THE IMPERIAL VALLEY

AND

THE SALTON SINK

BY

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WITH INTRODUCTORY MONOGRAPH

BY

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PROF. BLAKE ON TRAVERTINE POINT FIFTY-THREE YEARS AFTER HIS FIRST VISIT IN 1855.

PART I.

SKETCH

OF THE REGION AT THE HEAD OF THE GULF OF CALIFORNIA

A REVIEW AND HISTORY

by

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of the Colorado Desert were to be reclaimed by irrigation; and that his engineer, Mr. Ebenezer Hadley, County Surveyor of San Diego County, in reporting on this project, recommended a canal location which was practically identical with that actually adopted 40 years later.

"Mr. Hadley said, among other things, that irrigation was practicable, as water from the Colorado flows there now. He stated that he had found by actual survey, that there was a fall of 5 feet per mile available along the proposed canal route. He called attention to the necessity of carrying water through Mexican Territory. He proposed a canal 25 feet wide and 10 feet deep, which was to tap the river at the point of rocks adjoining Pilot Knob and immediately above the International Boundary line."

At various times proposals have been made to fill the Salton Sea with water from the Colorado River or from the gulf with the view to fundamentally changing climatic conditions, particularly increasing the rainfall throughout the territory. In particular, Dr. J. P. Widney, an army surgeon, published some articles in the *Overland Monthly* urging the flooding of this sea, the first of these contributions appearing in 1873. None of these proposals were given very serious consideration.

Later Irrigation Suggestions.

In the years 1875 and 1876 an examination was made under the direction of Lieut. George M. Wheeler to determine the feasibility of taking water from the Colorado River anywhere between the Grand Canyon and the International Boundary Line for the irrigation of lands in California. Lieut. Eric Bergland had immediate charge of this work and presented an adverse report, stating that a canal from some point below the International Boundary Line would be less expensive and more practicable in every way. He suggested the possibility of utilizing one of the branches of the New River (doubtless what is now called the Alamo) from where it leaves the Colorado near Algodones, for conveying water to the Imperial Valley proper. In order to avoid the sandhills he thought the canal should be as far south as Seven Wells in Mexico and then bear toward the northwest. He considered the amount of excavation required to construct such canal as moderate since "the water flows into this area from the river when it overflows its banks."

Almost at the same time a partnership was formed between Mr. Thomas Blythe, a capitalist of San Francisco, and General Guillermo Andrade for the irrigation of the latter gentleman's immense land holdings in Lower California. This partnership did not have any definite result other than to involve the title of Gen. Andrade's estate to a certain portion of the land in later years.

III. LAKE CAHUILLA.

Origin of Lake.

The head of the gulf being cut off by the Delta from the free access to the sea, became an inland lake of salt water, or at least of brackish water, with the great Colorado River at certain seasons and stages of flood flowing into it. This stream then, as now, was laden with the rich alluvial earths of its upper course, torn from the ravines and canyons of the Rocky Mountains and the Grand Canyon of Arizona. This influx of river water, though variable in duration and quantity, must have exceeded the loss by evaporation. Consequently the level of the lake was raised until the excess overflowed to the gulf by a lower outlet.

Antiquity.

That such conditions continued for centuries appears certain, for the enormous accumulations of sediment within the old beach lines tells the story of long continued lacustrine conditions; of the displacement of the sea water, and of the final occupation of the valley by fresh water. This is shown to us by the fresh-water shells, not only on the surface but in the blue clay sediments; in the banks of ravines and arroyos, and in the deep borings for water—showing that the shells dropped to the bottom and were thus entombed. These fresh-water shells are so abundant in the lacustrine clay of the desert, especially at the northern end, that they accumulate in windrows before the wind. The thin pearly shells of *anodonta* are common in the clay about Indio. Four or five species of uni-valves, new to science, were collected in 1853.

The long continued existence of such a lake is shown, not only by the fossil shells, but by the ancient shore lines and beaches as fresh as if recently left by retiring waters. These are especially vivid and convincing north of the Delta, where they are visible for miles.

At an outlying mass of rocks at the base of the main ridges of the Peninsula or San Jacinto Mountains, a deposit of travertine marks the former height of the water by a thick incrustation, covering the granite boulders from view. The foundation rock must have been a small islet of granite projecting above the waves of Lake Cahuilla. It is now known as Travertine Point and its base was nearly reached by the rising waters of the Salton Sea in 1907.

