially all of the instrumental equipment, excepting lenses, prisms, diffraction gratings and other highly specialized optical parts, and the more massive parts of instruments, by the Observatory itself. In this connection we mention especially the great number of silver-on-glass mirrors sixty inches and smaller in diameter. The silver-on-glass mirror for the 100-inch reflecting telescope is now under construction in the optical shops of the Solar Observatory.

In accordance with a third departure from previous practice, provision is made for the temporary employment of specialists, wherever their permanent connections may lie, to come to Pasadena and Mount Wilson for the application of their methods or special instruments to the work of the Solar Observatory. Professor J. C. Kapteyn, of the University of Groningen, Holland, has taken a leading part in planning the program of observations for the 60-inch reflector, in order that the results may bear efficiently upon the problems of the structure of the universe, which he has long been investigating; and several physicists of this country and Europe have assisted in the applications of minor instruments and in the study of observations secured.

The principal members of the staff are:

George E. Hale, Director
Walter S. Adams, Assistant Director
Frederick H. Seares, Chief of Computing Bureau
Arthur S. King, In Charge of Physical Laboratory
G. W. Ritchey, Optician
Charles E. St. John
Ferdinand Ellerman
Francis G. Pease
Harold D. Babcock
Arnold Kohlschütter
Adrian van Maanen

In addition, there is a large force of assistants, computers, draughtsmen, instrument makers, machinists, and helpers. The present staff numbers about sixty, not counting laborers engaged in construction work on the summit of the mountain.

The resources of the Solar Observatory are devoted principally to those lines of research which promise to bear most efficiently upon the problems of sidereal evolution. Special attention is given to the study of our Sun, the one star that is near enough to us to be observed in considerable detail. Many results of very great value have already been established, and the future is of rich promise.

The results of the investigations are published, principally, in the *Astrophysical Journal*, and re-issued as *Contributions from the Mount Wilson Solar Observatory*. A few of the most important conclusions are here set down briefly.

1. Very comprehensive studies of sun-spots, flocculi and other features of the Sun's surface have led to correspondingly valuable detailed knowledge, and to the announcing of a general theory of sun-spots.

2. A sun-spot is the center of a local magnetic field, and is probably an electric vortex caused by the revolution of negatively charged particles. The strength of the magnetic field decreases with increasing heights in the spot strata.

3. There is a connection between the variations of terrestrial magnetism and changes in the solar activity, as indicated by the flocculi. The intensities of sun-spot fields are too weak to account for magnetic storms observed on the Earth.

4. Evershed's discovery that the principal vapors of the chemical elements flow outward from sun-spot centers and tangential to the Sun's surface has been confirmed and extended, and the principal features of what may be called the circulatory system of sun-spots now appear to be well understood. The velocities of vapors flowing outward from sun-spot centers increase with distance below a neutral level, whereas the velocities of gases flowing inward increase with distance above this neutral level. The materials observed, in effect, to be flowing outward in the lower levels and inward in the higher levels do not of themselves form the

vortex system. The actual vortex is deep seated, the outflow in the lower observed strata being a portion of the upper part of the vortex, while the inflow of the higher gases and vapors is a secondary effect.

5. By means of their lines in sun-spot spectra the effective relative levels of the vapors of twenty-seven chemical elements have been determined. The dark lines of calcium proceed from the highest levels observed and next lower is the stratum which forms the red absorption line of hydrogen. In general the heavy elements occur in the lower strata of the solar atmosphere.

6. The Sun is a magnet whose poles are near the Sun's poles of rotation, and whose polarity—with reference to north and south—agrees with the Earth's magnetic polarity. The vertical intensity of the Sun's general field at the poles is estimated at fifty gausses. This is .01 the intensity of the strongest sun-spot field observed, and about eighty times that of the Earth's field.

7. By virtue of the large scale of the solar image, 1,200 bright lines in the chromospheric spectrum have been photographed, without an eclipse, and their wave-lengths agree well on the average with those of corresponding dark lines in the general solar spectrum.

8. Photographs of the more prominent spiral and irregular nebulæ, owing to the great scale and mechanical perfection of the 60-inch reflector, are of the highest excellence. It has been found that great numbers of nebulous stars are associated with many of the spiral streamers.

9. Photographs of the principal star clusters have revealed unexpectedly great numbers of stars in these objects, by recording stars fainter than those photographed with smaller reflecting telescopes. For example, the number of stars observed in the *Great Cluster in Hercules* is of the order of 30,000.

10. The 60-inch reflector is an admirable instrument for visual observations of planetary surface features. The observations of *Mars* show that the surface is a mass of details, but afford no evidence that a geometrical system of slender and straight "canals" exists.

11. With the 60-inch reflector and attached spectrographs the radial velocities of 372 stars of apparently uniform motion, chiefly helium stars, have been determined. The radial motions of 61 stars whose parallaxes and proper motions are known have also been measured, and twenty of these have space velocities exceeding 62 miles per second. Ninety-nine spectroscopic binary systems have been found in the progress of the radial velocity determinations.

12. The classic researches of the law of the solar rotation made in Sweden by Dunér a generation ago have been greatly extended at Mount Wilson, confirming Dunér's results in general, but establishing apparent departures in many details which promise to assist greatly in the interpretation of conditions existing in the Sun's atmosphere.

13. The spectrum of the *Milky Way* has been photographed. The greater part of the light utilized comes from stars whose spectra resemble that of our Sun.

14. Much work has been done to determine whether light from the stars is absorbed appreciably in its passage through inter-stellar space. This investigation has led to the development of a new method of measuring the distances of the stars.

15. Many investigations are being conducted with a view to determining the arrangements of the stars in space and the relations of great groups of stars to each other.

16. Extensive and elaborate studies have been made in the physical laboratory as to the effects of varying temperatures, pressures, magnetic fields and other factors on the spectra of the principal chemical elements. In many cases the results have been applied to the interpretation of solar and stellar spectra.

The late John D. Hooker, of Los Angeles, made a gift to the Yerkes Observatory for an expedition to the summit of Mount Wilson in 1904-5, enabling Professor E. E. Barnard to secure an admirable series of photographs of the *Milky Way*, especially of the more southerly parts of the *Milky Way*.

The observatory of the Smithsonian Institution of Washington has maintained a branch observing station on Mount Wilson, within the lands controlled by the Solar Observatory, in charge of Director C. G. Abbot, since 1905. It is utilized during the summer months for making measures of the solar radiation, the radiation from the sky, from clouds, etc., for comparison with and in support of researches made at Washington, on

Mount Whitney, and during two summers in Algiers. Mr. Abbot's observations have determined the average intensity of solar radiation to the Earth, the variation of solar radiation intensity as a function of the spottedness of the Sun, and have made it exceedingly probable that the solar radiation varies, in irregular periods of from seven to ten days, as much as eight or nine per cent.

While excellent instruction in the elements of astronomy has been given in Stanford University, notably by Professor Hussey, 1892-5, and by Professor Townley, 1907 — the authorities made no provision for an observatory. Chiefly through the efforts of Mr. A. G. Atkinson, a 6-inch reflecting telescope is in process of construction in the shops of the Engineering Department, and a suitable dome has been built.

The Frank P. Brackett Observatory of Pomona College, the gift of Llewellyn Bixby in honor of his instructor, was constructed in 1908. It contains a 6-inch refractor; a 3-inch transit instrument; a horizontal photographic telescope of six inches aperture and forty feet focus, fed by a coelostat mirror, for spectrographic observations of the Sun; and much auxiliary apparatus. The department of astronomy, in charge of Professor Frank P. Brackett, maintains a local astronomical society, and issues a journal of astronomy, as aids to the development of astronomical interest in the college and community.

The possession of powerful instruments, the great number of clear days and nights, the purity and steadiness of the atmosphere, the enthusiasm of the astronomers, and the favorable governmental conditions maintained for the observatories, give easy explanation of the fruitfulness of astronomical investigation in California. It has been said that the degree of civilization attained by any nation may be estimated from the provision made by its government and people for the study of the stars. Surely the future of California promises much as the abode of man and for the advancement of astronomical science.

W. W. Campbell

THE AGRONOMICS OF CALIFORNIA

THE term agronomics is a new coinage referring to climate, soil and cultural operations as applied to crop production. Aside from cultural operations the three factors which make for success in crop production are a proper temperature, suitable soil, and an adequate moisture supply for the particular crop to be grown. Practically the whole problem in agronomics is involved in securing a perfect harmony between the plant and its environment, the term environment including both climatic and soil factors. This, however, is not a treatise upon how to produce crops in California, but a presentation of the several natural features of the state which contribute to her well renowned agricultural standing.

The details of California climate are presented elsewhere in this publication, hence need not be mentioned in this chapter further than as applied specifically to crop production. Much has been written of California climate, and by many writers, and while it is widely known in a general way, its highest and best interpretation is exhibited in the marvelous range of the products of the soil. There is no other country or principality on the globe where can be found growing all the varied products which characterize this wonderful state. Why this is true has never been satisfactorily explained, but the fact cannot be disputed. It is not due to temperature alone for the seasons are propitious in Italy and Spain, yet the results attained here are not possible there; it is not due to soil alone, for other countries have rich soils; it is not due to the recurrence of a wet and a dry season—a period of rain and a rainless period—for this peculiarity is found in the Mediterranean basin; nor is it any known peculiarity of the atmosphere. Yet in a most happy union of all these, together with a wonderful variety in topography, there is an alchemy of nature which has made California productions phenomenal. The same wonderful range of field crops and fruits, attesting climatic and soil peculiarities not found in other states, are found in the extremity of the Sacramento valley as are found in the extreme southern part of the state. Latitude here cuts but little figure; elsewhere it marks the zones of heat and cold. Here these zones are marked by altitude and not latitude, and the isotherms, in general, run north and south instead of east and west.

The climate of California has usually been set forth as an attraction for tourists, but one cannot live on climate alone; it is, most of all, an agricultural resource of incalculable value by the influence of which the inhabitants are able to diversify and increase the number of products. It is a resource of cash value because man's labor can be turned to profit every day in the year. Every day is a growing day in California; in the field, orchard, garden, on the stock farm and in the dairy, every day is one of productive labor.

Then, too, climate means variety of production. The whole gamut of vegetable life is run here. The whole range of productions from the hardy crops of the New England states to the rice and cotton of the southern states; the wheat of Minnesota or the oranges of Florida; the apples of Michigan or the lemons of Sicily; the peaches of New Jersey or the olives of Spain; the corn of Kansas or the melons of Persia; the barley of Russia or the vines of France; the potatoes of Ireland or the peanuts of Georgia; the sugar beets of Germany or the figs of Smyrna; all bespeak the wonderful cash value of California's range of climate and soil. They work for the farmer and not against him in crop production.

Still not every place in California is adapted to the entire range of crops; selection of locality on the basis of both climate and soil must be made with reference to the particular crops one desires to grow. Somewhere in the great state, however, with a range of climatic conditions associated with a latitude of 33 at an altitude of 270 feet below sea level, to a latitude of 24 with an elevation of 14,339 feet, can be grown the entire range of products mentioned above, and practically all crops except those which characterize solely the strictly tropical portions of the world. Climatically, then it may be well claimed that California is not only unique, but is wonderfully favored for productive labor of man.

The favoring characteristics of California climate find their fitting complement in the adaptability of her soils to a very wide range of field crop production, and to the perfect development of fruit bearing tree, vine and nut. In their wonderful variety, and consequent range of special adaptation, even within narrow limits of area, the soils resemble very strikingly the climates. On account of this wide range of both climate and soil the secret of success in producing crops most abundantly and cheaply depends very much upon close attention being paid to the choice of specially adapted locations for the desired crops. Over climate we can exercise little or no control. Either the plant must be adapted to suit the climate, or its production is limited only to those regions where a natural climate is found to which the plant is suited. Soil environment, however, is subject to modification in a very large degree, and in permanent crops errors in soil situations are much more easily remedied than mistakes in suitability of climate. Many mistakes have been made in California from the fundamentally wrong idea that any crop would grow anywhere, an idea fostered by certain promoters, whose optimism takes on as wonderful a growth under this climate as do the crops when grown under suitable conditions. As a matter of fact, notwithstanding the wide range of adaptability in the state generally, a most careful selection of both climatic and soil situations, as well as water supply, must be made if one meets with the most abundant success.

The grand divisions which constitute the arable areas of the state are determined by the topography of the country. The Sierra Nevada forms a natural boundary on the east. The Coast range mountains form a broad belt traversing the entire coast, and consist of a number of parallel ranges between which are many small and rich valleys, some of large extent. The Coast range mountains merge into the Siskiyou mountains on the north, a connecting link with the Sierra Nevada, and the Tehachapi mountains, which form another connecting link at about two-thirds the length of the state from north to south. Thus is formed superior California north of the Tehachapi mountains and southern California on the south.

Between the Sierra Nevada and the Coast range, and their connecting links, lies the Great Valley of central California, about four hundred miles long and from fifty to sixty miles wide; an agricultural area of great productiveness and comprising more than one-ninth of the entire state. The Sacramento river, rising in the extreme north of this valley, runs through the northern portion of it, which is known as the Sacramento valley; the San Joaquin river runs northward through the southern portion, known as the San Joaquin valley. The two rivers unite near the middle of the Great Valley and flow westward into San Francisco Bay.

South of the Tehachapi mountains the Sierra Nevada continues at a less elevation, and is locally known as the Sierra Madre. The region known as southern California lies west of these mountains, while on the east is still the Mohave region, and on the extreme south the Colorado basin region, both of which are included in the grand division of southern California.

If we except the region in the extreme north-western portion of the state—the region extending northward from the bay region of San Francisco—where the conditions of rainfall approximate more nearly those of the humid states, the soils of California have been formed under the conditions which characterize those of all regions with scanty rainfall, and as a result they present some very distinct differences from those of the humid regions. Soil is formed by a complex process, broadly known as weathering, from the rocks which constitute the earth's crust, and as a matter of fact, is only pulverized and altered rock intermingled with such organic matter as may have grown and decayed upon it. Two distinct classes of forces are active in soil formation: physical and chemical. The physical agencies merely cause pulverization of the rock; the chemical so thoroughly change the essential nature of the soil particles that they are no longer like the parent rock. The resultant action of all the chief physical soil-forming agencies is more vigorous in regions of limited rainfall than in the humid regions, and the resulting rock powder formed by these physical agencies is constantly, and not intermittently, being acted upon by other agencies which change its chemical composition. While the physical agencies of soil formation are the most active in the semi-arid regions the same does not hold for the chemical agencies. As a matter of fact, the process of soil formation, whether in semi-arid or humid regions is essentially that of the "fallow," or so-called resting period, given to dry-farmed land. The fallow lasts for a few months or a year, while soil formation is always going on and has gone on for ages, and the result in quality, though not in quantity, is the same as in the fallow—the rock particles are pulverized and plant foods are liberated. The net result of the action of these agencies is the formation of a rock powder containing a great variety of sizes of soil grains intermingled with clay. The larger grains are called sand; the smaller silt, and those so extremely fine that they do not settle from standing water within twenty-four hours are known as clay. In the formation of clay, water is the most active agent, and under humid conditions its formation is most rapid.

Soils formed under semi-arid conditions thus contain less clay than those of humid regions, and we find loams, or even sands, predominating rather than the heavy clays of the southern and eastern states. But even here we must make a careful distinction between the sands produced under humid conditions and those formed under such conditions as exist in California, for here it is found that even the apparently barren sands are extremely fertile when supplied by irrigation with the necessary moisture. Here the descriptive term sand does not bear the same relation to fertility as in the humid states. There the term refers to *quartz* sand which is incapable of forming clay under the weathering agencies; here, the sand is not simply siliceous, but consists largely of comminuted portions of granitic and eruptive rocks, with an admixture of the ancient schists which cover the flanks of the Sierras, which under humid conditions would have formed clays instead of sands. Thus we find that even the desert-like sands are rich in plant food in California and produce excellent crops whenever water is applied to them. Some of the most productive orchards and vineyards of the state are upon what would appear to our eastern brothers most unpromising barren sands.

Again the humus content forms another interesting and important difference between California and eastern soils. In humid regions the native plants cover the ground thickly and form a thick mass of humus-forming material. Under semi-arid conditions they are bunched scantily over the surface and form a limited mass of humus material. The prevailing forces in countries of low rainfall tend to yield soils low in humus, and California is no exception to this fact. The classic investigations of Dr. E. W. Hilgard, however, have shown a most important difference in the humus composition in the arid as compared with that of the humid regions, viz: that the humus formed under the former conditions carries three and one-half times as much nitrogen as does that formed under the latter conditions, which is a most important matter when considering the relative fertility of such soils. Owing to the more sandy nature of these soils as already indicated, the high percentage of humus is not so much needed in California soils to maintain them in good tilth as in the case of the more clayey soils of the more humid climates. Since the nitrogen content, from the standpoint of intrinsic fertility, is the most important quality of the humus, the smaller quantity of humus is not so important as would at first appear, a fact which is abundantly borne out in experience.

One of the most distinct differences between the soils of California and those of the eastern states lies in the lack of any clear line of demarcation between soil and sub-soil. There is no true sub-soil in California lands, in the sense that it is known in the eastern states, and here again the peculiar conditions under which California soils have been formed is evidently to their advantage.

In the regions of the eastern states the sub-soil has been profoundly modified by the actions of the heavy rainfall, which, in soaking through the soil has carried with it the finest of the soil grains, especially the clay, into the lower soil layers, thus making the sub-soil more distinctly clayey than the top soil. The final result of this together with the carrying down of lime and other soil components by the rains has been the formation of a subsoil of the fine clay particles which is so compact as to render it difficult for roots and even air to penetrate it. Normal weathering, then, goes on most actively in the top soil and the subsoil remains raw and unweathered, so that when turned up a normal state of fertility is reached only after several years of exposure to the elements. Hence the prevalent idea that to turn up the undersoil and expect to secure a profitable crop the first year is a fundamentally wrong procedure. In the semi-arid regions, the light rainfall seldom fills the soil so completely full of moisture to any great depth as to effectually exclude the air, or to carry downward any large amount of the fine clay particles, or remove serious amounts of lime. Thus the top soil and the undersoil are left in essentially the same degree of porosity. The soil remains deep, the air moves through it freely, and all forms of plant life root deeply. Thus California soils are weathered and suitable for plant nutrition to very great depths. There is little or no distinction between soil and subsoil and the California farmer need give little attention to the danger from plowing his lands deep, which is evidenced repeatedly by the impunity with which the California farmer proceeds to scrape off the top of his soil and dump it in the low places in the levelling of his land for alfalfa under irrigation. As compared with the same acreage it is as though there were three or four farms, one above the other.

Again, a difference is found in that the leaching action of rains, which is often great in the eastern states, practically causes no loss of material useful as plant foods, for the top water seldom gets into the general underground drainage, and thus the plant foods are held more abundantly for plant use. The effect of this very limited leaching is further shown in the higher lime content of the California soils, and as Hilgard has well said, "they are naturally marled," making their plant food very available and easily obtained by plants.

To sum up the chief characteristics, then: California soils, on account of their condition of formation carry less clay than those of humid regions; the sand which takes its place is fertile because it consists of particles of many kinds of the parent rock instead of being essentially siliceous sand; they carry less humus, but of higher quality, because its nitrogen content is higher; they carry more lime which renders the plant foods more available and improves wonderfully their texture; they are more uniform in structure, are more permeable and deeper; they have subsoils as fertile as the topsoil. In ease of handling, productivity, certainty of crop-lasting quality, they far surpass the soils of the countries where scientific agriculture was founded, and confound many of the theories and methods developed under such conditions.

Any attempt to scientifically classify, or even describe in detail all the soil types of California in their wonderful variety would lead far beyond the limits of this chapter, and a limit must be set by discussing only the most general types which characterize the great agricultural areas of the state.

The Alluvial Loams. These loams exist along the courses of the existing streams, and extend back from the stream channel to variable distances until they finally merge into the loams of the valley plain, or the adobes. These alluvial loams have been built up by deposits from the streams, and in their natural condition represent the highest type of an all-around soil. They consist of fine alluvium, with seldom any admixture of coarse material. They are naturally very deep, but as they approach the valley plains become more shallow and gradually merge into the soils which characterize that area. These soils are naturally well drained, but very retentive of moisture, and for the most part are farmed to high-class products without irrigation.

Important areas of this class of soil are found along all the important streams of northern California, particularly in the region of San Jacinto, Hamilton, Colusa, and Chico, where they are being extensively farmed to sugar beets, alfalfa, corn, and garden crops, as well as hops, prunes, pears, to all of which they are particularly well adapted.

In the San Joaquin portion of the Great Valley the alluvial loams are also an important class, and are found notably in the valleys of the streams crossing the eastern side of the valley, as well as about the borders of Tulare Lake. Here the type takes on a brownish to black color, varies in texture from heavy to light, but is always easily tilled and exceedingly fertile. The noted soils of the Mussel slough region and the country about Fresno are of this general type.

Their extreme fertility, excellent texture, retentiveness of moisture, and ease of cultivation class them among the most highly productive soils of the world.

The coast valleys also present important areas of this class, among which may be mentioned the important and highly developed fruit sections extending from Oakland southward nearly one hundred miles, including the Alameda and Santa Clara valleys. It is mainly to this class of soil that this noted region owes its preëminence in fruit production.

The Loams of the Valley Plains. Broadly speaking, in the northern division of the Sacramento valley the soils are prevalently loams, a type of soil consisting of an admixture of clay with enough coarse material to secure permeability to air and water, give ease of cultivation, deep root penetration and free drainage of surplus water. These loams are more or less heavy, according to the proportion of clay commingled with the sand or coarse material. Interspersed between these main loam areas are tracts of heavy clay, locally known as "adobe," which is often the exact counterpart of the prairie soils of the Mississippi valley.

In the southern portion of the great central valley, the San Joaquin valley, the soils are of a decidedly different character, being much lighter in texture owing to a much larger admixture of sand, and frequently are distinctly sandy soils, but seldom to such an extent as to render them sterile when supplied with irrigation water. Even in the case of the heavier soils, called "adobe" by contrast, although not strictly such, they take on a lighter character and would elsewhere be classed as medium clay loams.

In the matter of intrinsic fertility it would be difficult, if not impossible to decide between the two divisions; for while the heavier soils of the northern portion of the Great Valley are usually richer in plant food, and thus more lasting, the generally greater depth of the lighter soils of the San Joaquin valley, seems to compensate in a measure for their lower percentage of plant food. This is further true since the descriptive term sand does not bear the same relation to fertility in an arid region as it does in the humid states of the east, as already explained in earlier portions of this chapter. Here the sand is not simply siliceous, but consists largely of comminuted portions of granitic and eruptive rocks, with an admixture of the ancient schists which cover the flanks of the Sierras, to which material we have also added the marly residuum from the underlying material of the rolling plateau lands which commonly border the foothills of the valley side. This commingling of materials forms a more or less sandy soil, but one which is intrinsically fertile and one whose plant food is in an unusually available form owing to the presence of a high percentage of lime. The only factor which appears necessary to make any of these sandy soils very productive is an adequate quantity of water for irrigation.

On the east side of the Sacramento valley low ridges and swales at right angles to the river's course come in from the foothills, forming a gently undulating plain with a general fall of fifteen to twenty feet to the mile, often extending clear to the river's edge. The soils on this side of the river nearly all have a distinctly reddish tinge, showing intermixture of the red foothill soil with the valley deposits. The soils of the extreme northern portion of the Sacramento valley, north of Stony creek, are usually of a reddish color and of a more or less gravelly nature. It is devoted very largely to grain production, with here and there successful orchards of deciduous fruits. Gradually, however, as irrigation water is made available either from gravity or from an underground supply by pumping, it is being developed to alfalfa and a wide variety of other crops with marked success. South of Stony creek the valley is quite level and the soils consist principally of silty or sandy loams, especially bordering the strictly bottom lands along the rivers and streams.

Immediately adjoining this body of silty loam is found a variation of the type, locally known as Gridley loam, a more or less sandy loam soil of reddish color, underlaid at a depth of two to six feet by a dark reddish clay loam, and occasionally by a gray, calcareous hardpan at a depth of about six feet. Taken as a whole this type appears as an extensive level plain, and where other soils intervene between this type and the river there is a well defined terrace noticeable. This type is largely of sedimentary origin, though altered somewhat by the action of the Feather river. Alkali is not found in this soil and it is well supplied with all the mineral elements of plant food, though sometimes deficient in humus. Almost the entire area of this soil has been highly developed to a wide range of field crops and fruit. Peaches have proven very remunerative on a large portion of the area, but find their highest development on the lighter phases. Pears, apples, apricots, figs, olives and prunes have also proven profitable crops, although apricots do not give as good results as in some other sections. On the heavier phases of this soil in the Sacramento valley the noted Thompson Seedless grape reaches its highest perfection, and the Tokay, Mission, and Zinfandel do well. Where there is sufficient moisture, alfalfa, cow peas, beans, corn, and potatoes are well adapted.

A marked agricultural change in the Sacramento valley is taking place at the present time on this soil. The large individual holdings which have prevented the highest development of agriculture are being sold in small tracts, water both from gravity supply and pumping, is being developed for irrigation and there is a rapid increase in the acreage planted to the more intensive crops.

The loams of the valley plains about Fresno and Tulare have been the scene of some of the highest development to fruit in the world. In this region the general character of these soils is lighter than in the Sacramento valley, as already pointed out, and with a much less rainfall, irrigation has been more extensively developed than farther north. On account of the limited precipitation the region represented by these soils in the San Joaquin valley in its pristine condition appeared almost desert-like in lack of vegetation, yet wonderful transformation has been brought about through the magic touch of irrigation and is represented by the exceptional quickness of growth, early bearing, and lavish production of tree, vine, and field crops in general. There is a wide variation in the surface appearance of these lands throughout the San Joaquin valley, and they are locally known as "reddish loams," "white ash," and "sand hill," in the different phases, but all will pass under the general classification here used, viz: loams of the valley plain. With their variation in color, there is also a variation in texture, the first named being the heaviest and the last named the lightest. Although the sand hill class often carries as high as 90% sand, yet it is highly calcareous and the plant food exists in such highly available form that it is intrinsically very fertile, and produces magnificent crops, both fruit and field, where the bottom water does not rise sufficiently to prevent satisfactory root development.

In the semi-tropic region of Los Angeles, San Bernardino, and San Diego, the uplands, or mesas, which occupy the larger portion of the surface, is usually found prevailing a reddish, gravelly loam soil, the coarse material of which consists chiefly of granitic sand. These lands are conspicuous for their orange-red tint and vary in depth from ten to many feet. It is these soils which are chosen as preëminently adapted to citrus fruits. These soils are evidently a modification of the foothill soil northward of the Sierra Fernando, but of greater depth, more easily tilled and with higher percentages of plant food, especially phosphates. On the lower lands frequent gravel beds are found, which in their original condition seem to be too barren for any useful purpose, and yet orange planting on these areas has proven remarkably profitable and some of the finest orange groves in the state can be found on these unpromising masses of debris. The reddish gravel loam soils of the south are probably excelled by few for the crops and fruits which are adapted to the climatic conditions of the region. In the San Bernardino valley proper the red loams are very conspicuous and give the name to the noted citrus district of Redlands.

On the lands which rise from the seashore the loams take on a different aspect and appear as dark colored, sandy, micaceous loams, impregnated to some extent with alkali. Such lands are notably found in Los Angeles, Orange, and Ventura counties, and extend northward as far as Santa Barbara. It is on this type of lands that the sugar beet industry has been highly developed in the southern part of the state. As a rule these lands are extremely productive and are yielding rich returns under cultivation, but both fruit and field crops must be chosen with reference to their adaptability to low levels and exposure to costal influences.

The soils of the so-called desert regions of southern California, under influence of irrigation have surpassed all expectation in crop production. They are usually loams of light color, with sometimes a reddish tinge, and of unusual depth. They are all highly calcareous, exceedingly rich in potash, but comparatively low in phosphoric acid, and all notably deficient in humus. It is on this type of soil, which characterizes the now well known Imperial valley, that a very wide range of crop production is being developed, notable among which may be mentioned alfalfa, melons, and cotton.

Northward from Ventura to Humboldt counties the Coast Range valleys are mainly characterized by soils of a gray, silty loam, quite different in appearance and composition from those found farther south. Chemically they are distinctly less calcareous than those southward, but markedly superior in phosphoric acid. These silty soils are very remarkable for their retention of moisture near the surface even in dry seasons—a property of exceeding value in any country of limited rainfall. In such a broken area the soils naturally show a correspondng variety in phase, but in general they may be classed as loams in that they carry a sufficient proportion of gritty material to enable free working conditions.

The Clay Loams. This general group of soils varies from the former in being distinctly heavier and more tenacious, rendering them more difficult of cultivation. They are, however, stronger and more lasting in character. They exist in great variety of color and physical condition in California, but are not found in such distinctly large areas as those formerly described. They are exceedingly rich in all the elements of fertility and what they lack in ease of working they compensate to a degree in their great durability. Crops upon these heavier soils have to be chosen with greater care as to stocks upon which fruits are to be grown.

From Redding, at the head of the Sacramento valley, to Bakersfield, at the south end of the San Joaquin, the valley has along its eastern border a belt of upland, or foothills, falling from an elevation of four thousand feet at the base of the mountains to five hundred feet, or less, at the edge of the valley proper. The rocks are chiefly sandstones in the southern part of the belt and clay slates from Mariposa county northward, giving rise to bright red clayey loam soils, which, though but a few feet deep, are productive, and have underlying them upturned layers of slate, between which plant roots are able to penetrate to considerable depths and thus secure both moisture and plant food. In texture these foothill soils vary from a moderately heavy clay loam to a heavy, though not uncommonly gravelly, clay, often of an orange-red color. This color is due to a high percentage of iron which is often present in amounts varying from seven to over twelve per cent. These soils generally carry a good percentage of lime, though the potash and phosphoric acid is sometimes low, seldom to such an extent, however, as to make them non-productive in the presence of sufficient amounts of moisture, which is doubtless due to the high availability of these elements in the presence of a good lime supply.

Interspersed in these foothill lands are granitic areas in a belt reaching from Feather river south to Amador county, forming gray or reddish gravelly soils, less productive than the distinctly red lands. Lava beds cover the foothills northward and furnish no agricultural land of value, except along the small streams.

While at present the main portion of this land is devoted to early spring pasture, it is without doubt, destined to be in the near future productive of products of high value. Where the foothill soils obtain a sufficiency of moisture either naturally or from irrigation, and are of sufficient depth, they are highly productive. At a higher elevation than the valley plain the danger from frosts is less and the writer ventures to predict that they will finally be devoted to the culture of citrus fruits which are too sensitive to be risked upon the plain lands generally.

There are numerous distinct phases of this general division of these soils, notable among which may be mentioned along the foothills in Fresno, Tulare, and Kings counties. Here may be found a narrow belt of irregular width where these clay loams, both red and black in color, become quite heavy, and are so highly calcareous as to break up, when dry, into small granulations, producing a condition locally known as "dry bog." On this type of land is found the noted citrus district of Porterville. Westward of this area, reddish or brownish heavy loams predominate, which by contrast with the lighter soils of the immediate region, are designated as "adobe," although far from true adobe in character. This type of land characterizes a belt varying from eight to ten miles in width at its widest part in Tulare county and narrows both northward and southward. When under irrigation, these lands are proving of great fertility both in field crop and orchard productions.

The Clay Soils. Under this general classification is placed all of the very heaviest of the soils, most prominent among which is the well-known "adobe" type. Under this name, however, there is a wide difference in character in different localities until the term has come to be used to distinguish relatively between soils of any region as to whether very heavy or sufficiently intermingled with coarser material to enable it to be easily and freely worked. This type of soil consists essentially of clay and fine silt, and popular terms are used to classify its various phases as "black adobe," "gray adobe," and "black waxy." All of these phases are exceedingly sticky when wet, and bake very hard when dry, making them very hard to work; in short, they are clay soils of an extreme type. The depth, fineness and virginal fertility of these soils, when free from injurious salts, render them very fertile when properly handled. Large bodies of this soil occur in the Sacramento valley, lying between the Sacramento river and the Coast range. Here the color is for the most part gray and the soil is more difficultly tilled than the black adobe on the east side. In this region these soils are being extensively developed to rice culture to which they lend themselves admirably on account of their richness and their imperviousness to water. For many years little has been done with this type of land, but with the introduction of rice upon them, they are returning phenomenal results with this staple, and their value has been very much enhanced. So far the adobes have been very little used for fruit, but alfalfa has been placed upon them with much success. In the bay region and in the vicinity of Stockton these soils assume prominence, in the latter region forming a natural division between the Sacramento and the San Joaquin valleys.

While predominating in the region of the northern Coast range, the loams gradually take their place southward from the bay region.

The Peat Soils. In the deltas of the Sacramento and the San Joaquin rivers is found a very large body of land, which under natural conditions is unproductive on account of swamp conditions, but which in point of area, the progress of reclamation, and agricultural possibilities, is of great interest and importance. These lands lie for the most part in

San Joaquin, Contra Costa, Sacramento, and Solano counties. In typical section this soil consists of six feet or more of fine alluvial river and tidal silts, intimately intermingled with partially decayed vegetable matter. A considerable variation occurs in the structure of these soils for in certain districts subject to overflow by streams in flood times, the surface of the soil consists largely of river silts, in which the usual proportion of vegetable matter is much decreased, while in other cases the soil mass consists principally of peaty material. These soils need only to be protected from overflow, and to be properly drained, to be surprisingly productive as has been thoroughly demonstrated upon thousands of acres of this class of land. Extreme lightness in weight constitutes a very striking feature of these soils. They carry a large supply of plant food, and under proper culture return enormous profits from asparagus, beans, onions, potatoes, celery, barley, corn, and truck garden crops. On the higher and better drained areas alfalfa is also grown with much success. When it is remembered that every month of the year is harvest time for some of the products grown on these lands their value can be the better appreciated. These lands are all below the water level of the rivers and streams, and are irrigated not by the addition of water to the surface, but by raising the water table from below, thus giving ideal conditions for plant growth to all except the very deep rooted crops. The unique conditions which obtain here, including those of long season, suitable climate, rich soil, subirrigation, coupled with both water and rail transportation, combine to promise a value in these lands equal to that of the polders of Holland.

It has been impossible within the confines of this chapter to more than treat of the most general classes of California soils in their wonderful variety. Their productiveness is proverbial, and under the best of conditions even fabulous, and to even relate stories of actual yield would stigmatize the writer as a decided victim of California optimism.

G. W. Shaw

IRRIGATION IN CALIFORNIA

THE importance of irrigation in California is well illustrated by the great number of official reports which have been made on many phases of the subject by state and federal bureaus.

The old State Engineering department, which was created in 1878 and discontinued in 1887, prepared maps showing the irrigation systems and irrigated areas in the San Joaquin valley and in parts of southern California, made stream measurements and assembled and compiled much hydrographic data, and published, under date of October 1, 1888, an exhaustive treatise on irrigation in San Diego, San Bernardino and Los Angeles counties.

In 1888 the United States geological survey began its work of surveying reservoir sites for irrigation purposes. During the nineties it established steam gaging stations, and for the past ten years has maintained such stations on most of the California rivers used or useful for irrigation purposes. Besides hydrographic data, it has published in its "Water Supply Papers" many reports on storage possibilities and underground waters for various parts of the state.

In 1900 Irrigation Investigations of the United States department of agriculture instituted a study of "the existing legal, engineering, and agricultural conditions along nine typical streams used for irrigation in the state." The work on each stream was in charge of a recognized expert, and the report (published as Bulletin No. 100 of the Office of Experiment Stations, United States department of agriculture) is especially forceful in portraying the dire need of rational legislation regarding water rights. Since 1900 Irrigation Investigations has been very active in California and has published many bulletins giving the results of its examinations in many irrigated sections.

The United States census bureau, coöperating with Irrigation Investigations, made an unusually careful census of irrigation in 1909, and the results have been published as advance sheets.

In 1911 the California legislature created the conservation commission to investigate and report upon certain specified subjects of conservation. The commission contracted with Irrigation Investigations and with the United States geological survey, so that the state funds were expended under the direction of the two federal bureaus and a needless duplication of field and office work was thus obviated. As a result of this coöperation, Irrigation Investigations was able to extend and perfect the statistical work started by the United States census, and the geological survey compiled and published in three volumes all stream flow data for the state up to July 1, 1912.

In addition to work outlined above, the Topographic branch of the United States geological survey has been active for over twenty years in making contour maps of parts of California, and its published sheets are now much used in irrigation reconnaissance. The agricultural experiment station of the University of California has also published many bulletins on soils and crops, which are intimately related to irrigation studies.

Area Irrigated and Irrigable. In another chapter in this volume the subject of rainfall is treated. It is sufficient here to call attention to the striking difference in seasonal precipitation for different parts of the state. At Salton, in the Imperial valley, some seasons have no more than a trace of rainfall, while at Crescent City, in Del Norte county, the minimum seasonal precipitation for the period 1885-1908 was 53.73 inches—about four and one-half feet. It is interesting to note that Del Norte county is the only county in the state in which irrigation is not practised.

In a recent examination of lands irrigated and irrigable, Irrigation Investigations divided the state into three parts—northern California, central California and southern California. The data, as published in the report of the Conservation Commission of California (January 1, 1913), are as follows:

	Valley agricultural land.	Valley. plains.	Foothill agricultural land.	Areas irrigated.
	Acres.	Acres.	Acres.	Acres.
Northern California.	4,621,200	790,000	789,000	487,805
Central California..	7,889,000	1,046,000	730,000	1,959,355
Southern California.	*6,070,325			745,486
	18,580,525	1,836,000	1,519,000	3,192,666

*Includes valley and foothill.

After considering the total irrigable area in each of the three divisions and the available water supply, Irrigation Investigations estimates that, of the 6,200,000 acres irrigable in northern California, it is likely that 3,450,000 acres (about fifty-three per cent) will be irrigated in the future; of the 9,665,000 acres irrigable in central California, it is likely that 4,300,000 acres (about forty-four per cent) will be irrigated; and of the 6,070,325 irrigable acres in southern California, it is likely that 1,949,600 acres (about thirty-three per cent) will be irrigated.

Summarizing the above data for the entire state, the estimate is that, of the 21,865,200 acres irrigable, 9,699,600 acres (about forty-four per cent) may be irrigated. As the report shows 3,192,646 acres irrigated in 1912, the estimate is that the present irrigated area may be trebled.

Types of Irrigation Enterprises. The types of irrigation enterprises, as well classified by the United States census bureau, are as follows:

"United States Reclamation Service enterprises, which operate under the Federal law of June 17, 1902, providing for the construction of irrigation works with the receipts from the sale of public lands.

"United States Indian Service enterprises, which operate under various acts of Congress providing for the construction by that service of works for the irrigation of land in Indian reservations.

"Carey Act enterprises, which operate under the federal law of August 18, 1894, granting to each of the states in the arid region 1,000,000 acres of land on condition that the state provide for its irrigation, and under amendments to that law granting additional areas to Idaho and Wyoming.

"Irrigation districts, which are public corporations that operate under state laws providing for their organization and management, and empowering them to issue bonds and levy and collect taxes with the object of obtaining funds for the purchase or construction, and for the operation and maintenance of irrigation works.

"Coöperative enterprises, which are controlled by the water users under some organized form of coöperation. The most common form of organization is the stock company, the stock of which is owned by the water users.

"Commercial enterprises, which supply water for compensation to parties who own no interest in the works. Persons obtaining water from such enterprises are usually required to pay for the right to receive water, and to pay, in addition, annual charges based in some instances on the acreage irrigated and in others on the quantity of water received.

"Individual and partnership enterprises, which belong to individual farmers or to neighboring farmers, who control them without formal organization. It is not always possible to distinguish between partnership and coöperative enterprises, but as the difference is slight this is unimportant."

All of the types are represented in California with the exception of Carey Act enterprises. In order to take advantage of the provisions of the congressional Carey Act, each state must accept its terms by the passage of a state Carey Act. California has not done so. The failure to do so has not been due to any opposition to such projects, but has resulted from the lack of interest in such on account of the small bodies of irrigable desert land remaining as public lands in the state.

The acreages irrigated and irrigable by each type of project in California, as given by the census, are as follows:

U. S. Reclamation Service, irrigated in 1909	400
Enterprises were capable of irrigating in 1910	1,200
Included in projects	14,200
U. S. Indian Service, irrigated in 1909	3,490
Enterprises were capable of irrigating in 1910	3,490
Included in projects	3,800
Irrigation districts, irrigated in 1909	173,793
Enterprises were capable of irrigating in 1910	294,108
Included in projects	606,351
Coöperative enterprises, irrigated in 1909	779,020
Enterprises were capable of irrigating in 1910	984,570
Included in projects	1,388,435
Commerical enterprises, irrigated in 1909	746,265
Enterprises were capable of irrigating in 1910	1,204,059
Included in projects	1,965,063
Individual and partnership enterprises, irrigated in 1909	961,136
Enterprises were capable of irrigating in 1910	1,131,951
Included in projects	1,512,511

United States Reclamation Service Projects. The only reclamation service project entirely within California is the Orland project. The project consists of a reservoir, on one of the tributaries of Stony creek, and canals diverting water from the north and south banks of the main creek for the irrigation of 14,000 acres in Glenn and Tehama counties. The project has recently been completed, but has not yet been formally opened as a project subject to all the provisions of the reclamation act.

The main canals formerly belonged to private companies which, owing to lack of storage, served water in the early part of the irrigation season only. The Service, in purchasing the canals, has unified all interests, and the project is certain to be a success.

Irrigation Districts. California was the first state to pass an irrigation district act. Its "Wright Law" of 1887, with later amendments, has been the model of irrigation district legislation in other irrigation states.

It is not unusual today to meet men in northern California who not only can see no need of irrigation, but positively hold it to be a menace. As the act was passed over a quarter of a century ago, it is not surprising that there should have been intense opposition to the formation of districts under its provisions. As the valley lands were then, for the most part, in very large holdings, the owners naturally objected to an act which subjected their property to irrigation taxes against their will. As a result, practically every feature of the act was tested in the courts, and the supreme court of California and of the United States finally upheld the constitutionality of the act.

Forty-nine districts were organized soon after the passage of the act, but only twenty-five ever issued bonds. Of the twenty-five, only four are now being operated—the Modesto, the Turlock, the Alta, and the Tulare, and the last is not operated as a district, although its system is in use.

It is apparent, therefore, that districts under the original act were generally failures. The money invested in their bonds was either entirely lost or only partially recovered by settlement payments of from thirty cents to eighty cents on the dollar.

Each district was controlled by a board of directors elected from among the residents of the district. As few, if any, of the directors had any experience in the management of such projects, the consequent lack of proper supervision is generally given as the principal reason for the failures. It is now realized, however, that most of the proposed projects would have failed under the best management, as they were initiated far too early to be properly colonized. Projects of the best type, even today, find difficulty in securing purchasers for their lands.

Regardless of the causes of failure, the fact remains that irrigation district bonds became a drug in the market. Within the past few years, the district movement was revived, and two districts, the South San Joaquin and the Oakdale districts, were organized. The two new districts were properly advised along engineering and legal lines, but they experienced the old difficulty in selling bonds.

As a result, an organization of all those interested in irrigation districts was formed to wage a campaign to secure legislation deemed necessary, and the movement has succeeded. In 1911 legislation was adopted creating a commission, composed of the attorney-general, the state engineer and the superintendent of banks, to report upon the feasibility of district projects when so requested by the district board of directors. Upon approval of the project by the commission, the bonds of the district may be registered at the office of the state controller and thereupon shall be considered legal investments for all trust funds and funds of insurance companies, banks, etc. By this method the district bonds are placed upon the same legal basis for purposes of investment as the bonds of school districts and of cities and counties.

COÖPERATIVE OR MUTUAL ENTERPRISES

The Anaheim Union Company. The coöperative or mutual enterprise is an old type in California. So long ago as 1856 the Los Angeles Vineyard association was formed in San Francisco and purchased eleven hundred and sixty-five acres of the Rancho San Juan y Cajon de Santa Ana, lying along the Santa Ana river in Los Angeles county. The original plan was to work the land upon a coöperative basis for about three years, and then make an allotment of the subdivisions—aggregating fifty vineyard lots and fifty town lots—to each member. The town of Anaheim was started in 1857. In 1859 the Anaheim Water company was incorporated, and the irrigation system was conveyed to it. The stock of the water company was divided into fifty shares—one issued to each of the fifty vineyard lot owners. The stock was made appurtenant to the land and could be conveyed only with the land. The Anaheim Union company is still an excellent example of the mutual type of enterprise.

Mutual Water Companies of the Imperial Valley. Although the members of the Anaheim colony must be recognized as pioneer irrigators, their work is no more praiseworthy than that of the settlers of the Imperial valley, almost half a century later.

The Imperial valley was an uninhabited desert so late as 1900. It is mostly below sea level, the bottom of Salton Sea being more than two hundred and eighty feet below sea level. Its summers are long and hot—the maximum daily temperatures ranging from ninety to one hundred twenty-six degrees Fahrenheit. Its average annual rainfall is less than three inches.

The valley is now irrigated by a main canal belonging to the California Development company and by lateral systems belonging to seven mutual water companies—known as Mutual Water companies Nos. 1, 4, 5, 6, 7, 8 and 12. These mutual companies differ from the ordinary mutual companies in that they own a part only of the system. The California Development company originally owned the lateral systems and sold stock in the mutual companies for from fifteen to twenty-five dollars per share—one share of stock being appurtenant to one acre of land. The Development company charges fifty cents per acre foot for water delivered to the mutual companies.

In 1912, the seven mutual companies irrigated 228,600 acres—a remarkable showing for twelve years.

COMMERCIAL ENTERPRISES

Commercial enterprises may be divided into three groups as follows:

First—Enterprises furnishing water on a rental basis only;

Second—Enterprises selling water rights and charging either a fixed or variable annual rate in addition;

Third—Enterprises selling water rights and a pro rata interest in the irrigation system. The enterprises of this group may become mutual enterprises.

