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THE COLORADO DESERT*

BY W. C. MENDENHALL, OF THE U. S. GEOLOGICAL SURVEY

With Photographs by the Author

THE Colorado Desert is not in Colorado nor even near that imperial State. Instead, it is in the extreme southeastern part of California and adjoining parts of Mexico, and represents one of the geographical and physical extremes for which California is noted.

This state extends for 1,000 miles north and south along our Pacific shore line, so that it passes from tropical to temperate conditions and from the most arid to one of the most humid sections of the continent. It includes the great Sierra, dominated by Mount Whitney, 14,501 feet above the sea, while just east of this culminating peak of the United States lies Death Valley, the lowest point on the continent, 276 feet below sea-level. These physical contrasts are matched by contrasts in vegetation and temperature, so that nearly every type of natural environment under which man exists is represented within the boundaries of the state, and often, as in the case of Death Valley and Mount Whitney, the juxtaposition is so immediate as to greatly accentuate the contrasts.

The valley of southern California, with its orange and lemon groves, its acacias and palms, its geranium hedges, and its riot of roses, is only 100 miles from the region that is the subject of this sketch, originally one of the most desolate spots on the globe, a veritable furnace in midsummer, with recorded official temperatures of 130 degrees in a shadeless land, but now destined through the agency of man to become a unique agricultural section, in which products not capable of production elsewhere in the United States can be successfully grown.

This desert derives its name from the Colorado River, its creator and until recently the erratic master of its destinies. Now the river is sullenly yielding to man the dominion that it has maintained since the evolution of the desert from sea bottom to arid valley. This evolution is a very recent event, in a geologic sense, and is one which the scientist is able to decipher with exceptional and satisfactory definiteness.

The desert valley is a northeastward extension of the depression whose southern portion is filled by the Gulf of California. During a time that is not at all remote, geologically speaking, the gulf occupied all of this depression, extending

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inland 200 miles farther than at present, so that its waves lapped the base of the Santa Rosa Mountains and of San Jacinto Peak—physical features that are now far inland. At that time the mouth of the Colorado River was in the vicinity of Yuma, Arizona, 60 miles in an air line north of where it now is. Presumably, then as now, the river discharged annually into the gulf sufficient silt to cover one square mile to a depth of 53 feet. This material represented the products of the erosion of the great canyons in Utah and Arizona that are properly regarded as among the wonders of the western world.

At the point where the river discharged into the old gulf this silt was deposited as a great delta which gradually extended entirely across the gulf to the Cocopah Mountains on its western shore. As a result of this extension the water body was divided into two parts, the one an inland sea and the other the modern gulf, with about the same dimensions and outlines that it has today.

Delta growth, however, did not cease with this separation; silt continued to be brought down by the Colorado and to be deposited in its bed, along its banks, and in the still waters at its mouth. By this process a stream builds up its immediate channel until this channel is higher than the adjacent land on either side. It is then in an unstable condition and will shift to more favorable courses at times when extreme floods breach its immediate banks. By this process continually repeated it comes eventually to flow over all parts of its delta, building up each part in turn, until the whole stands well above sea-level. By such a process the Colorado River has built the famous delta lands of the Imperial Valley, and meanwhile has discharged alternately into the Salton Sink and the Gulf of California.

During those periods when it discharged into the sink this basin was filled with water and became an inland lake. During the other periods when it discharged southward away from the lake the supply of water which it contained quickly dried away and left the old lake bottom as the Colorado Desert. Doubtless this process was repeated many times, but there exists clear evidence of only the last occupancy. This evidence is in the form of a remarkably well-preserved old water line (see page 682) that rims the desert from Indio to the Cerro Prieto at a height of 40 feet above sea-level. On the rocky points that projected into the lake this shore line is indicated by thick deposits of calcium carbonate, usually spoken of as coral by the desert dwellers because of a fancied resemblance to this mineral. Where alluvial cones and the sandy floor of the desert formed the shore line, beaches have been developed, and although of soft sand and easily eroded, they are even now well preserved, thus testifying to the recency of the action that produced them. Over the floor of the desert and along the sandy beaches are myriads of shells of brackish water mollusks that lived in the lake. So abundant are these tiny fossils in the northern end of the desert that it has been called, on account of their numbers, the Conchilla (Little Shell) Valley.