Identification and Description.

The former lake, the shores of which are recorded on the rocks and slopes of the Cahuilla Valley north of the Delta had an area of approximately

2100 miles. It was 110 miles long and about 34 miles wide. It was first identified and described by me in 1853, in a communication to the *San Francisco Commercial Advertiser*, edited by J. D. Whelpley, in the winter of 1853-54, and later in the "Reports of Exploration and Surveys for a Railroad Route from the Mississippi River to the Pacific Ocean," vol. V., and in the appended report, "Geological Reconnoissance in California," 1855.* Its boundaries were then approximately shown and its origin explained. I have named it *La Cahuilla* from the name of the valley and of the Indian tribe.

The Desert Revisited.

By the courteous invitation of Dr. MacDougal, I had the pleasure of revisiting this place in the month of May, 1906. Crossing the valley from Mecca, on the Southern Pacific Railway, we visited the then rising Salton Sea, skirting it to Travertine Point which I again ascended half a century after its discovery and description in 1853. The old water-lines and beaches were comparatively unchanged in appearance. Concentric lines of sparse vegetation marked where the waters had stood centuries before. Looking out from the summit across the Salton Sea it was difficult to realize that the old traveled trail across the desert lay ten fathoms deep under water, where before not a drop could be found.

The name "Salton Sea" is appropriately applied to the recent inflow and partial inundation of the valley covering the salt beds at Salton, but the ancient lake in its entirety requires a distinctive name. If any precedent is needed for naming an ancient lake which has disappeared, it is found in the naming of the old lake in Utah by Clarence King as Lake Bonneville. Lahontan is another example. The Great Salt Lake of Utah is the residual lake of Lake Bonneville much as the Salton Sea is the residual lake of Lake Cahuilla. Lake Cahuilla occupied the northwestern end of the basin of the California Gulf—that portion cut off from the sea by the delta deposits.

The northwestern part of the valley is also known as the Cabezon or Cahuilla Valley, so named from the Cahuilla Indians who have inhabited the oases and tillable fringes of the desert from time immemorial. There is a difference of opinion regarding the proper orthography of this name. It is ably discussed by Dr. David Prescott Barrows in "The Ethno—Botany of the Cahuilla Indians of Southern California."† He writes:

"A word should be said as to the pronunciation and spelling of the tribal name, *Coahuilla*. The word is Indian, and the tribesmen own designation for

*This appended report was republished as "Report of a Geological Reconnaissance in California," by W. P. Blake. H. Bailliere, New York and London, 1858.

†Dissertation for degree of Ph. D., University of Chicago Press, 1900.

themselves and means 'master' or 'ruling people.' There is some slight variation in its pronunciation, but the most usual is probably, *Kow-wee-yah*, accent on the second syllable. The spelling has been various. That used by the early writers and correct according to the value accorded to "ll" in Spanish-American, is that adopted here—Coa-hui-lla."

The writer, in the year 1853, when passing through "Ka-wee-yah" or the Four Creek Country in California, with Lieut. Williamson, in the endeavor to conform phonetically to the Indian name wrote it "Cohuilla," and sometimes "Cahuilla." This last form seems to have been more generally accepted and is preferred to Cohuilla, Coahuilla, or any other.

Desiccation of Lake Cahuilla.

With our present knowledge of the delta deposits of the Colorado, the varying phases of the stream, the lightness and depth of its deposits of silt, its quicksands, its shifting channels and uncontrollable ways, it is easy to realize that the inflow to Lake Cahuilla must have been extremely variable and uncertain. We can realize that under favorable conditions the whole volume of the Colorado may have been diverted alternately to the Lake and to the gulf, and that long intervals of drought accompanied by drying up were often experienced.

Writing upon the subject in 1853, attention was directed by the writer* to the traditions of the Cahuilla Indians as follows:

"The explanation of the formation of the lake and its disappearance by evaporation which has been presented, agrees with the traditions of the Indians. Their statement that the waters retired *poco-a-poco* (little by little) is connected with the gradual subsidence due to evaporation, and the sudden floods of which they speak, undoubtedly took place. It is probable that the lake was long subject to great floods produced either by overflows of the river at seasons of freshets, or by a change in its channel, or by a great freshet combined with a very high tide, so that the river became, as it were, dammed up and raised to an unusual height. The present overflows, though comparatively slight, are probably similar, and yet it is possible that the interior of the desert might be deluged at the present day, provided no elevation of the land has taken place and that the river should remain at a great height for a long time—long enough to cause the excavation of a deep channel for New River."