First Group of Commercial Enterprises. There are many examples of the first group among the old systems of the state. The old Moore ditch, now the property of the Yolo Water company, was started in 1856. It diverts water from Cache creek for the irrigation of lands in Yolo county. The largest system on the west side of the San Joaquin valley—the San Joaquin and Kings River Canal and Irrigation company—is another example. Many of the mining ditches constructed during the fifties for hydraulic mining in the Sierra and foothills are now used for irrigation purposes and fall into this group.

Water is delivered by the systems of the first group on a quantity basis (that is, so much per twenty-four hours inch or per acre foot), or on a flat acreage basis at rates formerly fixed by the county board of supervisors and now fixed by the Railroad Commission.

Second Group of Commercial Enterprises. Although there are many examples of the first group, the favorite type of commercial enterprise in the past has been the second group—those selling water rights and charging an additional annual rate. Prominent examples in the San Joaquin Valley are the Fresno Canal and Irrigation company and the Consolidated Canal company, diverting water from Kings river for the irrigation of about 360,000 acres in Fresno county, and the Crocker-

Huffman Land and Water company, diverting water from Merced river for the irrigation of about 60,000 acres in Merced county.

There has been much litigation over the rights of companies to charge for the so-called "water right." The most notable instance is that of the California Development company, delivering water on a contract basis to the mutual companies of the Imperial valley.

The United States circuit court of appeals in *Imperial Water Company No. 5 v. Holabird* (as receiver of California Development company) [197 Fed. 4], decided May 6, 1912, holds that the contract in question is void, as the company is a public service corporation and, therefore, obligated to furnish water on tender of the annual rate. The whole decision is based on the assumption that the company is a public service corporation.

The supreme court of California, however, in *Thayer v. California Development Company* (128 Pac. 21, 164 Cal. 117), decided November 8, 1912, holds that the company is not a public service corporation as it has not sold water to any users except those under contract with it. The court, therefore, denies the right of Thayer to receive water from the company without purchasing and holding a water right—that is, stock in one of the mutual water companies.

According to the Thayer decision, the water right contracts of enterprises of the second group will be upheld in all cases where the company has delivered water only to those holding contracts. In order to place such companies in the class of public utilities subject to the jurisdiction of the Railroad Commission, legislation was recently passed (approved April 30, 1913) declaring all water companies public utilities except those organized for the sole purpose of delivering water to their stockholders at cost. This act makes all irrigation companies, except mutual companies, public utilities.

Third Group of Commercial Enterprises. There are very few examples of commercial irrigation enterprises (of the first two groups) in any of the western states which have been successful financially. To the uninitiated there seems great potential wealth in a project which will cause desert-like land, worth only a few dollars per acre, to jump to fifty or more dollars per acre. Those experienced, however, know that this great increment goes, and has gone, to the land owner and not to the water company. The successful plan adopted today is to place the enterprise in the third group—those selling water rights entitling the purchaser to a pro rata interest in the system. Not only are commercial enterprises so organizing, but the Reclamation Service projects and the Carey Act projects, under the provisions of the respective congressional acts, become the property of the land owners when all charges are paid.

Recent examples of the third group are the Sacramento Valley Irrigation company, diverting water from the Sacramento river for the irrigation of about one hundred and fifty thousand acres in Glenn and Colusa counties, and the Patterson Land company, diverting water from the San Joaquin river for the irrigation of nineteen thousand acres in Stanislaus county.

The big problem before such companies is colonization, rather than irrigation. The companies own the land (or most of it) under their systems and make their profits out of the sale of the land. The installation of the irrigation system is but an incidental, though prominent, part of the colonization scheme. A great number of the mutual water companies of California were started as commercial enterprises of this group.

IRRIGATION LEGISLATION

Although the miners of California in the construction of ditches in the early fifties departed from the old common law doctrine of riparian rights and recognized their new doctrine of appropriation only, the former doctrine is the paramount rule in California today. The miners in each district formulated rules governing the possession of both mines and ditches and the early practice of initiating a claim—to either mineral land or water—was by posting a notice. This practice rested on local rules only for many years and was finally adopted as the statutory method in 1872.

The other western states followed the lead of California, but most of them have adopted better legislation during the past twenty years. Under the newer codes, one intending to appropriate water must apply to a state officer for permission to do so. The state officer, in approving the application, fixes the time of beginning and completing construction work and the application of the water to beneficial use. The applicant, therefore, knows, before expending any money in construction, just what he must accomplish so far as time is concerned. As it is now in California, an appropriator, after posting and recording his notice, must proceed with *reasonable* diligence, and just what *reasonable diligence* is, must, in contested cases, be decided by a jury.

California has no special procedure for adjudicating water rights. One must protect his right as he would any other property right, by suing everyone who injures him. Under the newer codes in other western states, the rights along an entire stream system are determined by a state officer or commission, specially and technically qualified, in a comparatively short time and at very little expense to the claimant.

Under the present system in California, there is no state officer whose duty it is to divide the waters of a stream in accordance with the court decrees, where such exist. After long and expensive litigation one may have the case decided in his favor, but generally he must choose between physical force or more litigation in order to stop the wrongful diversions by the losing parties. Unfortunately, physical force is accepted as the only alternative to secure results, and lamentable frays between armed guards follow. Other western states have adopted statutes providing for water masters to close or partially close ditches having late rights so that the water will go down to those entitled to its first use. These water masters supervise the orderly use of irrigation water as a well organized police corps preserves order in a town.

Since 1900, many irrigators in California have been striving to secure better legislation regarding water rights. A bill containing most of the good features of the newer legislation in other states was passed by the legislature in 1913 and approved by the governor. Its operation has been suspended, however, by a petition to refer it to a vote of the people at the general fall election in 1914.

It is believed by those who know the successful operation of the newer irrigation codes in other western states that the opposition in California is due to lack of knowledge of the real purpose of such legislation. In southern California, the water rights on many streams have been settled by years of litigation. The owners of such rights are fearful that the new statute will necessitate more litigation for them—which is not the case. Many others, although admitting the crudeness of the present system, or lack of it, hesitate to accept a new scheme of which they are not sure. The fate of the new bill at the general election is, therefore, very uncertain.

As stated above, the doctrine of riparian rights is superior to that of appropriation in California. The supreme court of California so decided in the famous case of *Lux v. Haggin* (69 Cal. 255) in 1886, and has since in many cases refused to depart from its opinion therein given. A riparian owner along a stream has a right to use its waters for irrigation purposes provided he does not take more than his proportional share, considering the other riparian owners. He is not limited to any degree of reasonableness of use when attempting to restrain a diversion by an appropriator to nonriparian lands.

As the great bodies of land to be irrigated in California lie distant from streams—that is, are not riparian thereto—the riparian doctrine is an obstacle in the way of industrial development. It has been fixed upon the state by the courts and must remain until they decree otherwise—which is a consummation devoutly to be wished but not likely to be realized.

DEVELOPMENT OF UNDERGROUND WATERS

According to the census of 1909, 125,590 acres were irrigated in the arid states from flowing wells, and 308,043 acres irrigated from pumped wells. Of these totals, 55,818 acres were irrigated in California from flowing wells, and 276,595 irrigated from pumped wells. It is clear, therefore, that California far outranks the other arid states in the use of underground waters.

The census (1909) gives California 1,604 reservoirs with a total capacity of 743,269 acre-feet, and gives Colorado 1,084 reservoirs with a total capacity of 2,646,591. Arizona, Idaho, Oregon, and Wyoming are also far ahead of California in the aggregate capacity of reservoirs. Although California leads in the number of reservoirs, the great number is due to the fact that many very small reservoirs are used in connection with its pumping plants.

The reports of the United States geological survey and the United States reclamation service show that there are many reservoir sites which have not been utilized in the Coast range and in the Sierra. In southern California, however, practically all available sites for feasible reservoirs are now in use and the irrigators are turning their attention to subterranean storage. Detailed studies of water supply in southern California, particularly in the Owens valley, the San

Bernardino valley, and the vicinity of San Diego, show the need for such underground storage on account of the tremendous losses of stored and natural waters in transit in the regular channels. This need has been so recognized by congress that public land in the "debris cones" of southern California streams has been reserved for the sole purpose of underground storage—through the artificial spreading of the flood waters of the streams over the surface.

The extended use of underground water in California, and particularly in southern California, is reflected in the resulting litigation—which has been so extensive that a new doctrine governing the use of percolating waters has been established.

Elsewhere in the western states, the common law rule of percolating waters applies—that is, such waters belong to the land owner. Under the new rule, as adopted by the supreme court of California, the land owner is restricted to a reasonable use of the water on his overlying land, and his neighbor may pump from his (the neighbor's) land to land not overlying the percolating water, provided he does not interfere with such reasonable use. The aim of the new rule is to secure a reasonable use of the percolating waters. It is very different from the riparian doctrine, governing surface waters, as, under the latter, the riparian owner may restrain a diversion to nonriparian land regardless of the reasonableness of use on the riparian land.

The new rule of percolating waters, therefore, results in economy of use and conservation of the water supply, while the riparian doctrine fortifies waste and prevents efficiency.

THE OUTLOOK

Although the legal situation regarding irrigation water rights in California leaves room for great improvement, it must not be concluded that it is an insurmountable obstacle in the way of irrigation development. A business house adopting the most efficient methods operates at far less cost than one which sticks to those of fifty years ago. So, in California, greater expenditures than in other states are necessary to perfect the water rights, but the difference in selling prices, of land irrigated and land not irrigated, is ample to stand the greater outlay.

As stated above, the problem regarding new irrigation works is one of colonization rather than one of engineering. The attractiveness of the climate and the fertility of the soil insure an ever increasing population, so that the real difficulty in the way of irrigation development must disappear as the years roll on.

A E Chandler

THE CALIFORNIA FRUIT INDUSTRY

WILD apples, pears, plums, cherries, grapes, blackberries, raspberries, strawberries, gooseberries, cranberries, huckleberries, elderberries, currants, etc.—practically all fruits whose names and characters are common to English speech are native to California, and the species thereof are, for the most part, different from those found wild elsewhere. Besides these, other fruits of semi-tropical fame, such as the almond, the walnut, the olive, the jujube, etc., have botanical relatives indigenous to California. The wild fruits were the delight of the aboriginal Indians and bears—many of them refreshed the throngs of gold seekers of 1849 and some still remain in local esteem. Wild fruits hang about the snow line on the mountains, crest the ridges of the foothills, festoon the river banks of the valleys, hang upon the cliffs, or spread upon the sand beaches of the ocean.

The Spanish missionaries, who reached Lower California in 1697 and entered our territory in 1769 to Christianize the Indians, established missions which comprised churches and residences and farms to render the establishments self-supporting. Between 1769 and 1823 more than a score were founded through a distance of about 500 miles along the California coast under the authority of the king of Spain and all of them had irrigated gardens which were planted with fruits from Mediterranean countries.

Thus came the first cultivated apples, cherries, pears, plums, peaches, and apricots—grown from the seed of the then popular kinds in Spain. The grape and fig came also in the form of cuttings. But the most significant contribution by the padres was the introduction of distinctively semi-tropical fruits: the orange, citron, lime, olive, and pomegranate. Fruits were grown in considerable quantities at the missions. The mission vineyards were of notable area and value of wine product—in fact, the beginning of the export wine trade consisted in a shipment of mission wine from Lower California to Mexico in 1707 where it was exchanged for other goods. The first commercial fruit growing by Americans was in 1850 when, securing possession of the remnants of the old mission gardens, they stimulated them to new production and sold the products to the inrushing gold seekers.

Fruits also came to California by way of Siberia for the Russian outpost on the coast of Mendocino county, as early as 1812, possessed an orchard of apples and cherries and some of the original trees still survive—old, mossy, and not very thrifty but still bearing fruit.

Improved fruits came to Oregon with the American pioneers as early as 1847, and trees from this stock reached California in 1851. This introduction is notable because the trees were grafted and were the first of improved and named varieties to reach the state.

Fruits came to California from everywhere. The almost fabulous prices of the early fifties, the surprising size and excellence of the fruits first grown and the sight of the semi-tropical fruits growing in the open air at the missions, stimulated the pioneers to send for fruit trees to all countries whence they had come, and an industry full of unique phases arose rapidly with plants from every clime and has attained an eminence in volume, value and variety of products which it is our purpose to outline.

In passing to this task, however, let it be noted that the California fruit industry is not new, but is of ancient and honorable origin. It is not generally known that at the time of the establishment of the United States as a nation, there was a larger acreage of bearing fruit trees and vines in California than in all the rest of the territory which now constitutes our national domain.

WHY DOES FRUIT GROW SO WELL IN CALIFORNIA?

California soils are prevalently deep, rich, and loamy. Not only are the alluvial deposits often of similar character to the depth of many feet, but the soils of higher lands formed by rock decomposition are also free and fertile to a notable depth. Only in spots does the planter encounter an infertile subsoil; the rule is that the roots of trees and vines strike deeply—five, ten, yes even at twenty to thirty feet below the surface, well diggers have found them helping themselves to subterranean moisture. Thus the California fruit grower who makes a good location may buy the equivalent of several ordinary eastern farms, one above the other, and his trees and vines will strike roots through all of them. This is one of the reasons why deciduous fruit trees in California can grow thriftily and bear large fruit, though not a drop of rain may fall during the half year of spring and summer, while at the east a few weeks of drought may seriously distress them.

Another reason why California fruits are large is the length of the growing season. The high winter temperature makes Februaryand March the months of bloom, then come the months which are warm enough almost everywhere and then September, October, and part of November, with temperatures still favorable for deciduous fruit ripening. Thus it appears that for these fruits California has a month or two advantage in the spring and a month or two again in the fall—at least three months advantage on the whole in the length of the growing season as compared with average eastern locations—a quarter of a year more growth for the fruit, a quarter of a year more of delightful conditions for outdoor labor for the man in helping the tree to do its best. But this comparison is, of course, unjust to California, for it is based only on the activity of deciduous fruit trees such as are grown in wintry climates. After this comes the season of ripening of many semi-tropical fruits—the orange, lemon, grapefruit, olive, etc. They reach their fruitage while the deciduous trees are resting and the temperatures which favor the fruiting of these trees also encourage, in many places, the strawberry and raspberry to add another delightful fragrance to the winter air and another phase of deliciousness to the winter menu. All this is merely another way of saying that California has an evergrowing temperature—each fruit according to its nature spreads its bloom, makes its growth and completes its maturity without haste or hindrance. How can it escape being large, handsome, and luscious, providing man gives it the culture which meets its requirements and befits its nature?

But there is involved a finer point still. There is in California an atmospheric quality which works together with light and heat for the development of fruit and the preparation of fruit products. The dryness of the air promotes the efficiency of sunlight: the energy of that light opens opportunity for the fullest employment of heat. In a moist summer climate there is a screen invisible to the eye but nevertheless, to a degree, destructive of the efficiency of sunshine. It is to the perfect transparency of dry air that the sunlight of California owes a part of its efficiency, and the evidence thereof is the clearness and delicacy of the colors of California fruits. Moist air deepens tints and tends toward russet blemishes; the dry air tends to brilliance and to refinement. Then, too, light and heat work together in fruit chemistry and promote the production of sugars, oils, and essences whence come fruity flavors and the nutritive qualities and they continue their labors, in connection with dry air, in the preservation of fruit from decay while it is maturing, and in retaining natural colors in dried fruit so that California sun dried fruit reaches the highest standard described in the trade as "evaporated fruit."

All these factors contribute to the distinctive excellence of California fruit but all these would fail of results without the ever present promotive and protective skill and devotion of the growers. California fruit growers as a class have no superiors among agricultural producers in the application of science, invention, and experimental knowledge to the promotion of their business. They have practically revolutionized fruit growing all the way from soil to sale. They plant, prune, cultivate, irrigate, protect, pick, pack and sell fruits according to methods they have themselves devised. All other fruit growing states and countries study their ways and are imitating them so far as adaptable to other conditions.

But after all, the underlying secret of success in California fruit growing is the conception of the tree or vine as a producing machine which must be developed and maintained in the highest degree of efficiency. This idea of a tree widely prevails, and in commercial plantings is sharply and diligently pursued. The tree must have the best shape to bear a fair amount of large, well-developed fruit. It must be a low tree in order that all work upon it can be most cheaply done. It must grow every year a sufficient amount of strong, new wood, and to do this it must be pruned to prevent overgrowth and over-bearing. On the other hand, satisfactory growth and fruit-bearing must also be promoted by constant cultivation of the soil and by irrigation and fertilization, when necessary. It must be protected in its strength by the absolute destruction of injurious insects, blight, and diseases. All this signifies that the tree must be maintained in full possession of its producing powers, and the California grower expects to stand beside his trees, constantly training and pushing them to their work and generously assisting them to all that they need to do it well. It is this conception of the grower's relation to his trees and the discharge of the duties which such relation requires, which have brought to California fruit growing such notable success and wide repute.

VOLUME AND VALUES OF THE CALIFORNIA FRUIT PRODUCTS

The reader can better understand the confidence with which the foregoing declarations are made when the demonstration in terms of volume and value is cited. A third of a century ago California did little beyond the supply of her own people. Since then the advancement has been rapid and the following is her position among the states and the volume of the product by which it is attained, as compiled from the thirteenth census of the United States:

RANK OF CALIFORNIA IN THE UNITED STATES IN THE PRODUCTION OF FRUITS

Kind of Fruit	Rank Among States	Value of Product 1909
Almond	first	$ 700,304
Apple	ninth	2,901,622
Apricot	first	2,768,921
Cherry	first	951,624
Fig	first	260,153
Grape	first	10,846,812
Lemon	first	2,976,571
Olive	first	401,277
Orange	first	12,951,505
Peach	first	8,563,427
Pear	first	1,660,963
Plum and Prune	first	5,473,539
Walnut, English	first	2,247,193
Berries	third	1,789,214
Total value*	first	50,704,834

*Including minor fruits not listed.

Thus it appears that California leads the other states in every fruit except two and leads in the total value of all fruits produced by all states—producing in fact about one-fourth of all the fruit grown in the United States.

Four crops have been gathered since the census year, 1909, and the California fruit interests have notably advanced. Including this increase and using the commercial value of the fruits as they reach the markets instead of the "farm value" which the census gives, a total value at the present time is estimated to be one hundred millions of dollars.

But striking as is the rapid advance in fruit production in California during the last quarter of a century, it must be conceded that the achievement in successfully marketing such an immense product at a mean distance of 2,500 miles from the place of its growth is without parallel in the commercial history of the world. The Mediterranean countries, it is true, have for centuries done a thriving business in long distance fruit marketing, but they never reached such an aggregate of value and they handled chiefly citrus fruits and that by water routes—most durable fruits by the least trying transportation. California has not only marketed more destructible fruits at a greater mean distance, but has had to employ the most expensive and most trying transportation—the incessant jar of the railway train, the dessication and dust of the desert; the stress upon fruit twice lifted a mile and a half into the air and twice rattled down again to the plain, as two great mountain ranges are crossed, including the protection of the fruit against freezing cold and melting heat—all these and similarly trying conditions have been triumphed over in the development of this interesting traffic.

The record of the marketing of California fruits and fruit products beyond state lines therefore commands attention. In the following figures no account is made of the fruits handled in the local markets of California:

CALIFORNIA OVERLAND SHIPMENTS IN TONS IN 1912

Citrus Fruits	479,098
Deciduous Fruits	167,603
Dried Fruits	194,175
Nuts and Olives	15,399
Canned Fruits	89,946
Fresh Vegetables	129,659
Wine and Brandy	93,249
	1,169,128

Thus it appears that the equivalent of 116,912 carloads of ten tons each of fruits and fruit products were shipped out of the state of California by rail in the year 1912. Shipments by sea might add the equivalent of 20,000 carloads to the total.

RELATIVE AMOUNTS OF DIFFERENT FRUITS IN OVERLAND SHIPMENTS

To show the standing of different fruits shipped as fresh fruits the following compilation is made:

	Carloads	
Apricots (1913)	169½	
Cherries "	231	
Grapes "	6,363¼	
Peaches "	2,395¾	
Pears "	2,485¾	
Plums "	1,668	
Miscellaneous (1913)	18½	13,331¾
Oranges (1911)	46,394	
Lemons "	6,764	53,158
Total carloads		66,489¾

CALIFORNIA DRIED FRUIT AND NUT PRODUCT OF 1912

	Tons	
Apples	3,600	
Apricots	20,000	
Figs	5,000	
Peaches	30,000	
Prunes	102,000	
Raisins	95,000	
Miscellaneous	3,000	258,600
Walnuts	11,250	
Almonds	3,000	14,250
Total of dried fruits and nuts		272,850

INFLUENCE OF FRUIT GROWING UPON THE DEVELOPMENT OF CALIFORNIA

The records already cited to show the preëminence of California in the fruit industries of the United States convey also, by inference, an idea of their importance in the development of the state, but a definite measure thereof is pertinent. This is found in the growth in assessed valuation of a number of counties which have the greatest orchard and vineyard interests.

ASSESSED VALUATION OF LEADING FRUIT COUNTIES IN MILLIONS OF DOLLARS

County	1876	1903	1912
Santa Clara	27	60	78
Sonoma	15	28¼	40
Napa	8	13	17
Solano	9	19	25
Placer	5½	7½	13
Fresno	8	31	79
Los Angeles	14*	165	726
Orange	—	13	44
San Bernardino	2½†	17	58
Riverside	—	14	31
San Diego	2½	18¼	59
	91½	386	1170

*Including Orange
†Including Riverside

Here then we have a group of counties before and after taking the fruit interest, showing property value increased nearly thirteen times by the operation. Some counties have advanced but little it is true, but one must remember that in some cases, as other industries declined, their territory would have lapsed to range value had not the fruit interest arisen. Again, other counties have advanced so remarkably that one is prone to seek the cause in the inrush of eastern capital for home making and city building. But even here it was the glory of California fruit which incited and has sustained the movement. This is particularly true in Los Angeles county.

If, however, one is inclined to regard fruit growing rather more as incidental than fundamental in the development of southern California, let him consider the growth of Fresno and Santa Clara counties. Their advancement argues indisputably the direct, attractive, and constructive power of fruit growing. These counties, and their famous cities of Fresno and San José, have risen to settlement and wealth by the achievements of those who pursued fruit growing and fruit preservation, not for their health but from strictly business considerations, and the attendant growth of manufacture and commerce is a corollary of the fruit industry.

Another important contribution of the fruit industry to the development of California is found in the quality of citizenship. Fruit growing operations are exceedingly attractive to those who turn from the professions to seek an outdoor life in a salubrious climate. Man has never outgrown his taste for fruit which was first manifested in Eden, and the thought of constant association of sunshine, fruits, and flowers with his life and work is most delightful to his esthetic sense. The horticultural arts seem also to be more elegant and the manual labor which they exact more clean and honorable than the coarser forms of agriculture. The result has been the attraction to California in fuller degree than to any other new state, of people of culture and of refined tastes, people loyal to education and morality and generous in their support of such interests. The class of trade to which fruit products pertain was also attractive and the opportunity to invest freely in building up new trade in such products interested people who had accumulated wealth in all lines of manufacturing and commerce.

The result has been that the population attracted to California by fruit growing has been of an exceptionally desirable class and at the same time the fruit interest has advanced still more rapidly by reason of this acquisition because the promoters were possessed of ample wealth, organizing skill, business ability, and quick apprehension not only of the most successful cultural details, but of the broad principles upon the basis of which a new phase of industry must advance and a new community escape crudity. No other form of agriculture could have accomplished for California what fruit growing has done in securing and promoting quality in citizenship and in establishing a type of homes, which, from cottage to villa, manifests the same aspirations and attributes of enlightened manhood and womanhood.

WHAT CALIFORNIA HAS DONE FOR FRUIT GROWING

The ability to originate and invent and to adapt means to ends has been most clearly displayed in the up-building of the fruit interests of California and it is interesting to note briefly that a significant service has been rendered to fruit growing everywhere because methods and policies recognized as Californian are being introduced, wherever practicable, in all parts of the world. Governmental commissioners have appeared from all civilized countries and have made elaborate reports of their observation of California methods. Not only have young trees and vines been shipped in all directions from our nurseries, but implements and machinery employed in fruit growing and preservation have been widely exported. Greater service than this has been rendered in the demonstration of the value of certain pomological methods and policies which are proving helpful to fruit growers in other parts of the world. Among these may be named:

First: The importance of clean cultivation during the growing season, not alone in the conservation of rainfall but in promoting physical conditions in the soil which are favorable to vigorous root-action. California may not have invented such cultivation but the world paid no heed to it until California exhibited its benefits by thousands of acres. Now it is the accepted method nearly everywhere and the epoch of grass growing in orchards has closed, even in the most humid climates. In his report of the experiments made on Woburn farm in England in 1903, the Duke of Bedford shows that trees in cultivated ground made in some cases twice, and in some cases thrice, the growth of trees growing in grass. The ancestors of the Duke of Bedford probably in their adoration of turf scorned old Jethro Tull's "Horse Hoeing Husbandry" in 1733, but the California demonstration of the truth of Tull's theory of tillage is bringing belated honor to the prophet in his own country.

Second: California has shown the essential nature of thorough surface cultivation in connection with irrigation and this demonstration is influencing practice wherever irrigation is employed.

Third: Irrigation supplies always available in case of deficiency in rainfall are recognized in California as the safeguard of horticultural investments and of thrift of trees and vines and this, too, is being provided for now in humid regions where recently irrigation was looked upon as only valuable in deserts.

Fourth: Low, vase-shaped fruit trees were formerly grown in gardens. Today they are found in orchards on all continents, but California furnished the demonstration of their superior economy, thrift, and profit and banished the old, high-trunk, cow-browsed fruit trees from commercial orcharding. Modern fruit growers cannot afford to use spliced ladders, nor can trees afford to pump sap through several yards of fire wood in the shape of useless trunk and main branches.

Fifth: Orchard and vineyard protection from pest and disease first reached great and systematic development in California and the two most effective insecticides for fruit tree insects now in use originated in this state. In California also the most striking demonstration of the value of pursuing injurious insects by multiplying their natural enemies, has been reached.

Sixth: California has led in the new and aggressive American policy to market fruit products abroad and has reached signal achievement in supplying American markets with certain fruits and fruit products previously available only through importation.

Seventh: Success in the organization of fruit growers for coöperative action in preparation and marketing of their own products has enabled California to enforce policies of wide distribution and economic production which alone could avert the disaster which usually attains very rapid increase in the volume of products which are not already recognized as staple foods.

Eighth: California has reached such success in plant breeding that a very large part of the varieties commercially grown are of local origin. The production of fruit in large quantities required varieties adapted to local conditions of climate and suited to the definite purposes involved in long shipment, in drying and in canning. The varieties which delight the amateur may bring no profit to the commercial grower. California succeeded so well in reaching these commercial standards that the California varieties are being accepted as a basis upon which to begin fruit growing in the uttermost parts of the world. California conditions also must be credited with bringing new life to a number of old varieties too delicate in their nature to reach commercial standing in more trying climates.

Ninth: California also holds the leading place for the creation of new varieties, found unique and valuable both to commercial growers and amateurs, in the achievements of Luther Burbank, who has worked with an eye on the requirements of the world at large.

THE SATISFACTION OF IT ALL

Enlistment in California fruit growing has proved exceedingly satisfactory to tens of thousands of people in the various ways along which they have approached it. The fruit districts are full of cottage homes sheltering families of those who have begun with small investments and have made a good livelihood and often considerably more, from a few acres of fruits grown largely without expenditure for hired labor. The study of the needs of the tree or vine and ministering to them by personal effort has brought new health, new strength, and new incentive to the worn and weary, who have taken up outdoor life and activity in California fruit growing, with a wise choice of location, land, and fruits; for obviously, in all investments one must be wise as well as willing.

In larger operations hundreds have today notably succeeded by purchasing good land in large tracts at low rates and making ample investment for its development and improvement. Some of the most delightful of our towns and villages have arisen as a direct result of such employment of capital. Well established communities, well churched and schooled, well provided for in local trade and transportation and widely known for the high intellectual, moral, and social standing of their citizens, have followed investment of money and devoted effort in colony enterprises.

Hundreds also have purchased large tracts of wild land and have developed fine estates for their own personal gratification, with thriving orchards of all kinds of fruits, rich pastures tenanted with improved live stock, parks, gardens, and buildings comparable with the estates of the European nobility, except that California conditions favor freedom and variety in outdoor effort unknown in Europe and command proportional interest and enthusiasm. Estates for winter residence in California are exceptionally desirable not only because of natural advantages and greater possibilities of development but because of the advanced standing of the state financially and socially.

All of these three lines of effort then—home making in a small way, colony enterprises and private estate development—have yielded, on the whole, great satisfaction and success. Fruit growing has been the central idea in nearly all of them but it is obvious that activity in any productive line begets opportunity for other lines and so all branches of agriculture have advanced and the diversification is highly desirable. Opportunities in manufacture, trade, and professional effort of all kinds have been quickly seized and developed with much originality and success. Fruit growing has created them all and has in turn been advanced by them all, for every accumulation of capital promotes it. Successful toilers in all lines become planters. The ancestral delight of the race, to sit beneath one's own vine or fig tree, is nowhere more enthusiastically manifested than in California and nowhere does the emotion of comfort in ownership yield such profound and protracted satisfaction.

THE OUTLOOK FOR CALIFORNIA FRUITS

The outlook for California fruits and fruit products involves considerations of much economic interest. Though the volume is already large and there may be experienced now and then temporary dullness or depression in this line or that, the business is on the whole brisk and profitable. There is such a wide range in the fruits grown and the products made from them and such changes in local conditions in the many purchasing states and foreign countries with which Californians deal, that there must be some fluctuation in the values of some of the supplies offered in distant markets. The result is that first one fruit and then another seems to be more or less profitable. The fact, however, that all are increasing in volume and that the total traffic brings each year more money to the state, is a demonstration of the standing of the collective output. Each year new markets are found both at home and abroad and the capacity of old centers of distribution is shown to be greater than anticipated. There seems to be every reason to expect that the products can be profitably multiplied. Although there still remain problems to be solved in overland transportation, there has been such improvement in the last few years that distant shipment has become more safe and profitable and distribution far wider. It is reasonable to believe that further improvement in movement and reduction of cost will be realized and the per capita consumption in the populous parts of our own country proportionally advanced. In spite of all that the wintry states can do for local supplies, California can find open markets before and after the short ripening season of the eastern states for her early and late fruits and can use her own mid-season fruits in the drying and canning industries, though it is a fact that even in the height of the eastern fruit season, a considerable quantity of California fruit will command the highest prices because of its exceptional size, beauty and keeping qualities. The citrus fruits will continue to supply an American product of exceptional quality and freshness, while prunes, nuts, raisins, and wines will not only do this but will push forward into the trade of Europe as they are now beginning to do in a most vigorous manner. A very startling and significant report was made by one of the United States consuls in France recently, that our canned and dried fruits were appearing on the shelves of all the provision shops of the smaller French towns and were being freely sold without reducing the prices of the locally grown fruit. Practically the same thing could be said of points in Germany and in other European countries. The fact is that European countries cannot grow fruit enough to supply their own people and fruit has been largely a luxury. California dried fruits are being welcomed by the great middle classes and are likely to become a staple of their diet. This explains the ultimate disposition of the large amounts now going direct from California to Europe. The promotion of such traffic by the building of the Panama canal need only be suggested.

OPPORTUNITY IN CALIFORNIA'S GEOGRAPHICAL POSITION

California's exports of high class food supplies to European countries are likely to reach values like those of the wheat and barley, which were formerly shipped to that part of the world but the development of adjacent territory on the American continent and other Pacific countries may shape the future of California as a fruit producing state in a way which can at present only be dreamed about. It should be remembered that California has a unique character from a horticultural point of view. Not only does the state have a monopoly of semi-tropical conditions of the United States (excepting parts of Florida and Arizona), but California has command of the whole of northwest America and the whole of northeast Asia, not only in the supply of semi-tropical fruits but in early ripening of hardy fruits as well. California does not grow tropical fruits; they must come from the islands and the tropical south-coast countries. Semi-tropical fruits are however, vastly more important in commerce than tropical, and a region which successfully combines northern orchard fruits with the whole semi-tropical class commands the fruit trade of all accessible populous regions which have limited fruit capabilities. There are now four such regions with the kind of population which makes for industrial advancement: southern Europe, south Africa, parts of Australia and California. As already shown, we are competing successfully with south Europe in the capacious markets of north Europe. South Africa and Australia are unfortunate in lying in the southern hemisphere which is mostly ocean wastes and they are handicapped by tropic-crossing in their northern shipments, although the fact of opposite seasons may help them, and us also, in avoiding competition for trade which both desire. California by the Panama Canal is less than half as far by sea from European and Atlantic coast ports than formerly, but California in the future will have less occasion for such distant recourses. Prophets farseeing in world courses declare that the Pacific Ocean is to be the arena for commerce greater than the world has yet seen, and Pacific coast countries are to contain the greater part of the world's population. This greatest quarto-sphere with its superlative opportunities and activities will have California as its treasure house of fruits and fruit products. During the half-year of winter the citrus fruits will afford tonic and refreshment, and before hardy fruits bloom in northern climes, the same fruits will appear from the early ripening districts of California. In this traffic California will not only be practically without a competitor, but sitting beside the sea, there will also be every advantage of water transportation and the sustaining ocean temperatures for the fruits in transit. California dried and canned fruits will render acceptable diet available even through the most Arctic stretches along which development may advance in north America and north Asia while a succession of fresh fruits will flow to all Pacific ports throughout the year. California, too, will be the winter residence for all the north Pacific millionaires and the haven of rest and recuperation for all who are worn by Arctic cold or tropical heat throughout the great circle of the Pacific Ocean. Here the arts will flourish, and education will attain its highest achievements, and culture will prevail. Then fruit growing both as a commercial enterprise and as a home delight will attain value, volume, and perfection of which the present achievements are but a promise and a prophecy.

E J Wickson

THE DEVELOPMENT OF THE PETROLEUM INDUSTRY IN CALIFORNIA

PETROLEUM has been known to exist in California for a long period. Gas emanations, seepages of oil and asphaltum deposits occur in many places from San Diego to Humboldt. The attention of the mission fathers was attracted to these substances and they were used to some extent as roofing materials, as natural lubricants and as liniments. Various attempts were made to distill the products and obtain an illuminating oil. In 1855 Andrés Pico, a brother of one of the early governors of California, made some kerosene in a small copper still for the Mission of San Fernando. He obtained his raw material from what is now known as Pico cañon, in Los Angeles county, where natural seepages occurred. In 1857 Charles Morrell, a druggist of San Francisco, erected a somewhat elaborate refinery in Santa Barbara county, near the present town of Carpinteria. He used iron stills, condensers and operated on a somewhat extensive scale. There apparently was no sale for the product, and the project failed.

Various other people from time to time attempted to make use of the natural petroleum occurring in various parts of the state but little record is left of their work.

In 1859 and 1860 the great oil excitement began in the east. This excitement spread to California. The gold production was diminishing and there was little new territory unexplored. It was well known that there were indications of oil in many parts of the state. There were possibilities of vast deposits with resultant great profits. Speculation seized upon the people as it did in the east. Claims were located in all parts of the state and companies organized to work them. In 1865 there were sixty-five companies in existence with a nominal capital of $45,000,000. Shares sold for as high as $1,000 and $1,500 was paid for a single share. Glowing prospectuses described in detail the enormous profits that were sure to come. One company narrated that the seepage of oil on its property was so voluminous that cattle were engulfed and drowned in its flow. They probably had reference to the prehistoric animals that were mired in the asphaltum beds of La Brea.

Frenzied finance methods were not unknown then. One company was exploited as follows: 10,000 acres were bought for $22,000 greenbacks, equal to $10,000 gold. One-half was sold to eastern speculators for $50,000. This half was sold for $450,000 and then went into the assets of the California Petroleum Company as $1,000,000 which advertised to have twenty natural oil wells of the largest size. Another company advertised that spring No. 1 contained 144,500,000 gallons of oil actually in sight. Ten of these wells would yield in twelve months $5,460,000. A man digging in a swamp dug up some mud that smelled of petroleum. A company was immediately capitalized for $600,000. Oil properties were exploited in every county from Humboldt to San Diego, but there was no apparent success.

The cause of the failure is easily seen in the light of subsequent developments. In the first place most of the companies were not bona fide. They existed on paper only and were formed for stock selling purposes alone. In the second place, the prospecting was not thorough, the wells were not deep enough, and very little oil was obtained. Third, the oil obtained was very different in quality from the eastern oil and yielded practically no good illuminating products, which at that time was the only valuable constituent of the petroleum. Fourth, many scientific men of the day, notably Clarence King and J. D. Whitney pronounced the oil of no value whatever, which was true as far as their knowledge went at the time. In the fifth place, the supply was so small and uncertain, that no demand could be created. All these influences combined, gave a setback to the industry, until in 1887 according to W. L. Watts, there were only four companies in operation. All the projects were not fakes; some companies worked with a serious purpose but the development was on a small scale, as was the case in the east during this period. As a matter of fact, little oil was obtained. The methods of drilling were crude and deep wells were unknown. The only known use for petroleum was for the production of illuminating oil. The petroleum from the northern part of the state was more like eastern oils, containing no asphaltum and yielding a large percentage of kerosene. This stimulated prospecting in the north, and a paper by Professor Silliman, the noted scientist, published at this time, giving the analysis of a sample of crude oil from Humboldt county and maintaining that California oil was suitable for all refining purposes, encouraged the prospectors. But apparently little petroleum was obtained.

In 1865 six twenty-gallon casks of crude oil, were shipped from Mattole creek, Humboldt county. A well five hundred feet deep at Moody Creek, in Santa Clara county, yielded one barrel a day. Forty cases were shipped from the south. Other small yields were obtained but little was done with the product. This indicates the condition of the industry at this time.

In 1866 operations on a somewhat larger scale were conducted, mostly in the south. A still of 300 barrels capacity was constructed in Kern county. Wood, which was hauled thirty miles, was used as fuel. Some 4,000 gallons of refined oil was manufactured but the freight to San Francisco, amounting to $75 to $90 per ton, destroyed any possible profit. Some few other serious attempts to distill the oil met with like disastrous results.

Such was the condition of the petroleum industry in California in 1865–1866. About the only tangible results were the specimens of crude petroleum exhibited in the Paris Exposition, of 1867.

The second period in the development of the California oil industry was from about 1868 to 1892. During this period prospecting was continued in the various territories, small refineries were erected and attempts to create a profitable industry were made by various individuals. At first little progress was made. The oil business had a bad name. Many men had lost their entire investments. Imaginative promoters and fake companies had failed to justify their promises. Clarence King, of the United States geological survey, and J. D. Whitney, the state geologist, had pronounced against the quality of the oil and gave little hope of ever finding any large reservoirs. Oil investors became discouraged and in 1884 there were only four companies in existence that were actually producing oil.

This period was one of readjustment. The fact that oil was present in many parts of the state was established. It was shown that certain districts in the south were promising. The problems of refining, due to the difference in composition between eastern and California oil, were gradually solved. Methods of making gasolines, kerosenes, and lubricants were worked out. Uses for asphaltum, an important constituent of the southern petroleum, and which did not exist in eastern oil, were developed and methods for its manufacture were devised. In general there was a slow development. Most of the smaller companies perished in the process, for as a rule, the industry was not profitable. Some of the larger modern companies had their inception during this period. The Pacific Coast Oil Company, afterward bought by the Standard Oil Company, was organized in 1879, with C. N. Felton as president and G. S. Schofield (the present president of the company) as auditor. In 1882 they had two refineries, one at Alameda Point, costing $160,000, and one at Newhall costing $25,000. Their principal sources of supply were Pico cañon and Moody Gulch in Santa Clara county, and their entire production was about six hundred barrels per day.

They supplied about one-third of the local demand for refined products and had a small export trade to British Columbia, Mexico, and the Pacific islands.

In 1884, Mr. Lyman Stewart, a member of an eastern oil firm, invested $13,000 in oil properties, mainly in Los Angeles county. This was the beginning of the present Union Oil Company, a company that at present is capitalized for $75,000,000.

Such was the condition of the oil industry in California up to the early nineties; a slow development mainly through the efforts of a few large companies (large for that period), and a knowledge that oil was present in many parts of the state.

In 1892 a well was sunk in Los Angeles to a depth of three hundred and sixty-five feet. It yielded oil. Instantly there was excitement. A recrudescence of the speculative fever of the sixties ensued. Within three years over three hundred wells were bored in the vicinity, of which about one hundred were fairly productive, yielding a gross total of six hundred barrels per day. In 1897, the total production from this Los Angeles field amounted to 1,400,000 barrels and in 1902 over fourteen hundred wells had been bored and had yielded about 9,000,000 barrels. The rapid increase in production was welcome. Crude petroleum was beginning to be used as a fuel. The increased supply stimulated its use and the demand soon overtook the supply. It was a profitable product. Its gaining importance reawakened the interest in prospecting. In 1899, J. F. Elwood, having noticed oil in some seepage water near Bakersfield, dug an ordinary well with a pick and shovel to a depth of seventy feet and then with an auger penetrated the oil sand. This discovery, received locally with indifference, attracted the attention of outsiders, and California witnessed the most striking oil boom in its history. Bakersfield, at that time an unimportant small town, grew up over night. The surrounding land, desert and forbidding, was eagerly bought and sold by speculators. As is so often the case, most of the old inhabitants refused to believe in the value of the strike and as a result the profits were reaped by outsiders. The profits were immense. Land that was practically valueless, that could not be disposed of for $1.25 per acre, was sold for $1,000 to $5,000 per acre and instances of $10,000 were known. Of course, many of the claims were worthless. It took time to develop them. Transportation was difficult, supplies were for a time unobtainable, but at the end of three years, in 1902, the limits of the field were fairly well determined and it was known to be one of the great oil districts of the world. At that time there were eleven hundred productive wells yielding from a few barrels to six hundred barrels a day, the average being 50-60 barrel wells.

This huge production, amounting to over 4,000,000 barrels per year, lowered the price of oil, which had been selling for $1.00 to $1.50 per barrel, to twenty to twenty-five cents, and even at this price could not be sold. This condition was only temporary. Oil had been used for fuel but until the discovery of the Los Angeles field there was not enough of it to supply any great demand. The Los Angeles production, later supplemented by the Kern river field, began to solve the fuel question. Coal was not plentiful in California, and what there was, was of an inferior quality. Practically all was imported and sold at prices varying from $8.00 to $12.00 per ton. Owing to the fact that the calorific value of petroleum was higher than even the best coal, it made an economical fuel. About three and a half barrels of oil were equivalent to a ton of coal. There were many other advantages of oil as a fuel. The ease of transportation, the compactness of storage, the simplicity of firing, doing away with stoking and removal of ashes, and the absence of smoke, all combined to make petroleum an ideal fuel, and add to that its cheapness—it is little wonder that coal burning is now about a thing of the past.

There was a setback in 1889, when an explosion on the Southern Pacific steamer *Julia*, in Carquinez straits caused the railroad company to go back to coal in its ferry boats for a number of years. With the present method of topping to remove the volatile constituents, oil can be made as safe as coal, and the result has been that at present oil is in universal use for steam making purposes and its consumption for this purpose is increasing daily.

This third epoch in the history of the petroleum industry brought in a new factor; viz: transportation. During the first and second periods the production of oil was so small that while transportation was incredibly high, in most cases the question was not of much importance. During the third period, beginning in 1892 with the discovery of oil in Los Angeles, the increased quantity was consumed locally and by the railroads, but the relatively enormous yield of the Kern county fields created a new condition. This immense quantity of oil could not be consumed locally. It had to be transported to new markets. This condition was promptly met. The railroads built hundreds of tank cars. The Standard Oil Company constructed a pipe line from Bakersfield to Point Richmond with numerous laterals. Other trunk lines were laid. The Associated Oil Company has pipes terminating at Martinez and Port Costa. The Producer's Transportation Company, an offshoot of the Union Oil Company, has laid a line from the San Joaquin valley fields to Port Hartford. Thus outlets to tide water are amply provided for. Each of these companies owns fleets of vessels to carry the oil from these terminals to distant markets, which now comprise the whole Pacific coast of North and South America, China, Japan, India, and Australia, and will, before long, Europe. A pipe line across the Isthmus of Panama was built seven years ago, but its value, except for local use, will be diminished when the canal is opened.

The problems connected with pipe transportation of oil offer peculiar difficulties. California petroleum differs from eastern oil in containing asphaltum. Any considerable quantity of this asphaltum renders the oil so viscous that it is very difficult to pump. Various methods have been devised to overcome this difficulty. The usual method is to heat it; it is much more fluid when hot. Another method is to add water. The use of a spirally rifled pipe to increase this lubricating action of water, is a California invention.

Transportation has kept up well with production and the thousands of miles of pipe lines serve to move the oil promptly to its destination.

Pipe line transportation existed on a small scale very early in the history of oil production, but usually more for local use. The first, that might be called a trunk line, carried the oil from the Ventura fields to Ventura on the Pacific ocean, from whence it was transported in two tank steamers of 7,500 barrels each. But the large scale development did not begin until much later.

The speculative spirit excited by the Kern river discovery induced prospecting in other parts of the San Joaquin valley. Indications of oil were known to exist in various parts of Kern and Fresno counties from the early days and various attempts to exploit them had been made. But owing to lack of capital and to primitive methods of boring, little progress had been made. In later years improved processes for drilling were invented and wells thousands of feet in depth could easily be bored. The rich deposits at Bakersfield showed the possibility of enormous rewards to the prospector who could find another such field. Many of these wildcatting attempts met with failure, but some were successful. One of the districts that showed the presence of petroleum in large quantities was Coalinga, west of Fresno. Here the first gushers were struck. This territory has shown itself to be a great producer. In 1897, Fresno county produced 70,000 barrels; in 1901, 547,000; in 1911, 17,830,433 barrels.

Another district that was shown about this time to be promising was Sunset and McKittrick, in Kern County, west of Bakersfield. The fact that petroleum existed on the west side of the San Joaquin valley, at McKittrick on the south, and at Coalinga in the north, led the thinking oil men to believe that it also lay in between. Prospecting showed this to be so. Within recent years the territory in the neighborhood of Taft, Maricopa, Midway, Buena Vista and Lost Hills, has produced some of the greatest wells in the world. Even the famous Blue Goose well of the Home Oil Company, in the Coalinga fields, with its initial output of 15,000 barrels per day, and the Silver Tip well in the same district that produced 45,000 barrels in seventy-two hours, were surpassed.