It is not possible to state the exact period at which this lake disappeared. The time units of geology are too large and too indefinite to translate satisfactorily into years, so that when we say the last existence of the lake and its disappearance are the most recent of geologic events, we still leave the mind groping for a definite human standard of time. It is the crudest of estimates, merely a guess, indeed, to state that, reasoning from geologic evidence alone, it may be a thousand years since the lake vanished, yet it puts in concrete form such a guess as the geologist is able to make.

When human records are studied, some evidence on this point is found, but it is almost as uncertain as to time as that furnished by the physical features. The Indians now living at Toro and Alamo Bonito have distinct legends to the effect that at some time in the past the valley was occupied by a large body of water. They record that this water contained many fish, and that it disappeared grad-

until eventually the lake became When questioned as to the date of event they state that it occurred as ago as the lives of four or five very men, say three or four centuries ago most. It is not probable that their ements are at all accurate as to time, by combining them with the evidence nished by physical conditions it is ible to say that the lake may have appeared and left the desert, as we ve known it in historic time, 600 or 0 years ago.

With the establishment of routes across continent, as a result of the discovery gold in California in 1849, the west-ard-faring emigrant who selected the uthern route regarded the Colorado esert as the last and most difficult of e areas to be crossed before the prom-ed land was reached. Its summer heat extreme and its aridity is such that metimes a year or more passes without drop of rain, and the average for many easons is less than 3 inches annually—uch less in twelve months than in New ork city in one month. The native egetation includes such curious and dis-orted forms as the ocatilla, the spiny arrel cactus, the dreaded cholla, the leaf-ess palo verde, the ironwood, whose iber is so dense that the dry trunk will ink in water, and here and there clumps of greasewood or gray sagebrush.

Many legends have been related of the desert and the tragedies enacted within it, and among these one of the most interesting appeared in a magazine of wide circulation in September, 1891. This article was a graphic account of the finding of the hulk of an old Spanish galleon in the playa which at that time formed the lowest part of the desert.

The story was reported .to have been told to the writer of the article by a prospector who, leaving the groups of springs in the vicinity of what is now the Toro Indian Reservation, attempted to cross the 100 miles of waterless desert that separates these springs from the old Butterfield stage line far to the south near the Mexican line. The narrator states that while riding down the western edge of the basin his attention was attracted by a curious object within the lowest part of the sink. He attcmpted to ride to it, but when still some distance away his horse broke through the salt crust of the saline marsh and was so injured that it had to be killed, The rider then tried to approach the hulk on foot, but the marsh was too treacherous **and** he was not able to reach it. He states, however, that it was distinctly visible; that it was clearly the hull of a vessel of antique type, with high prow and stern and stumps of broken masts.

After his attempt he retraced his steps to the western border of the desert and continued his journey to the south on foot, but long before getting to his objective point, Carrizo Station, the water that he carried in his canteen was consumed and he was in danger of death. He wandered on in delirium across the sandy wastes and through the bad lands, losing consciousness and reviving again and again, and was finally found barely in time to save his life by the keeper of the station. The tale is graphic and picturesque enough to be its own excuse, but it bears the earmarks of belonging to the type with which the imaginative and sardonic western plainsman is wont to beguile the tenderfoot.