Salton Sea.

This is precisely what has recently happened by the cutting of irrigation canals, and by the uncontrolled flow of the Colorado River, deep and destructive channels were cut, a partial flooding of the desert followed, and

*Report "Geological Reconnaissance in California," Govt. Print, 1855, p. 238.

the "Salton Sea" was formed. The body of water which so recently threatened the restoration of the former lake conditions in the month of February, 1907, had attained a length of 45 miles, a maximum breadth of 17 miles and a total area of 410 square miles with a maximum depth of 83 feet. It extended from Imperial Junction nearly to Mecca Station. It submerged railway stations and necessitated the removal of the tracks of the Southern Pacific for 67 miles to a higher and more northern bed. By the great and masterful exertions of the engineers in charge, seconded and supported by the Southern Pacific Railroad, the destroying deluge was stopped in the mouth of February, 1907, and the gradual disappearance of the Salton Sea, by evaporation, commenced and is now in progress. In this we have immediately before us a practical exhibition of what must have happened many times before.

Evidently in the case of the ancient Lake Cahuilla, with the loss of the supply of water from the Colorado, the lake disappeared by evaporation. The conditions for this were extremely favorable. Of the rate of evaporation and the time required for the complete desiccation of the valley, we have no direct evidence, but there is every reason to accept the statement of the Indians that the water retired little by little, or very slowly, and no doubt years passed before the lake dried up.

Rate of Evaporation.

Experiments by me upon the rate of evaporation in the Tulare Valley, California, in 1853, indicated one-quarter of an inch per day, or between seven and eight feet yearly.* Dr. Buist found that the amount of evaporation from the surface of the water at Aden, on the Indian Ocean, was about eight feet per annum. At the rate of eight feet yearly, the 83 feet of water now covering the desert, and known as the Salton Sea, will require ten and a half years for its complete evaporation.

It is estimated by Mr. H. T. Cory, the engineer in charge of rediversion of the Colorado River in 1906-7, that, if the inflow of the Colorado to the Salton is prevented, the sea will practically dry up by evaporation in about eighteen years.

The recession of the Salton Sea now in progress affords an excellent opportunity for the determination of the rate of evaporation of such a body of water, and it is being availed of by the U. S. Geological Survey, which has established stations where the rate is being carefully observed.

*Report "Geological Reconnaissance California," p. 195, and Trans. Geo. Society, vol. IX, p. 39, 1849-50. See also, Trans. National Institute, Washington.

From measurements of the evaporation from a tank at Calexico by Mr. J. E. Peck, of the California Development Company, the annual evaporation was shown to be about 6.73 feet, as will be seen by the following tabular report:

Evaporation From a Water Surface at Calexico.

Month	1904 Inches	1905 Inches	1906 Inches
January	4.39	2.72	2.57
February	6.32	1.47	2.43
March	8.86	4.44	5.06
April	9.55	4.74	5.99
May	10.91	8.38	6.84
June	13.89	12.86	7.41
July	12.47	10.43	6.76
August	10.98	8.52	8.47
September	8.61	7.83	6.73
October	8.78	6.77	5.45
November	5.40	3.23	3.61
December	3.48	3.43	2.40
Total	103.64	75.00	63.66

IV. COLORADO DESERT.

Depressed Area.

The drying up of Lake Cahuilla left a broad region at the head of the gulf, a depressed area below the sea-level, a trackless waste of nearly level land extending, including the Delta, for some 200 miles northwesterly beyond the present limits of tide-water in latitude 31° 30′ N. approximately 80 miles south of the mouth of the Gila River at Yuma on the Colorado. The limits of this desiccated area are approximately marked indelibly on the ground by the shore-lines and beaches of Lake Cahuilla, extending on both sides of the valley from near Yuma to Indio and beyond.

The name *"Colorado Desert"* was given to this region by the writer in 1853.

This was before the State of Colorado received its name. It was deemed most appropriate to connect the name of the Colorado River with the region inasmuch as the desert owes its origin to the river by the deposition of alluvions and the displacement of the sea-water.

A tendency is shown by some writers to extend the area known as the Colorado Desert so as to include the arid regions north of it, especially

De Fer's Map (1720), Showing California as an Island and Placing Alarçon's Gulf with its Associated Rivers at about the Center of the Strait Separating California from the Mainland.