The most famous of these gushers, that are now so common that they excite but little more than passing comment, was the Lakeview, in the Maricopa district. This well had been sunk to a depth of about 2,300 feet without any success. A discouraged board of directors had directed the superintendent to discontinue drilling. In spite of these orders he continued for a few days, when suddenly without warning, in the morning of March 15, 1910, a bailer, weighing half a ton, was shot up out of the well and was embedded in the top of the derrick. With a roar that could be heard a mile, oil, rocks, sand, bones and teeth of prehistoric animals, and gas were thrown out under terrific pressure. The column rose 300 feet in the air. No provision had been made for collecting the oil and it ran down gullies like a water flood. Various attempts were made to control the gusher but they were futile. The flowing oil was collected in a sump and from there pumped to Port Hartford on the coast and then stored in concrete tanks. One of these tanks collapsed and nearly 500,000 barrels of oil were irretrievably lost.

This well flowed almost continually for two years at a rate of about 42,000 barrels a day, although at times its output was at the rate of 60,000 to 70,000 per day. Towards the end of its life the flow was but a few hundred barrels a day, but the total yield was immense, amounting to nine or ten million barrels and netting the owners (the Union Oil Company being the majority stock holder), about $300,000. It ceased producing in March, 1912. Attempts since then have been made to revive it but without success.

Many other gushers have been bought in California with an initial flow of from 3,000 barrels to as much as 4,000 barrels daily, but none of them have had the long life and the continuous large flow of the Lakeview.

The period from 1900 to the present has been one of ever increasing production. The contrast between the condition of the industry in the early days and now is best shown by the following table:

PRODUCTION OF PETROLEUM IN CALIFORNIA

FROM BULLETIN 64, MINING BUREAU

Year	Bbls.	Year	Bbls.
Prior to 1876	175,000	1894	783,078
1876	12,000	1895	1,245,339
1877	13,000	1896	1,257,780
1878	15,227	1897	1,911,569
1879	19,858	1898	2,249,088
1880	40,552	1899	2,677,875
1881	99,562	1900	4,329,950
1882	128,638	1901	7,710,315
1883	142,857	1902	14,356,910
1884	262,000	1903	24,340,839
1885	325,000	1904	29,736,003
1886	377,145	1905	34,275,701
1887	678,572	1906	32,624,000
1888	990,333	1907	40,211,171
1889	303,220	1908	48,306,910
1890	307,360	1909	58,191,723
1891	323,600	1910	77,697,568
1892	385,049	1911	84,648,157
1893	470,179	1912	90,074,439

The present year will probably witness a production of about 100,000,000 barrels.

The transportation and disposal of this huge quantity of oil is in itself a large problem. We have already spoken of the pipe line systems that are being increased every year. The larger companies maintain fleets of vessels for coast wise and foreign distribution, the Standard Oil Company having 28 tankers; the Union Oil Company, 18; the Associated Oil Company, 10. Many other vessels are engaged in this trade and it is constantly increasing.

In addition to ships and pipe lines, petroleum is transported in tank cars. Several thousands of these cars are now in use.

Connected with transportation, is the question of storage. The stocks of oil at the beginning and the end of the transportation lines must be cared for. The tanks are of steel or concrete. The usual capacity of the steel tank is 33,000 barrels, although some are larger. Ordinarily larger amounts are stored in concrete reservoirs. Some of these contain 500,000 barrels, or even 1,000,000 barrels. The petroleum is frequently stored in sumps, or earthen reservoirs, but this method is not economical. The amount of oil thus accumulated is naturally variable but at the present time it is in the neighborhood of 100,000,000 barrels.

Another phase of the petroleum industry is the refining. Oil is a mixture of substances of different boiling points. When crude oil is distilled, the more volatile gasolines come off first, then the kerosenes, then the light and heavy lubricants and a residuum of asphaltum is left. All of these products are of value and are being made in larger and larger amounts. Some of the refineries are of great capacity; the

Standard Oil Company treating about 15,000,000 barrels per year and the Union Oil Company about 8,000,000 barrels.

There are numerous smaller refineries in various parts of the state but they are not increasing in number. The crude petroleum frequently contains a percentage of volatile constituents that give off vapor at ordinary temperatures. Such oils are dangerous to store in quantities and the laws of certain communities require that their volatile constituents be removed before use. This has given use to the process of topping and large works have been constructed for this purpose. These volatile bodies more than pay for the cost of topping, as they are redistilled into gasoline and kerosene.

An increasing amount of oil is being used for road making; either the crude oil or topped oil is employed for the purpose. The railroads use a large amount for dust-laying purposes. Comparatively small amounts of the crude oils are used for other purposes, such as sprays and crude lubricants.

Practically all the gas in California is being made from crude oil. There were many problems to be overcome but the processes are now a success. Natural gas from the southern oil fields has been used locally for a long time, but recently the gas has been carried into Los Angeles.

The natural gas contains considerable quantities of gasoline vapor. Much of this is now saved by various compressing and cooling processes, adding considerably to the gasoline production.

The refineries have given rise to other industries. In addition to the large equipment of boilers, engines, pumps, piping, storage tanks etc., can factories, cooperages and printing establishments are necessary for packages for retail distribution. Large amounts of chemicals, such as sulphuric acid, caustic soda, Fuller's earth, and many others, are used in the refining. Of these sulphuric acid is the most important; about one hundred tons a day are used, mostly for the purification of the kerosene.

Petroleum technology is no exception to the general rule, that the development of any industry gives rise to allied industries.

There are few other uses for petroleum and its products beyond what have been enumerated. But this is only a beginning. Crude oil is a mixture of many chemical bodies; some simple and some complex. The future will show a development of petroleum technology that will be of the greatest importance. Coal tar made enormous wealth for England, although latterly Germany has outstepped her. Petroleum will play a similar part in California.

Dyes, drugs and other organic products will come from the retorts of the chemist. The value of the oil will be enhanced a hundredfold. It will be too costly to use as fuel. Another source of wealth will be added to this already rich state.

The Indian and the Spaniard did not see the gold in the mountains. The pioneer did not appreciate the agricultural possibilities. The citizen of today does not imagine the potential wealth contained in our mineral resources. In less than a hundred years California will have passed through the three great stages of natural growth; the pastoral, the mining, and the agricultural. Now it is on the eve of the technical and manufacturing era, and in this development, petroleum will play no mean part.

Edmond O'Neill

CONSERVATION IN CALIFORNIA

GENERAL CONSIDERATIONS

UPON the proper use of natural resources depends the progress and prosperity of the pubilc.

The natural resources of California were, from the beginning, thrown open to private exploitation without effective restrictions concerning waste or destruction, and without requiring any direct remuneration to the public, the former owner of them, for the great value of the properties given away. The very natural result is that the personal interests of private owners have been the only touchstone as to whether the natural resources of California, as they have been relinquished by the public, should be wasted and destroyed, or economically used at such times and in such quantities and under such conditions as the public's necessities require.

If, for instance, the private owner of a California forest, given away by the public, determines that it is to his interest to destroy that forest, he is permitted to destroy it, although irreparable damage may result to the public because of that destruction, and although its destruction is not necessary in order to provide the public with forest products. Or, if the private owner determines that it is to his benefit to preserve his forest intact, the public permits him to preserve it, even if such preservation does cause the more certain and quicker destruction of other forests, or does cause such a starving of the market for forest products as to raise the value of the preserved and other forests and to put a constantly increasing price, which the public must pay, upon forest products, and causes an economic loss to the public because of the deterioration and decay of ripe trees, which ought to be used.

Most natural resources are destroyed when they are used. Natural gas, coal, oil, and practically all the metal and mineral resources are of this kind. They occur in inexhaustible quantities; and upon their constant use, in sufficient quantities and at reasonable prices, the public comfort and prosperity very largely depend. The public has given away such natural resources, and permits the private owners to waste, destroy, monopolize, and hold them out of use without regard to the necessities, distresses, or financial troubles of their former owners, the people.

Coal is a good example of the prodigality of the public with and the wastefulness of private exploitation of natural resources. For every ton of coal that has been mined and used in this country, another ton has been abandoned and lost in the mines—not because it would not have paid to mine the abandoned ton, but because it better paid the private owner of the coal to mine the one ton and abandon the other. The result is that the coal deposits of this country will be exhausted much sooner than would have been the case had the mines been properly worked.

The coal that the public gave away has been so monopolized that only a quantity sufficient to keep the coal market starved is mined. Thus the coal necessities of the public force higher prices for the coal than would obtain were not this natural resource privately monopolized. Similar conditions prevail with regard to iron and other metals and minerals which the public has given away.

Agricultural lands, next to water the most necessary of all the natural resources, have been fairly well conserved. The majority of private land owners are more interested in conserving than in destroying the fertility of their lands. The opinion is fast gaining ground that, from the standpoint of the public good, it is better to conserve for all time the fertility of agricultural lands than to destroy it through the use of gold-dredgers in order to realize even very large immediate returns.

The demand for conservation of natural resources is of recent growth in this country. In California and nearly everywhere else in this nation, those resources were originally so enormous in extent and quantity that they seemed to be inexhaustible. No sooner was one frontier peopled and its natural resources given away into private ownership than another step took the adventurous into new, virgin regions, with a new, natural resource wealth to be disposed of. Reckless waste and destruction, for personal financial aggrandizement has been the rule; and he was laughed at who ventured to sound a warning of future dearth.

Steadily, step by step, from the Atlantic to the Pacific, have our natural resources fallen into private ownership. The best of the public lands is all taken up; coal, iron, oil, and other minerals have been monopolized; whole states have been deforested, and within half a century from now all the existing privately owned forests will have been destroyed, and the only timber that will be left will be in the conserved national forests and parks.

On the Pacific coast sufficient time has not elapsed to permit results of the destruction of natural resources to become apparent to everybody. But with a constantly increasing population, and with not only the United States but foreign countries drawing upon them, the value of the Pacific coast forests is rapidly increasing with the result of increasing monopoly and growing rate of destruction, which are detrimental, in a financial and economic sense, to the great mass of the present and future inhabitants of the coast and the country.

It is not necessary to preserve forests unused in order to conserve them. Preservation of forests, of any natural resource, is, in fact, not a conservation of them—they must be used to conserve them—properly used to properly conserve them. Conservation of natural resources, such as forests, which may be used and not destroyed, is the antithesis of preservation and also of destruction. Forests in other countries long have been, are still being used and not destroyed—are being conserved. Our national forests under governmental control are being conserved. But practically every natural resource other than land, forests, and water must finally be destroyed, if, as they should be, they are continuously used. Water, however, is perennial. It will always be found in the channels in which it is accustomed to run, even if the quantity so running be limited and variable from season to season. But the places in which it may be conveniently and economically reservoired in California are so readily counted; the localities at which it may be easily harnessed for power purposes or cheaply diverted from the streams for irrigation are so few; and the area of irrigable land is so great that a monopoly of the state's water resources holds out greater Midas-like possibilities than any other monopoly can.

GOLD, THE FIRST GREAT LURE TO CALIFORNIA

When, by the Treaty of Guadalupe Hidalgo, the United States, in 1848, came into possession of California, the unreckonable extent and value of the state's natural resources were not dreamed of. Its acquisition was opposed by men of the highest standing and influence in the councils of the nation, on the grounds, among others, that its soil was infertile; its climate arid; its coast rock-bound, fog-bathed, inhospitable; its torrid valleys uninhabitable and uncultivable; and its forbidding mountains unsurmountable by those who would be brave and enduring enough to attempt to cross the "Great American Desert."

Hardly was the ink dry on the signatures to the treaty when Marshall made his discovery. Then began one of the greatest and most momentous migrations the world has ever known. Gold was freely offered to all who would come and take it. The adventurous young from every walk of life throughout the civilized world hastened to California and filled her mountains with restless, all-compelling men.

Deceived by the reports concerning the unfavorable character of the country, the Argonauts came here with the intention of remaining only long enough to make their fortunes. To them the dry valleys, the great trees, the lakes, the rivers did not appeal. Of the gold-seeking period there is, therefore, little to say concerning any conservation of California's natural resources.

To those men there was but one resource worth considering, viz, gold. The forests were useful to furnish lumber for sluice boxes, flumes, cabins; they were nuisances when they interfered with mining operations. Water? It was a blessing when it could be used for rockers, long toms, sluices; when rivers were to be turned from their channels in order to glean gold, it was a curse. Agriculture, viticulture, horticulture? The man had lost his reason who imagined that those sun baked valleys and red soiled foothills could yield a living to their cultivators.

It was an army of careless young men who were drawn hither by the gold discovery; yet what they did, they did with all their might. Did the state need a constitution? They dropped their shovels and picks for a moment and sent down to Monterey their representatives. There these men, the pick of all the world, constructed a constitution better than the organic law then possessed by any state in the union. Childless and not intending themselves to live in "barren" California, they did their best in constitution making, as they did in everything else, and provided even for a free public school system crowned by a free State University. Unconscious of the application of the word "conservation," they prepared the way for the conservation of California's brains and California's intellect.

Having done these great things for the conservation of civilization here, these young men continued their work of destruction of natural resources. They tore down mountains, and washed them into the rivers, filling the streams with debris, which subsequently caused them to burst their banks and flood and bury farms and orchards under infertile "slickens." They soon rendered unnavigable the lower reaches of some of the streams upon which they were dependent for the cheap transportation of the things they needed. When they abandoned the sites of their great works they left them scarred, gashed, stripped. On all sides are the monumental evidences of their destructive prodigality which has plagued their successors, and caused all to wonder at, even while they murmur over, the gigantic recklessness of their accomplishment. They were restrained by no laws save those of their own making, which permitted the doing of almost anything that would forward their enterprises. Looking forward to no future of the country for themselves, they recked nothing of the morrow—today was theirs, the morrow interested them not at all.

They were great men, those pioneers of forty-nine and fifty; great in intellect, in daring, in determination, in achievement. But they established customs of prodigality in the use of California's wonderful natural resources that tinctures even the Californians of today, and causes many of them to resent and oppose any proposal to conserve for their own and their children's benefit the natural resources upon which the prosperity and progress of California's people depend.

CONSERVATION OF PUBLIC LANDS

The act of congress under which California was admitted to the union reserved to the federal government the public lands within the state, with the exception of the 16th and 32d section in each township.

These lands, with 500,000 additional acres, were given to the state as an endowment for her public schools. Later, the nation also gave the state certain swamp and overflow lands, totalling something like one million acres. Later still, there were set aside to the state other large areas of the public lands, amounting to over 200,000 acres.

The lands set apart for California's public schools amounted, as near as may be reckoned, to something like five and one-half million acres. These lands contained valuable agricultural, oil, mining, and forest lands, and valuable power and diversion sites and water-rights. Yet the state, with true California prodigality, has frittered away nearly all the valuable lands so given to her. From the beginning, the state sold, at the rate of one dollar and a quarter per acre, lands worth, at the time of sale, many times that amount—sold it without any reservation of whatever mineral or other rights there might be appertaining to it, and without any investigation whatever as to its forest covering, its agricultural value, its availability for power sites, or its adjoining water-rights. Not until 1911 did the legislature even raise the price of the unsold school lands from one dollar and a quarter to two dollars and a half per acre. It was the policy of the state to dispose of its patrimony with Prodigal Son-like rapidity. Minnesota has no state taxes—the royalties from the state owned iron mines provide ample funds for state expenses. Texas, retaining ownership of her public lands, is enormously wealthy.

The legislature of 1911, in regular session, created the Conservation Commission of the State of California, and instructed it to investigate the natural resources of the state, among which were enumerated the state owned lands. The commission found that there had been kept no adequate or systematic records of the sale of the state lands, the amount that has been sold, or the amount remaining unsold. After a careful investigation of the records at Sacramento and in the general land office at Washington, the commission found that there appear to be something like one million acres of school lands remaining unsold. The uncertainty as to the exact amount results from the facts that certain of the 16th and 32d sections are swamp and overflow lands, or mineral, or desert lands, or are contained in national forests and parks, or have been covered by government or state scrip, or have been taken in lieu of other land. But the results of the investigation are sufficient to show that not only has the far greater part of the patrimony of California's school children been sold at a fraction of its real value at the time of sale, but that large amounts of school lands have been lost through frauds and felonies.

Up to December 31, 1912, California had received from the sale of her school lands only $5,934,062.27. The average value of the lands, even when sold, was, no doubt, ten dollars per acre; much of it was worth several times that sum. Instead of our schools receiving only $5,934,062.27, the endowment ought to have netted at least $40,000,000; and instead of an income of less than $300,000 from land sale sources for the support of our public schools, that income should now be not less than $2,000,000.

The legislature, at the extraordinary session of 1911, withdrew from sale for two years the remaining school lands, pending investigation of their real value. The legislature of 1913 extended the withdrawal period for two more years. But neither legislature provided any machinery or money to bring about that investigation and valuation. Much of the remaining lands are wild mountain lands, on which there are, in all probability, valuable power and reservoir sites, and adjacent to which are, very probably, valuable water-rights; and some of these lands, too, are probably covered with valuable forests or contain minerals or oil.

Practically every acre of the enormously valuable swamp and overflow lands given to the state by the federal government has been frittered away by the state. The 1,000,000 acres of that land, now worth from $100 to $500, or more, per acre, were sold by the state at one dollar per acre. One of the conditions of the gift to the state and of the sale by the state was that that those to whom the state should sell it should reclaim the land, so that it might be made productive. Much of that land has not yet been reclaimed. Even if the million acres sold by the state at one dollar per acre had been sold for only ten dollars per acre (and many of those who bought from the state at one dollar sold the unreclaimed land at ten or more dollars per acre) the school fund of the state would have been increased by $9,000,000.

It will thus be seen that had the lands given to the state been properly conserved, the people would have been relieved of a large percentage of the many millions of dollars now annually required of them for the support of the public schools.

The University of California, having been administered by a careful board of regents, has taken better care of its land-patrimony than the legislature has taken of the public-school lands. Its 200,000 acres have been sold for $886,945.41; and its income from that source is annually $49,668.93. Had the school lands been sold for even equal prices, the school-fund would now contain $21,000,000, instead of less than $6,000,000.

The federal government exacted no tribute, either from foreigners or citizens, for the gold taken from its lands in California. Other nations exact a fixed percentage from even their own citizens who mine the precious metals. But the American people have always assumed that the precious metals, although the property of all the people, are at the free disposal of all who wish to take them. The result has been that enormous quantities of our gold and other precious and semi-precious metals and other natural resources have gone to enrich the subjects of other nations, without toll or tribute.

Mining was the overshadowing, practically the only, industry of the new state of California, and the miner was permitted to carry on his operations with only scant regard for the rights of others. He destroyed forests, denuded great areas of their soil, clogged streams, rendered rivers unnavigable, and did great damage to the public domain and private property. But, as the fertile valleys became more settled, and farming, horticulture, and other similar industries began to be practiced, the farmer objected to the miner floating debris down upon his farm and protested against such destructive operations.

In 1850 steamboats drawing three and four feet of water ascended the Sacramento river to the Feather, up the Feather to the Yuba, and up the Yuba to Marysville, landing their passengers at the foot of a bluff-bank, up which they scrambled to the city's streets. In those days Marysville required no high levees to protect her from the Yuba's floods. Now she is surrounded by high levees, the top of the Yuba's bed is nearly at the level of the city's streets, and no steamboat has landed at the city for many years. All this is the result of the work of the hydraulic miners on the headwaters of the Yuba.

CONSERVATION OF AGRICULTURAL LANDS

It was not until early in the seventies of the last century that the farmers of the Sacramento valley were really able to make themselves heard. They organized "Anti-Debris Associations" and "Protective Associations"; they employed lawyers to bring injunction suits; they appealed to the legislature and to congress for relief. But the mining interests were so strongly intrenched, so dominant in politics and in the creation of public opinion that, try as they might, the agriculturists made slow headway in compelling the miners to respect their rights. Some ineffective legislation was passed as early as 1855; and the legislature of 1875-6 asked congress for legislation to conserve from further damage by mining operations other industries and properties. Nothing came of this; and it was not until 1893 that the legislature passed an act so regulating hydraulic mining that it could be carried on only in such a manner as to prevent material injury to streams and the lands adjacent thereto. This practically stopped hydraulic mining; and the state, in conjunction with federal engineers, has, after several failures and the expenditure of large sums of money, succeeded in confining the riotous Yuba within its banks and in preventing the constant flow from that river into the Feather and the Sacramento of the enormous amount of "slickens" that, coming down from the hydraulic mines, filled the Yuba's bed in places to a depth of two hundred feet.

The legislature of 1877-8 passed an act to provide a system of irrigation, promote drainage, and improve the navigation of the Sacramento and San Joaquin rivers. Under this act a state engineer was appointed who proceeded to make stream-gaugings and to do other necessary work preliminary to carrying out the provisions of the act. In 1885 the engineer published his report on irrigation, a very valuable document, containing exact information concerning streams and stream-flow. But before the provisions of the act could be complied with and the work called for by it done, the legislature of 1887-8 repealed the act and abolished the office of state engineer; and nothing of any consequence was done along these lines for a number of years. Since 1903, however, under authorization by the legislature, the work has been continued under a newly-created state engineer, acting in conjunction with the United States department of agriculture, the state conservation and water commissions and the United States geological survey. Steps have also been taken for coöperative work between the owners, the state, and the federal government to reclaim the valuable swamp and overflow lands along the rivers.

FOREST CONSERVATION

The original forests of California were among the most magnificent of all the world. Redwood and pine and other conifera covered approximatey 30,000,000 of the state's 100,000,000 acres. Nearly all of these forests lie in the northern three-quarters of the state; and of these three-quarters practically forty per cent are or were forest lands. The United States has disposed of enormous areas of California's forests; most of it in quarter section tracts at two dollars and a half per acre. Of our enormous area of unique redwoods, none remains in public ownership. When the state, a few years ago, purchased something like one thousand five hundred acres of redwood lands for a public park, it paid $250,000 for what the nation had parted with for a song.

Those who purchased forest lands from the government made oath that they took them for themselves and not for other people. There were and are other restrictions in the law for the prevention of private monopoly-areas of the public lands. But, nevertheless, by evading the law, by fraudulent floutings of it, even by felonious breakings of it, by lieu-land and other scrip, and by numerous other legal, extra-legal, and illegal methods, enormous tracts of California forest lands have fallen into private ownership. Such lands, for which the people received two dollars and fifty cents per acre, are now held at prices up to five hundred dollars and more per acre.

The report of the conservation commission of California for 1913 shows the following table of forest-lands in private holdings in this state, in areas of 5,000 acres or more:

Approx. acreage of individual holdings	Number of holders	Acreage
Over 500,000	2	1,536,238
" 100,000	1	156,696
" 50,000	6	399,809
" 20,000	21	671,155
" 15,000	18	304,757
" 10,000	19	236,052
" 5,000	41	279,654
Totals	108	3,584,361
Average holding for each of the 108		33,225

One of the two largest holdings is a railroad grant-gift, made by the federal government, nearly half a century ago, to the California and Oregon Railroad Company. Among the conditions of this grant, given to aid the company in building its road, were that the land should be sold, in parcels not greater than 160 acres, for not more than $2.50 per acre, to "actual settlers." The evident object of congress was the cheap and quick settlement of the central northern part of California. The company, however, has not observed these conditions of the gift, but has sold large quantities of the land in larger parcels than 160 acres, at more than $2.50 per acre, and to others than actual settlers. Its contention is that, while it is prohibited from selling in greater quantities than 160 acres and at greater prices than $2.50 per acre to actual settlers, the terms of the act do not apply to its relations with others than actual settlers. And construing the latter term as referring only to those who had actually settled in the country contiguous to the line of its road previous to the date of the grant, the corporation has for many years refused to sell any of its granted forest lands to anybody. It, no doubt, claims that there are none of the original "actual settlers" living in that section of the country who want to buy any of its lands, and that it is not compelled to sell to anybody else.

The company, given these lands—something like 3,000,000 acres of them—for the double purpose of aiding it in building its road and in settling up the country, is keeping them in order that it may finally realize enormous prices for them. It also demands that we, having given it those lands, shall be required to pay it passenger and freight rates large enough to yield returns upon the constantly appreciating value of these lands. Mr. Harriman, asked at a public meeting why his company was holding these lands, replied: "For the benefit of future generations of American citizens."

Under that grant and others of similar nature, the Southern Pacific Company, the successor in interest of the original grantee, now holds something like 821,078 acres of California forest land. Another holder owns at least 715,160 acres of them. If 60 other corporations or individuals each owned an area of California's territory equal to those two holdings, every inch of California's enormous area—the second largest in the union—would be privately owned.

Neither of these two owners is cutting any of the timber on these great holdings; but, with quite a number of other owners of large areas, both are holding the timber for the constantly increasing prices which decreasing supply and increasing demand are fast bringing about.

The withholding from use, the preservation intact, of forests is not conservation of forest natural resources. The term "conservation" carries with it the postulate of use. The non use of forests is simply the wasteful preservation of that which may be used without destruction. It is the holding for greater values and profits, at the expense of the people, that which the people gave away with the understanding that it would be used for the benefit of the donors. Because certain forests are held out of use, their value and the value of those that are being used, as well as the products thereof, are constantly increasing. Unused forests are one cause of the rapid and wasteful destruction of other forests, as well as of loss through the non use of ripe trees.

That forests may be conserved, that is, used without being destroyed, is proven by the experience of other countries. The forests of nearly all the countries of Europe are publicly owned and conserved; and many of these publicly owned forests have long since ceased to be charges upon the public treasuries. Germany's forests are a source of considerable profit to that government; and the same is true of the forests of France, Switzerland, and other European countries. Privately owned forests always have been destroyed, always will be destroyed, as more money can be quickly made by destroying than by conserving them.

The impending destruction of all of California's remaining privately owned forests will result in great disturbances of and variations in the flow of the streams along which those forests are situated. Every country that has permitted its forests to be destroyed has suffered from winter and spring floods and summer and autumn low stages of their rivers because of that destruction. China, the Holy Land, parts of Spain and other countries, certain localities even of California, all show the conditions of flood and low stream-flow that follow the destruction of stream-protecting forests.

Because of her rainless summers California is dependent on her mountain streams for the irrigation of her valleys, for hydro-electric power, and for water for her great cities. Anything, therefore, that interferes with the steady flow of her streams will greatly retard the progress and prosperity of her people.

Fortunately, however, for California the federal government has set apart as national forests vast areas along the headwaters of her streams. From these national forests will finally come the only forest-products for the use of our citizens. And they will forever, being themselves conserved, go far toward conserving the streams on which they stand. This generosity on the part of the whole people of the United States to the people of California is all the more marked because some of the states, having given away their forest lands, are spending great sums of money to buy back such of those forests as have not yet been destroyed in private ownership. The consent of these states to the setting apart for the benefit of the people of California of the great area of national forests in this state amounts to a contribution to the people of California of the many millions of dollars for which the federal government could sell these lands.

In 1905 a forestry bill was introduced in the California legislature. It created an ex-officio forestry commission, with the governor at its head, and an appointive state forester, with authority to compel owners of forests to adopt measures for the prevention and extinguishing of forest fires. But through the opposition of the Southern Pacific Company, which wished no regulation of any of its properties, the bill was shorn of its most effective provisions before being allowed to pass. Subsequent forest legislation was passed by the legislature, but failed of signature by the governor.

WATER CONSERVATION

Mining being the only real care of the constitution-makers of 1849, no precautions were taken in our first state constitution for the conservation or regulation of use of our water resources. Agriculture was not seriously considered by a population of miners. By the year 1879, however, when the present constitution was adopted, the evils and oppressions arising from certain phases of the private ownership of the right to appropriate and distribute water had become unbearable. The constitution of 1879, therefore, provided that the use of all water "now appropriated, or that may hereafter be appropriated for sale, rental or distribution is hereby declared to be a public use subject to the regulation and control of the state in the manner to be prescribed by law," and it provided for the forfeiture of the franchises and waterworks of any water company collecting water-rates other than those established by the proper legislative body. The courts, however, have several times refused to impose this penalty of foreiture upon water companies which have wilfully, continuously, and openly violated this constitutional provision.

The California legislature, at its first session in 1850, passed a measure which had great influence for evil on the conservation of land and water in this state. That enactment was to the effect that, where no statue law governed, the common law of England should, where applicable, govern. Under the English common law, water-rights are governed and regulated by the riparian doctrine. This is, in effect, that any proprietor of land riparian, that is bordering on, any stream may require that the water of that stream shall come down to his land undiminished in quantity and unpolluted in quality, in order that he may enjoy the rights of fishery, ferriage, domestic use, and such other rights and privileges as the position of his land upon the stream may guarantee to him. Under this doctrine, each riparian proprietor can compel all riparian proprietors whose lands are situated above his to refrain from putting any of the water of the stream to any use which will sensibly reduce its quantity or pollute its quality; and he can prohibit anyone above him, except a riparian proprietor, from using any of the water for any purpose.

The far greater part of California's lands require irrigation for the production of the best crops. It is to the interest of the whole people of California, therefore, that lands requiring irrigation shall be irrigated. But a strict application of England's common law riparian doctrine to this state would result in a practical turning of the far greater part of the country back to the pastoral conditions that prevailed before the conquest.

The state supreme court in its earliest decisions recognized the necessity for permitting the use of water from the streams by those who had use for it; but it also recognized the riparian doctrine, without actually declaring it to be, in all its rigorous provisions, the law of the state. The same court, however, later declared the riparian doctrine to be applicable to California. By this declaration the state supreme court laid the foundation for numerous ills for our people. For, as a result of that decision and subsequent ones, certain California riparian proprietors are requiring that enormous quantities of water shall annually run to waste into the ocean, which water, but for the decisions of the California supreme court, would long ago have been conserved and put to uses which would have conserved the fertility of great areas of our lands and caused them to produce valuable crops where they now produce comparatively little.

The requirements of the miners for water without reference to the riparian proprietor were early recognized by the supreme court of the United States, which decided that miners should be permitted to appropriate and take water from the streams when and where the lands riparian to the streams were public lands, as the government "by its silent acquiescence assented to the general occupation of the public lands for mining." It is safe to say, however, that when the supreme court made this decision, there were on every

California stream below the mines some private riparian proprietors, whose riparian rights this decision controverted. The decision was, of course, necessary to the miners. But, recognizing the riparian doctrine, the courts, both state and federal, violated it in these decisions.

Section 1410 of the Civil Code of California reads: "The right to the use of running water flowing in a river or stream, or down a cañon or ravine, may be acquired by appropriation"—which is the direct antithesis of the riparian doctrine. And the supreme court of the state has several times declared that the riparian doctrine is not applicable to the climatic conditions in this state; and has also said that "in no case should a riparian owner be permitted to demand as of right the interference of a court of equity to restrain all persons from diverting any water from the stream above him simply because he wishes to see the stream flow by or through his land undiminished." Nevertheless, the supreme court, in 1884, by a 4 to 3 decision, in the case of Lux v. Haggin, settled upon California's unsuited, reluctant, and protesting shoulders the doctrine of riparian rights, causing irreparable damage to agriculture, and holding back the development of great areas of the state. And up to date, the court has not wiped out the bad doctrine of Lux v. Haggin.

Thus, California has the law of riparian rights, which is judge-made, and also the law of appropriation, which is legislature-made. Here we have two opposite California rules concerning the right to use water resources. Attempting gracefully to ride these two legal horses headed in opposite directions, the court has been compelled to check the full speed of both. One rule, that of appropriation and beneficial use, is well suited to the climatic conditions of the state. The other rule is based upon the proposition that "non riparian owners have no rights in streams at common law." And thus, because of an ill-advised decision of a court, which subsequent judges, following "precedent" and "authority," have adhered to, the conservation of California's water and lands has been very greatly interfered with.

The legislature has made repeated attempts to provide for the conservation of the arid and semi arid lands and the waters of the state. These attempts, however, have too frequently met with disaster at the hands of the courts. The result has been great loss to the agricultural interests and, therefore, to the whole people.

Besides the riparian doctrine interference with the progress and prosperity of the state, there has come down to us a perversion of the law of appropriation, under which anybody may go upon a stream and, without any supervision by competent, public authority representing the people, post his notice of appropriation for a "useful or beneficial purpose," of any portion, or of the whole, or of even more than the whole flow of that stream, and, having recorded a copy of that notice, obtain a shadow of a title to the right to use that water of sufficient substantiality to support a law suit. True, the law requires that, after posting and recording his notice, the appropriator "must prosecute the work diligently and uninterruptedly to completion." But who shall say whether the law in this respect has been complied with? There is but one method by which this may be tested; and that is by a suit brought and paid for by some private person whose water need is great enough, whose purse is long enough, and whose patience is enduring enough to warrant him in bringing and maintaining an expensive, uncertain suit to prevent the unlawful use of the property of the people.

The result of this condition is that much water in California is held in "cold storage" by those who neither use it themselves nor permit others to use it, but who hold it out of use to prevent competition with themselves, or for sale at high prices. These high prices, of course, become a part of the capital investment of those who buy the unlawful right rather than inaugurate a law suit, and who develop the water and sell it or its products to the consumer. And upon that capitalization they very naturally demand returns from the public. The public, therefore, is compelled to pay returns on an illegal appropriation-value of its own property.

Running water in California belongs to the people or the state and cannot be alienated. But in the very beginning of things Californian, individuals were permitted to acquire title to the right to use such water as they appropriated, diverted, and, without protest from an inferior riparian proprietor, put for at least five years to some useful and beneficial purpose. These gifts have been made, are still being made, without any cost to the recipient; he has never been required to pay the people for the right to make private property of the right to use this valuable and necessary natural resource; and he has always acquired this right through his own unsupervised acts. The theory on which these and similar gifts of natural resources have been made by the public to individuals is that the public will be benefited only if the natural resources are conserved, that is, used. That theory is, of course, correct. But the public has provided no means for insuring that its gifts shall be diligently or even at all put to use.

That this right to use is enormously valuable is proven by the fact that, in the bond selling prospectuses of California hydro-electric companies, their water-rights are quoted as worth many millions of dollars; and among the properties mortgaged, or to be mortgaged, under the bonds these water-rights are listed. The property values of one California hydro-electric company will illustrate them all. This company has demanded that its property be valued at $20,000,000 for rate fixing purposes. Of these $20,000,000, six millions represent the actual cash invested in the company's plant, which was constructed for the benefit of the public; the remaining $14,000,000 represent the present value the company puts on the water-rights which the public, giving them away for nothing, contributed to the partnership which was organized between the company and the public for the purpose of serving the public. But the company, nevertheless, demands that its patrons, the public, shall pay returns not only upon the $6,000,000 of actual investment, but also upon their gift of $14,000,000.

Worth $14,000,000 today, those water-rights will be worth $28,000,000 tomorrow, and $56,000,000 the day after. The public, therefore, will be called on to pay always more money on the value of its contribution to its own benefit.

It is estimated that there are 5,000,000 electrical horsepower capable of development by California's falling waters, and that about 450,000 such horsepower have been given away to and developed by private parties. Each of these horsepowers is worth at least $200. The public, therefore, has already given away property worth today $90,000,000. That property will rapidly and greatly increase in value. At the same value per horsepower, the power-value of the state's water will soon be $1,000,000,000. A future entirely probable value of $10,000,000,000 for the state's water resources, for power purposes only, can easily be shown.

The value for irrigation purposes of the California water resources has not been closely estimated. The right to use some of that water for irrigation has been sold, by one private party to another, for $2,000 per miner's inch—the public having parted with it for nothing. It is safe to assume that, taking the state through, irrigation water is now worth $200 per inch. There are, say, under present conditions, 9,500,000 irrigable acres in the state. An inch of water will, on the average, irrigate four acres. Irrigation water in California is, therefore, worth in the aggregate $600,-000,000. Ultimately, there will easily be 15,000,000 irrigable California acres. Ultimately, also, an inch of water will easily irrigate, on the average, six acres. Ultimately, too, that water will be worth $2,000 per inch. The irrigation water resources of California will, therefore, ultimately be worth $5,000,000,000—very probably several times that sum.

For power and irrigation purposes, therefore, the water resources of California have a present or immediate future value of at least $750,000,000. An ultimate value of $15,000,000,000 is entirely within the bounds of reason.

Californians are face to face with this question: Shall public property of such great present and enormous future value be permitted to fall into private control, or shall the public retain control of it?

Other states, with much less valuable water resources are spending many millions to buy back that which they gave away. New York has reserved and will herself develop, for the use of her people, all her publicly-owned water power resources.

Many years ago, the question began to be discussed in California whether it is wise to permit the continuance of the unsupervised private-appropriation into private ownership of the right to use the water resources belonging to all the people of the state. A result of this discussion was the organization of the Water and Forest Association, the activities of which resulted in the appointment, by the United States department of agriculture, of a number of experts to investigate California water and water-rights. The report of these experts was published by the government in Bulletin 100, U. S. Department of Agriculture, 1901. In the legislature of 1903 there was introduced a bill for the creation of a State Water Commission to control the appropriation of water, and to represent the public in the disposition of the water resources of the state. The power and irrigation companies succeeded in defeating this bill; but the legislature of 1911 created a Board of Control—later changed to the Water Commission of the State of California—to which, as the representative of the public, was delegated the power to see that water appropriations, for power purposes only, are made with due regard for the requirements of the law.

The same legislature created a Conservation Commission, charged with the duty of investigating, among other things, the water and water-right conditions of the state, and to report to the governor and legislature recommendations for the reform of the laws applying thereto. The report of the commission was transmitted to the governor and legislature January 1, 1913. It exhaustively discusses the natural resources of California and proposed a bill giving the water commission, under the provisions of the bill, power necessary for the conservation of the waters of the state and for the protection of the people from water monopolies. This bill, after a fierce fight against it by a lobby representing certain water and power companies, was passed. The opponents of the bill, however, succeeded in getting by fair and foul means sufficient signatures to a referendum petition, and the operation of the act was suspended until November, 1914, when it will be submitted to the people.

OTHER NATURAL RESOURCES

Among California's natural resources is natural oil. This has been classified by the courts as a mineral. Its appropriation by private parties is, therefore, controlled by federal laws. All the state may do is to regulate, under its police powers, the method by which oil may be taken from the ground. In the exercise of that power, the state has decreed that oil-wells must be so constructed as to prevent the flooding of oil bearing strata with water—which flooding may displace and cause the loss of large quantities of oil. This is an oil conservation measure.

There are also great quantities of natural gas in California. Because it is mixed with oil and there is, as yet, no sufficient market for it, great volumes of it are wasted in the operation of oil wells. Unnecessary gas wastage is also permitted from abandoned oil wells, although the legislature of 1911 passed a law making it a misdemeanor to permit such wastage. Natural gas, like natural oil and all other mineral resources, is limited in quantity. It should, of course, be conserved as much as possible. But it is generally regarded as a useless expense to cap abandoned wells merely to prevent the waste of gas. And so California's natural gas is being unnecessarily wasted. The annual loss from this source has been estimated at $2,000,000.

Of coal California has but little, and that of poor quality. What there is of it fell long ago into private ownership. For many years the coal was used by river boats and locomotives. Both of these are now supplied with fuel oil, and the coal mines are shut down.

In the waters of some of the outletless lakes of California there are various minerals in solution, which, extracted from the water, are used for commercial purposes. These minerals were long used without paying any royalty to their owners, the people. The legislature of 1911 passed an act assessing a small sum per ton on the mineral output of these lakes. The amount of money thus obtained is small; but the principle established is of great importance.

There are great deposits of iron ore in this state. But, owing to the fact that there is no coking coal cheaply enough available for its reduction, nothing has yet been done with these deposits. Either when coking coal becomes cheaply available or some other method of iron-ore reduction is discovered, a new era of industrial activity will develop in this state. The full public benefit of these ores will not be realized, however, if they are permitted to be monopolized—if they are not conserved.

It is evident, then, that conservation of the natural resources of California demands that none of them, whether privately or publicly owned, shall be monopolized or unnecessarily wasted or destroyed; but that all of them shall be used at such times and in such quantities as the needs of the people may require. All having once been the property of the public, and enormous quantities of them having been given away into private ownership in order that they might be used for the benefit of the public, the latter has a right to demand that there shall be no monopoly combination among the private owners of these public necessities whereby the prices of their products shall be put so high as to pay to the investors more than a reasonable return upon their actual investments.

It is also evident that the great mass of the nservation legislation that has been passed in California has been the result of private endeavor for private gain. While such conservation is not entirely undesirable or unwelcome, it is generally only for the direct benefit of the individual and, at best, only to the indirect benefit of all the people. Such legislation leads, of course, to the increase of the total wealth of the whole people of the state; but it tends to increase the wealth of the few and to reduce that of the many. It is seriously doubted by many students of history and economics whether a body politic is in a healthy condition when a few of its members are enormously wealthy and, controlling natural resources, are able to extort monopoly prices for the use of those resources from the necessities of the many, their former owners.

The great work the University of California has done and is doing for the conservation of the soil and mineral wealth of the state is worth far more to the people than that institution has cost or ever will cost the California public. Of equal worth has been the work it has done for the conservation of the agricultural and allied interests of the state in crop and soil experiments at Berkeley, at the state farm at Davis, and at the several agricultural experiment stations. Great also has been its work in the defense of the deciduous, the citrus, the viticultural, and other similar industries against the many and various insect pests and blights that have threatened their destruction.

Great also have been the results of such class conservation measures as have been passed by the legislature. But of far greater importance to the whole people would be broad and effective measures for the conservation of such natural resources as the forests and waters of California, upon the cheap, certain, and continuous use of which the real progress and prosperity of the whole people of the state now depends and will, with a constantly increasing necessity, always depend.

Such conservation legislation has not yet been fully secured. But the fight for it will not cease until it has been won. Posterity, to be sure, has, as yet, done nothing for us. But, nevertheless, we owe something to ourselves and our posterity that can be gained only by the conservation of the undestroyed remnants of our natural resources.

Conservation, let it be remembered, has been defined as: "The use of natural resources at such times, in such quantities, under such conditions as the needs of the people, their original owners and donors, may require, but without unnecessary waste or destruction, without private monopoly of them."

Geo C. Pardee

HISTORY OF

THE LAWS OF CALIFORNIA

THE territory which now forms the state of California was formerly a part of the domains of the kings of Spain and afterwards of the republic of Mexico. The Spaniards who invaded Mexico under Hernan Cortes brought the laws and customs of Spain with them, just as our Anglo-Saxon ancestors brought the laws and customs of England to Jamestown and Plymouth. These laws continue to exist in Mexico, with slight modifications until the present day. In California they existed until the invasion and capture of the country by the Americans in 1846. In some respects they still remain in force, notably the laws concerning husband and wife, and the property of either or both of them, and in a modified degree the law of mines and water.

In the period which elapsed between the formal occupation of the country by the Spaniards and Mexicans (1769) and the subsequent invasion by the Americans (1846), the population of the country was not large. In fact it may be said to have been exceedingly small. Up to the year 1847, the population did not exceed eight thousand souls. This of course is exclusive of Indians. A few villages dotted the coast line, such as San Diego, Santa Barbara, Monterey, and San Francisco. Some inland towns there were such as Los Angeles, San Luis Obispo, Santa Clara, and San José. Along the line of the Pacific from San Diego to San Francisco was stretched a chain of missions at intervals of a day's journey, which fulfilled the double purpose of churches for the Indians and houses of rest and entertainment for the traveler. The hospitality of the priests of these missions was boundless, and only limited by their abilities and the extent of their possessions.

The first concern of the Spanish and afterwards the Mexican settlers of California was to procure a title to the soil. This of course must be the first care of any people pretending to any degree of civilization, even the smallest. There was enacted under the authority of the Mexican congress a law or plan providing for the colonization of the territories of the republic. Of course there had been grants of land by the Mexican and territorial governments to the immigrants to California for many years before 1824. But they were made under special authority to the governors of California, or under authority assumed for the occasion. Suffice it to say that the grantees under those grants, their heirs and vendees have remained in unchallenged possession until the present day. After the successful revolt of Mexico from Spain and the throwing off of the Spanish yoke, all this was changed. A law was passed (that of 1824) providing for the colonization of vacant lands in the territories of the republic. This was followed after a brief interval by a subsequent law of 1828 (in the nature of an amendment), which remained the law until the occupation by the Americans. The grants made under these laws did not exceed in quantity the amount of eight million acres. One peculiarity of these grants, although not expressed in terms, was that they were not subject to be taken in execution for the debts of the grantee. This no doubt was a direct result and consequence of the feudal system, under which the result and consequence of the holding of lands was the liability to be called upon to take up arms and resist invasion under the leadership of a feudal superior. Nothing could be permitted to interfere with this paramount duty. The claims of creditors were as dust in the balance in comparison with the duty of taking up arms in defence of their homes and country. All the land grants in California descended to the sons of the grantees and to their sons forever. There were occasional grants made to women, married or single, but these were few and far between.

One striking fact about the population of California during the Mexican regime was that there were no lawyers. Whether this was due to the fact that there was no law to practice or that there were no courts, is a question which will plague the inquirer. One thing is certain—there is no occasion for litigation about land, where land in any desired quantity may be had for the asking. Of course there were some men versed in the law among the Californians. Take the case of Governor Figueroa, who was said to be a capable lawyer and administrator of the system of land laws which existed in California at the time. Another was the secretary of the governors of California from 1832 to 1845—Manuel Jimeno Casarin. The care, circumspection, ability, and integrity of this individual were remarkable. He was the one official at the time of the American conquest who was found faithful among the faithless. He had compiled an index of Spanish and Mexican grants in California which was the touchstone by which all grants were tried. If they were found registered in Jimeno's Index they were correct and valid and were confirmed. If they were not, they were at once dismissed as fraudulent and void.