No later explorer has found a trace of the old Spanish galleon, although many have visited the Salton Sink, and before its inundation by the Colorado River salt mining was carried out on a commercial scale within it for many years, so that it was intimately known. Furthermore, it must have been inherently **im**possible for any of the earlier Spanish explorers who passed up the west coast of North America and into the Gulf of California to penetrate to the Salton Sea, even had it existed at the time of their explorations, because so nearly did evaporation' balance inflow from the Colorado that the stream connecting the lake and the gulf must have been too small for navigation and, if we may judge from present grades, too swift for ships of the old galleon type to make headway against the current. Cut even

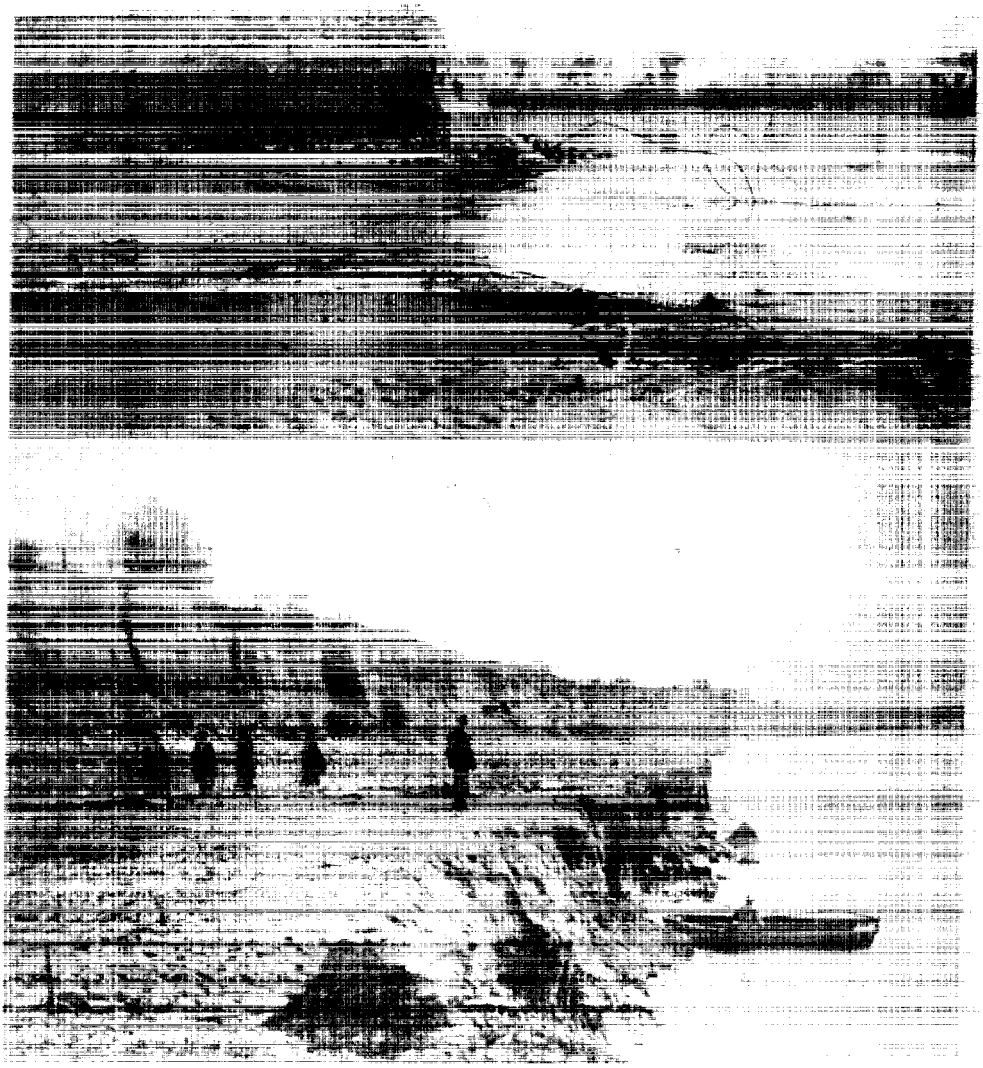
SEVENTEEN PALM SPRINGS NEAR THE SOUTH END OF SANTA ROSA MOUNTAIN, ON THE WESTERN BORDER OF COLORADO DESERT