II. GEOGRAPHICAL FEATURES OF THE CAHUILLA BASIN.

BY MR. GODFREY SYKES.

General Description.

As now defined, the Colorado Desert may be considered to include the area between the Coast Range on the west and southwest; the Colorado River on the east; the San Bernardino and Chuckawalla Mountains on the north; and to merge, without any very definite limits, into the eastern bajadas of the peninsula mountains to the south—some 8,000 square miles in all.

Topographically the Colorado Desert is divided into two main and parallel basin areas which merge at their southeastern extremities in the alluvial plains of the delta of the Colorado and are separated elsewhere by the Cocopah Range of mountains.

The Pattie Basin, which is the smaller and most southerly of the two, lies almost wholly within the Republic of Mexico. It has not as yet been fully examined or described, but we know that its central and lowest portion is occupied by a fluctuating lake or lagoon, fed by overflow from the lower Colorado, and it is probable that the bottom of this depression is many feet below sea level.

The basin to the north and northeast of the Cocopahs, which constitutes the main portion of the Colorado Desert, and to which the name Cahuilla Valley was given by Professor Blake, has the general form of an acute-angled scalene triangle, the apex of the triangle being at the summit of the San Gorgonio Pass, between the San Bernardino and San Jacinto Mountains. The extreme length of this triangle is about 185 miles and its width at the base about 75 miles. The floor of the base is roughly spoon-shaped, gradually dropping from its southeastern end for a distance of about 140 miles, until it has attained a depth of 265 feet below sea level, and then rising with increasing rapidity until at the summit of the San Gorgonio Pass it has risen to an elevation of some 2,500 feet above. An area of sandhills and gravel mesas toward the northeast and a piedmont district which lies between the Superstition Mountains and the main escarpment of the peninsula range, complete the area under consideration.

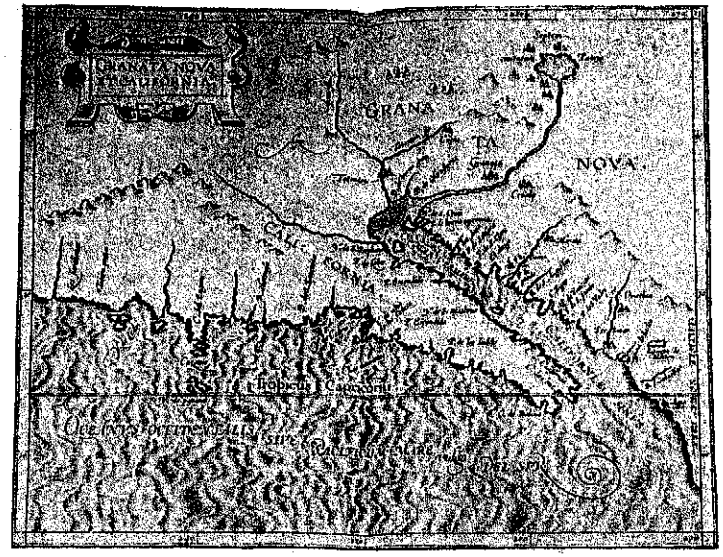
Early Maps and Exploration.

Our real knowledge of the Colorado Desert extends back but few years and is still, in many important respects, far from complete, but we know the Spaniards approached the region, if they did not actually penetrate it, within a few years after the discovery of the New World.

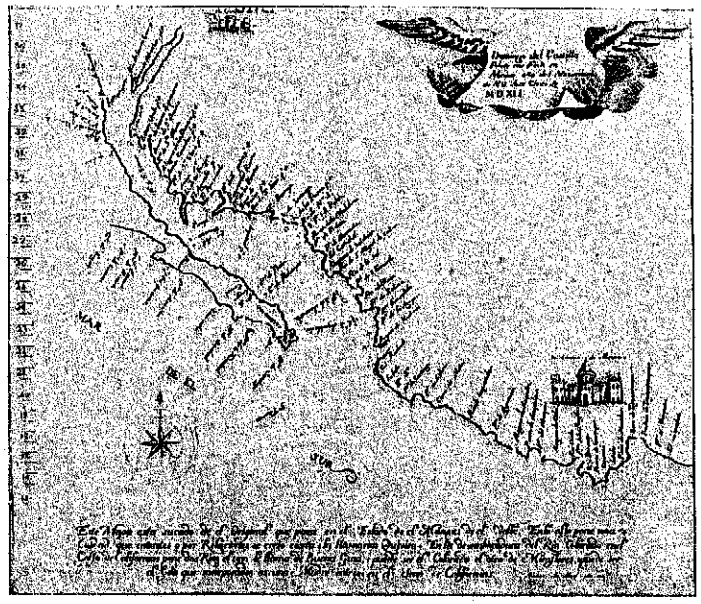
The first expedition to explore the head of the Gulf of California and examine the circumjacent region was the one sent out in 1540 by Don Antonio de Mendoza, the Viceroy of Mexico, under the leadership of Francisco Vasquez Coronado.