The fact that land was to be had in any quantity for the asking is a certain proof that it was of no value. But there is proof of the truth of this statement beyond its mere assertion. During all the period of the Spanish and Mexican sway over the territory of California there can be found only three proceedings in the nature of lawsuits, concerning the possession of real property. Two of these were concerning property in Los Angeles county, and another in Monterey county. Both the cases in Los Angeles county were settled in a somewhat Solomonic manner. The party out of possession was told to cease from troubling and to receive a grant of a like number of acres wherever he chose to select it. This ended all strife. Again there is only one record to be found of a criminal proceeding. This was in Monterey county. It was a prosecution for an assault with a deadly weapon, or an assault with intent to kill. Of course this was an Utopian style of existence. Imagine a community without lawyers for the reason that there was nothing worth contending for. Of course in such a community credit did not exist. There could consequently be no litigation about personal obligations.

The population of California being thus limited, the question of derivative titles from the first possessor or grantee was likewise limited. In the seventy-seven years which elapsed between the arrival of the first Spanish settlers and their Mexican followers, and the American invasion, men must have contracted marriages, made fortunes, and died. Their property must have descended to their sons. All these things happened without creating a ripple upon the surface of society. Sons stepped into the places of their fathers, daughters contracted marriages, widows continued to exist in the families of their children. In the third generation came the Americans. They soon changed all that.

Of all the law which existed in California, prior to its annexation by the United States, only one vestige remains. All else has passed away. That which remains is the law of the property of husband and wife. The common law of England provided that the property of a woman by the mere act of marriage became the property of the husband and descended to *his* heirs, not *hers*, upon his death. The civil law was that the property of the wife, before marriage remained her property after marriage, and descended to her heirs after death. This principle of law has been carried into the constitution and is now unchangeable by legislation. It is thus expressed by Section 8 of Article XX of the constitution:

Sec. 8. All property real and personal, owned by either husband or wife before marriage, and that acquired by either of them afterwards by gift, devise or descent, shall be their separate property.

The converse of the rule, stated by the constitution is also true: that all property acquired by the husband and wife after marriage, and the issues, increase, and profits thereof shall be community property. Thus far it is apparent that the civil law which existed in California prior to the American occupation had only a precarious existence; in fact it may be considered merely nominal. We have seen that its only force was in regard to the titles to real property. Of credit and personal obligations there was none.

When a native Californian was on a journey and his horse gave out, he immediately caught another from a neighboring band, leaving his own in its place, and went his way. When the same person needed food, he killed a steer in the nearest drove, cooked, fed, and was satisfied. He neither paid nor thought of paying anything. This was the universal custom of the country until the advent of the Americans. One of the hardest lessons to instill into the minds of the Mexicans after that time was the law of *meum et tuum* in regard to horses and cattle. They could not imagine that the old customs of the country had passed away. The frequency of convictions of Mexicans for horse and cattle stealing during the period 1850-60 must be attributed to the inability of the Mexicans to perceive the new order of events. It was not strange that the prosecutors in such cases were almost always Americans. The wealthy native Californians rarely ever brought a charge of horse or cattle stealing against their fellow countrymen.

After the discovery of gold in California a sudden increase of population took place. The population of the state may be assumed to be at least fifty thousand on the first day of January, 1850. Almost all of the newcomers were of the Anglo-Saxon race, to whom the civil law and its forms, methods and proceedings were unknown. Before the admission of the state into the Union a legislature was elected which met at San José, and enacted many laws. This was the only case on record of a country under a territorial form of government becoming a state without the passage of an Enabling Act by congress. The state was afterwards admitted into the Union in September, 1850. But the laws which were enacted by the legislature before the admission of the state into the Union were held to be valid and binding. Between the assembling of the legislature at San José and the admission of the state into the Union, courts were established, laws regulating their procedure, laws providing for the punishment of crime, laws of succession and inheritance, laws providing for the registration of deeds and mortgages, for taxation and for all the necessities of civilized society were enacted.

At the earliest moment of the organization of the legislature the question arose, what law should furnish the rule of decision in civil and criminal cases? Both systems of law, the civil and the common, had their supporters and advocates. At the head of the partisans of the civil law as a system stood Alexander P. Crittenden. He had come to California from Texas where the civil law prevailed. On the other side stood Nathaniel Bennett who was a native of Vermont, where the common law was established. Each system had its partisans. The leaders made reports to the legislature. The report of Judge Bennett in favor of the adoption of the common law as the rule of decision was adopted the by legislature. It may be found in the appendix to the first volume of the Reports of the Supreme Court of California, at page 556. The first edition of the reports is referred to. By either inattention or oversight, the report of Judge Bennett is omitted in the subsequent editions of the volume. We know not where else it may be found. Suffice it to say the adoption of that report by the legislature was immediately followed by an act adopting the common law as the rule of decision in civil and criminal cases, and so the law has continued to be and remain until this day. The civil law was the rule of decision under the Spanish and Mexican domination. That law was the Roman jurisprudence, *jus civile Romanorum.* It is in force at the present time in every state in Europe except England. In America it is the law of Louisiana, Canada, Mexico and all the republics of South America. It is the foundation of the Equity Jurisprudence which now prevails in England and the United States.

Between the advent of the Americans and the seizure of the country by them in 1846, up to the admission of the state of California into the Union in 1850, a space of nearly four years, an anomalous condition of affairs existed.

"The commanding officer of the American forces in California was the civil governor. He appointed judges, alcaldes, prefects, sheriffs and notaries; superseded or removed them; regulated municipal government; authorized and vacated elections; promulgated regulations which had the force of law and fixed the fees of public officers. This exercise of authority was acquiesced in by the people as their only refuge from disorder and anarchy; and the judgments of the courts thus established were respected for the same reason. By the judgments of these courts criminals were punished; property was attached and sold; large sums of money were collected under execution; numerous vessels were libeled; real estate, now of immense value, was sold at forced sale to innocent purchasers in good faith, and the estates of deceased persons were managed, administered upon and settled. The functionaries who thus administered justice, after a crude fashion, made little or no pretension to any knowledge of the Mexican or civil law, and did not attempt to follow the forms of procedure which that law prescribed. On the contrary, they generally adopted the common law forms; and their records exhibit a clumsy effort to administer what little they knew of the civil law by means of common law proceedings. If tested by the rigid and inflexible rules of the common law it is questionable whether any judgment ever rendered by any of these courts could stand. To say nothing of the tenure by which they held their offices, their proceedings were of so summary a character, and often so repugnant to the well-established principles which regulate the administration of justice in other countries, as almost to excite our special wonder at this day, after the lapse of twenty years. We are therefore, in this class of cases, reduced to one of two alternatives, to-wit; we must either treat the judgments and proceedings of these courts, however informal, as valid and operative, under the anomalous condition of affairs which then existed, or we must subject them to the rigid tests by which the validity of judicial proceedings is determined in other and older communities. When examined in the light of the latter rule, it is probable but few, if any judgments ever rendered by the court of first instance would stand the test of judicial scrutiny. Nearly every forced sale of real estate made under its process would be liable to be set aside as rendered under a void judgment; almost every man convicted and punished by it for crime would be entitled to his action for damages; and many innocent persons might be compelled to surrender their estates, acquired on the faith of judicial proceedings which transpired twenty years ago, and which at the time were universally recognized as valid proceedings of the only courts which existed in the country.

"We deem it to be our duty to adopt the former alternative, and to hold the judgments of these courts and the titles acquired under them to be valid, notwithstanding they might be void if tested by the strict rules of the common law. They do not purport to be proceedings at common law, and their validity cannot therefore be tested by the principles applicable to that system; nor are they, in any strict sense, proceedings under the civil law, but a sort of judicial anomaly, having some of the features of each, without the distinctive character of either. Nevertheless the judgment of the court of first instance was the judgment of a *de facto* court, exercising general and unlimited jurisdiction in civil cases and in matters of administration on the estates of deceased persons. It was the only court then in existence in California exercising these functions, and its authority was universally acquiesced in and respected by the people. Being a court of general jurisdiction, its judgments even if tested by the common law rule, would be upheld unless it appeared affirmatively from the record that it had not acquired jurisdiction of the parties in interest."*

Thus the attempt to subvert all judgments and all titles flowing from judgments of the courts established under military rule in California, failed. Then came the system of law and justice under a written constitution, laws duly adopted, and officers elected by the people. The common law was adopted by the legislature as the rule of decision. Courts and judges were elected, and administrative officers installed in office.

As this paper is only intended to deal with the peculiarities of the law which continued to exist in California, we shall devote ourselves to those which remain.

Upon the discovery of gold in California a vast increase of population occurred. Between 1850 and 1860, the population grew from fifty-five thousand to five hundred and sixty thousand. Almost all the newcomers went straight to the mines, San Francisco became the second county in the state in population. El Dorado was the first. At least three-fourths of the population of the state were engaged in mining or in pursuits tributary to mining. There was no law

Ryder v. Cohn (37 Cal. 87-89).

to govern contests or disputes with regard to mines. Strange to say no law was ever passed by the congress of the United States governing the primary disposition of mining property until the year 1866.

But in the meantime the legislature of California had got to work upon the question. In 1851, an act was adopted by the legislature, which by its terms was applicable to justice's courts authorizing the admission "of proof of the customs, uses or regulations established or in force at the bar or diggings embracing such claims; and such customs, usages, and regulations when not in conflict with the constitution and laws of this state shall govern the decision of the action." (Civil Practice Act of 1851, Sec. 621.) This act was never made applicable in *express terms* to the district or superior courts, or to appellate courts, but they acted on the presumed acquiescence of the legislature in adopting this self established code. It would seem from the foregoing that justice's courts alone had jurisdiction of mining controversies. At the same time the question of how or by what writing a mining claim should or could be conveyed made its appearance and demanded a decision. It was held that a mining claim could be conveyed by word of mouth coupled with an immediate delivery of possession, or by a bill of sale. At that time there arose in the state of California a school of lawyers and statesmen who contended that a mining claim was not real property, but that it was a mere right to the possession of real property. This notion seems to have made some impression on the law-making body, for it was not until 1860, that the legislature solved the question definitely by enacting that a mining claim was real property and that thereafter it could be conveyed only by deed or bill of sale. It followed from that act that actions for the recovery of mining claims or for trespasses thereon could only be maintained in the district courts, and subsequently in the superior courts.

This was followed by a decision of the supreme court of California (in *Melton v. Lambard*, 51 Cal. 258.) that a mine was real estate, and could only be conveyed by deed.

After the American invasion and occupation of California, a board of commissioners to examine and confirm Spanish and Mexican land grants was appointed by the president of the United States under the authority of an act of congress passed in 1851. To this board were presented almost all then existing grants. In addition to these there were presented many grants which had been manufactured, or to use plain terms forged, by unscrupulous adventurers who saw chances of great fortunes in their successful confirmation. These purported grants were rejected. The government was in possession of the Spanish and Mexican archives and of Jimeno's Index. But Jimeno's Index only contained the grants which had been issued prior to 1844. From that time until June, 1847, there was no index. But the government came into the possession of the books and proceedings of the departmental assembly or territorial legislature to which all grants had to be presented for approval. By the aid of these books the genuineness or fraudulent character of many grants made or purporting to have been made during the troublous times of California from 1844 to 1847 was established.

We have called attention to the fact of the small amount of litigation in regard to lands which existed in California prior to 1847. But in all the time from the settlement of California by the Mexicans in 1769 up to its invasion and occupation by the Americans in 1846, there was but one mine discovered of which there is any record. We refer to the New Almaden quicksilver mine in Santa Clara county. This mine was discovered and denounced by Andrés Castillero in 1843. The term "denounced" is a phrase of the civil law, nearly equivalent to discovery and appropriation as the terms are used in the common law of miners, under the American system. This was before the discovery of gold in California by James W. Marshall. The discovery and development of the New Almaden mine by Castillero was stated by him in contemporaneous correspondence, to be for the purpose of supplying quicksilver for the working of mines in Mexico. Suffice it to say, that the work of prospecting and developing the New Almaden mine went on apace. The title to the mine passed into the hands of Mexican and American citizens. Then came the discovery of gold and a market for the ores and product of the New Almaden mine was created almost at the mouth of the shaft. The mine became almost as valuable as any gold mine in California in a single night. Castillero then presented his claim to the land commission for confirmation. Two other claimants appeared at the same time—José de los Reyes Berreyesa claiming the mine to be situated on his rancho and Charles Fossat claiming it to be situated on his rancho called Los Capitancillos. The contest therefore was quadrangular—between the three individual claimants, in which each was opposed to the other, and the United States, which was opposed to each and every one of the individual claimants.

It is not necessary for me to enter into the merits of this litigation, or the justice of the final decision of the supreme court of the United States in the matter. Suffice it to say the supreme court finally decided that the mine was upon the rancho of Charles Fossat, and awarded it to him. But the most interesting question was as to the title of Andrés Castillero, the original claimant. He presented two claims to the mine originating in different sources. One claim was to the mine itself, the other to a certain tract of land, surrounding and embracing the mine, taken up under the laws of Mexico. These proceedings in relation to the denouncement of the mine had to be taken before the judge of the court of first instance in California, or in case of his absence before the alcalde of the jurisdiction. But at this time, and during the entire period of Mexican rule in California, there was no judge of the court of first instance, and consequently no court. Castillero then betook himself to the alcalde or justice of the peace and filed his papers with him. All this was in attempted compliance with the law for the denouncement of mines or mining property. But the supreme court held that the law prescribing the steps necessary to be taken before the judge of the court of first instance was mandatory, and that its provisions must be complied with. They therefore rejected Castillero's claim for the mine. There remained his claim for the lands adjoining and surrounding the mine, which was also rejected upon the ground that the grant for the same had been manufactured by the connivance of Mexicans high in office after the seizure of California by the United States. The result of all this was, that there were no courts and no judges in California, and that no title to a mine however valuable could be secured by a Mexican citizen. These observations are submitted for the purpose of showing the disorganization or lack of organization of the country at the time. Imagine a territory of ten thousand inhabitants without a court and where the governor is the supreme and final judge. This alone shows the primitive style of government under which the Mexicans were content to exist.

The pleadings and forms of procedure in these cases were unique. The governor in addition to his executive functions, exercised the powers and duties of a supreme and final judge. There is no record of a judgment or final decree pronounced by him.

An example of the invocation of the judicial powers of the Mexican governor of California is found in the case of *Mott v. Reyes* (45 Cal. 391). In this case although the judicial powers of the governor were invoked, they were not exercised. The governor (Alvarado) referred the entire matter in dispute to the departmental assembly (or local legislature) then in session, so that the matter might be arranged to the satisfaction of the litigants. The departmental assembly did nothing. The course of justice seems to have been no more rapid under the Mexican than under the American system. These proceedings were had in the year 1839. They then slumbered upon the files of the departmental assembly until 1847 when California passed under the power of the United States. Nothing was ever done by the Mexican authorities up to that time. But both grants were presented to the board of land commissioners for confirmation under the act of congress of 1851. They were both confirmed. Thereupon hostilities broke out anew. An action was brought in the district court for Los Angeles county, in which the lands are situated to solve and settle the question of title. It was finally decided in favor of the defendants in 1873. Thus we see that the time occupied by these proceedings from their inception under the provisional grant to Sepúlveda, under whom the plaintiffs claimed, to their termination by the final judgment of the supreme court of California, was exactly fifty-five years.

Another example of the invocation of the judicial powers of the governor may be seen in the case of *Nieto v. Carpenter* (21 Cal. 485). In that case, the title of the ancestor of the plaintiffs arose out of a license to enter upon and graze cattle on a tract of land in the county of Los Angeles containing thirty-three leagues. Manuel Nieto lived upon the premises until his death in 1804. He left four children, three sons and one daughter. They entered into and remained in possession of the premises until 1833, when the governor upon their petition granted to each of the children a specific portion in severalty. Afterwards the specific tract of land granted to Josefa Cota, widow of Antonio Maria Nieto, son of Manuel, was sold to the defendant Carpenter, under authority derived from the governor.

In an action subsequently brought by a person claiming directly under the original license it was held, that he had no title and could not recover; that the governor had the power to declare his estate in the premises forfeited or non-existent, and to grant the same property, or specific portions thereof to his children, and to authorize the sale of such tracts for the reasons given to the defendant. This latter was certainly the exercise of judicial functions. This contest lasted from 1834 to 1857. There was also a rancho situated in the Jolon valley in Monterey county. There was some contest of some kind over the rancho which lasted for years. For this reason the rancho was called "El Pleyto," which means in English "The Lawsuit." All litigation about this rancho began and ended under the Mexican government. No litigation concerning it was ever had in any American court.

Up to the year 1866 there was no legislation by the United States upon the subject of gold mines in California. No title, and no means whereby a title could be obtained from the United States, existed prior to that time. The legislature of California took cognizance of this subject in its characteristic pioneer way. We have seen the result of its work. Finally in 1866 the congress of the United States passed the first law providing for the acquisition of the legal title to mines of any description. And this provision for the granting of title to mines was hidden away in a statute professedly passed for the purpose of granting the right of way to ditch-owners. In other sections it provided for acquiring the title of the United States to claims in veins or lodes of quartz bearing gold, silver, cinnabar, or copper, the possessory right to which had been acquired "under the customs and rules of miners."

From this we learn one great fact that there never was any statutory law from 1848 to 1866, under which the primary legal title of the United States could be acquired to a vein or lode containing gold, silver, cinnabar, or copper. During that period all that the miner had or could obtain was the possessory title, depending upon discovery and appropriation, and further, upon constant work of exploration and development. This law of 1866 was availed of in a few instances. Its defect was that a lode only could be granted, which must be specifically described. The practical result of this legislation was, to use a phrase common among miners in California and Nevada, that a man was as well off without a patent as with it. In addition to all this, the rights of owners of placer claims were not mentioned or even hinted at. In six years the defects of the system initiated by the Act of 1866 had become apparent. Congress to heal its defects passed the Act of May 10, 1872, which was carried into the Revised Statutes, and now forms Sections 2318—2352 of the same, comprising chapter six, on the mineral lands and mining resources of the United States. This, with trifling amendments has remained the law of the United States until the present day.

The principal change made in the common law of miners by the Act of May 10, 1872, was the substitution of a new scheme of appropriation. Formerly the miner took up and appropriated a lode. After the passage of the Act of 1872, he took up a piece of land fifteen hundred feet in length by six hundred feet in width, supposed to contain or in fact containing a lode. Proceedings were provided for in the act upon compliance with which he became entitled to a patent. Provision was made by the act for the assertion and proof of adverse claims. Upon the trial of such adverse claims in a local court of competent jurisdiction a patent was to be granted according to and in pursuance of the judgment in such case. The force and effect of a patent has been defined in numberless instances by the supreme court of the United States and the state courts. A patent according to those decisions constitutes conclusive evidence of the title of the patentee. It is conclusive of the location and appropriation of the claim, and of the performance of the annual labor thereon required by local laws, customs, or regulations. The issuance of a patent dispenses with actual possession of the claim, and the performance of the annual work or labor required by the miners' laws. Any possession taken of patented ground must be notoriously open and hostile and must continue for five years before the title of the patentee enures to the benefit of the adverse claimant. In other words a patented mining claim becomes real property and the law concerning the sale, conveyance or devolution of title to the claim is the same as that which governs the sale, conveyance, or devolution of title to a man's house and lot.

There is also a question of supreme importance which has arisen in California at the same time with the law concerning mines. We refer to the law concerning the appropriation and possession of water. The rights to the possession and use of water had their origin at the same time with the discovery and use of mines. To the ownership and working of mines, the appropriation and use of water were indispensable. Water was necessary for washing placers and to supply power for crushing ores from veins. It is not strange that the appropriation of both to private ownership should have proceeded simultaneously. Accordingly we find actions concerning mines, and concerning water for the use of mines reported in the California Reports in the same volumes since the beginning.

In England and the eastern states, where almost all lands had been reduced to private ownership, and titles in fee had been obtained to them, the law of riparian ownership prevailed. That is, that the owner of one or both banks of a running stream had title to the use of the waters of the stream. But in California titles in fee did not exist, except as to the lands covered by Spanish and Mexican grants. Those grants were usually located in the valleys, far from the mines which were usually found in the hilly or mountainous sections, rarely ever contained any mines or minerals. In all the California Reports from 1851 to the present day there can only be found four cases in which mines found in Mexican grants were the subjects of litigation. And of these four cases two arose upon one grant. I refer to the cases of *Boggs v. Merced Mining Company* (14 Cal. 255) and *Frémont v. Flower* (17 Cal. 199) which both grew out of the same grant, that of Las Mariposas, issued to Juan B. Alvarado, and by him conveyed to John C. Frémont in 1847. The other was the case of *Moore v. Smaw* (reported in 17 Cal. 199). That case concerned the ownership of a ranch in Butte County, granted to Dionisio Z. Fernandez et. al., and by the grantees conveyed to Moore, the plaintiff. A fourth case was that of *Henshaw v. Clark* (14 Cal. 460). These are the only Mexican grants containing mines of gold and silver in California, which have come to my knowledge.

Suffice it to say that there was no title in fee or riparian ownership of lands containing or embracing bodies of water at the time. A new plan of ownership of the waters so indispensably necessary to successful mining operations had to be conceived and worked out. And it was so conceived and worked out under and by virtue of the doctrine of prior appropriation. A very lucid description of the system is given by the late Justice Field of the supreme court of the United States in his opinion in the case of *Jennison v. Kirk* (8 Otto, 98 U. S. 453-462). From his opinion I quote as follows:

"The discovery of gold in California was followed, as is well known, by an immense immigration into the state, which increased its population within three or four years from a few thousand to several hundred thousand. The lands in which the precious metals were found belonged to the United States, and were unsurveyed, and not open by law, to occupation and settlement. Little was known of them, further than that they were situated in the Sierra Nevada mountains. Into these mountains the emigrants in vast numbers penetrated, occupying the ravines, gulches and *cañons*, and probing the earth in all directions for the precious metals. Wherever they went, they carried with them the love of order and system and of fair dealing which are the prominent characteristics of our people. In every district which they occupied, they framed certain rules for their government by which the extent of ground which they could severally hold for mining was designated, their possessory right to such ground secured and enforced, and contests between them either avoided or determined. These rules bore a marked similarity, varying according to the several districts only according to the extent and character of the mines, distinct provisions being made for different kinds of mining, quartz mining and mining in drifts or tunnels. They all recognized discovery followed by appropriation, as the foundation of the possessor's title, and development by working as the condition of its retention. And they were so framed as to secure to all comers, within practicable limits, absolute equality of right and privilege in working the mines. Nothing but such equality would have been tolerated by the miners, who were emphatically the law-makers as respects mining upon the public lands in the state. The first appropriator was everywhere held to have within certain well defined limits, a better right than others to the claims taken up; and in all controversies except as against the government, he was regarded as the original owner, from whom title was to be traced. But the mines could not be worked without water. Without water the gold would remain forever buried in the earth or rock. To carry water to mining localities, where they were not upon the banks of a stream or lake, became therefore an important and necessary business in carrying on mining. Here also the first appropriator of water to be conveyed to such localities for mining or other beneficial purposes, was recognized as having, to the extent of actual use, the better right. The doctrines of the common law respecting the rights of riparian proprietors were not considered as applicable, or only in a very limited degree, to the condition of miners in the mountains. The waters of rivers and lakes were consequently carried great distances in ditches and flumes, constructed with vast labor and enormous expenditures of money, along the sides of mountains and through cañons and ravines to supply communities engaged in mining, as well as for agriculturists and ordinary consumption. Numerous regulations were adopted or were assumed to exist, from the obvious justness, for the security of these ditches and flumes, and for the protection of rights to water, not only between different appropriators, but between them and the holders of mining claims. These regulations and customs were appealed to in controversies in the state courts and received their sanction; and properties to the extent of many millions rested upon them. For eighteen years from 1848 to 1866 the regulations and customs of miners, as enforced and moulded by the courts and sanctioned by the legislation of the state, constituted the law, governing property in mines and water, upon the public mineral lands. Until 1866 no legislation was had looking to a sale of the mineral lands. The policy of the country had previously been, as shown by the legislation of congress, to exempt such lands from sale. In that year the act, the 9th section of which we have quoted, was passed. In the 1st section it was declared that the mineral lands of the United States were free and open to exploration and occupation by citizens of the United States and those who had declared their intention to become citizens, subject to such regulations as might be prescribed by law, and the local regulations and customs of miners in the several mining districts, so far as the same were not in conflict with the laws of the United States. From California the system of appropriation of mines and water spread to the adjoining states. In process of time the California system was adopted as the common law of miners in all the territory west of the Missouri River. In many cases the salient features of the system have been adopted by express legislation. The whole system whether adopted by legislative act or not furnishes a complete example of the growth of the common law upon the subject. First, the customs of the people in regard to the subject; second, the expansion of those customs in regard to lode claims; third, the legislative adoption and the digesting of customs and usages into a compact code of statutes; fourth and last, legislation by the United States providing for a grant of titles in fee to the mines by the government of the United States."

It is not often that the customs and usages of a people in regard to a certain kind of property have had their origin, development, successful operation and final adoption by the legislature, both state and federal, within the lifetime of a single individual. But such has been the case with the writer of these lines.

Crittenden Thornton

BANKING IN CALIFORNIA

UNDER the rule of Spain trade was absolutely forbidden in California; but by the beginning of the nineteenth century American ships had begun to visit the Pacific coast of North America for skins of sea otter and other fur bearing animals. These vessels carried goods for trade and landed their wares whenever opportunity offered, taking the chances of arrest and confiscation. After Mexico achieved her independence trade regulations were relaxed, a custom house was established at Monterey, and mission and ranchero were alike permitted to sell their furs, hides, and tallow, and to receive in return such goods as they required. No bonds or notes were taken for goods delivered and none were expected. A trading ship sold its goods along the coast and returning in twelve or eighteen months would receive in hides and tallow payment for goods sold the previous year. This custom was universal and there is no record of the repudiation of a debt.

After the American occupation and the discovery of gold, a long and bitter warfare was waged in the constitutional convention over the provisions of the article providing for the forming of corporations, and the sentiment of the members was unanimous against the establishment of a banking system. For two days the convention in committee of the whole struggled with the problem of how to prohibit the formation of banks of issue without hampering the transaction of business. It was held that if corporations were formed for the purpose of receiving deposits of gold and silver, the prohibition against the creation of paper to circulate as money would fail because such corporations would necessarily issue certificates of deposit which could and probably would be circulated as money. Several members insisted on forbidding the formation of banks of deposit, holding that this was the most objectionable of all forms of banking corporations. Such banks could issue certificates of deposit payable to bearer, thus making them bank paper, and circulate them as money, with none of the usual guards of the banking system attached to them. Others held that there was no need whatever for corporate banks; that if there were to be banks in the country, "let us have private bankers, who, if they abuse the confidence of the people, can be punished by the law." Stephen Girard was held up as an example of a safe banker in the United States, and the Rothschilds, Barings, Browns, and others, in Europe. The misery, ruin, and destruction to the citizens, and prostration of the public credit following the banking era of 1834, '35, '36 and '37, was described in support of the motion to forbid banking corporations.

The section, as finally adopted, was as follows:

> "The legislature shall have no power to pass any act granting any charter for banking purposes; but associations may be formed under general laws, for the deposit of gold and silver, but no such association shall make, issue or put into circulation, any bill, check, ticket, certificate, promissory note, or other paper, or the paper of any bank, to circulate as money."

Thus early did California take a firm stand for sound currency; a stand from which it has never receded.* With a soil that was pouring into the avenues of trade two hundred and fifty thousand dollars per day of

*The issuance of $13,040,000 clearing house loan certificates in 1907 may be considered an exception to this statement.

metal for coining the money of ultimate redemption, the members of the convention did not see the necessity for any other currency and were not disposed to leave a loophole through which any form of the detested paper money might creep in and sting them, as one member expressed it. The debate was long drawn out and was participated in by some of the ablest men in the convention, notably, Gwin, Jones, Botts, Price, Lippitt, Halleck, Hastings, Sherwood, and others.

Owing to the great volume of business transactions caused by the sudden influx of a large number of people, there was a scarcity of money, notwithstanding the product of the mines and the specie brought into the country by immigrants and imported from Mexico and the Hawaiian Islands. Like other commodities in California, the price of gold was subject to violent fluctuations. It sold at the mines in 1848 and 1849 at from four to nine dollars an ounce and the Indians who mined much of it in those years, would sell it for anything they happened to want at the time. The price was ultimately fixed at sixteen dollars an ounce and all stores, saloons, banks, and dealers were equipped with gold scales. The military governor received gold for custom dues and released the goods to merchants but he only took it on deposit, redeemable in three and six months, at a rate low enough to insure its redemption. Permission was secured for private firms to issue gold coins, and five, ten, twenty, and fifty dollar pieces were coined. In addition to the gold dust and the American coins, were Spanish doubloons, Mexican silver dollars, pesetas, reals, rupees, and some German coins; all of the foreign silver coins circulated much above their worth until the bankers decided to accept them at their bullion value. The establishment of a branch of the United States mint in San Francisco in April, 1854, brought relief to the business community and put an end to the makeshift circulation.

The danger of building up a moneyed oligarchy to which the people of the state would be exposed was so real to the members of the convention and to those whom they represented, that it was many years before corporations having banking privileges were formed. Almost any reputable merchant who had a safe in a well protected building was made a depositary of gold dust, and many of them combined banking with their mercantile business. The express companies, too, did a banking business, and as they penetrated the mining camps, they had superior facilities for such business and would take gold at the point of production and issue their drafts in exchange for it.

On January 9, 1849, Henry M. Naglee, who came to California in 1847 as captain of company D, Stevenson's regiment, and Richard H. Sinton, who came on the line-of-battle ship *Ohio* as acting paymaster, established the first bank in California, under the firm name of Naglee and Sinton. They received deposits and sold exchange in an office in the Parker House on Kearny street, fronting the plaza, now the site of the Hall of Justice. Sinton soon withdrew, and after the destruction of the Parker House by fire, the business was continued on the corner of Montgomery and Merchant streets, under the name of H. M. Naglee and Company until closed by a run, September 7, 1850. The next bank in San Francisco was that of Burgoyne and

Company (John V. Plume was the partner), which opened for business, June 5, 1849, on the southwest corner of Montgomery and Washington streets. Then followed B. Davidson, on Clay between Montgomery and Kearny streets. Davidson remained in business for many years. He was agent for the Rothschilds, and Mount Davidson at Virginia City, Nevada, was named for him. Thomas G. Wells, doing business under the firm name of Wells and Company began in October, 1849, and failed October 3, 1851. James King of William began business as a banker on the corner of Montgomery and Commercial streets December 5, 1849. His bank failed in 1854 and he became cashier of Adams and Company. In February, 1850, Drury J. Tallant opened his banking house on the corner of Montgomery and Clay streets. Judge Wilde afterward associated himself with him and the firm became Tallant and Wilde. Later it was Tallant and Company; was incorporated in 1881 as Tallant Banking Company and absorbed by the Crocker, Woolworth Bank in 1898. Page, Bacon, and Company (express company) and F. Argenti and Company, began banking business in June, 1850, on the south side of Clay street between Kearny and Dupont, and were followed by Adams and Company, Palmer, Cook, and Company, Drexel, Sather, and Church, Robinson and Company, Sanders and Brenham, Carothers, Anderson, and Company, and in 1853, Lucas, Turner, and Company, of which General William T. Sherman was the resident partner and manager. The firm of Drexel, Sather, and Church became Sather and Company on the retirement of Drexel and Church. It was incorporated in

1887 as the Sather Banking Company; was nationalized December, 1, 1897, as the San Francisco National Bank, and in July, 1910, was absorbed by the Bank of California. Robinson and Company had a savings bank and Dr. A. S. Wright opened a savings bank on the northwest corner of Washington and Kearny streets, known as Wright's Miners' Exchange and Savings Bank, where he paid eighteen per cent per annum for deposits. In 1852 the express company of Wells, Fargo, and Company entered the field and added a banking department to its express business. Other early bankers were Delessert, Cordier, and Company, Joseph W. Gregory, Robert Rogers, Abel Guy, and a few others in San Francisco, and D. O. Mills in Sacramento, who turned his mercantile business of 1849 into a bank in 1850, under the firm name of D. O. Mills and Company, Mills' partner being E. J. Townsend. In 1852 Townsend retired and Edgar Mills and Henry Miller were taken into the firm. In 1872 the bank took a national charter as the National Gold Bank of D. O. Mills and Company. B. F. Hastings also had a private bank in Sacramento and all the express companies had agencies there as well as in the mining towns, where they opened deposit accounts with their patrons. The confidence of the people in their bankers received a rude shock when on February 17, 1855, the mail steamer brought news of the failure of Page, Bacon, and Company of St. Louis, and though the statement was at once made that there was no connection between the St. Louis and San Francisco houses, a run was started on the San Francisco concern which had, with its branches, about two millions of deposits. On February 22d, a holiday not observed in San Francisco, the bank closed its doors. This was followed by the failure of Adams and Company, Palmer, Cook, and Company, and a number of the smaller concerns, some of which resumed later. It is said that Alonzo Delano, agent for Adams and Company at Grass Valley, received orders from the home office to pay out no money either on public or private deposit, which orders he did not obey, but calling his depositors together read to them his instructions and said, "Come and get your deposits; you shall have what is yours so long as there is a dollar in the safe." Delano immediately opened a bank of his own and in a short time had a larger line of deposits than he had ever held as agent for Adams and Company. He had a successful and honorable career as a banker until his death in 1874. Another establishment growing out of the failure of Adams and Company was that of Macy, Low, and Company of Marysville. Frederick F. Low, who had been in business there since 1850, formed a partnership in 1855 with Charles B. Macy, agent for Adams and Company, and opened a banking office. Macy died and Low took his brother Charles into the business under the firm name of Low Brothers, and in 1861 the firm sold out to Rideout and Smith. Low became governor of California, minister to China, superintendent of the mint, and finally associate manager of the Anglo-California Bank.

The bank failures of 1855 caused great hardship and cast a gloom over the community, particularly in San Francisco, coming as they did after a wasteful and corrupt administration of city affairs, due to the indifference of respectable citizens for their political duties, intent as they were on amassing wealth for enjoyment in an eastern home; the defalcations and frauds of Honest Harry Meiggs; the loss of all the city property through the Peter Smith execution sales; the threatend confiscation of the greater part of the privately owned real estate through the Limantour and Santillan claims, both admitted as genuine by the land commission; while a tax rate of 3.85 per cent and a rapidly growing public debt added their influence to the general dissatisfaction. The murmuring of the people became audible and increased in volume until the noise thereof was as the sound of many waters. Exasperated beyond endurance they rose and took back into their own hands the delegated powers of government. Under the consolidation act of 1856, the People's Party, born of the vigilance movement, threw the rascals out of office, cut down expense, and reduced appropriations to less than one-sixth of the amount expended during the previous year.

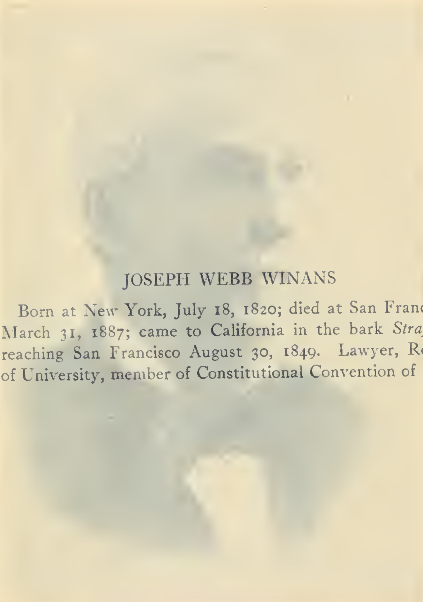
But the people of California could no longer regard their banking system with complacency and it was felt that a new and better method was desirable. In 1857 the first corporate bank was organized under the general laws: the Savings and Loan Society of San Francisco, with E. W. Burr, the reform mayor as president. After an honorable and profitable career of fifty-three years this bank was merged with the San Francisco Savings Union in 1910. The next banking corporation was the Hibernia Savings and Loan Society, a purely mutual bank, and the only one now existing in California. The bank was incorporated

April 12, 1859, as a capital stock bank. In 1864 it was re-incorporated under the law of 1862 as a mutual bank. It is still in existence, and has deposits of over $50,000,000. The Hibernia was followed by the French Savings and Loan Society, also a muual bank, February 1, 1860; the California Building, Loan, and Savings Society, May 31, 1861, and the San Francisco Savings Union on June 18, 1862. The latter is doing business as the Savings Union Bank and Trust Company, a large and flourishing concern. The French bank failed in 1878. The fate of the California Building Loan and Savings Society is unknown to me.

In 1863 Peter H. Burnett, Sam Brannan, and Joseph W. Winans organized under the general laws of the state the first chartered commercial bank in California. Burnett was the first governor of the state of California; he was born in Tennessee in 1807, came to Oregon in 1843, and thence to California in 1848. Sam Brannan, the whilom Mormon elder and preacher, was unquestionably the ablest business man in California, as he was the richest. Far sighted, clear headed, and energetic, he was quick to see the necessity for a change in the banking system and to take advantage of the opportunity. Joseph W. Winans was a lawyer of first rank. Born of Revolutionary stock, in the city of New York in 1820, he was graduated at Columbia College in 1840; admitted to practice in supreme court of New York in 1843; came to California in the bark *Strafford*, which he and a few companions bought and fitted out, arriving at San Francisco, August 30, 1849. They sailed up the Sacramento river and he and his companions used the vessel as a floating hotel. Until 1862 he practised law in Sacramento and then came to San Francisco. He was a trustee and treasurer of the San Francisco law library, one of the founders of the University of California and a member of the board of regents for many years; president of the Society of Prevention of Cruelty to Animals, of the Society of California Pioneers, and member of many other societies; a graceful writer of prose and verse, and a man of lofty integrity, of scrupulous regard for the rights of others, and of most gracious and charming personality. Under the name of the Pacific Accumulation Loan Society the bank opened for business in 1863 with Peter H. Burnett as president, and on April 18, 1866 the name was changed by special act of legislature to Pacific Bank. The bank established itself at once in the confidence of the community and did a very large business all over the Pacific coast. In 1880 Burnett retired and Dr. Richard H. McDonald became president and remained in that office until the bank, ruined by the mismanagement of the two sons of its president, closed its doors, June 23, 1893.

In 1854 William C. Ralston and Ralph S. Fretz came as agents for a line of steamers operating between Panama and San Francisco in opposition to the Pacific Mail.* Both were steamboat men of the Mississippi river and had been with Garrison and Morgan in Panama. In December, 1855, the two, in company with C. K. Garrison, who also represented the Nicaragua Steamship Company, and Charles Morgan of New York, formed a banking house under the name

*They were the *Winfield Scott*, *Yankee Blade*, and *Uncle Sam*.



JOSEPH WEBB WINANS

Born at New York, July 18, 1820; died at San Francisco, March 31, 1887; came to California in the bark *Strafford*, reaching San Francisco August 30, 1849. Lawyer, Regent of University, member of Constitutional Convention of 1878.

he practiced law in Sacramento and then came to San Francisco. He was a trustee and treasurer of the San Francisco law library, one of the founders of the University of California and a member of the board of regents for many years, president of the Society of Prevention of Cruelty to Animals, of the Society of California Pioneers, and member of many other societies, a graceful writer of prose and verse, and a man of lofty integrity, of scrupulous regard for the rights of others, and of most gracious and charming personality. Under the name of the Pacific Accumulation Loan Society the bank opened for business in 1863 with Peter H. Burnett as president, and on April 18, 1866 the name was changed by special act of legislature to Pacific Bank. The bank established itself at once in the confidence of the community and did a very large business all [illegible]. In [illegible] Burnett retired and Mr. Richard H. McDonald became president and remained in that office until the bank, ruined by the mismanagement of the two sons of the president, closed its doors [illegible] 1893.

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of Garrison, Morgan, Fretz, and Ralston, and opened for business January 2, 1856. Both Garrison and Morgan had been steamboat captains on the Mississippi and Garrison had been mayor of San Francisco. Captain Morgan remained in New York and later removed to New Orleans where he established the Morgan line of steamers running between New Orleans and New York. In July, 1857, Garrison and Morgan withdrew from the firm and the business was conducted under the name of Fretz and Ralston, on the southwest corner of Washington and Battery streets. In 1861 Joseph A. Donohoe, and Eugene Kelly came into the firm which now took the name of Donohoe, Ralston, and Company, the partners being Joseph A. Donohoe, William C. Ralston, Eugene Kelly, and Ralph S. Fretz. For some time the affairs of the house progressed smoothly and then, it is said, Donohoe became dissatisfied with the character of some of the loans Ralston was making. However this may have been, early in 1864 Ralston began preparations for establishing a new bank. As subscriptions to the stock came in, Ralston invested the funds in choice paper, discounts, bonds, etc., so that when the bank was ready to open it might start with a good business on its books. All of these proceedings were kept secret from Donohoe and Kelly, who knew nothing of what was going on until the middle of June, 1864, when, on the fifteenth of that month, the Bank of California was incorporated. On June 30th the firm of Donohoe, Ralston, and Company was dissolved and the business continued under the name of Fretz and Ralston until the opening of the Bank of California on July 5, 1864.

Donohoe and Kelly formed the banking house of Donohoe, Kelly, and Company, and they, with Ralston, contended for the business of Donohoe, Ralston, and Company. It is reported that the Bank of California paid Ralston $50,000 for such of the business of Donohoe, Ralston, and Company as he could bring to it. The bank of California opened in the rooms of Fretz and Ralston on the southwest corner of Washington and Battery streets, with a capital of $2,500,000, with D. O. Mills president, and William C. Ralston cashier. In 1866 the capital of the bank was increased to $5,000,000, and on July 5, 1867, the bank moved into its beautiful new building on the northwest corner of California and Sansome streets, the site of the old Tehama House. In this year, Thomas Brown, who had been manager in St. Louis for Page, Bacon, and Company became assistant cashier and remained an officer of the bank until his death in August, 1902.

A generation has passed since the commercial world of the Pacific coast was startled by the failure of the Bank of California. To none but those of the older generation of Californians is it given to know and understand the commanding position held and influence possessed by this great bank. As Minerva sprang full armed from the head of Jove, so the Bank of California came into existence full grown and equipped and was a power from the moment of its birth. Not only did it at once assume leadership in financial affairs, but in matters social and political it was a power to be reckoned with and its mandates were announced in no uncertain terms. From the very first the business controlled by the bank was enormous;

its influence was far reaching, and its power was unhesitatingly used to build up or to crush. The greater mercantile, manufacturing, and business houses at once enrolled themselves among its patrons and supporters and it was with pride that men spoke of their connection with the Bank of California. Its board of directors was composed of the heads of the largest houses in San Francisco; the oldest and strongest banker on the coast was its president and its cashier was considered a marvel of ability, and the ablest financier in California. Throughout the entire establishment the same excellence of appointment was followed. The best of tellers, accountants, exchange experts, and clerks were employed at high salaries. It was an honor to occupy a position in the Bank of California. So wide was the influence of this autocratic corporation that any undertaking that received its approval promised success, while all men hesitated to engage in any scheme that the bank frowned upon.

And yet, in less than nine years from the date of its birth, this bank, with its great financial, political, and social power was bankrupt, its enormous capital gone, and it was only by the most strenuous exertions of its directors, that failure was averted and the day of reckoning postponed. This they not only accomplished but they prevented the slightest suspicion of the true condition of the bank from becoming public.

Having arranged for the continuance of the bank, the president, D. O. Mills, resigned and sold his stock. The cashier, William C. Ralston, was made president and the assistant cashier, Thomas Brown, was appointed cashier. For two and a half years longer the bank continued its apparently prosperous course, when like a thunderbolt from the clear sky came the report that the Bank of California had closed its doors, and twenty-four hours later the dead body of its president was found floating upon the waters of the bay. The city was in a panic. Many of the savings banks of the city and several of the commercial banks were involved in the operations of Ralston, and ugly rumors were current of over-issued stock on which enormous sums had been borrowed for his use. To protect themselves from runs by their depositors these banks closed their doors and awaited developments with the greatest anxiety. From all parts of the Pacific coast came reports of bank failures and, for a time, the excitement was intense.

From the moment of the incorporation of the Bank of California, the soul of the organization—for it may be fairly credited with the possession of one—was William C. Ralston. From the modest position of clerk on a Mississippi river steamboat, he had, by sheer ability and force, become the leading financier of California. A man of warm feelings, kindly instincts, possessed of a thousand amiable traits, he was intensely patriotic for his state and city and sought in all ways to develop the resources of the one and advance the improvement and betterment of the other. His strivings, however selfish, were for the good of California and San Francisco. Nearly every one of his many projects was capable of development into particular utility. But the element of time was against him; the millions he handled were not his own; he was liable at almost any moment to be called to a strict account therefor, and he was reckless and extravagant to a degree. His partner, William Sharon, said of him, "Ralston was disposed to scatter. If he got into anything there was no end to it. He never beat a retreat until he struck the ocean. In building the Pine Street house [Ralston's city residence], it was to cost $25,000. The first thing I knew it was up to $225,000. In building the Palace Hotel he wanted to get some oak plank for it, and he bought a ranch for a very large sum of money, and never used a plank from it. When he wanted to make furniture for the hotel, he bought the Kimball Manufacturing Company. I said to him, 'If you are going to buy a foundry for a nail, a ranch for a plank, and a manufactory to build furniture, where is this thing going to end?' He said, 'It does look ridiculous to you.' 'Yes,' said I, 'worse than that; it looks pretty bad.' They say I talked extravagantly. Well, the imagination could hardly reach the extravagances. So far as I could read this bank, the directors were as much excited as I was, or any body else, for they held the paper of the bank largely and their salvation depended a good deal upon what was done in the Bank of California."