there is no Spanish hulk in the ... of the Salton Sink and no evi... that a lake had existed there within ... time, there can be no possi... of doubt of the existence of this ... in the latest of prehistoric periods. ... desert became known to white men ... the activities of the early Span... explorers, who, pushing northward ... Mexico into Arizona and Cali..., finally established an overland ... connecting the Mexican missions ... that Pacific Coast group that ... from San Diego to San Fran... The earliest of these Spanish ex... to leave a full record of his jour...ings is Father Francisco Garces, who ... at least four trips on foot through ... Sonoran deserts into southern Cali..., and on one of these journeys ... northward nearly to San Fran... Bay. The simple and devout padre, ... onward by the desire to extend ... faith to the California Indians, at last ... his life in the massacre on the Colo... at the mouth of the Gila in 1774. ... massacre checked the missionary ... for a time, but occasional ex... continued to penetrate the region, ... that it had become known in a general ... when the discovery of gold in Cali... in 1849 led to the crowding of all ... western trails by the argonauts.

One of the results of the stimulus given to western exploration by the gold discovery was the organization, under the auspices of the army engineers, of a series of expeditions whose object was the determination of possible railroad routes to the western coast. One of these explorations, commanded by Lieutenant Williamson, was assigned to the southwestern field, and to it was attached Prof. Wm. P. Blake, now Territorial Geologist of Arizona. In the course of the explorations of this party Professor Blake visited the Colorado Desert between November 13 and December 19, 1853. In the volume based on his explorations Professor Blake gives a complete and graphic account of the great desert and the phenomena displayed there. He recognized that the depression was but the bottom of a vanished lake, whose depth and extent, however, he was unable to outline definitely because of the lack of accurate maps. All later scientific descriptions of the desert are based on Blake's account and have done nothing more than add detail to the general principles which he outlined more than half a century ago. The work, though done in the briefest time and under great physical difficulties, has borne well the tests of all later investigations.

The desert, although known and traversed when necessary, continued to be shunned and dreaded until as late as 1879, when the Southern Pacific Railway became a transcontinental line by connecting New Orleans with Los Angeles along a route that crosses the southern extension of the Sierra by San Gorgonio Pass and follows the arid valley from north to south between the pass and Yuma. Since then access to this section has been relatively safe and easy, but it has been so uninviting and so apparently worthless that until about the beginning of the present century it contained no permanent human inhabitants except a few railroad and mine employees, who regarded their assignment as worse than exile.

Engineers, however, had long realized that the silt-covered floor of the desert required only the application of water to become a most productive agricultural area. The fact that it is a portion of the original delta of the Colorado River, across which that stream has meandered many times during the past centuries, means that the task of conducting Colorado River waters to it is a comparatively simple engineering feat; hence several attempts had been made to finance a plan to build such a system as the present Imperial Canal System before the successful organization of the California Development Company. Following the organization of this company construction was begun in 1900, and in 1901, in the month of June, water was delivered across the international boundary at Calexico and the first Imperial Valley lands were irrigated.



VIEW OF THE PROTECTIVE LEVEE AT THE INTAKE OF THE IMPERIAL CANAL SYSTEM
NEAR YUMA, CUT THROUGH AND DESTROYED BY THE COLORADO
RIVER IN DECEMBER, 1909

THE MAIN CUT IN THE NEW RIVER AT CHENOA IN THE SUMMER OF 1907
CLOSED AND OPERATED BY INDIANS

velopment from that time until 1904 rapid, but the silt carried by the rado River tended to clog the canals he irrigation system and to make it ult to secure sufficient water through to irrigate the tributary lands. In r to overcome this difficulty, new in- es were repeatedly cut at the head of ystem, and during the flood period 005 the river, enlarging one of these kes, abandoned its normal course to Gulf of California and, following the erial Canal nearly *to* the interna- al boundary, flowed again into the lton depression as it had doubtless e at many periods in prehistoric time. o we had the strange spectacle of a ighty river wholly abandoning the wer 80 miles of its course and ceasing terly to discharge into the sea. During the next two years repeated efforts were ade to redivert the river from its course land to that toward the gulf; but these ere all unsuccessful until February, 907, when, after the expenditure of hun- dreds of thousands of dollars, the stream was finally controlled and the menace to the valley removed; hut during the two years or more of inflow a great lake nearlg 500 square miles in area had ac- cumulated in the bottom of the Salton depression to a depth of nearly 80 feet, inundating 40 or 50 miles of the main transcontinental line of the Southern Pacific and forcing that road to rebuild on higher lines at great expense.*