Coronelli's Map of North America (1688) in Library of American Geographical Society in New York City.

Pedro de Alarçon journeyed up to the mouth of the Colorado River by sea, and examined some parts of the Delta, and later in the year Coronado sent Melchoir Diaz, with a small party, overland from Corazones to cooperate with him. Diaz reached the river, but failing to meet Alarçon, he



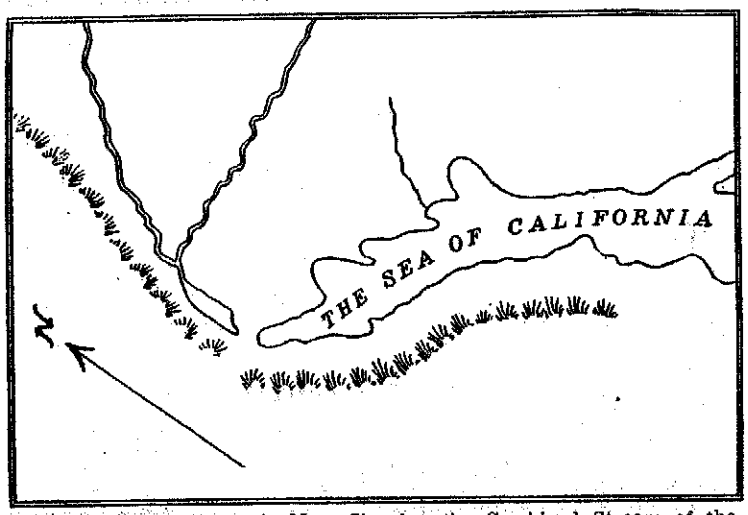
Wytfliet's Map (1598), Showing Area of Sand and Mud Banks at the Head of the Gulf of California.



Castillo's (the Pilot of Alarçon's Expedition) Map of the Gulf of California made in 1541 and published by Lorenzana in the City of Mexico in 1770.

crossed it on rafts, and was afterwards accidentally killed while on the west side. He has, however, left an account, as recorded by Castenada,* of reaching a land of "hot ashes and volcanic rumblings," which no doubt refers to the mud volcanoes near Volcano Lake.

Castillo, the pilot of Alarçon's squadron, made a chart of the head of the gulf, which appears to have been first published by Lorenzana in Mexico in 1770† and is doubtless the earliest authentic map we have of the region. Castillo's interest, however, was chiefly that of the mariner, and he made little attempt to portray inland features.



Detail from the Rocque's Map, Showing the Combined Stream of the Colorado and Gila flowing into a lake not connected with the Gulf.

The knowledge gained by this expedition was evidently the inspiration for the charts of all the early cartographers such as Joannes Cimerlinus,‡ Plancius,§ Mercator,|| Wytfliet¶ Wytfliet's map shows the area of sand and mud banks at the head of the gulf and is by far the best and most interesting of these early charts. Whoever his authorities may have been, they clearly had some first-hand knowledge of the country.

*"The Journey of Coronado," Castañeda de Nagera, translation by Geo. Parker Winship, Barnes, New York, 1904.

†"Lorenzana y Buitron, Historia de Nueva España, 1770," in British Museum.

‡British Museum, Maps, 70 d. 1. 1566.

§British Museum, Maps, 920 (279), 1590.

||A copy of Mercator's Map of 1569 is to be found in the library of the American Geographical Society of New York. It is included in Jomord's Atlas, and shows the influence of Castillo's work very plainly.

¶British Museum, Maps, 71, C. 7, 1598. Another excellently preserved copy of this map is in the library of the American Geographical Society, New York.