For some time before the failure the bank, owing to heavy losses and the extraordinary drain of Ralston's operations, was short of cash, and Ralston resorted to sixty-day bills drawn on the Oriental Banking Corporation of London which he discounted in San Francisco, paying therefor by other bills, in other words, "kiting." On Monday, August 23d, Ralston placed in the hands of Thomas Bell, agent for the Oriental Bank, a large amount of the bank's bills receivable and had Bell cable the London bank that he had the securities and ask credit for the bank for them. Ralston told Bell that Flood and O'Brien, who were preparing to open the Nevada Bank, were locking up all the coin and making money very scarce. The Oriental Bank did not answer Bell's cable message. On Wednesday night, August 25th, the directors met at William Sharon's house and were informed by Brown, the cashier, that instead of there being $2,000,000 of cash in the vault, as called for by the books, there was but $500,000 in money and $1,500,000 of cash tags of Ralston's. He also stated that the president had disposed of a large amount of bullion in the refinery and appropriated the proceeds, and affairs were in such condition it would be impossible to keep the doors open very long. It was determined that the two directors should go to Messrs. Flood and O'Brien and ask them to liquidate the bank, the directors giving a guaranty of $2,000,000. This Flood and O'Brien refused to do. The bank opened as usual the next morning and after ineffectual attempts by Ralston to get money from the other banks, closed its doors at two o'clock in the afternoon, having paid out all its cash but $30,000 or $40,000. The directors met at the bank the day after the failure and appointed a committee to look into the bank's affairs. Ralston did not come into the board room but remained in his office. His resignation was coldly presented for his signature. He signed it and putting on his hat left the bank by a side door and took his way to his usual bathing place at North Beach. At three o'clock word was brought to the bank that he was dead.

The committee reported that Ralston's liabilities amounted to $9,565,907.50 of which $4,146,290.57 were secured, leaving unsecured liabilities of $5,419,616.93 of which $4,655,973.36 was due the Bank of California. The situation was appalling. The capital of the corporation was engulfed. The calls upon the stockholders were likely to be ruinous and in the meanwhile there would be a dead halt in all the operations of Pacific coast finance, while at least one-half of the circulating capital of the state would be rendered immobile and paralyzed for an indefinite period. There were, besides, ominous mutterings heard from the sufferers by the disaster, and threats were openly made to hold the directors to a strict account not only to the management of their trust but to the extent of the bulk of their fortunes, as partners of the dead president.

There appeared to be but one way out of the jungle into which the bank and all connected with it were plunged. That was to resurrect the bank. A syndicate was formed of which William Sharon was made president. He had been in partnership with Ralston in many of his enterprises and was the one most involved. In 1865 Ralston had appointed him agent of the bank at Virginia City, Nevada, and had loaned him five hundred dollars with which to establish himself. A small, nervous, wiry man, full of vitality, always shrewd, with a wonderful grasp of situations and details, Sharon is described as a financier with the education of a lawyer, a lawyer with the education of a man of business. Realizing his opportunities in Virginia City, Sharon engaged in mining stock speculations, and when two years later he formed a partnership with Ralston under the firm name of William Sharon and Company he was able to put about a half a million into the joint account. He formed the Union Mill and Mining Company and, at a time when prospects were bad on the Comstock lode, he bought up most of the mills on the Carson river and obtained control of the Belcher, Yellow Jacket, Ophir, Kentuck, Chollar-Potosi, and other mines. The Union Mill and Mining Company, of which Sharon and Ralston each owned two-fifths and D. O. Mills one-fifth, paid in dividends over $14,000,000. Another large enterprise of William Sharon and Company—also in conjunction with D. O. Mills—was the building of the Virginia and Truckee Railroad, a wonderfully profitable venture. Such was the man chosen to lead in this most wonderful venture of all—the rehabilitation of the Bank of California.

Before entering into the details of this achievement, one of the greatest in the financial history of America, let us go back a moment to the statement made earlier in this article that the bank was virtually bankrupt two years and a half before. The claim was made that until the cashier, Thomas Brown, laid before the directors assembled at William Sharon's house that night of Wednesday, August 25, 1875, the statement of the bank's condition, they were totally unaware of what had been going on and were surprised and horrified at what they were told. What were the facts in the case? On February 19, 1873, there was due to the bank from George P. Kimball and Company $578,580.46, from the New Montgomery Street Real Estate Company $1,971,696.56, and from the Pacific Woolen Mills

Company $967,900.00, a total of $3,518,177.02. These loans, it is claimed, were made to the firm of William Sharon and Company, of which Sharon and Ralston were partners, the owners of the properties. The companies did not pay the interest on their loans, and the bank could not collect. To keep the bank from failing and to protect it during the prevailing money stringency, an agreement was entered into on that 19th of February, 1873, between John D. Fry and the Bank of California, whereby Fry was to pay into the bank the sum of $3,400,000 in gold coin in consideration of which the bank was to assign to Fry the indebtedness above described together with all collaterals and other securities held by it to secure the payment thereof. The payments by Fry were to consist of $750,000 gold coin on signing the agreement, and he was to deposit at the same time two notes of William C. Ralston of $250,000 each, one payable in six months and one in one year after the said date. From the first proceeds of the sale of securities and properties delivered to Fry, he was to pay the bank the sum of $950,000 cash, and further, if realized from the sale of the properties, the sum of $1,200,000 after paying $500,000 to W. C. Ralston for the two notes signed by him, and to Fry $750,000 for the cash advanced by him. This agreement was signed on said date by J. D. Fry and D. O. Mills, president, and ratified by the directors of the bank. I think it effectually disposes of the statement made that the directors were surprised to learn of Ralston's operations.

Sharon's first move was to enter his own subscription to the syndicate fund, $1,000,000. He then called on

D. O. Mills for a like subscription. Mills refused point blank to make any subscription whatever, saying he was out of the bank and had owned no stock in it for for more than two years. Sharon informed Mills that his stock had never been transferred on the books of the bank; that many of the irregularities occurred prior to Mills' retirement; that he was liable as a stockholder, as a director, and as a partner. Referring to the over issue of stock he said, "Mr. Mills, some of these certificates you signed, and they will not believe you have done that innocently. They will charge you. You will certainly be liable under these conditions." Mills came in and subscribed $1,000,000. He had, it appeared, been in the habit of signing stock certificates in blank. Sharon had a hard time with his subscriptions, and a man of less force, ability, and tenacity would have failed; but his mind was like a battery, constantly radiating energy. He had unbounded confidence in himself and the faculty of quickly impressing others with a sense of his masterful power. Certain rose colored reports began to circulate to the effect that the stock of the bank had good value. That was intended to inspire the stockholders with hope and ultimately they came into the syndicate to the amount of $2,000,000. This was very valuable in holding the men and business of the bank. But Sharon did not have an easy time with his syndicate men. Some he persuaded, some he cajoled, some he threatened, and some he guaranteed. James R. Keene subscribed $1,000,000. Then he became alarmed and told Sharon he would erase his name. Sharon consulted with Mills and let Keene down to $500,000. Then Keene would not have it and demanded that he be released entirely. Sharon reduced his subscription to $250,000 and gave him a personal guaranty in writing against loss. Another subscriber for a large amount came and took the pen to strike his name off. Sharon grabbed the pen from him. He gave a verbal guaranty to Peter Donahue, who was a subscriber for a large amount. He told Michael Reese, who had a large claim, that he would not be paid unless he subscribed. He succeeded in raising a guaranty fund of $7,000,000 of which only twenty per cent was called in.

One of the first difficulties to be overcome was to obtain possession of the over issued stock, some 13,180 shares of which were in the hands of various lenders as collateral for loans. This required careful management and skill. Sharon settled with some of these holders at fifty cents on the dollar; with others, who threatened suit, and whom Sharon considered as ugly, aggressive, and insulting, he paid close to par. He was deadly afraid of a suit which would bring out the full details of the irregularities of the bank and of the negligence of its directors. The matter was further complicated by the operations of Charles Webb Howard and Company, composed of Howard, Ralston, and Ryder, in Spring Valley Water stock. The liabilities of this firm were about $4,250,000 all secured by water stock and Ralston had a three-fifths interest in the firm. Sharon called in twenty per cent of the syndicate funds and with Howard visited each one of the closed banks which were carrying these loans, together with loans on the bank stock, and ascertained from them how much money each needed. To each amount he added fifty per cent and arranged for all to open on the same day. The liabilities of Ralston to the Bank of California, and to outside banks, and to firms and individuals on bank stock, Spring Valley Water stock, and the thousand and one other ventures, were so great, and so complex and interwoven were the interests that it was impossible to move on one part without moving on the whole if the bank was to be resurrected. It was an extraordinary scheme, but the large sized brain of the syndicate manager was equal to it, and all of the banks, including the Bank of California, resumed payment.

On the day of Ralston's death (August 27, 1875) he had executed a deed to Sharon of all his real and personal property wheresoever situated and under this conveyance Sharon proceeded to settle up Ralston's indebtedness and recover the property pledged to secure the same. The claim of the bank, $4,655,973.36, he settled for $1,500,000. To some creditors he gave fifty cents on the dollar and to some more, settling with each as best he could. There were certain irregularities connected with some of the transactions and Sharon was not slow to avail himself of the opportunity these offered in effecting settlement.

At the request of the Chartered Bank of India, China, and Japan, which offered to protect the credits of the Bank of California abroad, D. O. Mills took the presidency of the rehabilitated bank for two years. At the end of that period he resigned and nominated William Alvord for the position, and transferring all his stock to his private secretary, in certificates of one hundred shares each, he instructed him to sell the stock as the market would take it, and to *see that it was transferred on the books of the bank.* Mills was done with the bank forever. From the date of its reopening the Bank of California has gone steadily ahead. When all the old affairs were settled up, the capital account was in pretty bad shape. It was reduced from $5,000,000 to $3,000,000, but in a few years the balance was made good by earnings. The prestige of its name, the romance of its history and the hold it had on the imagination of the people, the character of the men in control, the large amount of its syndicate guaranty as well as the strength and standing of its guarantors, all told in its favor, and proved the perfect success of the rehabilitation—a success more wonderful than was dreamed of by the managers—for, from being the great bank of the state, the Bank of California has become one of the great banks of the nation. Several of the banks involved in the transactions with Ralston were obliged later to retire from business.

In Los Angeles the banking house of Hellman, Temple, and Company was formed in 1868, and out of it was organized, in 1871, the Farmers and Merchants Bank which in 1903, obtained a national charter. On the organization of the Farmers and Merchants Bank, the banking house of Temple and Workman was formed. Francis Pliney Fisk Temple was a Massachusetts man who came on the American bark *Tasso* from Boston on a trading voyage in 1841. He was then twenty years old. Four years later he married a daughter of William Workman, an Englishman, who came from New Mexico, also in 1841, in command of an immigrant party. The two continued the banking business until 1875 when they made a bad failure. The Los Angeles County Bank was established in 1874 and continued until 1894 when it retired, paying its depositors in full. In 1876 the Commercial Bank was organized and in 1880 was granted a national charter as the First National Bank of Los Angeles. In 1883 was organized the Los Angeles National Bank, now absorbed by the First National. On September 12, 1912,

Los Angeles had 9 national banks with assets of	$80,037,000
and 10 state commercial banks with assets of	17,329,000
Total	$97,366,000

Some of the state banks are savings banks that do a commercial business. The commercial assets alone are taken.

In Dutch Flat, W. and P. Nicholls established a banking house in 1860. The house is still in existence. Decker, Jewett, and Company had a bank in Marysville in 1858 which they incorporated in 1888 under the same name, and the bank is still doing business. In Napa, James H. Goodman opened a private bank in 1858, and in Placerville, A. Mierson had a bank in 1861. Both of these have been incorporated and both are still in business.

Among the private bankers in business in San Francisco in the sixties were Belloc Freres, Donohoe, Kelly, and Company, Daniel Meyer, Lazard Freres, Parrott and Company, and J. Seligman and Company. Belloc Freres failed in 1891. Donohoe, Kelly, and Company have been accounted for; Daniel Meyer is still doing business though the venerable head of the house died a year or so ago.* Lazard Freres turned their dry

*Since writing the above this bank has retired from business.

goods house into a bank and in 1884 it became the London, Paris, and American Bank, an English corporation. The dry goods house of J. Seligman and Company also became a banking house and in 1873 was incorporated as the Anglo California Bank, an English corporation. These two banks united in 1909 under a national charter as the Anglo and London-Paris National. Parrott and Company became merged in the London and San Francisco Bank in 1871 and this bank was later absorbed by the Bank of California. Thus have the private banks, which constituted the original California system, all but disappeared from San Francisco.

When congress adopted the national bank system as a war measure and to float the government loans, California did not respond. All the traditions of the state were against the establishment of banks of issue and the people refused to recede from their stand for hard money, but when the act was amended to authorize the issue of $45,000,000 in gold notes, redeemable in gold coin by the issuing bank upon demand, the First National Gold Bank of San Francisco was organized in November, 1870, and opened for business in January, 1871. In 1872 the National Gold Bank and Trust Company of San Francisco was formed, a conversion of the California Trust Company, organized in 1867. Two gold banks were organized in Oakland, one in Sacramento, one in Stockton, two in Santa Barbara, and one each in Petaluma and San José, ten banks, all issuing gold notes. After the resumption of specie payments in 1879, and the establishment of parity between all government paper and gold coin, the gold banks retired their gold charters but the number of national banks increased very slowly. The people clung to their gold currency and refused to accept the paper money. On March 10, 1885, there were but fifteen national banks in California, with total resources of $12,956,800. Of the fifteen, ten were in the northern and five in the southern section of the state. With the rapid growth of the south during the next fifteen years came the demand from the new element for the national system to which they had been accustomed in the eastern states, and by September, 1902, there were in California:

South of the Tehachipi,	29 nationals, with resources of	$30,213,989
North of the Tehachipi,	20 nationals, with resources of	62,769,504
A total of	49 nationals, with resources of	$92,983,493

After this the progress of the national banks in California was more rapid. While gold coin remains the circulating medium and all contracts are made therein the people seemed to realize the fact that there was greater protection for them in the federal supervision of the banks than under the state system, and during 1909 and 1910, the last of the great state banks in San Francisco were granted national charters. The reports to the comptroller of the currency under date date of September 4, 1912, show:

San Francisco,	9 banks, resources	$240,847,989
Los Angeles,	9 banks, resources	80,037,174
Other sections of the state,	213 banks, resources	179,581,562
Total	231 banks, resources	$500,466,725
Add commercial deposits of state banks,		129,115,954
		$629,582,679
Deduct for duplicated bank deposits		60,000,000
and we have banking resources of the state		$569,582,679

The report of the comptroller of the currency for 1913 shows that in the matter of savings deposits California is the fourth state in the union, the banks having $453,500,000 savings deposits to the credit of her people.

The great fortunes made in the Comstock mines of Virginia City were represented in the establishment of the Nevada Bank of San Francisco which opened for business October 2, 1875, under the presidency of Louis McLane, who had come to California in 1846 as passed midshipman on the frigate *Savannah* and was present at the raising of the flag at Monterey. He served as lieutenant of Fauntleroy's dragoons, and was captain in the California battalion, having charge of the artillery. Later he had the rank of major and was one of Frémont's commissioners in the treaty of Cahuenga. In 1850 he resigned from the navy and returned to California. He was for many years manager of Wells, Fargo, and Company's express, was one of the first directors of the Bank of California, and from 1875 to 1882, president of the Nevada Bank. The owners of the Nevada Bank were the so-called "bonanza firm" of Flood, O'Brien, Mackay, and Fair. The bank opened with a paid up capital of $5,000,000 which was increased about a year later to $10,000,000 and afterwards reduced to $3,000,000. In 1887 Flood and Mackay engaged in an attempt to corner the world's wheat supply and the deal, carried on through the Nevada Bank, was so disastrous in its results that, but for the interposition of James G. Fair, who put a large amount of cash into the bank, it would have been obliged to close its doors. Fair, who had withdrawn some time before from the bank and from the "bonanza firm," took the presidency of the bank until it reorganized with new capital and new people who brought it into the front rank. In 1897 the bank obtained a national charter and in 1905 it absorbed the Bank of Wells, Fargo, and Company. It is now the second largest commercial bank in California, under the name of the Wells Fargo Nevada National Bank.

The failures of 1875 demonstrated the necessity of publicity regarding the new system of corporate banking and the legislature of 1876 passed a law requiring all corporations and all persons doing a banking business in the state to publish on the first of January and July of each year statements of condition. The passage of the law was opposed by many of the banks and the statements were made in such a manner as to disclose as little of the condition of the banks as possible. The private bankers refused to comply with the law and the foreign agencies treated it with contempt. As there was no penalty for non-compliance the law was a farce. There was no supervision and the banks could publish what they pleased. In 1878 the bank commission act was passed under which a board of three bank commissioners was appointed with power to call for statements from the banks, make examinations of their affairs, regulate the conduct of their business, and to close insolvent concerns. The commissioners were appointed in the spring of 1878 and at once began their work. The first bank examined, the Masonic Savings and Loan Bank of San Francisco, was found to be insolvent and was closed and put into liquidation. The second passed safely through the ordeal, but the third, fourth, and fifth, viz: the Farmers and Merchants Bank of Savings, the French Savings and Loan Society, and the Odd Fellows Savings Bank, all of San Francisco, were found deficient and put into liquidation. Among the country banks the alarm caused by the action of the commissioners was such that a number of them closed their doors and went into voluntary liquidation. Having by its initial action justified its existence the bank commission rested on its laurels and the board soon became a refuge for broken down politicians, appointed without regard to efficiency. Most of the bankers resented what they considered an unwarranted prying into their affairs and continued to conduct their business according to their own fancies. The "examinations" of the bank commissioners were no more farcical than were the published statements of the banks, so far as showing the true condition of the banks was concerned. It is to the credit of the bankers of California that there have been so few betrayals of trust among them. A disastrous failure was that of the California Safe Deposit and Trust Company which closed its doors October 30, 1907, with liabilities to depositors amounting to $9,072,741 on which has been paid to date one dividend of ten per cent. This bank, incorporated in 1882, had built up a great business by personal and persistent effort and by the payment of four per cent on savings accounts, two per cent on accounts subject to check, and from two and one-half to four per cent on certificates of deposit according to the period of time for which they were issued.

In March, 1903, in order to get rid of some objectionable bank commissioners appointed by the former governor, the legislature repealed the act creating the board of bank commissioners. In the interim before the passage of a new law seventy-one charters were obtained for banking privileges, most of them for speculative purposes. The provisions of the new act created a board of four commissioners and fixed the minimum amount of capital required at $25,000 for small towns and up to $200,000 for towns of twenty-five thousand or more inhabitants. The court having ruled that provision unconstitutional the legislature of 1907 adopted a law requiring a capital equal to ten per cent of the deposits of a bank until a maximum capital of $1,000,000 was reached, but permitting no bank to be organized with a capital of less than $25,000. This was where the *ad interim* charters became valuable and many were sold from $1,000 to $2,500 each.

The indignation caused by the revelations concerning the California Safe Deposit and Trust Company were such that there was a general demand for more stringent regulations for banks and a better system of supervision. The legislature appointed a joint committee of the senate and assembly to investigate the cause of bank failures and suggest a remedy and the Commonwealth Club of California took up the matter and after several reports and debates following careful investigation by its banking section brought in a report submitting a number of changes in the law. Several meetings were held with the legislative committee and a bill was prepared and submitted to the legislature. The result of this movement was the bank act of 1909, which provided for a superintendent of banks, in place of four commissioners of equal power; provided for a cash reserve; a limit to loans; authorized department banking by banks of sufficiently large capital; limited the amount of bonds a bank could hold; prohibited loans to officers and employees and to directors without consent of two-thirds of the other directors and of the superintendent of banks; prohibited the purchase of shares of other corporations, and limited loans on stock of other banks; provided for examinations by directors; for reports to superintendent, and for publication of such statements as the superintendent should direct, and many other necessary requirements.

In 1876 the San Francisco Clearing House Association was organized with fifteen members. They were the Bank of California, the Bank of British Columbia, the Bank of British North America, the Bank of San Francisco, B. Davidson and Company, Belloc Freres, Donohoe, Kelly, and Company, the First National Gold Bank, Hickox and Spear, London and San Francisco Bank, Merchants Exchange Bank, Sather and Company, Swiss-American Bank, Anglo-California Bank, and Wells, Fargo, and Company. In 1877 were admitted the Nevada Bank, Lazard Freres, Pacific Bank, National Gold Bank and Trust Company, and Tallant and Company—in all twenty banks. The Swiss-American Bank mentioned above was not the present bank of that name but an earlier bank incorporated in Geneva, Switzerland, in 1873, with $2,000,000 capital. It retired from business in 1878. Other banks were admitted from time to time but the association has at no time had more than twenty members, the number varying from fifteen to twenty. In 1910 the assistant treasurer of the United States became a member. In 1887 the Los Angeles Clearing House Association was organized, in 1906 the Oakland and San José Clearing Houses and in 1907 the Sacramento, Stockton, Fresno, and San Diego Associations were formed, and in 1910 that of Pasadena.

The panic of 1893 caused the suspension of four national banks in California and a number of state banks and private bankers. Three of the four nationals resumed business and are today strong banks. A number of state and private banks were obliged to close their doors, but as there was no notice taken of their action by the bank commissions, they waited for the clouds to roll by and then reopened, as if nothing had happened, only to succumb later under the withdrawal of public confidence. The panic of 1907 caused the failure of twenty state banks including the California Safe Deposit and Trust Company and its Franches, and for the first time in its history the San brancisco Clearing House Association resorted to the issue of clearing house certificates in settlement of balances to the amount of $13,040,000. The clearing houses of San Francisco and Los Angeles have each a special bank examiner to examine all banks belonging to the clearing house and all banks clearing through members.

The fire which swept San Francisco in April, 1906, put its hot seal on every bank vault in the city. Warned by the bankers of Baltimore that it would be unsafe to open the vaults under three weeks from the date of the fire, a meeting of the San Francisco Clearing

House Association was called for April 23d to devise ways and means to relieve the distressed people who had lost homes, business, and all, and had not money to buy the commonest necessities of life. For a few days following the fire all stores of provisions were held by the military, but in a week the military grip was loosened, and those who had money could buy what little there was to sell. At this first meeting of the clearing house a measure was adopted for the relief of the depositors of the banks, which, when worked out, provided for the establishment of a union bank at the United States Mint, which had escaped the fire, to which could be transferred from New York through the subtreasury such sums as might be required. Each bank was to look after its own depositors, and was permitted to advance to them such sums as might be necessary up to a total of $500 in each case.

The banks transferred funds from New York and the manager of the Clearing House Bank, as it was called, opened a set of books and credited each of the seventeen members with its deposit. The officers of each bank signed across the face of the depositor's check a request to the Clearing House Bank to pay and the checks so endorsed were charged to the bank. The limitation of amount was because the books of most of the banks were in the hot vaults. The clearing house met daily, and soon the measure of relief was expanded to meet pressing business necessities. At last, May 23d was set for reopening for business without limit and the banks prepared to leave their temporary quarters in various residences and reëstablish themselves in their old locations, erecting temporary structures within the walls and upon the sites of their former buildings. Bank vaults were opened, and in most cases their contents were found uninjured. After being closed down for more than a month business was resumed without the slightest disturbance of any kind, and thirty-five days' clearings went through in one day.

There exists a radical difference in the manner in which business is conducted in California and the Pacific states from that which obtains in the east. Eastern merchants close their accounts by notes which they endorse and deposit for credit with their bankers. In California most business is done on open account and the borrower at the bank has little trade or commercial paper to offer for discount but gives his note for such accommodation as he requires. Both systems have advantages and drawbacks. The theory of the trade paper is a sound one, where each note the bank discounts represents a transfer of value, and the bank holds each party to the transaction; but in a great many cases the paper represents no trade at all, being merely accommodation, while the most of the great houses issue immense quantities of so-called commercial paper, which is accommodation paper, pure and simple, and sell it all over the United States. These notes are drawn in round sums, without interest, and the rate of discount is regulated by the credit of the house of issue, while the purchasing bank has no means of knowing, even approximately, the amount of paper afloat. The California merchant has only his book accounts and he borrows direct on his own personal credit. The banker in California knows his borrower and all about him—his resources, the manner in which he conducts his business, and the amount of money he owes. Except with very large concerns the borrowing is usually all at one bank, a regular line of credit being generally given. The bad feature of this being, where the notes given are payable on demand, and the credit is once established, the paper is liable to lie in the bank, year in and year out. It has no maturity, no time is fixed for payment, and no preparation for payment is made. The bank's money becomes part of the capital invested in the business, and when payment is called for it is usually at a time when money is tight and the borrower frequently cannot pay without great sacrifice—perhaps the closing out of his business. For the credit of the Californian it may be said that this contingency has seldom arisen, and from a somewhat extended observation of both systems I am inclined to think the California system is as good as the eastern. From the time of the establishment of corporate banking in California down to 1893 the practice of permitting bank customers to overdraw their accounts prevailed, inaugurated, it is said, by the branch banks of English corporations. This objectionable method of lending money was pronounced irregular by a clearing house resolution in 1893 and has about disappeared.

In 1849 the prevailing rate for money was ten per cent a month. By 1858 money was loaned on mortgage at two per cent a month, and for the next ten years the rate varied from one and a quarter to two per cent per month. It was not until 1871 that mortgage loans were made at an annual rate, and from that date until 1877 the rate was from ten to twelve per cent per annum. In 1879 the rate was nine per cent and by 1883 it had fallen to seven. Thereafter the rate became six per cent, the mortgagee paying the tax on the mortgage since 1880. The ruling commercial rate for money has been from five to six per cent during the last thirty years. The foregoing rates are for San Francisco, interior rates being considerably higher. The payment of mortgage tax now being optional with lender or borrower, the mortgage rate is five and one-half to six per cent when the borrower pays the tax.

That time has justified the wisdom of the founders of the commonwealth in their action regarding the circulating medium is proved by the prosperity of the state and the credit of its financial institutions.

Zoeth S. Eldredge

ART AND ARCHITECTURE
IN CALIFORNIA

IN attempting the wide retrospective survey of the graphic and monumental arts in California and being confronted by the incoherency and vagueness of the whole American field—the one thing that palpably emerges is just the question: "What then, after all, is one looking for, listening for?"

The historian can answer that question directly: "For some logical and consecutive expression of the American or Californian spirit, speaking through beauty in the distinctive speech of America or of California." To detect the timorous lisp of that spirit, any faltering intimation of what it had or has to say to the future, must be the central preoccupation of the historian; and he perceives (in the face of all the poverty and confusion), his task to be that of the sympathetic apologist, who is, ever so sympathetically, to take as the symbol this shining thread of the spirit and to follow it, disentangle it, knot the ends together where it has been broken—making it the clue in the maze and finally being content to say, that if the spirit has not always manifested itself in works of beauty, yet the humblest work of art reveals the maker and something of the social temper of his time.

It is then, in this American and Californian inquiry, not so much an estimate of art values that we are seeking, as the revelation of the human spirit, the temper of a civilization that has produced so prodigiously in so many ways and so meagrely in the way of art.

Art makes this confession of its time. Where there are so few notable examples of art to brood upon as in the

American vista, the brief essayist must, perforce, brood equally upon the social revelation and the social contrasts.

The arts with which we deal here, require for their orderly growth and flowering, a quiet unattainable in a new and lusty civilization; the absence of art does not of necessity indicate an absence of a wide-spread (though unconscious) appreciation of beauty. These pioneers of America and of California were encountering natural beauty in its abundance and freshness. Surely this prevailing beauty in the field of their excited enterprise, did win their response, even though they were too busy to translate it into consciousness and so, into the terms of art.

It would be interesting to trace the delight in natural beauty in the contemporary literature of the young America—for literature did, almost appallingly devote itself to nature and the theologic deduction from natural aspects. But our task is to trace the less spontaneous arts that have, unlike literature, to make terms with the current civilization in order to win a place and a voice. Speech and writing travel with so easy and light an equipment, they can foot it with the pioneers; the graphic and monumental arts must delay until the hearths are established and the time has come to build the temple. They move with the encumbrance of a tradition, they require material things for their expression—most of all, they require the serenities of a civilization established and the response assured.

It is with tradition that the historian picks up his thread, for tradition is an essential strand. That tradition runs straight to America from the cultural centers of Europe with the coming of the colonists; it weaves into the texture of that early life and shines suddenly as a new, bright thing in the domestic and public buildings of the Atlantic sea-board which we very properly name "Colonial." The tradition of European art is preserved and yet is translated into a new refinement and delicacy, indicative of a new choice and new predilections.

This refinement, this attenuation of the material employed, is the first speech in art of the recognizable new spirit—the American spirit. It stands as a reality in that architecture; but it appears, too, in every object that the American of that time molded for his use or his pleasure—in the early furniture, the "American" ax-handle, the "American" wagon. We see the spirit intuitively attenuating, refining, as though in an exquisite impatience that it must deal with material things at all; yet with supreme intelligence fitting the material to its perfect use.

How wide-spread this intuitive predilection was, has not been measured. It found its consummation, not in the architecture that so modestly blossomed on the Atlantic sea-board, but on the sea itself.

The American sailing ships! Those slim, unsung heralds that we set upon the seas of the world, to proclaim by every shining spar, by each adroit line of their swift bodies, that a new race of builders and conquerors had found their voice in America. Surely, our ships must continue to rank as the triumph of that early spirit's expressiveness.

The ship persisted long after our architecture had anything to say of the spirit's first fine rapture; and the ship, even now, sinks below our unsteady and changing horizons.

If then, it required fully a century of progressive community life for the descendants of the English race in America to evolve what was distinctive in architecture on land and sea, we should not be impatient in our contemplation of the art of the century that followed. It would be an unthinking critic who would ask that just that tradition of refinement verging upon fragility, be maintained by America, 'bride of change' as she is.

The inrush upon the young states of alien peoples; the conquest of the great territory to the west; most of all, the introduction of the machine in the processes of the world's manufacture—who in reason can ask coherency in the art of a nation, under revolutions of such magnitude?

Architecture fell from her delicate preoccupation with style; painting lapsed from the refinements and reserves of Copley and Steuart and both together sank into a universal disregard and a universal dowdiness. Sculpture practically had not existed as an independent art in the early time; and when she rose in the Nineteenth century, she was stamped with an even greater dowdiness than that worn by her sister arts. One can guess from her aspect, how completely art had become a thing apart from the general life—speaking in the strangest tongue to these American admirers, if it spoke at all in the arid marble portraits and the "chaste" nudes.

They speak now to us indisputably the fact that the contemporary American was not thinking or feeling "Art" at all. And it was just into this poor estate, that California entered when she became American. Yet through this period of neglect, we can follow our thread here and there as it gleams in individual works by solitary artists; and the thread suddenly gleams and shines again, in that little Renaissance of the arts that was nourished in the eighties by La Farge, McKim, White, and St. Gaudens, culminating in the exposition at Chicago in 1903. It was a phenomenal recapture of the early American spirit; as it was, beautifully and pathetically, the last word of that first American speech.

We caught the echo of it in California; we too, had our brief period of absorption in architecture as an art; there was a moment when the popular sympathy was involved, really responded to the work of art. The artists here, as in New York and Chicago, were expressing some vital thing that the people wanted to have said: the artists were speaking the speech of the American spirit again: that was all the reason.

The brief moment of illumination and mutual interchange and mutual understanding, passed; and now we wait for the newer language to be evolved from the bewildering prolixity of our present polyglotism.

Californian art has, of necessity, been more less an echo of the national state of things; but interestingly enough, she has caught the echoes of a wider field than the national. It has been her exceptional good fortune in more than the arts, to escape, in spite of her isolation, the blight of provincialism.

Her history begins with the resounding names of Cabrillo, Vizcaino, and Drake. Continuously have influences poured in upon her from east and west; and if in the arts her speech has been hesitant or delayed, it may be because of too many voices—too many echoes.

What the earliest of the explorers of these coasts found in the matter of art, humble as it was, was yet complete and perfect as an expression of the native life. The crude woodwork of the aboriginal house and canoe; the basketry for storage and utensils, the simple implements of the chase and for gaming, the leather and shell-work—all these objects afford us now, a picture of the people and the life they lived: so adequately reconstructs the scene for us, that the question presents itself, as to whether just this power of communication, is not the test of "value" to be applied to any work of art out of the past?

Truly these Indians of the lowest state of culture *did* leave a perfectly readable record of themselves and what desire for beauty was in them. Art is, of course, the fine flower of a people's existence, their highest expression; we know, that within its savage limitation, the life of this primitive people was so far coherent that they could give this entirely comprehensible account of themselves to the future. What is present in each of these sad relics, is the testimony that for them, art was an integral part of life: not a thing whimsically fostered or crowded aside.

Their art was far advanced when the first vessels of the explorers touched upon the coast. It is still practiced in obscure places for the love and need of it; and decadently for profit, where it is most to be seen. It has no place in our tradition and cannot be worked in, however curiously the effort persists to drag it into the arts of decoration. Its worth to us is purely that of record, and in its appeal to our understanding of these vanished fellow creatures.

If they, poor things, welcomed the first of us as gods (the first of us being the gentlemen adventurers of the *Golden Hinde*, straight from the court and city of the depraved Tudors), what did they, the natives, make of that first work of European art planted upon the land which is now California and which was then proclaimed "New Albion"?

It is deeper than amusing to think that here were sounded first the sonorous and solemn phrases of English speech in the great language of the "Book of Common Prayer," but the smile comes to our lips when we learn that the first work of art left upon the land which is now the United States of America, was the penny portrait of the Virgin Queen of England!

The old diarist records: "At our departure hence, our Generall set up a monument: namely a plate, nailed upon a faire greate poste * * * with her Highnesses picture and armes, in a peece of six-pence of current English monie, under the plate." Thus the thread of traditional art first gleamed upon the coast of California and ties us to the England of Elizabeth and Leicester, of Shakespeare and Francis Bacon.

The incident counts for us only as it enriches the long backward reach of our survey; the *Golden Hinde* lost in the distance: the gods vanished; and the bereft native gazing in perplexity at the minute image of the most notably artificialized female in history, in her monstrous ruff and her monstrous arrogance! It is a juxtaposition to appeal to the Comic Muse—and what *wouldn't* we give now for that same "peece of six-pence"?

It was nearly two hundred years before the native was confronted by any other work of art of European lineage. The coming of the padre and the setting up of the cross cannot be classed with the incidental. Here was a substantial historical event.

These missionaries and explorers and conquerors, marching northward from Mexico, planting the missions and the presidios from San Diego to Sonoma within the half century, did a work that has not been adequately measured as a building accomplishment.

To have builded by native labor and of the most primitive materials the twenty-one missions and settlements, while the work of conversion and conquest was going forward, is a noble record. It may be said that to engage the populace in labor, was the perfect way to subject and so to convert; but if the native had marvelled at the penny queen, how much more deeply must he have marvelled at these structures, which rose with the help of his own hands? The missions vary in value: few of them make the slightest claim to art, but all have the virtue of directness and of graciously belonging to the landscape.

The friars had come to a land reminiscent in every feature of the old Spain, with its wide sun-burned valleys and its strong hills, set between the sierras and the blue sea. They planted, upon perfectly selected sites, these simple buildings, more truly "Spanish Colonial" than are the buildings of the eastern states "English Colonial." We do not know how the plans and elevations were produced. They were apparently largely the product of old and pleasant memories applied to the new conditions of building, with the strange material and the poor skill at hand.

Here and there however, as at San Luis Rey and preëminently at San Antonio of Padua, hints of a schooled taste and knowledge come in. San Antonio hidden in its distant valley and its ruin mitigated by blossoming pomegranates and oleanders, has an art that none of its brethren can show. Its great arch of burnt brick (which still survived a few years ago) proclaims an audacity that could hardly have been ventured by any but a trained architect.

Yet these delightful and appropriate buildings and the whole brave record they embodied, from the moment of American occupation seem to have taught no lesson, as they have called forth no protective care on the part of the public: except where they have been attractive to the curiosity of sight-seers and tourists they have been permitted to fall into shameful ruin.

The padres brought little to California in the way of art to match their fervor and enterprise in building. Of the paintings that came up the coast from Mexico, there is never a hint of the sought masterpiece: and the colored wooden sculpture which was to be imported later, is of a like commonplaceness. Nothing which they brought compares with what they themselves made on the spot. They taught the natives to work agreeably in wood and clay and leather; and (one idly enough speculates) had the Sierras and the sea become impregnable barriers just at that moment, what extraordinary and delightful things might not have issued in art, from this domination and instruction of the native race? The results would not have been of the emptiness of any human significance that *our* "revivals" in the way of "mission furniture" and "Swatsika" pottery, now present.

The friars and the native artisans were scattered before the wind of change, and so far as art is concerned, nothing was effected except what still remains to be learned from the ruinous old examples of their high emprise.

One cannot leave out, for the sake of the touch of romantic color the mention confers, the brief occupation by the Russians, with their forts and stockades enclosing the chapel and barracks at Fort Ross. That little group of log buildings, set at the foot of the Coast Range and against the bleak sea, is memorable. There were orchards and a garden with its quaintly domed summer house in the Slavic manner. Nothing remains there now, but the governor's residence and the log causeway from the beach. There is no possibility of tying this strange, loose end into the thread of influence. The occupation was as little contributary as the transit of the *Golden Hinde* along the same stretch of coast, even though the Russian apple trees still yield their fruit and the Russian roses, hard colored and sweet, still bloom and shake in the wind.

The earliest Americans caught the high tide of Spanish occupation and turned it back. The artist had begun his work in the Spanish houses: for itinerant and now nameless portrait painters there were, who moved from settlement to settlement and painted the dons and senoritas. How good this first painting was, is an inquiry that is likely to be made in the future. This historian recalls examples seen in youth in Santa Barbara, Monterey, and Martinez, which looked down from the walls of high, dim rooms, with the aspect of having the best tradition in their keeping; they matched, these portraits, in courtesy and dignity, the living descendants of the pictured departed. For in these same rooms were even then, at that late day, manners and the art of intercourse and one saw even then, how the portraits and their possessors and the manners, were meeting adversities, were all to be lost and hustled away as superfluous in the new age; as superfluous as the missions themselves.

But these first hustlers brought with them something of their own established serenities and something of tradition in building and ornament and manners, which asserted itself as soon as they began to settle. That same English colonial architecture (grown heavier and coarser from having encountered the wave of pseudo-classicism that swept America in the forties), came to California along with such names as Benicia and Antioch, and set its stamp upon the homely, pleasant courthouses and dwellings that still delight us in the central California towns.

The larger communities had little to do with it: the style had become rural and suburban in its passage across the continent and unfitted for city building. In the cities a very agreeable manner was substituted that yet held with tradition. These buildings of brick and covered with stucco, still make wholly for the observer's pleasure in Sacramento, in Marysville (as in the old San

Francisco), as they repeat themselves with a discreet variety in all the shady streets. There is no question of their being "Art"; they offer merely the pleasantest most modest little facades, winning their chief distinction from the contrast they present to what immediately followed them and jostled them out of popular favor in the seventies and eighties.

In San Francisco, however, in these same years between 1850 and 1870, really notable buildings were erected, which stood in the older quarters of the town and impressed the observer with their grace and power, quite up to the hour of conflagration.

This architectural accomplishment has never been satisfactorily accounted for. The names of the architects were early lost, and lacking any reliable data and in the presence of work so much beyond what the rest of America had to show for that same period, an amusing body of legend gathered about them and was current in the talk of local enthusiasts, in which the names of the most distinguished European architects grandly figured. Where so much that was unexpected and romantic had happened, it seemed quite within the possibility that anyone might have laid his hand upon the young town and left for us the testimony of his talent. Certain it is, that these buildings were the design of trained intelligences, and the conclusion must be inferred that so much intelligence and taste was not locally concentrated, but that communication with Europe being regularly established, commissions for the drawings were placed in the hands of men practicing in Paris and London.

The local French community was large and influential and if the two French bankers immortalized themselves by commissioning Meryon to execute the first etched view of San Francisco, it seems altogether possible that the designs of certain of the buildings came as straight from the ateliers of Durban and Garnier.

Apart from surmise, there were gifted architects practicing in San Francisco, men like Patten, the beauty of whose Gothic manner was shown in the old Grace church and the Synagogue. There was restraint within and respect for the tradition of art everywhere evidenced, that meant nothing less than that the populace too, was maintaining something of the old forms and the good manners they had brought from the older civilization and weaving it into the new. They built homes: agreeable houses and gardens planted themselves upon the hills with a promptitude that was indicative of an inner stability and orderliness in the community; and they built churches, even while the "Eldorado" was dazzling the "transients" with its mirrors and "high stakes" and the atmosphere of the mining camp still hung over the town.

Literature has never sufficiently celebrated our respectabilities; the testimony to this delightful period of sedate life (not without its enlivening contrasts) rests almost entirely now in memories, such as are embodied in the strange "Chronicle of Manuel Alanus" and in the old photographs and lithographs of the time.

We have hung upon architecture because it bulks as the popular and revealing art. Painting was practiced obscurely. Sculpture appeared only in the ornamentation of the buildings: their stucco decorations being of no mean order, and where it occasionally broke away into the freer forms of life and the human figure, it did so in a manner showing capacity for true sculpture of merit.

We did, however, at this time, indulge almost inordinately in delineation by lithography. Here the artist had his fling—upon the letter papers showing views: in the broadsides picturing current events; transitory things, but posted to the ends of the earth. They were sober and respectable productions and historically they furnish a record surprisingly rich.

One of these faded blue sheets pictures the group of the first Chinese participants in a Fourth of July parade in San Francisco. The incident is momentous, as we look back upon our history. In the history of our art it signalizes a new and wonderfully rich influence; however we may regard it as alien, this oriental thread has the substantiality of a rope.

We cannot incorporate it as an entity in the texture that we are now weaving, but filaments of its splendor and dignity as Chinese, of its exquisiteness as Japanese, will inevitably weave in more and more as the barriers of nationality go down under the assaults of the spirit of human brotherhood.

If the artists of Europe were, at the moment of this first invasion of our coasts, opening their eyes to the lessons taught in art by these same orientals, we on our side of the world, in our out-post community, were taking coolies by the wagon load directly from the steamer landing, to the old "Bank Saloon," that they might gaze with equal wonder, though with probably less edification, upon a French canvas of ordinary merit, whereon was pictured the "Sleeping Samson Shorn by Delilah."

It was the "chaste" nude again. What they made of it, these simple Chinese—what they made of this first initiation to just what western art had to offer them, we cannot guess. The incident may have a lurking hint of allegory or prophecy in it, but its humor justifies its recording here.

The Chinese instantly began to offer us of their stored richnesses; they imported works of art and lavishly decorated the fine old buildings they occupied. They did not build, except here and there an outdoor altar and notably, the one perfect little temple beside the river at Marysville. But the stream of importation has continued and this flood of examples of a great art must ultimately yield an effect.

Its strength is diluted in the passage through the Japanese, and the west has already accepted that mitigated and very charming tradition; we shall touch upon that influence in California a little later: something happens between.

This happening was the whirlwind of the "Big Bonanza" years; all threads were apparently snapped short.

It was a powerful era of powerful men: an era of greed in getting and lavishness in spending and of a vulgarity such as the world had never before suffered. Here in California it happened that the flush times fell upon us when in the arts of the western civilizations there was no steadying tradition. Something had held over in California, of what the rest of America had lost: but this remnant was to be pushed aside ruthlessly enough, from the path of gross wealth. The masters of wealth dominated the scene so tyrannously that what art there was or whatever tradition, instantly succumbed.

It would be interesting to know what became of the scholarly architects with their reserves and hesitations, and of the modest delineators in lithography. Great houses and hotels were erected, importations of works in sculpture and painting began to pour in for their adornment. The foreign gaudy examples went where they belonged: the town positively "bulged" with imported "Art." One wonders, did the modest lithographers yield to the prevailing vulgarity, and taking service under Mammon, produce the shameless caricatures of the gutter publications that were sold upon the streets of San Francisco at that time? In so great a social revolution, perhaps the conservative element that made the earlier San Francisco, was not fully aware of more than the stir and the prosperity, and went in and out of its decent residences, with only a gratified sense of sharing in an increased life—even perhaps, surreptitiously buying and chuckling over "The Jolly Giant" and its caricatures, not really conscious that they and their civilization were in the clutch of a cyclone.

Money was so easy, that if the great getters and spenders began to distribute it in the purchase of works of art, they indiscriminately bought both bad and good; and it is at this time that painters of a merit seriously to be considered, came to and were supported in California. The Art School was inaugurated under the direction of Vergil Williams; and we pick up the thread just here, of our "connection," in the gracious courtesy of the French government's gift to the little institution, of casts from the masterpieces of sculpture in the Louvre. And it was not long before "the school" began to send the first of her pupils to Paris, with the "stumped" crayon examples of what they had learned from the French gift, under their arms—tender pioneers of Californian art.

The wives and daughters of the "patrons of art" went to Paris, too—for fashions in clothes and husbands—while the "patrons" stayed at home in the wooden palaces—they who had "sown the wind," while the community "reaped the whirlwind."

Virginia City, raised in a night and gutted in a decade, remains as the most expressive ghost of that inebriated period. It stands in its barren hills, a pitiable, falling, ever so fitting monument to its creators: and its "Internation Hotel" (where the banquets brought straight from San Francisco by train, with the champagne on the ice, were served) is the epitome of what vulgarity can do to architecture and the sister arts: the chapter properly closes there, where it began.

There was to be no resumption of the old good and sedate taste in building; things had come to too utter a smash in matters of taste. Whatever art there was, had something of the look of surreptitiousness worn by our old house holder, going about his decencies with "The Jolly Giant" in his coat-tail pocket.

Change was inevitable, even had California escaped the gross flatulency of the bonanza years. The railroad had spanned the continent and she was no longer a rich province apart from the world, but a sharer now in its wide unrest. San Francisco had earlier attained to public collections of art: at Woodward's Garden and at the "Cob-web Palace" on Meigg's wharf (that unholy bar-room, with its monkeys chattering over the sawdust floor). If in those early days, one's childish innocence was taken everywhere, the first impression of ranged works of art in gold frames, is permeated with the odor of animals, stuffed and alive: or as at the "Mechanic's Fair," with the scent of peanuts and popcorn. "Art" wore the aspect of being enormously popular, even though it was so largely foreign and imported.

"Duncan's Auction Rooms" had been succeeded by the established art stores. A little community of artists gathered and nested in the "Latin Quarter," and there must have been some latent discernment among patrons to support so meritorious a group as that formed by Hill, Keith, Tavenier, Yelland, and the others who managed to fruitfully survive.