With the control of the river regained and the menace to property interests in the valley thus removed, development, suspended for a long time, has been re- sumed at a rate that promises to more than make up for the delay.

The principal elements in the history of this extraordinary region may be briefly summarized: First, in earlier pre- historic time it was an arm of the Gulf of California; then, perhaps during the Middle Ages of human chronology it had become an interior lake, separated from the gulf by the delta of the Colorado River; after its separation the lake eventually evaporated and its site became the hottest and dryest as well as one of the lowest points in the United States. It was in this condition when it first be- came known to civilized man.

By the practice *of* the art of irrigation a part of it was later transformed from an absolute desert to a unique agricul- tural community, but as an incident in this reclamation a lake has again been created in the bottom of the depression, and for a long and anxious period there was serious danger that the inundation might extend over practically all of the lands that had been reclaimed. Fortu- nately this menace is passed and develop- ment again continues unimpeded by fear that the erratic river will destroy what in times past it has created.

The desert is interesting for other rea- sons than those due to its strange history. Within it or about its borders are most striking land forms of bizarre types. East of Holtville is **a** zone of sand dunes *12* miles wide and 50 miles long—a re- gion unsurpassed in aridity and in men- ace to the inexperienced traveler by the worst of the Saharan or Tibetan deserts. (See page 700.)

In the western edge of the Imperial Valley, at the east base of the Peninsula Range, are bad lands quite equal in pic- turesqueness and in uselessness to the worst of the Dakota bad lands. (See page 696.)

The rare torrential storms of the re- gion have caused the streams that drain from the bordering mountains into the desert *to* cut strikingly deep, narrow canyons through the sandstones around the desert margin. Some of these cleft- like gorges are scarcely wide enough at the bottom for a man to pass, yet have walls two hundred feet high or more. Others are broader and deeper, but with sheer sides that cannot be scaled except where broken down at the junction of some tributary arroyo. (See page *693.)*

Among the most incongruous elements in the desert physiognomy are two groups of mud volcanoes that seem uncanny, so strangely out of place are