The western river, which figures so prominently in nearly all of these early maps, although it appears merely as an estuary or entrance to a lagoon in Castillo's own chart, is clearly meant for the Hardy, and it is not at all improbable that in the days of these early navigators and cartographers the Hardy, the Colorado, and the comparatively insignificant channel which is now known as the Santa Clara Slough, may all have entered the gulf by separate estuaries, and each carried a running stream. Indeed there is some reason for surmising that this latter channel may at that time have constituted the main mouth of the river.

Spanish interest in these distant and inhospitable lands began to wane after this early attempt at their exploration, and it was not until the memorable journey of Father Kino in 1702 that any real addition was made to our knowledge of the region. Two other maps of that general period are interesting in that they both show all of California as an island.* Kino's map, which is carefully drawn and fairly accurate, was published in various forms some years later,† and shows two mouths to the Colorado, but as his detail to the west of the river is obviously less complete than it is elsewhere, this omission of the estuary shown by Castillo may be regarded as inconclusive.

Father Fernando Consag was contemporary with Father Kino, and a very interesting manuscript map showing the results of his work in the gulf exists in the British Museum.‡ His exploration was carried on by boat and extended some distance up the Colorado. Penciled range marks upon the original map indicate that his chief observational station was upon the south end of Angel Island, and his survey was mainly a marine and coastal one.

At some time subsequent to the journeys of Fathers Kino and Consag, some other explorer or explorers must have penetrated the region, and the result of this work is to be seen embodied in the remarkable map of John Rocque.§. This map is unique in several respects. The unusual accuracy of its detail over most of North America; the evidence that the cartographer must have had at his disposal very complete sources of information in regard to the Southwest; but chiefly, as far as the scope of this paper is

*One by Coronelli (1688), copy of which is in the library of the American Geographical Society in New York City, and another by De Fer (1720), which places Alarçon's gulf with its associated rivers at about the center of the strait which separates California from the mainland.

†A New Map of North America, by Eusebius Francis Kino, London, 1786. British Museum, 699, 15 (31).

‡Add. MSS., 17660 C.

§British Museum, K. 118. 32. A divided copy of this same map also exists in the library of the American Geographical Society, New York.

concerned, from the fact that it clearly shows the combined streams of the Colorado and the Gila flowing into a lake, and having no connection with the gulf.

The nomenclature throughout the region shows knowledge of the work of Kino, but this very radical feature in the topography is clearly due to the work of some explorer of whose work we as yet know nothing more.

A fairly comprehensive search for and examination of the early maps of the southwest has been made in the hope of finding some conclusive evidence of former fillings of the Salton Basin within historic times, and this map at least seems to indicate that such a diversion of the river water towards the west has been known to travelers at some time between 1706 and 1760. With this clue it is probable that further search may result in giving us positive information upon the subject. A common tradition amongst the Indians of the region points to the fact that such a filling of the basin has taken place within comparatively recent times, in which the water extended "from mountain to mountain."

Father Pedro Font traveled in and explored the region in 1776, and doubtless crossed the Colorado Desert at least twice, and also reached the shore of the gulf on the west side of the river. His map shows a large irregular opening still further to the west than his own approach to the gulf, and here again we may have the western opening of the early explorers, or another interpretation of the Lake of Rocque.* Father Font was the last of the Spanish explorers to add anything to our knowledge of the delta or desert, and his work was followed by a virtual blank of over fifty years.

Modern Exploration.

James O. Pattie was the first of more recent explorers to reach the head of the gulf. He, with his party of trappers, journeyed down the lower Colorado to tidewater in January, 1828, and during February of the same year they crossed the basin beyond, on their way to the Spanish settlement at San Diego.†

Lieutenant Emory marched across the basin in the latter part of 1848, and seems to have reached the shore of the Salton Lake.‡

Major Heintzleman, Commandant at Yuma, visited the mud volcanoes near Volcano Lake in 1852, and these were afterwards visited by John Le Conte,§ and others.

*An excellent reproduction of Font's map is to be found in the "Diary and Itinerary of Francisco Garcés," by Elliott Coues, F. P. Harper. New York, 1900.

†"The Personal Narrative of James O. Pattie," of Kentucky. Edited by Timothy Flint, Cincinnati, 1833.

‡Notes of a "Military Reconnaissance from Fort Leavenworth in Missouri to San Diego in California," by W. H. Emory, Govt. Print. Washington, 1848.

§"American Journal of Science and Arts," vol. XIX, May, 1855.

PART IV.

IRRIGATION AND RIVER CONTROL
IN THE
COLORADO RIVER DELTA

by

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