Looking now upon the paintings done at that time, there was every justification for survival. It was good painting and in particular instances of an expertness quite amazing. The painters were for the most part, men who had been well trained before their advent in California; and if their response to the new wonder of nature was expressed in the established language of their schooling, it was a language that adequately conveyed their bright surprise at the large prospect.

The work of Thomas Hill has been neglected of late, since it has become the fashion to diminish the creations of the school to which he belonged; that "school" managed its panoramic canvases with wonderful skill; and Hill with his sure brush and rapid execution had an eye open to the light and met and solved certain problems, at a time when the problems had scarcely become apparent to the majority of the painters in America.

Of William Keith, self-trained as he was in California, there is not space here to justly speak. As he remains the best known and most widely honored painter that California has produced, the critical estimate of his work is inevitably to be made in the future. How great that work was at its best: how it stands with the best landscape art that followed Constable and the Frenchmen of 1830, requires no temerity in assertion. The task will always be to protect our judgment, by holding to the highest in his enormous and very unequal production. The critic of the future is less likely to be 'swamped' in his estimate, than is a contemporary. Keith's art at its very personal best is of a rich imagining on the themes afforded by nature; but both Keith and Hill and the painters of their time and later, looked upon the actual nature about them with (shall we say) something of the eyes of strangers in a strange land. Their transcripts are undoubtedly of the California scene, but we feel (as we feel in the great majority of works of landscape art) that set down anywhere on the earth, the painters would employ this identical language of transcription. Here and there a great man *does* speak in the particular terms of the country about him, fits the language to his native theme; Vermeer, Constable, Corot, Titian, Valasquez, and the Chinese masters thus speak. It would seem to mean that the artist and his theme had become mutually penetrative, and it is this interchange and perfect transfusion that we must wait for in California's art.

The students returning from Paris began at this time to bring their gifts to the local altar; the late eighties and early nineties brought us the echo of the little Renaissance in New York through a group of young architects, painters, and decorators. It was a charming brief period filled with enthusiasm and a quite fresh perception of the city and its romantic beauty and the beauties of California. The social life had again attained something of the old orderliness and serenity, only now its activities in art were preëminently in the hands of youth. Writers, painters, sculptors, architects, and musicians communicated their enthusiasms one to the other, in a communion closer and more stimulating than has ever happened locally, before or since.

Things were accomplished in the community's sense of the meaning of art, if little that was actual and substantial took visible form. The artists were playing the part of discoverers and prophets in the California environment and then, having prophetized—most of them went to New York. The material opportunities here were not frequent enough that was all: California could not feed all her fledglings and they were crowded out of the nest, to sing or paint or carve their way to success or fame somewhere else. None of them failed and many have brought honor to the name of California. The sons and daughters of the state continue to seek and to pervade the older centers and to manifest their gifts in all the arts, in almost embarrassing numbers.

Architecturally, this decade witnessed the first attempt at a revival of Spanish colonial that was too excitedly undertaken to be successful in its adaptation to modern and changed uses and it is only now and occasionally, that the lessons of that old style are beginning to be sympathetically applied and the warnings afforded by the first adventures, regarded.

This decade of the nineties accomplished beyond its public buildings, a type of middle class dwelling that is distinguished by refinement and the use of the native woods. These dwellings inaugurated what may be regarded as almost a "Californian" style in homes. The redwood interiors of the dwellings made agreeable backgrounds for the domestication of the Japanese works of art that were being collected and the refinements of that art continue to exert a strong influence upon California life and its struggle toward a conscious sense of beauty.

This oriental thread appears as a leading influence in the art instruction in the public schools. That system is a notable one, the seed of which was planted and first blossomed in the old "Broadway School" in San Francisco, there proving the case for art as an educational means, as probably it was never so charmingly proved before.

The handicrafts and secondary arts began to flourish at this time in a legitimate association with architecture. Illustration, freed from its dependence upon the engraver, took the initial steps toward its present journalistic loquacity. Photography (which had put an end to wood and steel engraving) made her claim to a place among the arts. The gardens, that had heretofore "happened" were now brought to design and a wide field opened that promises to yield a local expression in a noble art. Sculpture found its true place as public monuments were erected under demand of a new civic pride.

There had been decorators at work in San Francisco during the middle period, who had capably frescoed the theatres and palaces and bar-rooms: but it was in the nineties that the first mural paintings in the modern sense, were executed by artists eager for the larger problems and the larger surfaces which the wall offers.

And in all of these various and faltering efforts there was a quality of ingenuousness that our later performances appear to have missed, and that might well make us pause.

Mere habit and increasing expertness seem somehow to rob the work of art of the bloom, the charm, of humbleness and self-forgetfulness. One suspects that it is this expertness of hand, this easy habit in production, that is the real menace to art in every age: and that most seriously is it the menace in the formative period of a people's expression, when old and essential truths are waiting to be retold in a new language—a language to be cautiously evolved by the processes of time and deep thinking.

If in the nineties we were a little hesitant and humble, yet out of that decade emerge two names that will make a distinctive claim upon the consideration of the future: Arthur Atkins the painter; Arthur Putnam the sculptor. Both men saw natively and with their own eyes and each inevitably spoke his own language. In their language we have perhaps, an intimation of what ultimately, the speech of California is to be.

Yet both men embody in their works the great traditions of the art of the past: and so they place securely in our hands again, the inspiring filament which connects us with all that is sanest in humanity's struggle to express beauty and the truth of beauty. With the assurance this thread affords us in the present confused state of the arts, we had perhaps, best reverently hold it as a clue (indubitably our own) and merely stand and wait the confirmation of the future.

What that future is to offer, we cannot guess. So far as we have gone, our worth appears to lie, not so much in what we have *done*, as in what we *are* and promise to become. The exodus of California artists continues. It is the strange sign of deeper things in the young commonwealth. It is the announcement of a rich fertility hidden and mysterious, in those spiritual qualities and impulses which, in a race, bring to birth the poet, the painter, the builder and the musician.

In our ignorance of what these spiritual impulses are and from whence they are derived, we must strive to learn how to nourish, how to cherish them: and how not, by any coarsening of our perceptions or receptivities, to thwart and destroy them.

The sign has been given to us and to the world. What it signifies cannot be claimed as our human accomplishment. It is an inestimably precious gift placed in our care. And the ultimate test of our civilization, will be the use that we have managed to make of it—our integrity as custodians.

Bruce Porter

CALIFORNIA BOOKS AND AUTHORS

A REVIEW of California books and authors within the limits of this article must make many omissions. Only the writers of real genius, the books that have made a strong appeal to the public can be included. Only the most salient features of these books, the most striking traits of their authors, can be dwelt upon. It has come to be accepted that something in the atmosphere of California has given to its authors a quality that sets them apart from those who have lived their lives under less sunny skies, under more conventional social rules. No one can fully understand California authors who has not come into some intimate touch with pioneer conditions in the Far West. The Sierra is an actual physical barrier between California, with its climate and sky of Italy, and the East, with its six months of snow and ice. The California pioneers raised an equally formidable barrier between this new life and the old conventional life east of the plains.

The California pioneer Bret Harte has drawn truly, but it is false to depict the women of pioneer days as he drew them—the outcasts of the dance hall and the gambling den. Some one will yet immortalize the pioneer mother of California—a woman whom no danger daunted and no labor tired; a woman of larger mold, physical and moral, than the average mother of our day, who knew neither fear nor sickness, but looked with clear vision beyond her rude and hard life and gave her children a Spartan training for which they bless her in these Laodicean days of a thin-necked and narrow-chested generation.

What has set the broad arrow-mark of originality and force on California books and authors? My theory is that the tremendous spiritual and moral rebound that followed the great gold rush of '49 has made itself felt ever since in the thought and feeling of California. Beside this unparalleled gold rush the Klondike episode was like a modern hunting trip into East Africa compared with one of Stanley's expeditions into the then unknown "Dark Continent." Beside the long six months' trip across the plains, beset by savage Indian tribes, the Chilcoot Pass was the pink tea of hardship and adventure.

These California pioneers lived a life free from all restraint save that of honesty and square dealing between men. If a man had a pet vice, that vice came out and reared its ugly head. Many lives were wrecked by the lust of the flesh and the lure of gambling, but the men who resisted these temptations, who had the courage to bring out their wives and children to this new land, developed a fine moral fibre that the strait-laced and conventionally-protected never know. They lived their own lives untrammeled by conventions. Those who had the literary faculty, who grew up here or came here in their plastic youth, felt the stimulus of this new, strange life and put it into their books. Some of these were not of heroic mold, for it is given to many writers to stir the hearts of readers when they are cold themselves. But the great majority felt the passion and the poetry of this strange pioneer generation, and they have put something of its splendid heat and its potent thrill into their books.

This revolt from old rules and conventions is also responsible for the large number of caricaturists and humorists found among California writers. From John Phoenix to Mark Twain, from J. Ross Browne to Wallace Irwin, there is the same delight in shocking the unco' good. The same spirit that moved the California pioneer is seen in another generation in the cowboy of the plains, now almost as extinct as the buffalo and the blanket Indian. The barb-wire fence and the small farmer killed the cowboy, but the aroma of romance lingers about him as the survival of that spirit which animates the literature of California. The man who spends six months shut in by frost and snow, who gathers about the family stove every night for comfort as well as for companionship, is entirely alien to the Californian, who has no fireside and a large part of whose life is spent in the open. To make these two kinds of people see things with the same eyes is as vain as to try to harmonize the nomad of the desert and the inmate of a monastery.

The California climate, like that of ancient Greece, has something in it which develops the artistic temperament. All the surroundings suggest the land of Phidias and Homer. When the Californian takes the ride from Patras to Athens, when he passes around the Gulf of Corinth, he is ready to exclaim that across the blue water is the Marin shore as seen from San Francisco. The rugged mountains, the glacier-smoothed hills, the sharp indentations of the coast line, the color of the vine and olive-clad slopes, the turquoise blue of the sea, with mottled shades due to floating seaweed—

all these are reminders of Carmel and Monterey Bay. The modern Greek is a far cry from the Greek of Marathon and Thermopylae, but he has the mental nimbleness, the artistic temperament, the keen curiosity about every new thing that marked the Athenian of the days of Plato and Socrates.

The same thing is true of the Californian. He develops early, both mentally and physically. He is lighter of fancy, more fond of pleasure and more artistic than his eastern brother, who spends six months in a long fight with cold and sleet and ice. And what he has contributed to literature is marked by these mental traits. It is bright, artistic, buoyant, optimistic.

Eastern and European people who saw the San Franciscans just after the earthquake and fire, marveled at the courage of the women and children, noted the absence of tears and lamentations, wondered at the hopeful spirit which saw already the ruins cleared and the old homes renewed. A large part of this spirit was due to the climate, which had molded and changed the character of these people—more than half of them born in the East, but transformed into genuine Californians by the influence of climate and environment. The Californian is a natural optimist; he always looks on the bright side. Hence he has none of those fierce wrestlings of spirit that disturb the descendant of the Puritan, whose digestion is faulty and whose liver does not work properly. The blessed alchemy of the sunshine sweetens thought as well as purifies the blood and clears the vision.

Humor and broad caricature marked the early California writers, of whom the first was Captain George H. Derby, better known as "John Phoenix" and "Squibob." He was an engineer in the regular army, and spent several years in San Diego and other parts of California, before it was a state. He not only made sport of the army, but he wrote many amusing sketches of early California life, which are as good reading today as when they were written. His best book is "Phoenixiana," which includes some of his ridiçulous recommendations to the army department, as well as veracious accounts of his management of a pioneer newspaper of San Diego. Derby did not make use of the outlandish spelling of Artemus Ward, but he was far more artistic, and the proof is that his book endures better than that of Artemus.

Mark Twain was the logical successor of John Phoenix and though he came west in his young manhood, he must be counted as a Californian, for it was the pioneer life of Nevada and California that first stimulated his genius. The printer's trade has given the world many great authors, but it is doubtful whether Mark Twain would ever have developed as a writer without the stimulus of the remarkable life of Virginia City into which he was plunged, and the association with many bright writers who were attracted to that mining camp by the large salaries paid to clever newspaper men. And his development was the more rapid because of his lack of early school training. Of all the California writers he became in his maturity the ablest. His genius as a humorist blinds most readers to the fact that as a literary artist he is head and shoulders above most of his contemporaries. All of his humorous work shows literary skill in the highest degree, while descriptive passages in "The Innocents Abroad" and chapters in his "Life of Joan of Arc" reach the high water-mark of genuine eloquence.

Mark Twain ripened with the years, and his work at last came to have a greater influence upon Europeans than that of any other American author. The man himself had queer kinks in his brain. His greatest failing was his want of reverence, which led him into such an act of incredibly bad taste as his famous caricature of Emerson, Longfellow and Holmes at a New England society dinner in Boston. There is rich humor in this after-dinner speech, but no normal man, with any reverence for these authors, would have had the hardihood to perpetrate such a joke as Mark attempted.

In broad humor, in tenderness for the weak and the oppressed, in pity for the unfortunate and in righteous wrath over hypocrisy and untruth, Mark Twain's work has never been surpassed. "The Innocents Abroad," "Roughing It," "Life on the Mississippi," the chapters in "Huckleberry Finn" on the southern blood feuds, and the "Life of Joan of Arc," I regard as his best work. Other chapters and stories should be gathered into a volume for permanent preservation, because his fame is really hurt by the mass of his work. Mark Twain deserves rank among the first of the great American authors, and it is equally certain that California has a valid claim on him as one of her writers, with the unmistakable tang of the soil.

For twenty years Bret Harte has been regarded as the typical California novelist and poet. Though his boyhood was spent in the rude mining camps of the foothills of the Sierra Nevada and his young manhood in San Francisco, still most of his literary work was done abroad. For many years he made his home in London, and there he died. It seemed as though absence from his old home endowed him with a peculiar clairvoyant power to reproduce so perfectly the scenery, the color, the very odor of the California woods and fields, that the reader is able to see them in his mind's eye. It makes no difference whether he is describing a great snow storm in the Sierra in "Gabriel Conroy," or the heart of the primeval redwoods in "In the Carquinez Woods," or the flat marshy country below San Francisco, brooded over by the mysterious fog, in "By Shore and Sedge," Bret Harte always paints a picture that is full of life and color. It is the same with his characters: they live and breathe, but unfortunately, they are no more like real Californians of pioneer times than Dickens' characters are like real flesh and blood English people of his day. In fact, Bret Harte bears the closest resemblance to Dickens in his sentimental view of life and his fondness for caricature of character. But there the resemblance ends, for Harte is far the finer literary artist in the sense of style and the ability to tell a story without digressions.

One who has followed Bret Harte's development closely can divide his productive life into two periods. The first was that splendid creative morning when he wrote the short stories that gave him fame. "The Luck of Roaring Camp," "The Outcasts of Poker Flat," and "Tennessee's Partner" always appealed to me as the greatest of his work, because in these he did not indulge in his propensity to caricature. "The Luck" is pure comedy, but gives a graphic picture of pioneer mining life. "The Outcasts" depicts a typical pioneer gambler and two women of the dance halls. The last tells of the love surpassing the love of woman that grew up between mining partners in early California days. These three stories show Bret Harte at his best, with less of the cynical comment and the cheap melodramatic flourishes that disfigure so much of his work. All three are flawless in their reflection of the strange life of the early California mining camps—wild, unconventional, yet ruled by the simple law of honesty and fair dealing, and presided over by Judge Lynch, whose decisions were never subject to appeal. These early stories Bret Harte never equalled in the years that followed, just as Kipling has never written stories as good as "Without Benefit of Clergy," "At the End of the Passage," "The Gate of a Hundred Sorrows," and "Beyond the Pale."

The second period of Bret Harte's artistic life began when in London he indulged in dreams of his early life in far-off California, and saw again in his mind's eye the scenes that were stamped on his boyish imagination. His is a case of arrested development, for he never advanced beyond a certain point and his latest work reveals no comprehension of the enormous changes that had transformed California and had made it a land in which the novelist would have felt himself an alien.

The poetry of Bret Harte shows no depth, but it reveals flashes of genius and an uncanny divination of character. His "Heathen Chinee" is perhaps best known and is a thing apart—a literary spotlight thrown on John Chinaman. His "San Francisco" still remains the best picture in verse of the gray wind-swept city that saw his first taste of fame, and his "Dickens in Camp" was the finest tribute laid by the world's poets on the bier of the greatest creative writer of the last century. In his poetry, as in his prose, he showed the most consummate artistry, never putting forth any work that was not highly finished. As a man, Bret Harte had some ugly traits, chief among which was a certain callous selfishness, shown in the cruel neglect of the work of other California poets, after promises of aid with publishers. With all his defects, Bret Harte remains among the most typical of our California writers.

Worthy of a place beside Mark Twain and Bret Harte is Joaquin Miller, whose poems, when they shall have been edited by a competent hand and reduced to a single volume, will stand as one of the finest expressions of the singing faculty. Miller had far fewer natural advantages than Clemens or Harte. He crossed the plains when a youth, and he was thrown into the wild life of early California with practically no education or training. He lived for months with the Indians of northern California, and much of the simplicity and poetry of the Indian's outlook on life remained with him to the end. Burdened with the absurd name of Cincinnatus Heine, he early showed his appreciation of the value of romance by changing this name to that of Joaquin, which had a mingled flavor of Spanish life and dare-devil outlawry. Miller found his first appreciation in London, where he helped his fame by wearing his hair long like an Indian and dressing in flannel shirt, with corduroy trousers tucked in his boots. The English public then as today, dearly loved a spectacular literary hero who flouts all conventions, and Miller was Byronic enough to suit the most romantic girl. His early work like "Songs of the Sierras," "The Arizonian," "With Walker in Nicaragua" he never surpassed. They have the fire of Byron's narrative poems with splendid pictures of the western prairies and the tropical jungles of Central America. His later work revealed more maturity, but even to the last, Miller strung pinchbeck ornaments with his pearls of song. He had no more real literary taste than a Piute Indian. He sang because he felt the impulse of song; he was often coarse in his talk, but never in his verse. He produced several fine short poems worthy to stand with the best work of the greatest English poets—"Columbus," "The Passing of Tennyson" and "Missouri." But in my judgment, some of his noblest verses have never been recognized. These are poetical paraphrases of Biblical stories, set as introductions to chapters of "The City Beautiful." They should be taken out of this book and printed alone, as they have the genuine spirit of the old Hebrew poets from whom Miller derived his best inspiration.

When one has passed beyond these three worthies of California literature, standing out like three great mountain peaks, the field widens, but it may be likened to an elevated tableland, with no more splendid mountains. In the life of a generation, although California has seen stirring deeds, it has recorded no great writer worthy to be classed with this triumvirate. All that can be done in this brief review is to touch upon the chief authors whose work makes them noteworthy. Omissions are inevitable, for even a bare list would fill all my available space. Many California authors would have had a far wider circle of readers had their work been published by one of the great Eastern book houses. Their books were issued here by firms that had no adequate means of circulation; so they missed that wide publicity which means so much to the author.

Of these minor writers a foremost place must be given to Charles Warren Stoddard, whose "South Sea Idyls" alone, should have given him immortality. This book reflects more perfectly than any other the curious lotus-eating life of the South Seas, before the various islands were spoiled by the missionary and civilization. Stoddard was a true poet, and his prose sketches are shot through and through with the iridescent gleams of poetry. Ina Coolbrith in many verses has given pictures of California scenes whose truth and beauty are best appreciated by those who have lived here for years. Closely akin to her work is that of Edward Rowland Sill, whose early death was a distinct loss to California poetry.

A man who would have deserved a place among the leaders of California literature, had he taken a wholesome, normal view of life, is Ambrose Bierce, noteworthy for his brilliant verse as well as for his short stories, which are as highly finished as those of Poe. But most of Bierce's work is devoted to subjects that are repellant to all healthy-minded readers; hence despite his literary genius, he is little read. His place in California literature is really that of the trainer of scores of young writers. His personal influence has been greater than that of any other Californian, for he has always insisted upon the best work and the highest ideals.

"The Man With the Hoe" gave Edwin Markham national reputation in a single day, but bitter and most powerful as is this arraignment of the rule of kings, Markham has done better work in such sonnets as "Semiramis." Much of Markham's recent work has been devoted to Socialism, of which he is an ardent advocate. His latest verse shows more maturity, but less fire than his early poems.

Fiction very naturally has attracted many California writers, who have tried to put into their mimic romances something of the same spirit of adventurous daring which marked the early pioneers of the coast. Of these novelists, the first place must be given to Frank Norris, for a certain largeness of view and mastery of a great theme. The trilogy of "Wheat," which he devised, may have received its inspiration from Zola, but in spirit and essence it was genuinely original, with all the strength of the San Joaquin soil from which it sprang. "The Octupus" and "The Pit" have many faults, but they are the greatest California romances that have yet been written. The scenes and the characters of the first story are distinctively Californian, but though the second is laid in Chicago, the strong wind of destiny that blows through it comes from the desolate cañons of the Far West, and there is something of the Californian spirit in the characters who work out their salvation in the storm and stress of the Chicago wheat pit. Norris showed more real art in his earlier work; his "Blix" and "McTeague," widely different as they are, reveal the same sure grip on character and incident and the same brilliant style. The early death of Norris was a heavy blow to California literature.

Two other novelists are naturally bracketed with Norris—Gertrude Atherton and Jack London. Mrs. Atherton's romances of early California days are remarkable for their dramatic force, their vivid portraiture, and their power of making us realize the pastoral life before the Gringo came, as well as the crowded life of the gold hunter and his successors. She spares no ugly features; she writes like a man who is endowed with a woman's intuition. Her later work shows rare maturity and power. Her "Tower of Ivory" is a great novel, with two fine characters—a typical Englishman of good family and a prima donna who has found herself in the realms of song, after being dragged through the gutter of shame and misery.

As for Jack London, he is in a class by himself. Self-educated, with a life that surpasses in romance that of any of his heroes, London, above all the writers of our day, has the power of visualizing his experiences, so that the man or woman of small imagination and narrow, circumscribed life, may see the wild, free places and enjoy to the full the strenuous life of adventure. This is a rare power which was exhibited at its best in "The White Silence" and other Klondike stories, and mingled with high poetic imagery, in "The Call of the Wild." That unique romance is enough to establish any author's fame, but London in the first half of "The

Sea Wolf" did equally good work. Into everything that he writes, he seems to crowd a certain dynamic force that thrills the reader. This is true whether he is describing his own terrible labors to get an education in "Martin Eden," or giving pictures of his battles with the present-day Apollyon, the actual, living Devil of Drink. If London had a finer nature, if his imagination could free itself from the physical, he would write novels for all time. As it is, he is far and away the most powerful writer that California has produced.

Notable work has been done in historical writing by several Californians. Of course, H. H. Bancroft stands at the head, not so much for his thirty-nine volumes of the "Native Races" and of the "History of the Pacific Coast States," as for his notes and the library of 50,000 volumes and manuscripts which he gathered for this monumental work. Much of his history was done by trained associates, but Bancroft mapped out the plan, wrote the introductions and gave life and spirit to the greatest literary enterprise this country has ever seen. The Bancroft library has now passed into the possession of the University of California, and its value increases with the years. Other historians whose work is noteworthy are Theodore H. Hittell, who has written one of the best histories of California in four volumes; Zoeth S. Eldredge, who, in "The Beginnings of San Francisco," has made a valuable contribution to the early history of the city up to 1850, and, as far as research goes, has left nothing for any successor to do; and John P. Young, for thirty-five years managing editor of the "San Francisco Chronicle," who in his

"History of San Francisco" has really written a comprehensive sketch of the development of the whole state as well as a readable story of the city by the Golden Gate.

A paragraph must be given to Geraldine Bonner, who has shown exceptional skill in reproducing the scenes and incidents of the overland trail as well as the gambler's passion, that is a legacy so many of us have inherited from our pioneer fathers. Her "Hard Pan" is one of the very best studies of the inevitable ruin that comes to one who is consumed by the thirst of speculation in mining stocks.

A dozen or more short story writers who flourished during the last thirty years must be grouped in a single paragraph. Among these may be named, W. C. Morrow, Arthur McEwen, Bailey Millard, Peter Robertson, Madge Morris Wagner, Dr. J. W. Galley, Charles Howard Shinn, John Hamilton Gilmour, Charles F. Lummis and George Wharton James. All these have written not only good short stories of California life, but they have painted the beauties of the scenery of the state in imperishable style.

More recent writers, whose work in prose and verse is seen in the magazines are, Theodore Dreiser, Will and Wallace Irwin, James Hopper, Eleanor Gates, Hermann Scheffauer and George Sterling. Of these, Dreiser seems to have the greatest originality and force. If he continues to develop, his should be the great name in the next five years. Wallace Irwin has an extraordinary command of the most difficult metres, as witness his "Sonnets of a Street Car Conductor," but it has always been my belief that were he to devote himself to it, he could produce poetry as fine as that of Hovey or Lanier. It is a great pity that Irwin is spending his force on humorous verse and pot-boilers. Will Irwin is one of the most versatile of California authors. He has to his credit one original character in fiction—a professional female spiritual medium, who is endowed with real humor and a warm heart.

Scores of California women have shown their skill in prose and verse. Their record may be found in "The Story of the Files," an invaluable work by Ella Sterling Cummins, which preserves much that is best in California literature, with interesting sketches and rare portraits. This was a labor of love by a Nevada woman, who has written many fine short stories of Far Western life, and who has the distinction of being the first to suggest the erection of a statue to the Pioneer Mother. She deserves some substantial recognition by the Native Sons and other California organizations for her unselfish labor in reclaiming from oblivion the work of so many California writers.

George Hamlin Fitch

SAN FRANCISCO:

THE EARTHQUAKE AND FIRE OF 1906

THE foundation of San Francisco has been treated in the earlier chapters of this work and the matter need not be repeated here. At the time of the American occupation the future possibilities of the Bay of San Francisco were, to an extent, realized, but the little village was so small and unimportant that in the contract with the Pacific Mail Company in 1848 San Francisco was not even named, but the steamers were to call at San Diego and Monterey and proceed with their mails to Astoria, in Oregon. The great immigration following the gold discovery changed all this, and from the Mexican village of 1846, San Francisco had become, in 1906, a city of the first class, and sixth in commercial importance in the United States.

A few minutes after five o'clock on the morning of the 18th of April, 1906, the people of the city were aroused from their slumbers by a shock of earthquake so violent that the most hardened and earthquake-proof among them realized that this time, at least, the "temblor" was something out of the ordinary. The main shock lasted about a minute and was followed by a number of minor shocks during the next two hours.

This earthquake had its origin in an ancient fault extending from Point Arenas, some ninety miles north of San Francisco, and running thence in a southeasterly direction to San Juan Bautista about eighty-five miles south of the city. This fault or earthquake crack had been known for many years to the leading geologists of California and had doubtless been, in the remote past, the scene of many earthquake disturbances. A surface expression of this fault may be seen in Tomales bay, a shallow inlet about twenty miles long and from half a mile to a mile and a half wide. From Bolinas lagoon the fault trace enters the sea, passing about three miles west of the Seal Rocks (San Francisco) and again returns to the land at Mussel Rock, about four miles below the city line, thence through the Cañada de Andrés and the Spring Valley lakes, another surface expression. The disturbance was caused by a rupture and horizontal slip along this fault, the offset ranging from two to sixteen feet, though in one place, affected by abnormal conditions, it reached twenty feet—the earth-block on the southwest side having apparently moved towards the northwest and that on the north-east side toward the southeast. This was accompanied in some places by a slight vertical displacement, the ground on one side being lifted one or two feet. In San Francisco on made or filled land there was in places a settlement of four or five feet, and an earth-flow of several feet carrying streets and buildings with it, causing great disaster. Buildings of poor construction standing on soft ground were badly damaged while those on firm ground with rock formation suffered but little when properly constructed. The estimate of the engineers who investigated the San Francisco earthquake and fire was that the damage done by earthquake was from three to ten per cent of the whole loss. Had the fire not followed the earthquake the latter had ere this passed into the limbo of forgotten things. Immediately after the first shock, fires started at hundreds of places and quickly converged into a general conflagration. By half past six in the morning all that part of the city east of Fremont and Front streets was burning fiercely and the fire was rapidly spreading through the manufacturing district. So great was the extent of the conflagration that it was a physical impossibility for the fire department, recognized as one of the most efficient in the world, to cope with it. The breaking of the distributing mains rendered unavailable the 80,000,000 gallons of water stored within the city, and the death of Chief Sullivan, who had been fatally injured by the earthquake, deprived the force of his guiding hand and to a certain extent demoralized it. Crowds of the roughest looking men from the dens of the city thronged the streets, but presently from the presidio and the military posts around the bay came the United States troops, in light marching equipment, to the aid of the police; while the governor sent a brigade of the national guard into the city. The military now patrolled all districts, and the roughs, overawed by the troops, made no attempt to plunder the banks and rich stores of jewelry and other things.

An attempt was made to check the progress of the fire by blowing up buildings in its path—first with black powder and later with dynamite—but little, if anything, was accomplished. There was no water at hand to extinguish the flames caused by the explosions, and as a rule, the buildings blown up were already on fire. The day was calm, without wind, and the progress of the fire was slow. By noon the fire had passed Kearny street in the neighborhood of Jackson; California street was beginning to burn west of Sansome, while the south side of Market street east of Fourth street, with the exception of the space occupied by the Palace hotel, was ablaze. A fight was made by the Palace hotel people, but at 4:30 P. M. the hostelry was abandoned by its defenders. Everywhere the people stood without the fire lines and looked upon the destruction of their property. There was no excitement, no terror, no hysteria, notwithstanding the wild press dispatches sent out and the wonderful tales of travelers. The citizens were not permitted to pass through the lines to fight the fire, or for any purpose whatever. All, soldiers and citizens, looked on quietly while the fire burned and no one tried to stop it. The soldiers marched up and down with their muskets within the ropes and every one must keep hands off. It was the fire's day. All through the 18th, 19th, and 20th of April I watched the fire and at one time only did I see any person engaged in putting out the fire, though I saw a number setting fire to buildings. Those were soldiers and were back-firing on Van Ness avenue. The commanding officer (Funston) says in his report that the citizens seemed too dazed to act intelligently in their efforts to save their own property. This was not true. They were abundantly able to act intelligently but soldiers with guns in their hands prevented them from acting at all. In the few instances where they were enabled to evade the soldiers, they not only acted intelligently but they saved their property—as will be seen presently.

By the morning of the 19th the fire had destroyed the main portion of the wholesale and retail section of the city, and was actively burning on an irregular line from about the corner of Montgomery avenue (now Columbus avenue) and Montgomery street to Van

Ness avenue at Golden Gate avenue. To the south of this point it had crossed Van Ness avenue and had worked its way up Market street to Valencia. Everything south and east of these points was burning. A little after noon on Thursday, April 19th, the soldiers began back-firing on Van Ness avenue. South of Geary or O'Farrell streets the fire had reached the eastern side of Van Ness avenue and from here north to Vallejo street all the buildings on the eastern side of the street were fired by the soldiers during the afternoon and evening. The soldiers would enter a building, set fire to it and leave in it a stick of dynamite to be exploded by the fire, and pass on to the next. What possible good this system of dynamiting buildings could do to arrest the progress of a conflagration none but a soldier could explain. On the southeast corner of Van Ness avenue and Washington street was the First Presbyterian church, a large wooden building with a high steeple. When this building was fired an extra amount of dynamite was left in it and when it exploded blazing brands were thrown across the avenue which set fire to a large dwelling on the west side. The fire thus started burned five blocks (from Sutter to Clay streets) when the citizens of the Western Addition, whose homes were threatened, rallied and forcing their way through the line of soldiers stopped the further spread of the flames in that direction. This was done by citizens and not by soldiers as was stated in the report of the commanding general. I did not see this action but know a number of the residents of the district who took part in it. The one time I saw persons engaged in fighting the fire, already referred to, was at

2:30 of the morning of April 20th, when some firemen (not soldiers) having gotten water sufficient to supply one engine stationed at Gough and Vallejo streets, were engaged in wetting down the fronts of the houses on the west side of Van Ness avenue between Broadway and Vallejo which were beginning to smoke from the fire across the street, and doing the same for houses on the north side of Vallejo street between Van Ness avenue and Polk street. Satisfied that the westward progress of the fire was stayed I left the fire line at three o'clock on the morning of Friday, April 20th, and turned my steps towards my home on Divisadero street, one mile west, carrying the glad news to the anxious watchers on the line of way.

At one o'clock on Friday afternoon I was again on Van Ness avenue; now on my way down town. Up to this time I had remained between the fire line and my home. Before crossing this line into the burnt district I took a careful survey of the situation as it appeared from the corner of Pacific and Van Ness avenues. The entire easterly line of Van Ness avenue from Vallejo street south was blackened ruins. There was no fire to threaten further danger to the Western Addition. Satisfied, I passed down to the junction of Kearny and Market streets. Half an hour after I crossed Van Ness avenue, the Viavi building, a large manufactory of patent medicine on Van Ness avenue between Vallejo and Green streets, filled with inflammable material, was dynamited by the soldiers and burned. The explosion scattered the burning matter over the adjacent buildings and in an inconceivably short period the flames, fanned by a strong wind, which had come up from the west, swept with amazing rapidity east and north carrying all before them. The conflagration thus started burned fifty city blocks. The commanding officer in his report says: "That part of the city west of Van Ness avenue was considered safe except from the danger arising from a very threatening conflagration working along the slopes of Russian Hill towards that part of Van Ness avenue lying north of Broadway. All day of the 20th an heroic fight was made by soldiers, sailors, firemen, and citizens to stop this fire which * * * was working its way slowly against the wind. A number of buildings were here destroyed by high explosives, and back-firing was resorted to." This statement is untrue. We have the testimony of property owners of this section who were fighting to save their homes. They were not assisted by soldiers, sailors, or firemen; but with their own hands destroyed fences and small buildings that might afford a pathway to the fire which was working north; they wet blankets, rugs, and carpets with water that had been collected in pails and bath tubs, and as sparks fell or shingles caught they beat out the flames. The soldiers repeatedly interfered and ordered the citizens to leave, but on one pretext or another they persuaded the soldiers to allow them to remain. They succeeded in stopping the fire at Green street. A well known citizen says: "I was watching the fire, with special reference to a friend's house on the north side of Green street near Larkin and had concluded it was safe. No fire was visible north of Green street and on the south side of Green the flames appeared to have been completely extinguished. A few moments later I again looked from the window of a house in which

I was on Pacific avenue—a house commanding an excellent view of the district in question—and was astounded to perceive several isolated fires in the district which a short time before had seemed to be free from danger. These blazes were quickly fanned by the wind into a roaring conflagration, and the house of my friend was within a short time burned to the ground."* I relate this because it corroborates my own testimony. The soldiers interfered time and again with citizens who were working to save their property. There is an abundance of testimony on this point. They repeatedly drove the people living on Russian Hill out of their houses, presenting their guns and threatening to shoot. James B. Stetson, a prominent merchant, living in a handsome house on the northwest corner of Van Ness avenue and Clay street, says: "At 4:45 (Thursday afternoon) I was ordered out of my house by the soldiers —not in a quiet manner but with an order that there was no mistaking as to its terms and meaning—about like this: 'Get out of this house.' I replied: 'But this is my house and I have a right to stay here if I choose.' 'Get out d—n quick, and make no talk about it, either!' So a soldier with a bayonet on his gun marched me up Clay street to Gough amid flames, smoke, and explosions. I stayed at Gough street a while, looking down upon my house, expecting every minute to see the flames coming out of it." Stetson watched his chance and got back into his house and with the use of an improvised swab and buckets of water, saved it. Mr. W. E. Keller had a large warehouse filled with flour and wheat.

*Van Ness avenue runs north and south. Green street crosses its northern portion. Next south of Green street, Valley street crosses, then Broadway, and next comes Pacific avenue.

It had brick walls, metal roof and window casings, with doors of very heavy iron. It was protected on two sides by Telegraph Hill, and had a salt water tank of unlimited capacity which connected with the bay. Within, he had twelve fire extinguishers, and believing his building, with its appliances and men practiced in fire drill, to be fire proof, he carried no insurance. On Friday he awaited the approach of the fire and with ten of his men prepared for the defense. The soldiers came and ordered him out. Arguments and explanations were of no avail. They were ordered to get out or be shot. I said to Mr. Keller, "Did you ascertain the name of the officer in command?" "There was no officer," he said, "only a lot of private soldiers and they were half drunk. We are millers, not fighting men," he said in reply to another question, "and besides they had guns. We went out and I remained on the hill and saw my property burn when one man, had he been permitted to remain, could have saved it." He lost $220,000. These instances could be multiplied many times were it necessary.

The military authorities claimed that everything they did was by order of the mayor of the city to whom they reported for duty. Technically I presume this statement is correct, but to such a degree was military rule imposed and with such a high hand was it carried, that most of the people believed that the mayor's authority was abrogated and that the city was under martial law. The president of the harbor commission issued passes in the form of requests to the military authorities to pass state employees during the period of martial law, and even the governor of the state granted passes "by authority of Brig.-Gen. Funston, U. S. A."; while passes from "J. F. Dinan, Chief of Police," did not go at all.

I have understood that after the San Francisco fire the war office issued general orders that hereafter the army should not be used in dynamiting buildings during a conflagration, and that soldiers of the U. S. Army should not be employed to evict citizens from buildings or property owned and occupied by them. An attempt to verify this report and obtain a copy of these orders resulted in failure; but I am satisfied that San Francisco's experience in these particulars will never be repeated.

In justice to the military I must say that after the fire they rendered most valuable service to the city in laying out the numerous refugee camps and in the sanitation thereof, in patrolling the city, and in guarding the bank vaults in the desert wastes of the burnt district.

The marines, too, and sailors from the Mare Island Navy Yard worked manfully in assisting the ship owners and steamship men to preserve the waterfront. In doing this they preserved the commerce of the port, which did not suffer even a temporary check.

The fire burned over approximately 2,600 acres and included four hundred and ninety blocks entirely burned, and thirty-two blocks partially burned, covering over four square miles of closely built city property with a loss of about $500,000,000, one-half of which was covered by insurance. The city had a population estimated at from 440,000 to 460,000. Of these 250,000 were rendered homeless by the fire and for the first few days the bread line represented 350,000 individuals dependent upon charity. Many of these were people who had been living in the greatest luxury but who suddenly found themselves dependent upon the relief stations for food for themselves and families. The situation was appalling. During the ten days subsequent to April 18th it was impossible to purchase anything. Most of the warehouses containing food supplies were burned and the warehouses saved were immediately seized by the authorities to feed the population. There was no money and rich and poor alike were compelled to stand in the bread line. From near by cities food was at once rushed into the city and quickly all roads leading to California were hurrying supplies to San Francisco. From all over the union and from foreign countries came contributions of money until the total of cash received, the value of goods shipped in, and the amount expended for the benefit of the sufferers reached a grand total not far from $15,000,000. On April 19th the mayor called to his assistance the leading citizens from whom he appointed a committee of fifty and gave them full power to purchase, seize, or confiscate food and clothing, establish camps, clear streets, and take all necessary steps for the rehabitation of the city. The railroads carried thousands away; 75,000 sought refuge in Oakland and neighboring cities, while 100,000 were encamped in the parks and vacant places in San Francisco. The relief was quick and effective, and so far as I have heard, no one went hungry or suffered unusual hardship.

A number of lives were lost during the earthquake and fire—though not as many as was first reported. Major-General Greely, commanding the Pacific division, places the number at four hundred and ninety-eight. Some of these were shot by the military and by self-constituted guards—for "looting," and for refusing to obey someone's order. A proclamation issued by the mayor April 18th authorizing the killing of any and all persons found engaged in looting or in the commission of any other crime, is partly responsible for this. Several killings were made subject of judicial inquiry but while none of the slain were found to have been engaged in the commission of crime, no slayer was subjected to punishment. The person who lost his life was unfortunate.

When the immediate necessities of food and shelter had been provided, the citizens pulled themselves together and considered their predicament. Two questions of paramount importance presented themselves: Would the banks stand the strain? Would the insurance companies pay? The banks, commercial and savings, held $439,000,000 of the people's money. The manner in which the bankers met their responsibility has been told in another article.* Insurance conditions were serious. As the extent of the disaster became apparent doubts were expressed of both the ability and the willingness of the companies to meet their liabilities. The fear and anxiety of the people were not allayed by the attitude of some of the companies. There was much talk of earthquake damage, a risk the companies had not assumed; of the question of liability for a fire caused by and the result of earthquake, and of the liability for property destroyed by the authorities. Many insurance managers became very exclusive; they

**Banking in California*, in this volume.

were hard to get at; they removed their offices to Oakland, and when a policy holder succeeded in interviewing one he was told when he might come again. Many of the companies sent adjusters from the home offices and took the settlement of losses out of the hands of their California agents, and the attitude of some of these foreign adjusters was exasperating to the last degree. The people of San Francisco were denounced as liars and thieves and their proofs of loss were contemned as attempts to defraud. After careful adjustment in which every possible reduction of values had been made, every argument and threat was used to induce the insured to accept less than the amount he was entitled to. This bore heavily on the poor man, the man with little insurance and nothing but that insurance with which to begin life again. The compromise meant cash at once. The large merchants and the wealthy insurers could fight for their rights. He could not.

On the 21st of April a meeting of all the fire insurance companies, native and foreign, having policies involved in the fire, was held in Oakland, at which a general adjusting bureau was formed to take charge of the adjustment of losses for all the companies. At a subsequent meeting resolutions were adopted providing for a level or horizontal reduction of thirty-three and one-third per cent (later reduced to twenty-five per cent) on all policies covering property supposed to have been subjected to earthquake damage, or where ensurers had lost their books and accounts by fire and were unable to make the proofs of value called for by their policies. In consequence of these resolutions thirty-five of the largest companies withdrew from the bureau and decided that all losses should be adjusted in accordance with the terms and conditions of their respective policies.

As the losses of these thirty-five companies amounted to nearly fifty per cent of the entire insurance loss in San Francisco, this action had an excellent effect on the people and created confidence in the companies. Adjustments were facilitated and a committee of five, appointed to adjust losses for the thirty-five companies, reported to the companies that they found claimants generally to be fair, patient, and honest, the exceptions emphasizing the rule; and the testimony shows that of the thirty-five, six companies paid at once on adjustment, declining any deduction for cash, twenty-four deducted two per cent for cash, one deducted one or two per cent, and in a few instances five per cent for cash, two five, one ten, and one from five to fifteen per cent for cash. The early stand for fairness taken by these companies, their firmness and the promptness of their settlements, entitle them as a whole to the greatest credit. Their action had the effect of causing other companies to settle claims more expeditiously and with greater fairness. Three American, three German, and one Austrian company withdrew and made no attempt whatever to settle their losses, and several English companies denied liability under earthquake clause but were forced to settle, which they did at from fifty to seventy-five per cent of the face of their policies. A few weak companies paid what they could and went out of business. The total insurance loss of two hundred and thirty-three companies doing business in San Francisco was about $225,000,000, of which the people of the city received perhaps $175,000,000.

The industrial situation in San Francisco after the fire was anything but satisfactory. The president of the building trades council issued a proclamation announcing to his followers that "Patriotism and humanity must govern every action. Brotherly love must prevail. The conditions that confront us are those of a general partnership of rich and poor alike. We must know no class or condition but unite for the general welfare. * * * There cannot and shall not be any advance in wages." How were these beautiful sentiments followed? The various unions immediately demanded increased pay and shorter hours. The employer was obliged to hire two men to do one man's work and to pay increased wages to each. No man was permitted to work Saturday afternoon at *any* wages. Notwithstanding the fact that wages were being advanced from day to day, the unfortunate owner could not get his work done without the most vexatious and unreasonable delay. The higher wages climbed and the shorter the hours were, the more surly and inefficient were the men and the poorer was the quality of their work. The labor leaders announced to the world that no more mechanics were needed in San Francisco; meanwhile 20,000 mechanics walked the streets unable to work because the unions would not admit them to membership. So great was the advance in wages and in cost of material that in September it was estimated that the cost of building had advanced from thirty-five to forty per cent, and some $32,000,000 of building contracts were held up to await the time when more reasonable conditions should prevail.

With the city prostrate, with predatory labor at her throat, there was now inaugurated a reign of disorder, thievery, and thuggery such as no municipality of modern times has ever witnessed. A reckless disregard of life and limb prevailed. Automobiles dashed through the streets at railroad speed, running down and crushing such luckless citizens as could not get out of the way; insolent carmen ran their cars over people and mistreated them in every way, while brutal teamsters took every opportunity of running down pedestrians who were obliged to walk in the streets, the only thoroughfares. The municipal government was corrupt. The mayor, supervisors, and heads of departments held up and plundered everyone who had anything to sell to the city or who had to have a permit of any kind. Franchises were sold for private pay; theatres were built and operated without complying with the law, and all sorts of disreputable houses were conducted under police protection.

But the city survived her afflictions and purified her government. The rascals were turned out of office and the chief municipal plunderer was put in prison. She rebuilt her houses—not as well, perhaps, as she might have done—but better than they were before.* She is building a beautiful home for her municipal corporation, and in 1915 she will entertain the world in a royal manner.

Buildings do not make a city great. What makes a city great is great men; men to whom adversity is but

*To finance the rebuilding of San Francisco, only $17,716,644 was borrowed outside the city. Nearly $303,000,000 has been expended on buildings since the fire.

a challenge to rise above circumstances and conditions. The general commanding the Pacific division (Greeley) says: "The conduct of the community during the days of earthquake and fire was conspicuous by its tranquillity and common sense. In all my experiences I have never seen a woman in tears, nor heard a man whining over his losses." The quality of courage is not given to any one people or nation. I am far from claiming for the citizens of San Francisco any extraordinary proportion of that attribute, but I do claim that throughout their trials they carried themselves like men.

Zoeth S. Eldredge

THE PANAMA CANAL

HISTORICAL

THE problem of providing a practicable route for commerce across the Isthmus of Panama has engaged attention since Balboa marched from near Caledonia Bay to San Miguel Bay, in 1513, and first made the Pacific Ocean known to the civilized world The Spanish, who settled at Nombre de Dios, about 1519, on the Caribbean coast, were earnestly desirous to establish convenient communication with the settlement made at Panama on the Pacific coast, in 1519, in order especially that the treasure brought up from the west coast of South America might be transported readily to the east coast for shipment, after being held in safekeeping on the west side until the accumulation of a sufficient quantity. Paved roads were laid out by them connecting, first, Nombre de Dios, and later, Porto Bello, with Panama, by way of Cruces, a town on the Chagres River about two miles above the point where it now joins the line of the canal. The earlier transportation was entirely by land. Later the journey from Cruces to the seaport was often made by water.