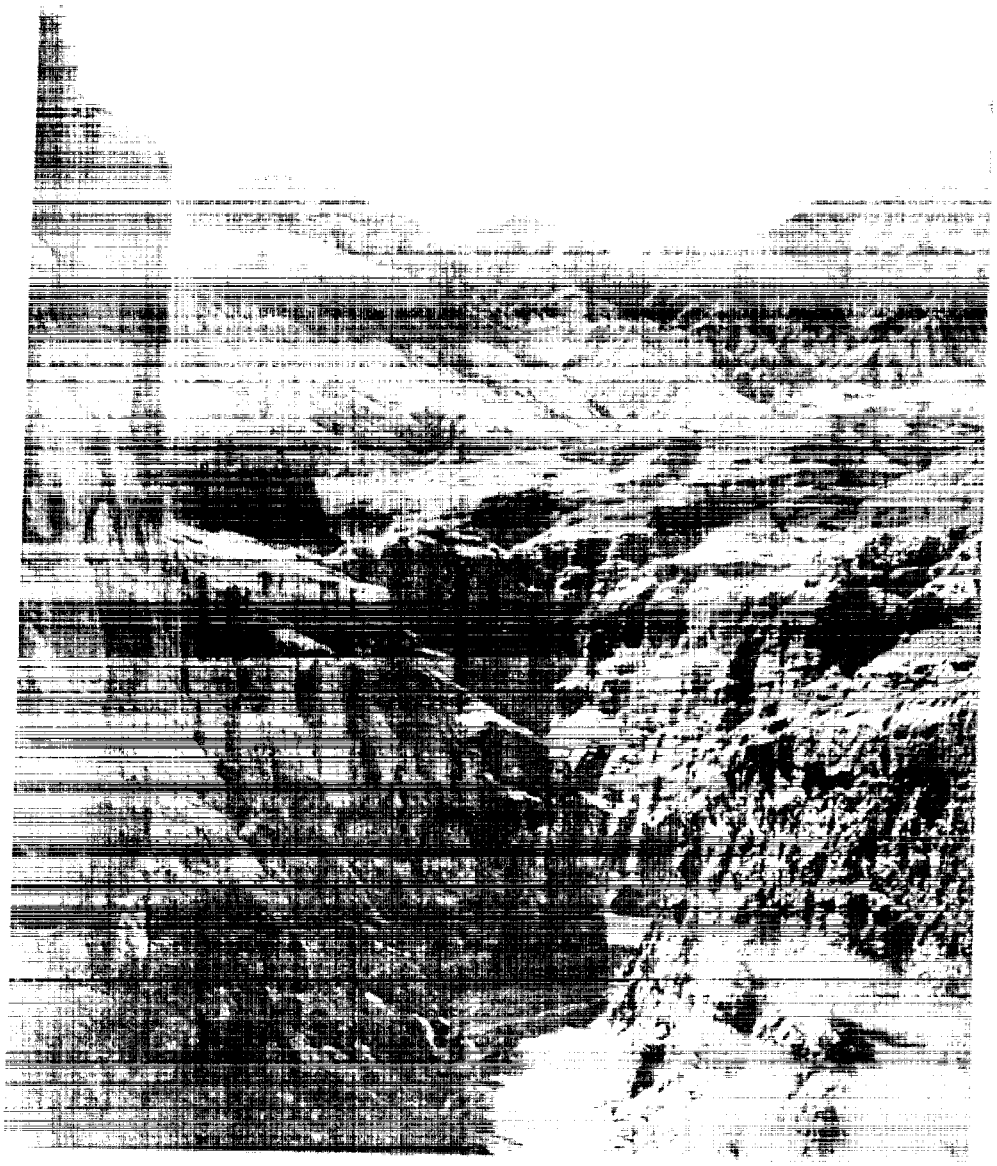
* For further description of this break of the Colorado River see "The New Inland Sea," by **A. P. Davis,** in **NAT. GEOG. MAG.,** January, 1907.

COLLAPSED MUD VOLCANO—A CALDERA IN MINIATURE—NEAR VOLCANO LAKE, MEXICO, 40 MILES SOUTH OF THE INTERNATIONAL BOUNDARY LINE

they in the featureless silt plain which constitutes most of the desert surface. The best known of these groups is now submerged by the Salton Sea. Its situation is about 6 miles south of the station of Old Beach, the junction point for the Imperial and Gulf branch of the Southern Pacific Railroad. These solfataras, before their submergence, were distributed in two or three sub-groups, near some mounds of volcanic rock which rise above the desert floor. They have been visited at various times by explorers and during at least one of these visits a tragedy was narrowly averted. The explorer, in attempting to cross the thin crust that covers the hot mud bog which separated the mounds from the solid ground around them, broke through the crust and was so scalded that his explorations had to be given up and his life even was for a time in jeopardy.

The craterlets of mud look more like irregular beehives in various stages of dilapidation than like any other familiar form which might be mentioned (see page 698). In the tops of these mounds there are often cup-shaped depressions and from these or from vents in the sides steam and other gases are constantly rising (see page 699). These gases contain much sulphurous vapor, and this vapor, condensing as it reaches the air, lines the vents with brilliant yellow crystals and powders the adjacent surface with a golden dust that gives curious and even attractive effects. Round about the mounds are pools of hot mud and water, the latter often so acid that hands or wearing apparel moistened with it are destroyed.

The second important group of solfataras lies not in California, but about 40 miles south of the international boundary line in Mexico, along the western shore of Volcano Lake and near the base of a large dark butte called Cerro Prieto. These volcanoes here cover many acres (see pages 698 and 699) and are much more active than those on the American side of the line. Many of them are boiling and bubbling continually, emitting weird and



DESERT EROSION. A DEEP-CUT CANYON EAST OF CONCHILLA

COYOTE WELLS VALLEY AND THE EASTERN FRONT OF THE PENINSULA RANGE VIEWED FROM THE SOUTH SLOPE OF CARRIZO MOUNTAIN

AN ARROYO WITH ITS SURROUNDING BARE CLAY HILLS IN THE CARRIZO VALLEY. A FRIGHTFUL WAY TO THE DESERT FROM THE WEST

BAD LANDS IN THE COLORADO DESERT

THE SLOPES OF A DESERT RIDGE: THE SOUTH SIDE OF CARRIZO MOUNTAIN NEAR THE WESTERN EDGE OF THE COLORADO DESERT

NEAR THE CENTER OF THE BIG SLIDE OF COLUMBIA GLACIER, ALASKA, THE SURFACE IS CONVEX. TOWARD THE EDGES IT BECOMES CONCAVE. THE SERIES OF SLIDES ARE CONSEQUENTLY MUCH LONGER THAN THEY WOULD BE IF THE ICE WERE FLAT

MUD VOLCANOES NEAR SALTON, SALTON SINK, CALIFORNIA

UPPER TERRACE, EASTERN EDGE OF THE DESERT NEAR MAMMOTH STATION

...give the vicinity an uncanny ... effect, moreover, is in... strange hues of the surface, ... the alkaline efflovescence ... yellow by the sulphur or ... orange by mercury sulphides. ... bluff separates the area occu... solfataras from the flat occu... times of flood by Volcano ... small openings lead from the ... lake into this bluff. These ... like the volcanoes themselves, ... charge vapors, and from some ... hot springs or mud flows issue. ... related that one of the riders ... by a big cattle company that ... the greater part of the range ... the line decided in a moment ... olic inspiration to explore one of ... canny caves. He came out quickly, sobered and shaken, and started for his pony. "The crust's too thin in this neighborhood for me," he is reported to have said. "I don't believe the end of that hole is more than forty feet from hades, and while I'm a fair gambler and only an ordinary sinner, I don't want to take any chances hereabouts. Calexico and the forget-it-water for mine."

But for the sober man the region about Volcano Lake, although a veritable inferno in the desert summer heat, with the puffing of the steam jets, the sulphurous odors, the treacherous, hot marshes, and the weird coloring, is perhaps for that very reason an area of deep interest; but it is only one of many interesting features in a most unique and even yet very imperfectly explored corner of North America.

KING HERRING

Account of the World's Most Valuable Fish, the Industries it Supports, and the Part it Has Played in History

By Hugh M. Smith

U. S. Deputy Commissioner of Fisheries

WHEN one takes a bird's-eye view of the fisheries of the world he quickly perceives that there is no family of fishes and no group of aquatic animals that contributes so largely to the support of the human race as the herrings. The family has 200 members, nearly all of which exist in great abundance.

In nearly every country having extensive fisheries some kind of herring is of importance, and in many countries representatives of the family are among the most valuable of the water products. Some of the herrings live exclusively in salt water, some exclusively in fresh water, and some alternately in the sea and streams.

Characters by which the herrings may readily be recognized are the presence of a single dorsal fin, which, like all the other fins, is composed only of soft or non-spinous rays; the absence of an adipose dorsal fin, such as occurs in the salmons and trouts; a swim-bladder, which communicates with the esophagus by a pneumatic duct; four gills; a forked tail; a terminal mouth with weak or deficient teeth; a fully scaled body but naked head; the absence of a series of "lateral line" organs, and a generally silvery coloration. The structure of the mouth parts determines the food, which usually consists of minute animals and plants, strained from the water by the numerous gill-rakers.