Porto Bello soon became the more important of the eastern ports. Its harbor, which is far better than that at Nombre de Dios, was visited and named by Columbus in 1502. It was sacked by Morgan's buccaneers in 1668. Later the same band landed at the mouth of the Chagres River, and captured the fort there. Ascending the river to Cruces and marching across on the paved road, they assaulted and destroyed the city of Panama in 1671.

Two years later the present city of Panama was founded, seven miles away from the old site. It now has 35,000 inhabitants. It forms the southern terminus of the Panama Railroad, and lies within a mile of the port of Balboa, where the canal opens into the ocean.

Other routes for land passage of the isthmus were used, but the establishment of these was subordinate to the search, at first for a natural waterway, and later, for the best route for a canal. This search was prosecuted vigorously by Spain in the early part of the sixteenth century, but was later laid aside and not resumed until a short time before the successful revolt of the Central and South American colonies, ending in 1823. The loss of these possessions led Spain to cease her efforts to establish a waterway between the oceans. Other nations, however, took up the investigation when she laid it down, and in all, no less than nineteen different routes have received consideration. Between 1823 and 1849 negotiations looking toward the construction of a canal were begun several times between the Central American governments interested, and the governments of other nations, or companies formed by private citizens. In 1850 the Clayton-Bulwer treaty, between the United States and Great Britain, was ratified, providing support and encouragement to such persons or company as might first begin a ship canal through Nicaragua. An American company, which had previously been negotiating for this privilege with the government of Nicaragua, under the name of the American Atlantic and Pacific Ship Canal Company, was incorporated by that republic, and preliminary steps were taken to carry the project into execution, involving a careful instrumental survey of the location. This was made and considered, but construction was not undertaken. The survey remained of value as a basis for the later projects along the Nicaragua route.

PANAMA RAILROAD

The first result of commercial value was the building of the Panama Railroad. In 1838 the government of New Granada made a grant to a French company conceding the exclusive right to build a road, railroad, or canal across the isthmus within certain time limits. The French government took an interest in the matter, and, in 1843, sent an engineer named Napoleon Garella, who made a careful report recommending the construction of a canal; nothing was done, however, and the grant lapsed. Another concession was given in 1847 to another French company, but was soon withdrawn, and, in December, 1848, the franchise was given to Messrs. Aspinwall, Stephens, and Chauncey, representing an American company. The railroad was built from Aspinwall, now Colon, to Panama, between 1850 and 1855. The franchise was so modified later as to give the Panama Railroad Company exclusive rights within certain geographical limits for a period of ninety-nine years, dating from 1867.

EARLY CANAL PLANS

The railroad was of great benefit to the people of the United States, in lessening the hardships of the journey from the east to the west coasts, at a time when the discovery of gold in California was turning thousands of travelers in that direction. Nevertheless, the need for a canal was still felt, and the United States government took the matter up after the close of the Civil War. Under authority of Congress, an interoceanic canal commission was appointed by President Grant in 1872, and surveys were made of several lines, including those via Caledonia Bay, San Blas Bay, Lake Nicaragua, and the Atrato River. An examination was also made of a line following the general course of the Panama Railroad. In 1876 the commission reported in favor of the Nicaragua route. Before further measures were taken by the United States government, a French association, backed by a committee of the Society of Commercial Geography, of which M. Ferdinand de Lesseps was the head, obtained a concession from the Columbian government in 1878, known as the Wyse contract, giving it the exclusive right for ninety-nine years to build and operate a canal between the oceans, in the territory of the Republic, provided that an amicable arrangement should be made with the Panama Railroad, should the route lie in the territory covered by its grant. M. de Lesseps then called together an "International Congress of Studies for an Interoceanic Canal," which congress met in Paris in May, 1879. M. de Lesseps, who had already expressed himself strongly in favor of a sea-level canal, dominated the congress and secured the adoption of conclusions favoring a sea-level canal from the Gulf of Limon to the Bay of Panama. The committee which formulated the conclusions, presenting them for consideration to the congress in full session, predicted that it would take twelve years to build the canal and that it would cost $232,000,000, of which sum $25,000,000 represented interest during the period of construction. Only sixteen members of the committee voted in favor of the conclusions, forty members being absent, ten members abstaining from voting, and three members voting in the negative. In the full congress the conclusion in favor of the sea-level canal was adopted by a vote of ayes, seventy-eight, nays, eight, not voting, twelve, absent, thirty-seven. The list of those favoring the resolution does not include a majority of the engineers and contractors who were members of the congress.

FRENCH CONTROL

Immediately after the congress the Universal Interoceanic Canal Company was formed, with M. de Lesseps at its head. The company purchased the Wyse contract of 1878, additional surveys were made, upon the basis of which the estimates of cost and time were reduced to $163,000,000 and eight years, respectively; and it was finally announced by M. de Lesseps that it was necessary to provide for an expenditure of only $127,000,000. The company purchased the controlling interest in the Panama Railroad, thereby protecting itself against any claims from that source, and proceeded with the work of construction. It was at first intended to let the entire work as one contract, the unit prices to be determined after two years spent in organization, surveys, and preliminary work. A contract made on this basis was annulled at the close of 1882, and the work continued until 1889 under contracts, small and large, covering different parts of the work.

FIRST PLAN

The plan followed until 1887 contemplated a canal at sea level, 46 statute miles in length, with bottom width of 72.2 feet and depth of 29.5 feet. The course lay from Limon Bay to the valley of the Chagres at Gatun. From there it followed the river valley in a general south-easterly direction to Gamboa, where it left the valley and crossed the line of hills forming the watershed, finally reaching the Pacific Ocean about two miles south of the city of Panama. The floods were to be regulated by a dam at Gamboa where the river valley and the canal join; and the water of the Chagres and its tributaries from both sides were to be kept out of the canal and carried to the sea by diversion channels on either side. The estimated quantity of excavation was 157,000,000 cubic yards.

In the course of a few years it became apparent that there was no hope of finishing the canal on the original plan, within the estimated limits of cost and time. Toward the end of 1887 a change was made to a plan involving a canal with locks and a summit level with surface, 160.75 feet above mean sea level. The company, however, was at the end of its resources, and went into the hands of a receiver in February, 1889. A new company was formed under the name of the New Panama Canal Company, and the Colombian government was induced to extend the time for completing the canal to October 31, 1910. This company continued the work until the enterprise was taken over by the United States government.

PLAN OF NEW FRENCH COMPANY

The plan adopted by the new company contemplated a canal of the same general alignment as that of the original project, with low-water depth of 29.5 feet throughout. From Limon Bay to Bohio, a distance of 14.9 miles, the canal was to be at sea level, guarded on each side by diversions to intercept the natural drainage. At Bohio a dam was to be built impounding the waters of the Chagres, and making a lake about 23 square miles in area at high water. The rise in level caused by the dam was to be overcome by a flight of two locks. From Bohio to Bas Obispo, near Gamboa, 13.7 miles, the navigation was through the lake formed by the Bohio dam. Where excavation was necessary the bottom of the channel in the lake was placed at an elevation of 23 feet above sea level. At Bas Obispo, a flight of two locks was planned to raise vessels to a summit level extending for 6.6 miles through the hills, and drawing water through a feeder canal from a reservoir to be made by a dam at Alajuela higher up the Chagres Valley. The bottom of the channel in the summit level was to be 68.1 feet, and the low water surface 97.6 feet above mean sea level. The summit level was to occupy the stretch now known as the Culebra Cut, and to end at Paraiso, where a lock was to be built, lowering vessels to an intermediate level 1.4 miles long, with bottom elevation 43.5 feet above mean tide. This level terminated at Pedro Miguel, where a flight of two locks was planned to lower vessels to a second level 1.8 miles long, with bottom 12.3 feet below mean tide. The final drop to the sea was to be through a lock at Miraflores, with sea-level channel

8.1 miles long. Including the channel dredged from the shore to deep water in the Bay of Panama, the length was to be 46.6 miles. All locks were to have twin chambers, giving two routes to vessels. The chambers were to be 738 feet long and 82 feet wide. The bottom width of the channel was fixed at 164 feet in Lake Bohio and the Bay of Panama, 118.1 feet in the summit level, and 98.4 feet elsewhere.

It was the hope of the new company to omit the summit level, described above, making the Lake Bohio level continuous to Pedro Miguel, thus saving two locks on each slope, but making the cut through the ridge correspondingly deeper. This was to be done in case experience in the early work on the first plan should demonstrate the feasibility of the change.

The work of the New French Company was confined principally to excavation in the summit level. Under its control about ten million cubic yards of material were removed, and data of great value were collected, bearing upon the regimen of the Chagres River and the topographic and hydrographic characteristics of the region bordering the canal. The first French Canal Company expended about $254,000,000, of which about $152,000,000 were spent on the isthmus. The second French Company expended in all about $11,000,000, principally on the isthmus.

AMERICAN CONTROL

By act of March 3, 1899, the Congress of the United States empowered the President to make full and complete investigation of the Isthmus of Panama with a view to the construction of a canal. To accomplish this, he appointed a commission of nine members, headed by Rear Admiral J. G. Walker, U. S. N., which reported in November, 1901, in favor of the Nicaragua route, having in view the fact that the New Panama Canal Company demanded what was regarded as an excessive price for its rights and property. The company, after further negotiation, reduced its demands from $109,000,000 to $40,000,000. In consequence of this reduction, which made the estimated cost via the Panama route less than that via the Nicaragua route, the commission in January, 1902, submitted a supplementary report favoring the Panama route. Congress then passed the "Spooner Act," of June 28, 1902, empowering the President to proceed with the construction of a canal by the Panama route, provided that the New Panama Canal Company would sell its rights and property for a sum not exceeding $40,000,000 and that suitable arrangements could be made with the Colombian government for the control of the necessary right of way. Failing fulfilment of these conditions, the Nicaraguan route was to be adopted. The law required the canal to be of sufficient capacity and depth to "afford convenient passage for vessels of the largest tonnage and greatest draft now in use, and such as may be reasonably expected."

The condition as to the acquisition of the French company's property was readily fulfilled. A treaty known as the Hay-Herran treaty, empowering the United States to build the canal, was formulated after negotiations with Colombia. This treaty was thought to be satisfactory to both governments, and was ratified by the United States senate, but was finally rejected by the Colombian congress in 1903. The province of Panama thereupon seceded from the Republic of Colombia, on November 3, 1903, and achieved its independence. The United States recognized the new government at once, and negotiated a treaty by which it agreed to pay Panama $10,000,000 outright and an annual sum of $250,000 beginning nine years from the date of the treaty, acquiring in return the right to build the canal, and the exclusive sovereignty over a strip of land across the isthmus, ten miles wide, five miles on each side of the axis of the canal. The cities of Panama and Colon, although geographically within the Canal Zone, are reserved as Panamanian territory.

There is no doubt that the United States received fair value for the sum of $40,000,000 which it paid the New Panama Canal Company for its rights and property. The Panama Railroad alone had cost the French $18,000,000, although the par value of the stock was only $7,000,000. The machinery and buildings which the United States acquired were worth a large sum, the land holdings were valuable, and the work done by the French in places where it proved useful to the Americans, was also an asset of great importance. A careful appraisal made by a committee in 1911 placed the total value of the property and rights acquired from the French Company at $42,799,826. It appears, therefore, that the bargain was a fair one.

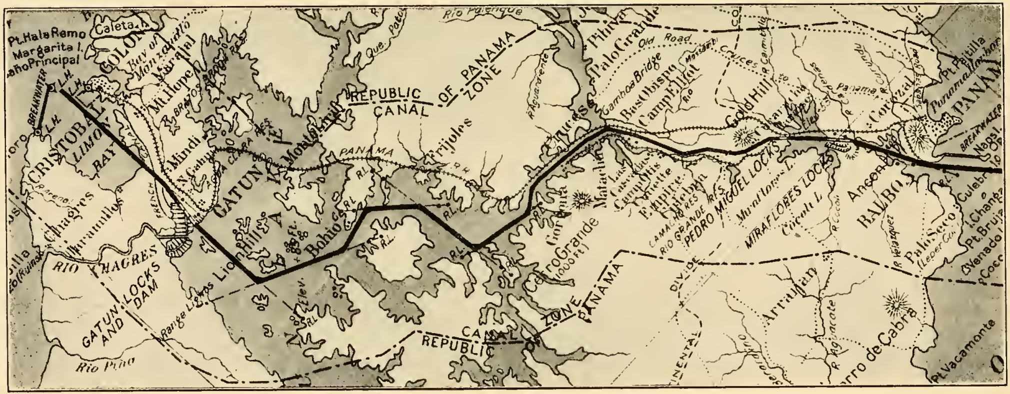
PROPOSED SEA-LEVEL PLAN

Under authority of the Spooner Act a commission of seven members, with Admiral Walker as chairman, was appointed in 1904 to prosecute the work. The type of canal to be built was decided after discussion of the subject by an international board of consulting engineers appointed by the president of the United States on June 24, 1905. This board consisted of eight members from the United States and five appointed upon nomination of Great Britain, France, Germany, and the Netherlands, one of the foreign members being also connected as consulting engineer with the Suez Canal. Seven of the twelve, of whom two only were Americans, reported in favor of a sea-level canal, with bottom width of 150 feet in earth cutting and 200 feet through rock, and with a low-water depth of 40 feet, except in Panama Bay where it was to be 35 feet. The canal was to follow a line consisting practically of a series of curves, and was to have a tide lock near the Pacific end, where the extreme tidal oscillation is about 20 feet. At the Atlantic end, where the tidal oscillation is only about 2 feet, no lock was deemed necessary. The Chagres River was to be regulated at Gamboa by a dam with devices by which the water of the impounded reservoir could be admitted to the canal at a rate not to exceed 15,000 cubic feet per second. This amount is larger than the mean discharge of the river in the wet season. Floods of greater volume were to be absorbed temporarily by the reservoir, and admitted gradually through the regulating gates. The main tributaries were to be diverted from the canal, but smaller ones were to be admitted, a possible current of 2.6 feet per second being contemplated. The cost was estimated at $247,000,000 and the time of construction at from 12 to 13 years.

ADOPTED PLAN (SEE PLATE I)

The minority of the consulting board, consisting of five members, all American engineers, favored the construction of a lock canal. The plan as formulated and finally adopted placed the summit level at 85 feet above mean sea level. This level is formed and maintained by a dam across the Chagres River at Gatun. The total length of the canal is 50 statute miles. From deep water in Limon Bay to Gatun, a distance of 7.7 miles, the canal lies at sea level with width of 500 feet and depth of 40 feet at low water. The rise from sea level to the surface of Gatun Lake is accomplished by three locks in flight. From Gatun to Gamboa, a distance of 23.3 miles, the channel lies in Gatun Lake, with a width varying from 1,000 to 500 feet. From Gamboa to Pedro Miguel, 8.4 miles, the channel, with surface still at the summit level of 85 feet above mean tide, passes through the Culebra Cut, and was originally planned with a bottom width of 300 feet for 3.4 miles, and 200 feet for the rest of the way. This latter width was increased during construction to 300 feet. At Pedro Miguel a lock is placed to overcome the difference of 30⅓ feet between the level in the Culebra Cut and the intermediate level next below, which is 2.2 miles long and 54⅔ feet above mean tide, and is formed by a lake impounded by a dam at Miraflores. A flight of two locks in this dam allows vessels to pass into the sea-level stretch below, which is 8.4 miles long. In the intermediate level below Pedro Miguel and in the sea-level stretch extending to deep water in Panama Bay

Plate 1


Pt. Hala Remo
Margarita I.
Caleta
COLON
Bay of Manzanillo
Mt. Hope
Mindi
CRISTOBAL
LIMON BAY
BREAKWATER
Chagres
RIO CHAGRES
GATUN LOCKS AND DAM
Range Lights
Rio Piña
GATUN
Bohio
REPUBLIC
CANAL
OF PANAMA
ZONE
PANAMA R.R.
Frijoles
Rio Palenque
Old Road
Gamboa Bridge
Bas Obispo
Palo Grande
Cerro Grande (1000 Ft.)
Matachin
Las Cascadas
Empire
Culebra
CAMACHO RES.
RIO GRANDE RES.
PEDRO MIGUEL LOCKS
MIRAFLORES LOCKS
Miraflores L.
Cocoli L.
Gold Hill
Corozal
Cruces
Ancon
BALBOA
Palo Seco (Leper Col.)
R. Velazquez
R. Aguacate
Arraijan
Cerro de Cabra
DIVIDE
CONTINENTAL
Pt. Vacamonte
Pt. Brujas
Venado I.
Culebra
Naos I.
PANAMA
Pt. Paitilla
Panama Bay

the width is 500 feet. The least low-water depth is 41⅔ feet in fresh water and 40 feet in salt water, except in the Pacific sea-level stretch where it is 35 feet.

The dam below Pedro Miguel was originally planned to close the valley of the Rio Grande near its mouth in Panama Bay. Because of difficulties which developed after construction began, and because of military considerations, it was later moved inland to Miraflores.

The canal alignment consists of a series of tangents widened at the points where the direction changes. It has 22 angles with a total curvature of 600° 51′, of which 281° 10′ are measured to the right, going south.

The minority members of the consulting board estimated the cost of the plan at $139,705,200 and the time of construction at nine years.

The report of the minority was indorsed favorably by the Isthmian Canal Commission excepting one member, by the chief engineer of the commission, by the Secretary of War, and by the President. Construction along the lines recommended therein was authorized by Congress in the act of June 26, 1906.

The decision to build a lock canal instead of a sea-level channel, although based principally upon the initial estimate and the greater convenience to navigation of the lock canal proposed, justified itself on other grounds during the period of construction. Difficulty much greater than had been anticipated was experienced in the course of the dry excavation, because of earth and rock movements or slides. Even in the shallower cuts of the lock-level plan, the increase in excavation due to these movements had reached the total of 22,870,000 cubic yards on the first of July, 1913, and there were at that time several formidable slides still moving. The slides increased in volume and frequency as the cutting grew deeper from season to season, and the amount of material removed because of them increased even more rapidly. In the period from 1904 to 1909 the material removed from slides was 7.87 per cent of the total removed in the Central Division. This percentage shows a steady gain from year to year until, in the year ending June 30, 1913, out of a total of 12,773,338 cubic yards of material removed from the Central Division, 5,889,200 cubic yards, or 46.67 per cent, were due to slides, and the material thus added was more than usually difficult to remove. One can only conjecture what the result of such earth movements would have been, had the cut through the summit level been 85 feet deeper, as for a sea-level canal of equal navigable depth; but no one can doubt that the addition in material to be removed would have been far greater than was experienced in the plan actually followed, and that the duration of the work would have been more than correspondingly increased.

The difficulties in cutting a sea-level channel through the marshes which now lie at the bottom of Gatun Lake cannot be so directly estimated by experience, since the plan adopted wisely avoided such excavation altogether; but they would certainly have been serious. On the whole, it is probable that any nation, however rich, which should have undertaken the construction of a sea-level canal, would have become so discouraged in the progress as either to abandon the work, or to change to a lock-level project, as did the French.

PREPARATORY WORK

The first three years after the appointment of the commission under the Spooner Act were devoted largely to the preparatory work of organization, sanitation, and equipment. Comparatively little was done in the way of actual excavation until the year 1907. During the time of preparation the commission, as a body, did not reside on the isthmus, but made periodic visits there and administered the work from an office in Washington. The personnel of the commission was changed from time to time, the chairmen before April 1, 1907, being successively Rear Admiral John G. Walker, U. S. N., retired, Theodore P. Shonts, and John F. Stevens. The chief engineers were successively John F. Wallace and John F. Stevens. By executive order of March 4, 1907, the president of the United States appointed Lieutenant-Colonel George W. Goethals, Corps of Engineers, U. S. A., a member of the commission, and named him chairman April 1, 1907, upon which date he was also appointed chief engineer. At the same time the personnel of the commission was changed, and the members were all required to live on the isthmus in close touch with the work. This plan was followed until the completion of the canal.

The main constructive features were the excavation, the lock and dam construction, and the harbor and terminal work.

EXCAVATION

The excavation was divided between dredging and dry excavation. Of the entire amount removed by the French about 29,908,000 cubic yards were useful in the plan adopted by the Americans. In addition, the work required the removal of about 232,000,000 cubic yards, of which about 129,000,000 cubic yards were dry excavation and the remainder dredging. The progress made by years is given in the following table:

May 4 to December 31, 1904	243,472
January 1 to December 31, 1905	1,799,227
January 1 to December 31, 1906	4,948,497
January 1 to December 31, 1907	15,765,290
January 1 to December 31, 1908	37,116,735
January 1 to December 31, 1909	35,096,166
January 1 to December 31, 1910	31,437,677
January 1 to December 31, 1911	31,603,899
January 1 to December 31, 1912	30,269,349
January 1 to October 1, 1913	22,767,886
Total	211,048,198

The highest monthly record made at any time was in March, 1909, when a total amount of 3,889,327 cubic yards was removed from the canal prism, of which 1,527,434 cubic yards were dredged and the remainder taken out in the dry.

The equipment for dry excavation consisted of 101 steam shovels, of which 45 had 5 cubic yard dippers, 43 had 2½ cubic yard dippers and the remainder were smaller. The record for a single shovel was 4,823 cubic yards loaded in one day of eight hours. In the month of March, 1911, the average daily performance of 50.6 shovels was 1,434.6 cubic yards each in eight hours under steam. To remove the earth handled by the shovels, 1,760 flat cars, unloaded by plows, and 1,803 side dump cars, with an adequate supply of locomotives and auxiliary rolling stock, were provided.

For the wet excavation there were available in all—

7 small ladder dredges, old French
1 large ladder dredge, new
4 pipe line suction dredges, new
3 pipe line suction dredges, old
3 5-yard dipper dredges, new
2 sea-going suction dredges, new
1 clamshell dredge
2 15-yard dipper dredges, received in 1914.

The floating equipment included the necessary tugs, scows, drill barges, and one Lobnitz rock crusher.

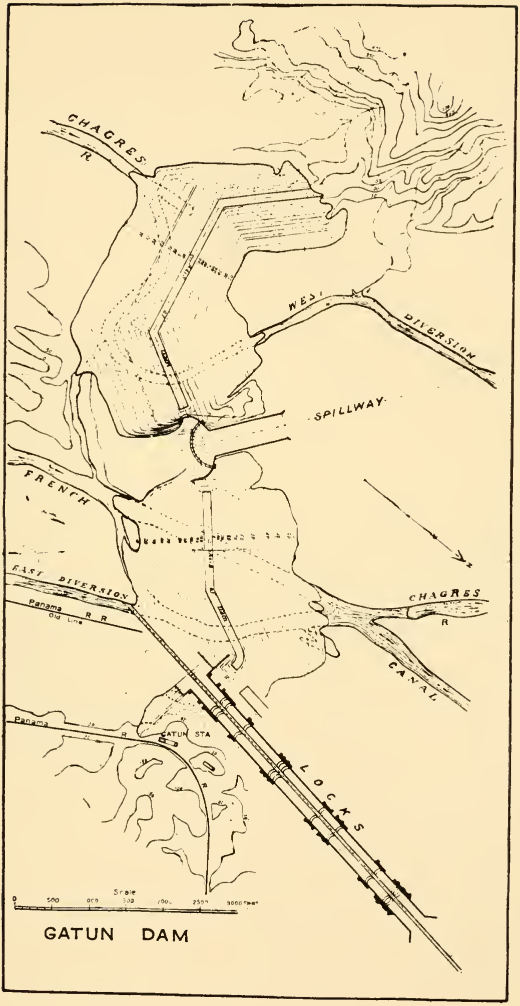
The end of the dry excavation was practically reached in September, 1913. Up to that time, the Culebra Cut had been excavated in the dry, the trench being drained by gravity both to north and south, and being closed at the north end by a dike at Gamboa, which protected it, first, from the floods of the Chagres, and, later, from the rising water of Gatun Lake. The drainage flowing to the north was pumped through the Gamboa dike into the river outside. On September 10, 1913, all the excavation in the Cut which it was practicable to do by dry methods had been finished, the material remaining to be removed being principally that due to slides, which could be handled most advantageously after the admission of water to the prism should provide some support to the banks and partially check the movement of the lower strata. After removal of equipment from the Cut, the pump valves at Gamboa were opened on October 5th, and water gradually admitted, and on October 10, 1913, the Gamboa dike was blown up. The water in the Cut rose at once to the level of the lake outside, and the remaining excavation was accomplished by dredging.

LOCK AND DAM CONSTRUCTION

The work of construction of the locks and dams was localized at three places, Gatun, Pedro Miguel, and Miraflores. At Gatun a dam closes the Chagres Valley, making Lake Gatun, and having as one of its abutments a flight of three locks to raise vessels from sea to lake level, a distance normally of 85 feet. The dam is of earth and rock, the crest being 105 feet above sea level, or 20 feet above the normal level of the water retained. The ground upon which it is built was in part low and soft. It was necessary, therefore, to make the base very wide and the slopes gentle, in order to avoid overloading the foundation. The dam is about 7,800 feet long, measured on the crest, and about 2,500 feet wide at the base of the highest portion. It contains about 23,000,000 cubic yards, of which about 12,000,000 cubic yards are dry material and the remainder hydraulic fill. Two rows of hard rock were first deposited along the site of the dam, 1,200 feet apart, and parallel to the axis. The natural surface between these rows of rock was cleared and a bonding trench dug. A mixture of sand and clay, excavated by hydraulic dredges from borrow-pits above and below the dam was then pumped between the rows of hard rock, and these were at the same time extended upward on the selected slope by dumping dry material toward the axis of the dam. The base was also widened outward in the same way (see plate 2).

A spillway is built near the middle of the length of the dam, in the rock of a natural hill. It is arched in plan, and consists of a concrete dam with crest 16 feet

Plate 2



CHAGRES
R
WEST
DIVERSION
SPILLWAY
FRENCH
EAST DIVERSION
Panama
R R
Old Line
CHAGRES
R
CANAL
Panama
R
GATUN STA
LOCKS
Scale
GATUN DAM

below normal lake level, surmounted by fourteen regulating gates, the tops of which are three feet above normal lake level, and which may be raised between piers 45 feet apart, as a window sash is raised between its jambs. When a regulating gate is raised the water flows out under the lower edge and over the crest of the concrete dam. With all the gates raised, the discharge with the lake level at $+87$, or two feet above normal level, would be about 154,000 cubic feet per second, or more than the greatest discharge of the river at flood. Work on the dam began in July, 1907, and was finished six years later. The spillway was closed on June 27, 1913, and the lake was allowed to rise until it reached full height.

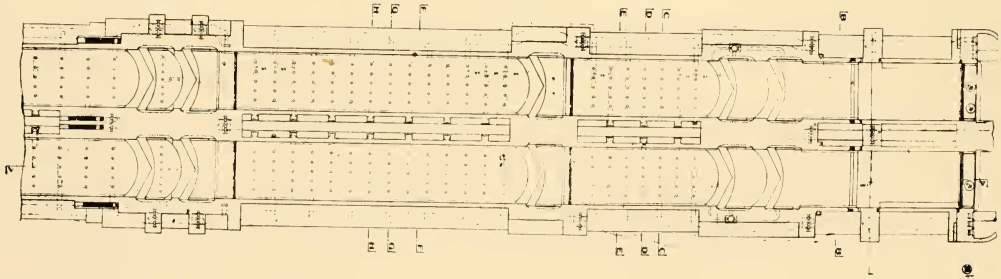
Gatun Lake extends over an area of 164 square miles and has a watershed of 1,320 square miles. It covers the line of the canal from Gatun to Pedro Miguel, a distance of 32 miles. At Pedro Miguel the water is retained by an earth dam with crest 105 feet above mean tide, extending northward from the west wall of the lock and parallel to it, forming an artificial bank to the canal, which, with the lock, closes the old valley of the Rio Grande. The dam is 1,800 feet long and contains 696,000 cubic yards of material. It was built of dry fill and consists of a core of puddled clay retained by parallel toes or masses of rock and earth. A twin lock with single lift enables vessels to pass between the waters of the Culebra Cut at the Gatun Lake level of $+85$ and those of the Miraflores Lake at level of $+54\frac{2}{3}$. The normal lift of the lock is therefore $30\frac{1}{3}$ feet.

Miraflores Lake, which has an area of 1¼ square miles, constitutes a level of the canal intermediate between Gatun Lake and the sea at Panàma Bay. It is retained by Miraflores dam and lock. The dam with crest at elevation +70 extends southward from the head of the upper lock in a direction nearly parallel to the lock wall for about 2,400 feet to a hill opposite the foot of the lock flight, closing the valley of the Cocoli River, a tributary of the Rio Grande. The lock and spillway close the remainder of the old Rio Grande valley. The main dam is of earth and rock. It contains 2,370,000 cubic yards of material of which 661,000 are hydraulic fill.

The spillway is similar to that at Gatun, except that it has eight regulating gates instead of fourteen, and is straight in plan instead of curved. It is much larger than would be needed to regulate the small lake above it, and was designed to provide against the flow which would come from Gatun Lake if the gates in one of the Pedro Miguel locks should be carried away. A flight of two locks lowers vessels from Miraflores Lake to the sea level below. The lift varies with the tide from 64⅔ feet to 44⅔ feet. The sea-level stretch extends to deep water in the Pacific Ocean, eight miles below Miraflores locks.

The locks are similar at all the dams, there being a flight of three at Gatun, two at Miraflores, and one at Pedro Miguel. Plate 3 shows the upper lock of the Gatun flight. Each lock is double, having twin chambers separated from each other by a middle wall. Each chamber has useful dimensions of 1,000 feet in length and 110 feet in breadth, capable of taking in the largest

Plate 3



ship now afloat, with some margin for growth. Intermediate gates divide the chamber into two locks 600 and 400 feet long, either of which may be used in order to save water. For reasons connected with the tidal oscillation, the lower Miraflores lock has no intermediate gates. The locks are filled and emptied through culverts in the base of each wall. These culverts, which have a cross sectional area of 254 square feet, the equivalent of a circle 18 feet in diameter, run the entire length of each lock wall, from the intake in the fore-bay to the outlet in the tail-bay. They communicate with the chamber by means of lateral culverts, at right angles to the main culverts, which run under the lock and open upwards through holes in the floor (see plates 3 and 4). The entrance to the side wall culverts is by three openings closed by gate valves. The middle wall culvert is also entered through three openings into the fore-bays on each side. At each lift the main culverts are closed by gate valves in pairs, each valve closing one-half of the culvert area. The side culverts have similar valves at the intermediate gates, permitting the lock chamber to be divided. At the head and foot of each lock there are two sets of main culvert valves, one of which can be used when the other is out of service for any reason. The gate valves are all of the "Stoney" type. The lateral culverts from the middle wall to the chamber on each side are controlled by individual cylindrical valves, in order that the water in the middle culvert may be sent into one or the other of the twin lock chambers at will.

The lock gates are of steel, cellular in construction, 7 feet deep, and ranging in height from 47 to 82 feet.

There are 92 gate leaves on the canal. They are hung by collar and pintle only, no rollers being used. The heaviest leaf weighs 730 tons and the lightest 390 tons of 2,000 pounds. If piled on top of each other, end to end, they would make a tower more than 1¼ miles high.

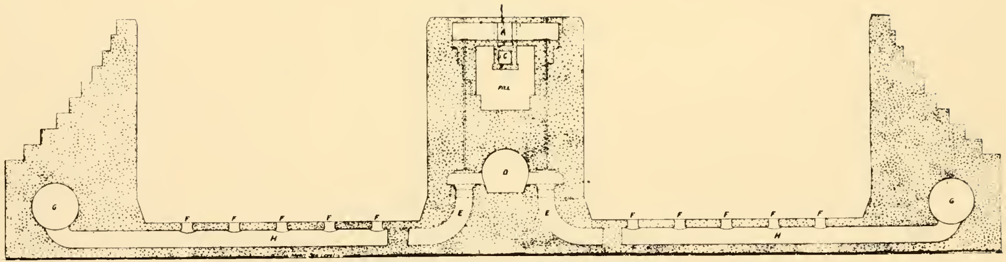
The most important of the gates are guarded by fender chains stretched across the lock near the water level, when in use, and lying in a groove of the lock floor, when not in use. The chains pay out against a hydraulic resistance when struck, and are capable of arresting a vessel weighing 10,000 tons and moving at 3½ miles per hour, before the gate would be reached.

Above the upper guard gates of each lock is placed an emergency dam, for use in case, through an accident, the gates should be carried away and the water of the upper level allowed to flow through the lock. The dam, which can be turned like a pivot drawbridge, would then be swung across the lock, girders dropped from the lower chord to a bearing on a sill in the lock floor, and wickets of rectangular form lowered along the runway formed by the upstream flanges of the girders. These wickets are placed in horizontal tiers, thus progressively closing the waterway in the face of the current and enabling the gates below to be closed or repaired.

A floating caisson is provided for closing the chamber when it is desired to unwater the entire lock.

Vessels are not permitted to use their own power when in the lock, but are towed through by electric locomotives which receive them on entering and release them after passing the last gate. The number of locomotives to be used varies with the size of the vessel.

PLATE 4



CROSS SECTION OF LOCK CHAMBER AND WALLS, GATUN LOCKS

Four are usual, two ahead, one on each lock wall, to tow; and two astern, to hold back. Lines are also used to pass over snubbing posts and hold the vessel steady in the locks. The operation of filling or emptying causes no noticeable surging in the locks, even with small vessels.

All machinery is driven electrically by current generated at the Gatun spillway. The hydro-electric plant there is capable of supplying 6,000 kilowatts. It is supplemented by the steam generating plants which were used during construction and which are now maintained as reserves, although not used except in an emergency. The motors of all machines at each locality are operated from a central control house. A control board, with devices representing the moving parts, shows the operator just what effect his manipulations are producing. The different controllers on the board are mechanically interlocked against false movements. The Gatun control house operates 310 motors located at distances up to 2,700 feet from the point of control.

Concrete work on the locks was begun at Gatun on August 24, 1909, at Pedro Miguel on September 1, 1909, and at Miraflores on June 1, 1910. The main concrete was finished at all the localities in the summer and early autumn of 1913, and one of the twin lock flights was used to pass dredging plant through at that time. The first lockage took place at Gatun on September 26th, and on the Pacific side on October 14, 1913. The final completion of the locks was delayed until some months later by the erection of the gates and the installation of the machinery and electrical apparatus.

The total amount of concrete laid in the locks, spillways, and accessory works, is approximately 4,800,000 cubic yards.

The maximum amount of concrete laid at each place in any one day is—

For Gatun locks and spillway	4,983 cu. yds.
For Pedro Miguel lock	3,844 cu. yds.
For Miraflores locks and spillway	4,728 cu. yds.

HARBOR AND TERMINAL WORK

The work on the terminals and breakwaters was not fully complete when the canal was opened to navigation. At Limon Bay it includes two breakwaters, with a system of docks, a coal handling plant, a small dry dock, and shops. At Balboa it includes a breakwater from the mainland to Naos Island, to protect the channel in Panama Bay, and a system of docks with large marine shops, a coal handling plant, and two dry docks. About 290,000 tons of coal can be stored at the Cristobal plant, and about 160,000 tons at Balboa. The larger of the two dry docks at Balboa will accommodate any vessel which can pass through the locks of the canal, while the other is intended only for small boats. The small dry dock at Cristobal was used during the construction of the canal and will accommodate any unit of the floating plant used in maintenance. The terminals of the canal are protected by sea-coast defences mounting heavy modern guns and mortars.

AIDS TO NAVIGATION

The general plan for lighting the channel includes providing head ranges for all tangents, when practicable, and side lights at intervals of about one mile, in the open channel, with spar buoys alternating. Noticeable changes of direction are marked by two side lights on the point, or convex bank, and one in the bend opposite. Certain of the shorter tangents cannot be provided with lighted ranges without danger of confusing the range lights with the turning lights; and in these cases the range lights are omitted and the center line marked by two day-beacons. Ordinarily the ranges are indicated by two lights in line, the rear light showing above the front one. The sailing line ranged thus for vessels bound north is 200 or 250 feet from the line indicated for vessels bound south. Vessels meeting, therefore, if kept on their ranges, would pass each other without turning out. Conditions in the Culebra Cut do not permit the use of range lights or buoys, consequently lighted beacons are placed on the berms of the Cut at intervals of about 1,200 yards. When it is convenient to make connection with the transmission line, the towers and beacons are provided with incandescent electric lights. For the remaining stationary lights and for the buoys the illuminant is acetylene dissolved in acetone. Suitable characteristics are given all lights to prevent confusion.

LABOR AND SUPPLIES

The recruitment of labor; assignment and care of quarters; procuring and distributing materials of construction, and construction and repair of buildings were under charge of the Quartermaster's Department. Commissary and subsistence supplies were furnished by the Subsistence Department of the commission and the Commissary Department of the Panama Railroad. Supplies of all kinds were purchased on requisition from the isthmus by a general purchasing officer in the United States, whose office also was charged with filling requisitions for gold employees.

The main work was done by a force employed directly by the commission, only parts of the work, such as the lock gates, emergency dams, etc., being built under contract. The supervisory and clerical force, as well as the artisans and mechanics, all of whom were classed as "gold employees," were practically all American citizens, no others being engaged in such capacities when Americans were available, except in the earlier stages. The unskilled laborers, classed as "silver employees," were all foreigners, the majority being West Indian negroes, with the Spaniards next in order.

On March 30, 1910, the force actually at work for the canal and railroad combined was 38,676, of whom 30,837 were employees of the commission. Of the commission's employees, 4,553 were on the gold roll, and the remainder were silver employees. The commission furnished its employees free quarters, heat, light, medical attendance, and hospital privileges. Whenever practicable married quarters were given to those desiring them, and their families received medical attendance at a low charge. Commissary stores were provided, at which supplies of every description could be purchased, practically at cost; and hotels, messes, and kitchens were maintained, where gold and silver employees could procure meals at small cost. Gold employees were allowed leave of absence with pay, six weeks annually for monthly employees and four weeks for hourly employees. Sick-leave with pay was allowed, not to exceed thirty days in each year; and compensation was given, under provisions of the law, for permanent injury due to the work.

SANITATION

The health of the employees was properly regarded as a matter of the first importance. It was cared for by the Department of Sanitation, under charge of men who were experienced in fighting tropical diseases. Prior to the American occupation, the Isthmus of Panama had always been a nursery of yellow fever and of various forms of malarial fever. In the time of the French work, the proper defence against these diseases was unknown; and, in spite of medical care and hospital facilities, the losses were great. The American Department of Sanitation instituted at once measures for the protection of the working force. Knowing that the propagation of yellow and malarial fever was due to certain varieties of mosquitoes, the problem became chiefly one of exterminating these enemies or guarding adequately against them. All commission quarters were carefully screened with wire gauze, pools of water where the mosquitoes might breed were covered with oil or poisoned with larvacide, grass and shrubs were kept closely trimmed around the settlements, and suitable sanitary regulations were rigidly enforced. The results were soon apparent. Yellow fever vanished, malarial fever was reduced, although not exterminated, and the general health of the force reached and maintained a high standard. It is estimated that the deaths among employees during the nine years of French activity numbered at least 16,000. During the eight years of American occupation, ended June 30, 1912, 5,141 employees died, among them 284 Americans.

The expenditures for sanitary purposes of all kinds, including hospital and Canal Zone sewage and water supply, reached about $20,000,000 for a period of, say, ten and one-half years. The population affected by the sanitary measures, according to the census taken in 1912, was—

Canal Zone	62,810
City of Panama	35,368
City of Colon	17,748
	115,926

GOVERNMENT AND LAW

The civil affairs of the Zone were cared for by a Department of Civil Administration, with a member of the commission at its head. During the period of construction, the Canal Zone was governed by the President, under authority conveyed by act of Congress approved April 28, 1904. Special legislation, for the government of the Canal Zone after the opening of navigation, was later enacted.

A Department of Law was created to look after legal matters in which the commission was interested. It has been especially active in connection with proceedings for the procurement of land needed for canal purposes.

NEW PANAMA RAILROAD

The line of the Panama Railroad, as first constructed, followed the valley of the Chagres River to Gamboa, crossing to the west bank of the canal at San Pablo and recrossing to the east bank near Paraiso. It was therefore necessary to relocate a large part, either because it would be under water, or because it would lie on the wrong side of the canal. This involved building 39.3 miles of new railroad, a considerable portion on heavy embankments, rising above the water of the lake, and resting on soft, marshy soil. The work began in 1906 and finished on May 25, 1912. The cost was $8,787,000.

COST

The estimate of the cost of the canal, made by the minority of the board of consulting engineers in 1905, was $139,705,200. It soon became evident that this estimate had been vitiated by the changes which had been made in the plans, some of which added greatly to the amount of work to be done, and by the increased cost of labor and material over the unit costs adopted by the board. In February, 1909, a revised estimate was laid before Congress and was adopted as the basis of future appropriations. The revised estimate placed the engineering cost of the work at $297,766,000. Adding to this the purchase price and the estimated cost of sanitation and civil government, the entire estimate for the canal amounts to $375,201,000.

H. F. Hodges.

THE CITY OF LOS ANGELES

ON the last day of July, 1769, the expedition of Portolá camped near the site of the present city of Los Angeles, and remained in camp the following day for needed rest and for exploration, and to enable the people of the command to gain the great indulgence of Porciúncula. The priests said mass and the sacrament was administered. The next day, August 2d, they resumed the march and traveling a league and a half entered a spacious valley surrounded by low hills, abounding with poplar and alder trees, through which flowed a beautiful river. This they thought an excellent site for a mission, and in commemoration of the festival, named the river Nuestra Señora de los Angeles de Porciúncula, and passed on into the San Fernando valley. The site was not forgotten and several years' observation showed the explorers that the flow of the river was permanent, even when the winter rainfall was scanty.

In 1776 Don Carlos III, King of Spain, dissatisfied with the colonization of California, required Don Teodoro de Croix, comandante-general of the Provincias Internas de Occidente, to inform him what could be done to improve conditions in that province. Croix sent the letter to Felipe de Neve, governor of the Californias, and requested him to make such suggestions as seemed to him fitting and proper. In response to this the governor sent in a full and well digested plan for the regulation of California. This plan of Neve was forwarded by Croix to the king and on his approval it became the *reglamento* or ordinance for the government of California and Neve was instructed to put it into effect at the beginning of 1781. Among other provisions of the *reglamento* was one for the establishment of three missions on the Santa Barbara channel, a pueblo on the Porciúncula, and all to be under the protection of a strong presidio to be erected on the channel, in the neighborhood of a place called Mescaltitan. Captain Rivera y Moncada was sent to Sinaloa to recruit fifty-nine soldiers for the presidio and twenty-four settlers for the pueblo. Both soldiers and settlers must be married men, accompanied by their families, healthy and robust, likely to lead regular lives and to set a good example to the natives. Extra inducements in the way of pay and other privileges were promised but the best Rivera could do for the pueblo was the collection of twelve men with their families; viz: two Spaniards, two negroes, four Indians, two mulattoes, one mestizo, and one "chino."* With this motley crew the famous pueblo of Nuestra Señora La Reina de los Angeles de Porciúncula was founded, September 4, 1781. Within a year three of these promising settlers were pronounced worthless, their property was taken from them and they were driven forth. The settlers were put in possession of a house lot and a tract for planting, and supplied with the necessary live-stock, implements, and seed. Each settler was to be paid $116.50 per year for two years and $60 per year for the next three years. Their lands were to be free of taxes for five years, and all had the use of the government lands for pasturing their cattle and for wood and water. In 1886, Alférez

*A Chino is the off-spring of a Salta Atras and an Indian woman.
A Salta Atras is the off-spring of white parents having a trace of negro blood.

José Darío Argüello came from Santa Barbara and put the remaining nine settlers in full possession of their lands, giving them deeds therefor.

Notwithstanding the fostering care of a paternal government the progress of the pueblo was very slow and at the end of the century it had but seventy families and three hundred and fifteen population. The increase had come mainly from the growing up of the children and from the families of retired soldiers. It was in the vicinity of the pueblo that the first rancho grants were made in California. The rich soil of the locality and the plentiful water supply caused several of the old soldiers to apply for land. The first grant was that of the famous Rancho San Rafael (Los Verdugos) of eight leagues, granted October 20, 1784, by Pedro Fages, governor, to José Maria Verdugo, a soldier of the Portolá expedition. The next grant was made by Fages, November, 1784, to José Manuel Nieto, also a soldier of the Portolá expedition. This grant, known as Los Nietos, reached from a little below Los Angeles to the Pacific Ocean, east of the river. It contained thirty-three square leagues (146,472 acres) and was regranted by Figueroa in 1834 to Nieto's widow and sons, in five separate tracts. The third grant was the famous San Pedro, or Dominguez rancho. This consisted of ten leagues (44,385 acres) and was given to Juan José Dominguez, likewise a soldier of the Portolá expedition. It is south of Los Angeles and reaches the ocean at Wilmington. It was on this rancho, near the ranch house, that the fight between Captain Mervine and his marines and the caballeros under José Antonio Carrillo occurred in 1846. Mariano de la Luz Verdugo, another soldier of the first expedition received a grant of the Portezuelo rancho. Mariano Verdugo brought with him on the first expedition cuttings of a grape vine planted at the presidio of Loreto, Lower California, by the Jesuit priests. These cuttings he planted at the mission of San Diego and from this vine cuttings were sent to all the other missions. This was the origin of the famous Mission grape.

While the pueblo increased slowly in population, its equitable climate made it a favorite residence place for retired soldiers and for traders. The valley to the north and west, called San Fernando, was originally a chasm several hundred feet deep, which had become filled by a deposit so porous that it absorbed the run-off of the surrounding mountains over an area of more than one hundred and fifty square miles, and impounded it in a natural reservoir from which it gradually drained. As the city grew the water of its river was developed until under careful husbanding, it has provided Los Angeles with forty million gallons of water per day, and up to the present time has been the main source of supply for the system which has faithfully served the city, to which it brings a gross revenue of about one million and a quarter dollars per annum. In making an examination for a site for a city, the early explorers found a sufficiently wide river bottom, with a mesa of moderate height adjoining, backed by hills covered with native grasses while to the north, some fifteen miles away, arose the Sierra Madre, ranging from a mile to nearly two miles in height, and acting as a shelter from the desert winds, cold in winter, hot in summer, and dry always. Seventeen miles west of the chosen site lay the deep and cool waters of the Pacific and here the way was open to the inrush of ocean winds, seeking to fill the vacuum caused by the rising of the superheated air of the deserts of the interior. These winds, bearing the even temperature of the water and made more equable by their passage over the land tend to give a climate warm in winter and cool in summer. The site seemed to fill all the requirements for agriculture, surrounded as it was by fertile lands, and the padres at the San Gabriel mission, nine miles away, demonstrated that the orange, the olive, and the vine throve equally as well as the fruits and grains of the strictly temperate zone, and that the cattle increased and waxed fat on the native grass as well when it was green in winter as after the summer sun had turned it into nutritious hay.

The padres, and later the settlers, set little store by the asphaltum which they found dried in places on the plains, not knowing that it was evidence of the store of liquid petroleum which lay beneath, in strata varying from a few hundred feet in depth to those hardly reached by the persistent modern drillers at four thousand feet.

Nor did the founders of the pueblo forget their need for a port near at hand. As the ocean, seventeen miles to the west, had no facilities available, they chose San Pedro, twenty-five miles to the south, where the estuary permitted vessels of slight draft to come into the harbor. This has now been deepened so that ships drawing thirty feet of water may enter, and a breakwater some eight thousand feet long built which provides excellent holding ground inside in water having a depth of thirty-five to fifty-five feet. This can be gained without the aid of either pilot or tug and it is within a mile of the inner harbor where rail, electric road, and paved boulevard give quick and easy access to the center of Los Angeles, of which this harbor is now an integral part.

Under Spanish rule trade with California was forbidden. This condition was greatly modified after Mexico achieved her independence and the Boston traders who came for hides and furs found the pueblo of Los Angeles the best place to barter their wares, and as they became acquainted with the town they were not silent concerning it on their return around the Horn. Sailors tempted way from their ships, met in Los Angeles men of hardy spirit who had crossed mountains and deserts in quest of gain or adventure, and when in 1847 the American forces marched from San Diego and occupied Los Angeles the officers found conditions of climate and location much to their liking.

In accounting for the rise of Los Angeles the fact should not be forgotten that the city has been free from the domination of any clique or faction; and although there have been times when such domination has seemed to be dangerously near, public opinion, a certain part of the public press, and the large class of broad minded men who have made the city their home, have worked together and have kept the doors open for all competent labor, and the immigrant has has not been required to pay a tax or to submit to dictation in order to make a living for himself and his family. The development of the petroleum industry in California, providing one of the most available and cheapest fuels in the world, has contributed more than any one factor to the great increase in manufactures in Los Angeles. One of the productive fields, now largely suppressed, occupied part of the hills within the original grant to the city. Now pipe lines from far and near bring crude oil for refining and foreign shipment, not only to the city itself, but to the harbor, where steamers, especially built for the service, provide transportation to Peru, Hawaii, Japan, and the Panama Canal, and it is largely the power generated by this petroleum that has united the Atlantic and Pacific months before the appointed time.

Some eight years ago the Los Angeles City Water Board became convinced that while the water supply draining from the San Fernando valley was ample for a city of not more than one hundred thousand inhabitants, should the rainfall be scant over a series of years, there would be a shortage which might retard the growth of population and hamper the surrounding country in agricultural development, and therefore, a new source of supply should be sought, even at the expense of going far afield, because of the utilization of other water sources nearer at hand. The choice fell on the Owens river, some two hundred miles to the north, which is fed by the melted snows of the eastern slope of the Sierra Nevada. The estimated cost of the necessary aqueduct was twenty-three million dollars and though it seemed a heavy burden for a city of one hundred and forty thousand inhabitants to undertake, the vote was so largely in favor of the project that the bonds were voted and sold and the work, under the management of Mr. William Mulholland, the water engineer, has been completed within the amount of the estimate, and the conduit of some two hundred and forty miles, of which forty-two are tunnel, is now in operation to the San Fernando reservoir, from which the city water department is using the water pending the completion of the last link to connect it with the system at present in use.

Not only will the city's future needs be provided for but there is a strong probability that territory contiguous to the city will cast its lot with the corporation and thus participate in the benefits to accrue; for not only will the city have water for irrigation as well as for domestic use but the head of the aqueduct being at an altitude of nearly four thousand feet, and the average of the city being about five hundred, some 57,000 horse power is capable of being developed for electrical power for the use of the city, with a transmission line of less than sixty miles.

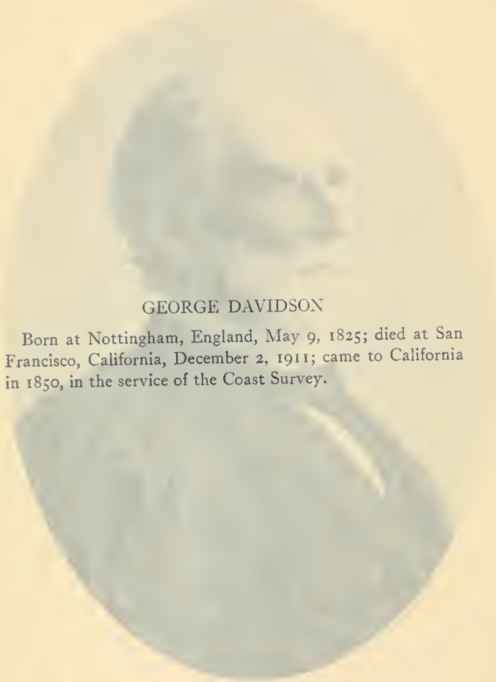
In addition to a genial climate southern California has a most attractive industry; one that has not only increased its material wealth, but its physical charm. To the enchantment of a romantic history with its nomenclature of musical Spanish place names, there is added its delightful climate, the beauty and fascination of its orange groves, the magic of sparkling seas reflecting an azure sky, and lofty mountains with flowery valleys. This combination of attractions has proved irresistible to the leisure classes of the north-eastern and the middle western states, and they have come by thousands, bringing with them wealth and refinement, and in addition to this they have found opportunity for the use of those abilities which brought them success in the localities where they formerly resided.

J. M. Elliott

GEORGE DAVIDSON

AND THE

COAST AND GEODETIC SURVEY



GEORGE DAVIDSON

Born at Nottingham, England, May 9, 1825; died at San Francisco, California, December 2, 1911; came to California in 1850, in the service of the Coast Survey.

GEORGE DAVIDSON was born in Nottingham, England, on May 9, 1825, of Scottish parents, and in 1832 came with them to the United States. He graduated from the Central High School of Philadelphia in 1845; and when his master, Professor Alexander Dallas Bache, who had reorganized the high school, resumed his position as professor of natural philosophy and chemistry in the University of Pennsylvania, Davidson for nine months worked from five to six hours a day after school in Bache's library. While pursuing these studies he was chosen a magnetic observer at Girard college, and continued these observations until he graduated in 1845, when he was appointed to the Coast Survey, of which his friend and master, Bache, had been made superintendent in 1843. After one year's service as computer to Superintendent Bache he chose field duty as his future labor, and thus began his life work.

In 1848 the march of improvement having gained the shores of Oregon, application was made to the treasury department for the extension of the operations of the coast survey organization, which had for several years been at work on the Atlantic coast, to include the coast of the Pacific. By virtue of an act of congress, passed March 3, 1847, the secretary of the navy had advertised for bids to carry the United States mails from New York to Chagres by one line of steamers and from Panama to Astoria by another, and to avail themselves of this engagement, Gardiner Howland, Henry Chauncy, and William H. Aspinwall formed the Pacific Mail Company and built three steamers to carry the mails from Panama to Astoria. The treasury department issued directions to the superintendent of the coast survey to begin the field and hydrographic work in Oregon, and in accordance with this order the superintendent sent a surveying party under Assistant James S. Wilson for the field work, and for the hydrography, Lieutenant Com'g William P. McArthur, U. S. N. For the general use of the party the top-sail schooner *Ewing*, one hundred and ninety-two tons, carrying four or six guns, was dispatched from New York on the 10th of January, 1849, under command of Lieutenant Washington A. Bartlett, who had seen service in California as first alcalde of San Francisco, and the field party followed on the 1st of February in the steamer *Falcon* by way of the Isthmus of Panama. The surveying party reached San Francisco in April, and while awaiting the arrival of the *Ewing* employed their time in a general reconnaissance of the north shores of the bay of San Francisco. After a long and dangerous voyage the *Ewing* reached San Francisco on the first of August only to lose the greater part of her crew by desertion to the gold fields, leaving Mr. Williams and his party unable to reach the mouth of the Columbia. Lieutenant Com'g McArthur arrived at the end of August and it was determined to defer special operations until the next year, while the field party employed their time in a general reconnaissance of the coast from Monterey northward.

In May, 1850, the superintendent sent out a party of four of the younger officers of his staff for field duty in California under the leadership of George Davidson. These young men volunteered their services for duty on the Pacific coast and pledged themselves to perform for one year any duty however hard or manual. This pledge was kept, not for one year only, but all through the subsequent years of the gold excitement. Unaffected by the great disparity between their stipend and the pay of day laborers about them, unswayed by opportunities for fortune that offered on all sides during the most brilliant period of California's development, Professor Davidson and his associates steadily advanced the work of the survey, striking instances of those who place duty above all thought of material advantage. There were many opportunities for amassing wealth and achieving independence, but through it all they remained steadfast and faithful.

Before the conquest of California by the Americans, and the discovery and development of its mineral wealth, comparatively little was known of the hydrography and geography of its coast, except by the few traders who frequented its shores and the daring otter hunters who were familiar with every cove, rock, and headland. We cannot withhold our admiration for the courage of the early Spanish navigators who in small, ill-conditioned ships, with crews wasted with scurvy, and with wretched and untrustworthy instruments explored these coasts as far north as Alaska. In speaking of them George Davidson says in his "Coast Pilot": "There were giants in the earth in those days."

After the discovery of gold in California the hitherto lonely seas of the Pacific fairly teemed with life. In every quarter of the globe individuals and companies were fitting out for the voyage to California. Every maritime town hummed with the noise of preparation and everything in the nature of a ship was overhauled and made ready for sea. Old condemned hulks were withdrawn from retirement, fitted with berths, and provisioned for the voyage. That greater disasters did not overtake these Argonauts seems marvellous. During the year 1849 over seven hundred vessels entered the port of San Francisco; there was not a light on the coast of California; the geographical positions of the principal capes, headlands, etc., were unknown, and when stated on the few charts that could be had, were generally wrong. George Davidson says that he heard of more than one vessel reaching California with only a school atlas for a chart. This then was the field for the work undertaken by George Davidson, and never was work more needed or more skillfully and faithfully performed. From the southern boundary of the United States in 30° 30′ to the northern boundary in 49°, there was an ocean shore line of over 3,120 miles, including the islands of the Santa Barbara channel, the strait of San Juan de Fuca, Admiralty inlet, Puget sound, the archipelago De Haro, etc., all of which he surveyed.

Davidson's first work in California was in determining the geographical position of Point Conception, a most important service at that time, for he found that prominent and tempestuous headland over six miles distant from the latest determination in good nautical authority. Having completed the latitude and longitude of Point Conception and selected a site for a light house, Davidson proceeded to establish an observatory near Monterey, in connection with a survey for a light house; thence to San Diego, and finally to Cape

Disappointment, whence he proposed to pass successively to the determination of Capes Orford and Mendocino. As the advance of winter rendered it necessary to leave the northern field he established stations along the coast of California and determined the longitudes of the principal stations by moon culminations and of the minor stations by means of transported chronometers. He also conducted triangulation operations to connect the Santa Barbara Channel islands with the mainland. In the summer of 1852 he turned over this work to Captain E. O. C. Ord, U. S. A., and proceeded with the hydrographic party of Lieutenant Com'g Alden to the Oregon and Washington coasts. For the next five years his time was occupied with the survey of the coasts of Oregon, Washington, the Columbia river, straits of San Juan de Fuca, Canal de Haro, Rosario straits, Puget sound, Admiralty inlet, etc., determining geographical positions, conducting triangulation operations, measurements, observation of tides, and all his various geodetic and astronomical duties. On the approach of winter he generally transferred his field of operations to California, occupying his time on his charts, reports, etc., determining longitudes by means of moon culminations, occultations, and solar eclipses, with latitudes determined according to the most approved methods and with the most delicate instruments. The observations of moon culminations generally extended through three lunations. So great was the care exercised by Professor Davidson and so exact his work that the superintendent of the survey characterized it as unique in the history of geodesy. Working as he did in comparatively unknown waters he had constant occasion to use the lead, and when seeking for an anchorage, drifting with the currents, or on boat duty, he almost invariably kept it going from his own hand. The exposure to which he was subjected, the landing through the surf of icy seas, and the inclemency of the weather, brought on chronic rheumatism, but while his personal energy kept him in the field for a time, in August, 1857, he was obliged to leave his work, seek medical treatment, and he found it advisable to return to the Atlantic coast, which he did in November, and reported to Washington at the end of that month.

In November, 1859, Davidson was back on the Pacific coast in full charge of all primary and secondary triangular work and in October 5, 1860, received orders to report at Washington. He left California November 5th of that year and was assigned to hydrographic service in certain portions of the Delaware river. In April, 1862, Davidson, in the surveying schooner, *Vixen*, carrying two Parrot guns and other means of making and resisting attack, proceeded to the Florida reefs where he was engaged in making soundings. In January and February, 1863, he made some surveys for the navy department at League island, Delaware river, and in June, July, and August, constructed, at the request of the military authorities, elaborate defensive works around Philadelphia, which had been threatened by an incursion of Confederates under General Lee. His employment on the Atlantic coast continued until 1867 and included a survey of the Isthmus of Panama for a ship canal to connect the waters of the Gulf of Darien with those of the Gulf of San Miguel. In June, 1867, he was ordered to make a general reconnaissance of the coasts of Alaska, just transferred to the United States. The United States revenue cutter *Lincoln* was placed at the service of the Davidson party and he arrived at Fort Simpson, a Hudson's Bay Company's post on Chatham Sound, August 3d, and at Sitka August 12th. The survey was necessarily a brief one. He went to the headwaters of the Lynn Canal, to the Kadiak group, and to Unalaska; thence back to Sitka and through the archipelago Alexander. On November 4th he was at Fort Simpson and on the 14th arrived at San Francisco. His report of November 30, 1867, is most interesting and with that of a subsequent trip in 1869 contains about all that was known of that distant land for many years. In this report Professor Davidson gives a full and particular report of the Kuroshiwo, the Black Current of Japan, that exerts such a great influence on the climate of the coast of North America above 32° 30′. On his return to Washington in 1868, Davidson was called into conference with Secretary of State Seward and Secretary of the Treasury McCullough; appeared before the foreign relations committee of the senate; the ways and means committee of the house of representatives; conferred with Senator Sumner and others, and appeared before the National Academy of Sciences, by invitation, to relate the chief points of scientific interest gathered in his Alaska reconnaissance.

In November, 1868, Davidson returned to California and in August following went to Alaska to observe the solar eclipse of August 7th. He left Sitka in an open boat and a war canoe loaded with provisions, declining a military escort and relying upon his knowledge of the Chilkahts. They were eleven days in reaching the village of Klu-wan, on the Chilkaht river, and were fired upon three times in going up the river, but, although well armed they showed no resistance. Two days before the eclipse, William H. Seward, ex-secretary of state, arrived at the mouth of the Chilkaht on the steamer *Active* and Davidson sent a swift canoe down to bring him up. He was received with great gravity and ceremony by Koh-klux, the great Chilkaht chief, and about four hundred of his people. This Indian chief, in August, 1852, went down the Lewis river to the Yukon and destroyed the Hudson's Bay Company's post, Fort Selkirk. He had also gone down the All-segh river to the Pacific. In 1869 he made for George Davidson a map of the rivers, lakes, trails, and mountains, from the Chilkaht to the Yukon.

Returning from Alaska Davidson made a number of observations at points on the Oregon, Washington, and California coasts. He also set up a temporary observatory in Washington square, San Francisco, to determine the difference of longitude between San Francisco and Cambridge, Massachusetts. He was now required, in addition to his own work to lay out the work for all land parties on the Pacific coast and advise with them and inspect all the fields of work. In 1870 he conducted triangulations at Magdalena bay, made general reconnaissance between San Diego and Panama, and from Magdalena bay to Alaska. The year 1871 was passed partly on the Atlantic coast. In 1873 he was sent to San José del Cabo to identify the transit of Venus station occupied by the French astronomer in 1769. In this he was successful after overcoming great difficulties. He was also appointed by the president one of three commissioners to investigate and report plans for the irrigation of the lands of the Sacramento, San Joaquin, and Tulare valleys, and in the latter part of 1863 entered into this work with his usual vigor.

In 1874 he was appointed chief astronomer of a party organized to observe the transit of Venus in Japan. He sailed from San Francisco August 29th and established his observatory in Nagasaki. He was also able to render friendly service to Japan in assisting the officials of that government in establishing their first observatory, selecting and trying their instruments and instructing the men in their use. Professor Davidson was also instructed by his chief to make a special examination of the harbors of Japan, China, India, Egypt, and Europe, particularly in regard to breakwaters, in view of the scarcity of protected harbors on the coasts of California, Oregon, and Washington. He was likewise instructed to make careful study of the irrigation system of India and to note methods of field work for the geodesy of India and elsewhere, and to compare appliances with our own resources for triangulation. This was all accomplished and at the end of February, 1876, he presented an elaborate report on the result of his observations. During the next few years he was engaged in his regular work and in 1878 was sent to Paris to examine and report upon the instruments of precision applicable to astronomy and geodesy deposited for exhibition in the International

Exposition of 1878. Here he was appointed on a jury of twenty-two members on machines and was unanimously elected president of the jury. For this service he received the large medal of the French government. His report states that while the inspection revealed much of deep interest there was nothing to discourage observers and mechanicians in the United States from claiming equality of rank with any in skill and precision. After his duties at the exposition were ended he visited the most noted workshops of Paris and the principal manufactories of Geneva, Neuchatel, Munich, Vienna, Dresden, Berlin, Hamburg, Cassel, London, and York; and early in December, 1878, was again in San Francisco and busy as usual with his regular work.

It is not necessary to give further details of Professor Davidson's regular work. A sub-office of the Coast and Geodetic Survey was created in San Francisco in 1876 with Professor Davidson in charge, and thereafter all reports were forwarded through him. He erected an observatory in Lafayette Park about 1884 and maintained it for several years at his own expense.

Very early in his work on the Pacific coast of the United States Professor Davidson became deeply interested in the early Spanish navigators who had followed the coast from Cape San Lucas to Alaska. He studied their narratives and endeavored, with considerable degree of success, to reconcile their discrepancies. The same course was taken with the English, American, and French navigators who followed. Much difficulty was experienced in ascertaining the proper names of localities and their orthography. With a changing population names are readily lost, changed, or corrupted. Land parties consult residents of places on shore, and hydrographic parties, the pilots, fishermen and sea-faring men. Two sets of names are frequently presented, neither of which may be correct. Different names were sometimes given by successive discoverers or explorers to the same points, indentations, bays, and sounds. These often replaced aboriginal names, or names given by land expeditions, or by missionaries, which had been retained in their pure, uncorrupted form. Mistakes and the various titles and orthographies were exceedingly perplexing, and in some instances names were altered more than once, modes of spelling were changed and restored, and the whole subject seemed one of great uncertainty. It was then of the first importance to trace the history of discovery on the coast; to ascertain the original names and the successive ones; to restore those which were corrupted, and to fix those uncorrupted beyond the power of change; to go back to the earlier names when the later had not become so permanently attached to the localities as to make it too difficult; and in short to make the coast survey maps and charts the standard for names and their spelling, as well as for the geography of the country.

Notwithstanding the exacting conditions and the exhaustive character of his work, Professor Davidson found time to write a Directory for the Pacific coast. In his letter of transmittal to the superintendent of the survey, dated August 29, 1858, he states that in moving continually along the seaboard in performance of his work he early felt the want of reliable information, in tangible form, instead of trusting to memory, and he determined to embody for publication the information required, but for several years failing health prevented the execution of more than the regular duties. Now, as his health had forced him for a time to leave the Pacific coast, he felt he must arrange the matter while yet freshly photographed upon the mind. A small portion had been published in San Francisco (in 1855) and, although abounding in typographical errors, the avidity with which it was sought was a strong incentive to complete his self-imposed task. "The result," he says, "is now placed at your disposal, and having examined all the courses, distances, and positions, I trust that no essential errors have been overlooked, but whatever have, fall upon my own shoulders."

This Directory was gladly received by the superintendent and published in full in his report of 1858. In 1862, Davidson wrote a second edition embodying all the information collected since 1849, and this was published in the superintendent's report of 1862. A third edition of this work was published as the "Coast Pilot for California, Oregon, and Washington," in 1868, and in 1887 he transmitted to the office the manuscript for the fourth edition of this invaluable work. He also published in 1868, the Directory of the Coast of Alaska ("Coast Pilot of Alaska," Part I). The amount of literary work accomplished by him was wonderful and two hundred and sixty-one books and papers on scientific and historical subjects attest the great industry of a busy man.

In 1908 the American Geographical Society conferred upon him the Charles P. Daly medal for "Fifty years of distinguished work in Geodesy."

He was a member of the

National Academy of Sciences of the United States,

Correspondent of the Bureau of Longitudes of France,

Correspondent of the Academy of Sciences of the French Institute,

Correspondent of the Swedish Anthropological and Geographical Society,

Honorary Corresponding Member of the Royal Geographical Society,

Honorary Member of the Geographical Association of Berlin,

Honorary Professor of Geodesy and Astronomy and Professor of Geography in the University of California,

Knight Companion of the Royal Order of Saint Olaf in Norway.

He was for sixteen years president of the California Academy of Sciences, for thirty years president of the Geographical Society of the Pacific and was a member of other learned societies.

The degree of A.M. was conferred on him by the High School in Philadelphia in 1850.

Ph.D. by Santa Clara College in 1876.

Sc.D. by University of Pensylvania in 1889.

LL.D. by University of California in 1910.

Professor Davidson's work in the coast and geodetic survey, his study of the narratives, diaries, correspondence, and other original documents of the early explorers both by sea and on land, together with his knowledge of the aborigines, made him the best authority on matters of early history of the Pacific coast, and his papers and publications on historical subjects are most interesting and valuable. His testimony as an expert was frequently required in the great land cases, and it was his rule to refuse employment from either party to a suit, requiring a subpoena of the court, and then his testimony was given. In the Limantour case—a claim involving most of the property of the city of San Francisco—his testimony ended the case. Limantour was arrested, deposited thirty thousand dollars bail, fled the country, and never returned. Davidson's work on the Alaska boundary, the boundary between the United States and British Columbia, and that between California and Nevada is of special value.

In his article on "Francis Drake on the Northwest Coast of America," the author speaks of himself as one who in a somewhat long life of activity on this coast had enjoyed opportunities that would not again fall to the lot of one man. It was a just claim. He was the pioneer and he saw his work practically completed.

I have given enough of the detail of Professor Davidson's life to show the character of his work. As a man he was kindly in disposition and was very genial with friends. He ever held his vast fund of information for the benefit of all and few men were so appealed to for advice, while his powers as a conversationalist and raconteur ever made him a most delightful companion.

His long and useful life came to an end December 2, 1911. His memory needs no monument of stone or bronze. It is written in the hearts of those who go down to the sea in ships.

Zoeth S. Eldredge

THE DEVELOPMENT OF CALIFORNIA

CALIFORNIA is unique not so much in possessions which may not be approximated elsewhere in the world—for perhaps of all her wonders only the redwoods are confined to her boundaries—as in the remarkable combinations of conditions and products which exist elsewhere only in widely separated localities.

To Cabrillo who came with his Portuguese sailors into San Diego bay, undoubtedly the new country seemed one of sunshine, balmy breezes, and semi-arid conditions. To Drake who spent a full month on the bay that bears his name, it was a country of fresh west winds blowing the sea fog across green hills and through redwood cañons. The fog shrouded the Golden Gate so that he sailed past the greatest harbor on the Pacific coast line without discovering it. To the Russian traders who came down from the north on hunting expeditions for furs, California meant a rugged country covered with noble forests where wild animals hid from their hunters. To the Donner party, belated in the high sierra on their transcontinental journey, California was a land of alpine heights, buried in heavy snows, and bound by bitter cold. To others of the transcontinental travelers, coming in answer to the call of California gold, the reality of the new country proved to be a burning desert and the name of Death valley records the tragic fate they met. The Mission fathers by perseverance and relentless braving of a new country learned to know California more truly than those who went before them and many who came after them. Starting at San Diego and pushing northward until they had established twenty-one missions all the way from that town to Sonoma, forty-five miles north of San Francisco bay, they learned that California was a country of diverse conditions. Mountain and desert, heat and cold, with the delightful mediums of altitude, temperature, and moisture, which rested their souls in those days of stress and have called to all the world in later days—all these they found. Yet by carefully selecting their mission sites, they were able in every instance to grow fruits about their buildings, though the most southerly and northerly of these were separated by seven hundred miles.

The rapidity of modern transportation today saves the traveler entering California for the first time, from a one-sided conception of the state such as earlier visitors quite naturally had. A few hours of travel bring him from the wintry summits of the Sierra Nevada, down through the forest-clad slopes, to the fertile level of the great valley where crops grow the year round, or into the land of citrus fruits where the golden and green orchards stand against a background of snowy mountains. If he comes in the summer time, he crosses the warm interior of the state, and almost before he has forgotten to drop the fan from his hand, feels the need of his overcoat against the moist coolness of the coast. Mountain to valley, desert to seashore, cold to warm—in the unusual combinations of these and the conditions they produce is the real uniqueness of California.

Because of the diversity of the state's production, the popular ideas regarding the foundations of her wonderful wealth are as many and as varying as the earlier conceptions of her topography and climate. The remarkable record for gold production has given her the reputation of being a huge mining camp, than which nothing could be farther than the truth. The fame of her magnificent scenery has created the impression that the state is unbrokenly mountainous, whereas in fact, there are great level valleys. The fame of her fruits and flowers has made for the entire state a reputation of fertile acres and abundant harvests, when, if the truth were known, only one-fifth of California is estimated to be arable land suited to agricultural uses. Much exploitation of California climate and the fact that the state is both a winter and a summer resort, has given credibility to the report that here one may find continual summer, whereas, with the exception of certain places directly along the coast, there are decided changes of temperature, though not so extreme as in most parts of the United States.

There are cities and centers of civilization which are not easily explained in the light of physical setting, and seem to be more the result of man's reckoning and cleverness than of nature's intent. This is not the case with the development that has taken place in California. A master mind, given the foresight to see the changes that science and invention have wrought in methods of travel, manufacture, agriculture, and physical activities generally, and allowed the privilege of flying from end to end of California in the bird's-eye seat of an aeroplane, could have predicted on the day Cabrillo set the first white foot upon her soil, the setting of cities, the lines of travel, and the development of industries and commerce, for the prophesies are written in the world setting, the contours, and the substance of her soil and subsoils.

Such a survey would have revealed then as today a territory lying along the shore of the Pacific ocean for a distance of eight hundred and fifty miles, between parallels 32½° and 42° north latitude, and extending back from the coast to an average distance of two hundred miles. Along the east side rise the Sierra Nevada to heights varying from 8,500 to 14,000 feet above the level of the sea. On their crests the snows are white the year round. On the other side, following the line of the ocean is the Coast range, a broad belt of broken ranges from 3,000 to 6,000 feet high, and interspersed with many pleasant valleys. At a point two-thirds of the way to the southern boundary of the state the Coast range and the Sierra Nevada are joined in the Tehachapi range which cuts across the state. The mountains continue south from there in the Sierra Madre range. All the country east of the Sierra Nevada and the Sierra Madre is semi-arid. North of the Tehachapi range, lying between the Sierra Nevada and Coast range is the great valley of the state. Two rivers, the Sacramento from the north and the San Joaquin from the south, flow towards each other down the center of the great valley, which is usually spoken of as the Sacramento valley and the San Joaquin valley, to the north and south respectively, from the rivers which drain it, although in fact, it is one continuous depression down the center of the state. The two rivers empty their waters into the Bay of San Francisco. The great valley receives rain in varying quantities—the upper end of the San Joaquin receiving the least. The Coast range country receives an ample supply of moisture from the ocean, but its rainfall tends to become less toward the south. The year-long snows in the Sierra Nevada insure a continued flow to the rivers in the northern part of the state.

Three land-locked bays indent the coast of California. The Bay of San Francisco, near the center of the coast line, is one of the finest and largest deep-water harbors in the world. It is entered through a narrow opening less than a mile across and covers an area of four hundred and fifty square miles. Into it flow the navigable Sacramento and San Joaquin rivers. Well to the north is Humboldt bay with an area of twenty-eight square miles, also deep water, but hampered by a bar at its entrance which delays shipping in heavy weather. At the extreme south is San Diego bay—twenty-two square miles of water shut away from the ocean by the long peninsula, but with an open channel at all times. Los Angeles has a harbor in San Pedro bay, where the widened mouth of a river and the curve of the sand bar give protection for landing. Besides these there are ports along the coast in use at the present time, and still others which appear capable of use, at least by the secondary ocean-going vessels.

In general, the wooded areas follow the highlands. Although California redwood may now be seen in almost every country under the sun—for its unusual beauty has been appreciated by all the world—its natural habitat is California. Practically the world's whole supply of redwood timber is found in a tract in the Coast range extending from the northern line of the state for a distance of two hundred and forty miles with a width of ten to twenty miles. In addition to this tract, some particularly fine groves are found to the south in the Santa Cruz mountains (a part of the Coast range), where the state of California has created a reserve in Redwood Park. The monarchs of all the timber kind—the famous great trees, are on the western slope of the Sierra Nevada near the center north and south of the state. The western slope of these mountains—a territory four hundred miles long with an average width of twenty miles—is covered elsewhere with a mighty forest of white pine, sugar pine, "Bull" pine, and cedar. The best timber is found at elevations between 3,000 and 7,000 feet above sea level.

In the earth of California was stored rich mineral wealth. Of the fifty-eight counties, not one is without commercial quantities of some mineral, and nearly every one has several of the two score minerals found somewhere within the bosom of the state. From the precious gems of San Diego, through the oil district of southern and central California, and the borax mines of the desert, past the salt works of San Francisco bay and the quicksilver of the Coast range, and on into the gold-bearing country to the north and west, a trip throughout California on mineral inspection reveals a continuous series of precious and non-precious treasure troves. The floor of California was "rich inlaid" with mineral wealth. Hidden deeply in places, often remote on the well-nigh inaccessible fastnesses of the rugged mountains, concealed in physical and chemical combinations with disguising elements, the riches were imbedded waiting to reward the human skill and knowledge that searched for them with sufficient perseverance.

The soil of California is not homogeneous in character. The surface of the state is a patchwork of many types, irregularly intermingled. High in the mountains surrounded by barren rocky hillsides are found fertile valleys. Between the rich valley lands and the mountains without vegetation, intervenes the hill country with its shrub and thin soils suited only to grazing purposes. Along the rivers the almost bottomless soils invite deep cultivation and promise royal returns in the harvest.

The climate of California consists of a wet and dry season. The wet season corresponds to winter time in the rest of the United States, and the dry season to the summer. The heaviest annual rainfall is in the northern part of the state, and the rivers that rise there and draw upon the melting mountain snows for their supply of water have naturally the greatest and most evenly continued flow. Yet, aside from the northern coast country which feels the effects of the ocean fogs, the whole surface of California unless artificially supplied with water, becomes parched during the summer time. Even the country lying within a short distance of the great rivers which never cease their flow during the year, becomes dry and brown during the rainless period. Less fortunate areas, such as the upper end of the San Joaquin and the country east of the mountains, receive very slight allowance of moisture at any time of the year.

Among the plant life of California is found some variety of practically every product of the temperate zone, and species allied to semi-tropical plant life as well. In the waters of the rivers and along the coast live one hundred and thirty-three varieties of food fish.

Such was, and is, the physique of California.

The few native inhabitants were Indian tribes of a low type of physical development and civilization, who despite the natural advantages of their situation and the abundance of natural wealth at hand, had never progressed beyond the most primitive of customs and means of livelihood.

This great, diverse, rich, uninhabited country, on the last shore of civilization's westward march, visited by white adventurers some fifty years after the discovery of America, first felt the compulsion of white hands in 1769 when the padres established the mission at San Diego. Theirs was the first step in the development of this remarkable country. The cultivation of fruits, which has held its own in the state's production with increasing importance ever since, was begun by them. Although incidental to their larger work of Christianizing the natives, they performed a valuable service in the planting of their gardens by which they demonstrated the ability of California climate to grow semi-tropical fruits over a wide latitude. Nor is their agricultural contribution unappreciated today, for the aged trees and vines, survivors of the brown-clad fathers, tell a story of age limit and climatic effect which would, but for their thrift, still require years of of demonstration work upon the part of the orchardists.

By the year 1834 the production of the missions alone included grain, beans, wine, brandy, olive oil, cotton, hemp, tobacco, oranges, figs, and other fruits. The annual output of wheat, maize, and beans was one hundred and twenty thousand bushels. It is estimated that the annual total production of grain, fruit, and garden from the missions and rancheros was nearly two million dollars.

However, the raising of live stock was the most extensive and richest of the industries of California for many years. The Spanish people were established upon great grants where they ran their herds, cultivating relatively small areas. The exports from California in the year 1846 were 80,000 hides, 1,500,000 pounds of tallow, $10,000 worth of soap, $20,000 worth of furs, 1,000 pounds of brandy and wine, and 1,000,000 feet of lumber.

Following the American occupation agriculture was more generally pursued than before, but the land was held in large tracts. Vast grain farms became the rule, and the state's production of wheat rose to near 60,000,000 bushels per year.

The development of California took an abrupt and new turn on the day when gold was discovered on the now famous millrace. No longer Spanish, Russian, and American only, but every nation under the sun found a landing place in California. Corners of the back country which had never known other than Indian feet before, were trod by the eager seekers after gold. No mountain was too steep, no pass too difficult for those who sought the hidden wealth. Men came with ox-team, on foot, by boat—around the "Horn," and across the isthmus. The boats that brought them were discarded by captain and crew as all made a mad dash for the gold fields. It is not strange that the less venturesome occupation of farming, and the tempting acres of California, were passed unnoted by these eager men. Later some of them returned from the gold fields to the surer, if slower, wealth of the soil, and others who returned rich planted their gold in the soil of California where it has multiplied many times for them and their descendants.

The finding of gold caused new towns to spring up, and old settlements to experience a sudden new growth and energy. Indirectly it hastened the agricultural development of the state for it brought many people to the coast, and the hitherto little known country became a household word throughout the world. In 1868 the first railroad pushed over the tremendous heights that separate California from the rest of the United States, and opened up a new route for the trade of the coast which had hitherto been entirely dependent upon ocean transportation.

Not until the latter part of the Nineteenth century did the farmers of California begin to realize that they were (like farmers throughout our broad land), ill-treating their grain fields by slack, one-crop cultivation, and that their returns per acre were annually becoming less. The result has been the breaking up of many of the great holdings into farms of a size that one man can properly handle, and the introduction of other crops than grain. Today there are still many large holdings in the state lying uncultivated or returning small crops of long-suffering wheat, but the movement toward the smaller farms gains headway yearly, and in most of the valleys of the state the price of land has risen to such an extent that large, idle farms are becoming an extravagance few can afford. In the year 1850 the average size of a California farm was 4,465 acres; in 1860, it was 466 acres and the number of farms had increased twenty-three-fold (to 18,700). In 1910 the average farm acreage had decreased to 316, and the number of farms increased to 88,000. Over sixty per cent of the farms were in 1910 less than a hundred acres in size.

The small farm (40 acres or under) is very much in evidence in the fruit and vegetable growing districts, and in some dairying sections. Attempts have been made to prove that a man can support himself on one acre of ground, or that families can live with ease on five to ten acres, but while in a few isolated cases—generally in some unusual and highly specialized industry—it has been proven possible, as a rule disappointment and failure have followed such attempts. But the ten-acre farm has proven an economic possibility and success, and in many parts of California, and with a variety of crops, small families can live in modest comfort on this acreage, if properly cultivated.

It would be overlooking the most important factor in the development of the small farm, and the increased total area under cultivation in the state, if one failed to take account of the part irrigation has played. Men awoke to the potential worth of the water that was running unused to the ocean, past stretches of thirsty land, and turned it onto their fields with the result that crops were doubled, the chance of crop failure greatly reduced, and vast areas hitherto incapable of cultivation because of their arid nature were placed under the plow. The snows of the mountains tend to even the flows of the rivers that have their sources there, and the rough country, with its rapid falls and narrow passes lays the rivers liable to maneuvering by human hands for the still further conservation of their flow by storage and the utilization of their energy by power plants. The census of 1910 states that one-fifth of all the irrigated land in the United States is in California. Over three million acres are now irrigated, and the results of the recent official irrigation investigations indicate that fully three times that amount may ultimately be put under water. The flow of the rivers is sufficient to water the whole twenty-two million acres of agricultural land in the state, were it possible to control and distribute it over wide territories. At the present time, the possibility of the water actually reaching all this land, much of which appears wholly inaccessible to the rivers, seems slight.

The crops of the state include every product of the temperate zone as well as many of the semi-tropic. Each year sees new experiments—and usually successful ones—in the introduction of new crops. Among the most recent to prove their adaptability and value to the state are rice and cotton. The former is being grown on the rich, level Sacramento valley with its superabundant water supply. Although cotton was among the crops of the missions in 1834, it was not until recently that it became a commercial product of California. In the Imperial valley where the waters of the Colorado have turned the desert into productive farms, a very fine grade of cotton is being raised. Besides the plants brought from other countries, California has increased her list of products through the creation of new varieties by experimentation. Luther Burbank, the wizard of plant creation, has his experimental gardens in a valley of the Coast range, fifty miles north of San Francisco bay. He has added many new types to the horticulture of the state.

In the grand total of California's production for the year 1912 ($1,097,000,000), over one-third, or $344,445,000 was contributed by agriculture. An enumeration of the crops which helped to make this large total for agriculture would be too long to give here, but some suggestion of their diversity is indicated by the classifications into which they fall—Orchard products, including fresh and dried fruits, nuts and oil; vineyard products, including grapes, raisins and wines; dairy and poultry products; grain and hay; and other field crops such as hops, broom corn, cotton, tobacco, and sugar beets. Another classification which adds value to the amount of $69,000,000 to the state's output and which is indirectly a product of the soil, is farm animals and products. Nursery and florist products also add over $4,000,000.

With the exception of manufacturing, no other source of the state's production can compare with agriculture in importance. Fisheries yield $10,600,000; forest products, $23,305,000; mineral products, $87,425,000 (of which petroleum contributes $41,000,000).

The manufactures of the state were valued at $556,249,000 in 1912. California ranks eleventh in the list of states according to value of manufactured products. During the decade recorded by the 1910 census, however, the value of manufactured products increased by seventy-four per cent. The abundance of fuel oil, and hydro-generated electricity, favor the growth of manufacturing, while the geographic position with reference to world trade offers opportunities for almost unlimited market expansion. Among the cities of the United States San Francisco ranks sixteenth, and Los Angeles thirty-second, in value of manufactured products.

The development of California may not intelligently be interpreted in the light of any one of her many natural features or types of enterprise, without a consideration of the others. Her scenery becomes significant to the world in general only because it is accessible through the extension of transportation facilities; her climate, in combination with good soils and water supply, make possible the marvellously diverse crop production; her mountain streams furnish light and power for the growth of cities and the multiplying of transportation lines; her mines, forests, fisheries, and fields combine to supply the raw materials out of which are built manufacturing industries and trade; the deep-water harbors on the Pacific invite the ships of the world to enter into commerce with her. Her development is many-sided and inter-dependent, and in that lies a great promise for future strength and growth. The remarkable size and diversity of California is best appreciated, when, after summing up her present wealth and vast accomplishment, one turns again to the physique with which nature equipped her, and beholds that only a small part of her potential energy has yet been called into action.

Robert Newton Lynch

VITICULTURE IN CALIFORNIA

CALIFORNIA, the home of sunshine, fruit and flowers, was certainly blessed by the Maker of this great universe. No state in the union is better adapted for viticulture than California. In its vast expanse of about seven hundred and fifty miles along the Pacific ocean, with an average width of two hundred miles, with its irregular divisions and innumerable valleys, the geographical and topographical position of California embraces such a diversity of climatic conditions that grape culture may be successfully carried on over a vast area. Nature provides the foundation for magnificent results. Assisted by irrigation in the overheated valley districts and supplemented by judicious fertilizing where the soil has been overtaxed and exhausted, she readily yields to laudable efforts to produce "wine that maketh glad the heart of man," wine that promotes and develops the instinct of true temperance, because wine culture, refinement, sobriety, and good cheer always stand together and are affiliated against alcoholism. Although the industry is young, we have accomplished much and our wines are superior to a great many of the foreign wines which are sold on the open market.

The state is practically divided into two districts. The long stretch of coast counties, including Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Mateo, and Santa Cruz, have shown their special fitness for the production of dry table wines of the most delicious and exquisite types. In these counties, the climatic conditions and soil compare favorably with some of the most renowned vineyard sections of Europe, such as Germany, France, and Italy. In fact, some of the red wines grown in these sections today are superior to many wines made in Europe.

The other district comprises the vast and fertile tracts in the Sacramento and San Joaquin valleys, and south of the Tehachapi. Here is the center of the great sweet wine and brandy industry. The soil in most sections is very fertile. The cost of cultivation is less expensive than the northern part of the state, where the dry wines are made.

As to the early history of viticulture in California, records show that the Franciscan fathers, who settled in the southern part of the state near San Diego, first introduced wine making in this state. The variety of grapes grown by them became known as the mission grape. Whether the Franciscan fathers brought cuttings with them from Spain or whether they propagated the mission wines from seeds, is not known. The real work of California viticulture, however, came later, after the rush for gold—when a great many of the early settlers, disappointed in their quest of gold, engaged in farming and agricultural pursuits. Among those who have helped to establish this great industry and who will always remain a part of California's history, are Colonel Arpad Haraszthy, Charles Kohler, Jacob Gundlach, Charles Dresel, E. H. Sheppard, Professor Husmann, Charles Krug, Captain Gustav Niebaum, Jacob Grim, C. de Franc, Henry M. Neglee, Captain Eisen, G. H. Eggers, and many others who have spent fortunes in their vineyard estates.

The industry, however, has had many setbacks. The most serious of these were the ravages of the phylloxera, which appeared in the latter part of the 70's and early 80's. The beautiful vineyards which covered the hillsides in Napa, Sonoma, Alameda, and Santa Clara valleys were attacked by phylloxera, and totally destroyed. Science has never found anything that would successfully destroy phylloxera. The French government at one time offered a large amount to anyone who would find a practical remedy to kill this insect, but up to this day no one has ever claimed the prize. It is claimed that the phylloxera is a native of the United States and was carried into Europe through cuttings that were shipped from the United States. The native wild American vine is practically resistant to the attacks of the phylloxera and most of the vineyards today are grafted on this stock.

The leading varieties of grapes cultivated in the dry wine districts have, as the principal foundation, the Zinfandel, which consists of a prolific, full-bearing red wine grape with a fully developed fruity flavor and pronounced acidity. However, all of the progressive vineyards are supplemented by Mataro, Grenach, Carignan, Mondeuse, Malbec, Valdepenas, various specialties of Burgundy and Pineau, Beclan, Cabernet, etc. The leading white wine stock includes the Burger, various kinds of Chasselas, Gutedel, several species of Traminer, Semillon, Sauvignon, Folle Blanche, and many others.

The investments in the state of California in vineyards, cellars, plants, and cooperage today exceed $150,000,000. While statistical reports in the dry wine districts are rather difficult to obtain, the various vintages have been estimated as follows—these figures include both dry and sweet wine production:

1864— 2,000,000 gallons; 1874— 4,000,000 gallons; 1884—11,000,000 gallons; 1894—18,000,000 gallons; 1902—43,000,000 gallons; 1903—32,000,000 gallons; and 1914—42,000,000 gallons (about 25,000,000 dry and 17,000,000 sweet wine).

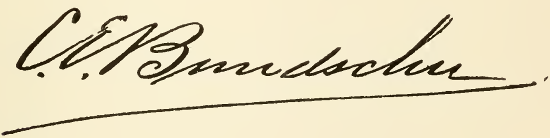
The vintage of 1902 was an exceptionally large one, as climatic conditions were most favorable, but the quality was inferior to the year 1903, when the crop was very much smaller.

The market for California wines extends practically over the entire world. The biggest markets today are in New York, New Orleans, and Honolulu. The wine is consumed mostly by foreigners, the American is still to be educated in the use of wine and a great deal of good can be accomplished by intelligently bringing before the American people the benefits derived by the use of wholesome wines. From statistical reports, we find that the home consumption of wine in other wine producing countries per head and per annum is as follows:

In France, 25 gallons, equal to about 126 bottles; in Italy, 20½ gallons, equal to 102 bottles; while in the United States, only 30–100 of a gallon, equal to 1½ bottles—per head per year.

San Francisco is the largest distributing point for California wines. Most of the shipments today move by water so as to secure a low rate of transportation and are, therefore, shipped to San Francisco to be reforwarded to the various parts of the world. Before the earthquake and fire of 1906 visited San Francisco, the large distributing plants were located here. Since then they have been rebuilt in various sections of the state, so that today, while the wines are not housed in San Francisco, this city acts as a distributing point.

With the advancement that has been made in the last ten years, the California wine industry will surely remain one of the most important industries of the state and California wines will be looked upon by the connoisseur as a standard for quality and superiority.



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