THE NEW INLAND SEA*

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MANY centuries ago the Gulf of California extended to a point about 150 miles northwestward from its present head. It also extended up the present valley of the Colorado River at least to Yuma and probably somewhat above. The Colorado River, rising in the Wind River Mountains of Wyoming and the Rocky Mountains of Colorado, carved the rocks along its course and brought the resulting sands and mud down in its swift current, discharging them into the arm of the gulf near Yuma. As this process went on, without cessation, century after century, the valley was gradually filled, a delta built up, over which the river flowed far out into the gulf. It encroached progressively upon the shores of the gulf until it built up a delta entirely across, joining the foothills of the Cocopah Mountains on the western shore. This cut off the head of the gulf, and the arid climate rapidly evaporated the waters thus separated and left an inland depression, which at its lowest point was nearly 300 feet below sea-level.†

The river continued to bring down its load of sediment and to build its delta higher and force it farther into the gulf. Like all such deltaic streams, the channel on the top of the delta is constantly shifting, cutting one bank, building up the other, overflowing both banks, and during high water sometimes entirely abandoning an old channel for a new one. In this way the river has from time to time flowed into the Salton Sea for some years or centuries, and anon has shifted to the eastward and discharged again into the gulf. This is the general course the river has followed ever since its discovery by the Spaniards in the 16th century. .It high water the river normally overflows its banks in the valley regions all the way from the Grand Canyon to the Gulf of California. In unusually high water, such as occurred in 1891, the overflow running into the Salton Sink has been sufficient to materially raise the level of the lake and overflow the tracks of the Southern Pacific Railway, which are built along its shores.

THE IRRIGATING COMPANY RESPONSIBLE FOR THE BREAK

The ease of diverting the Colorado River near the international line and conducting the water through natural channels to the Colorado Desert for irrigation has been recognized for many years, and various attempts to promote this project have been made from time *to* time. usually, however, without success, owing to the international complications involved.

About 1891 Mr C. R. Rockwood, a civil engineer, made plans for the construction of a headgate in rock at the foot of Pilot Knob, just north of the Mexican line, and of a canal to carry the water to the so-called Alamo River, an ancient channel of the Colorado which, by lapse of centuries, had been nearly filled with sand and sediment. Efforts to promote this project were for nearly 10 years unsuccessful, but finally a small amount of money was raised, which, however, was insufficient for the construction of the works as planned. The promoters then concluded simply to cut the dirt hanks of the river and lead the water by a small canal into an old channel. whence it flowed into the Imperial Valley without additional construction. A cheap wooden headgate was built in the canal near the river and was for a

* An address to the National Geographic Society, November 23, 1906.

† It is estimated that the amount of silt carried by the Lower Colorado River is sufficient to cover 53 square miles one foot deep with dry alluvial soil each year.

time used in the control of the waters. The water was diverted from the Alamo channel at a point called Sharp's Heading, just below the Mexican line, in the southern edge of the Imperial Valley. The water was led by canals over the land to be irrigated and settlement began.

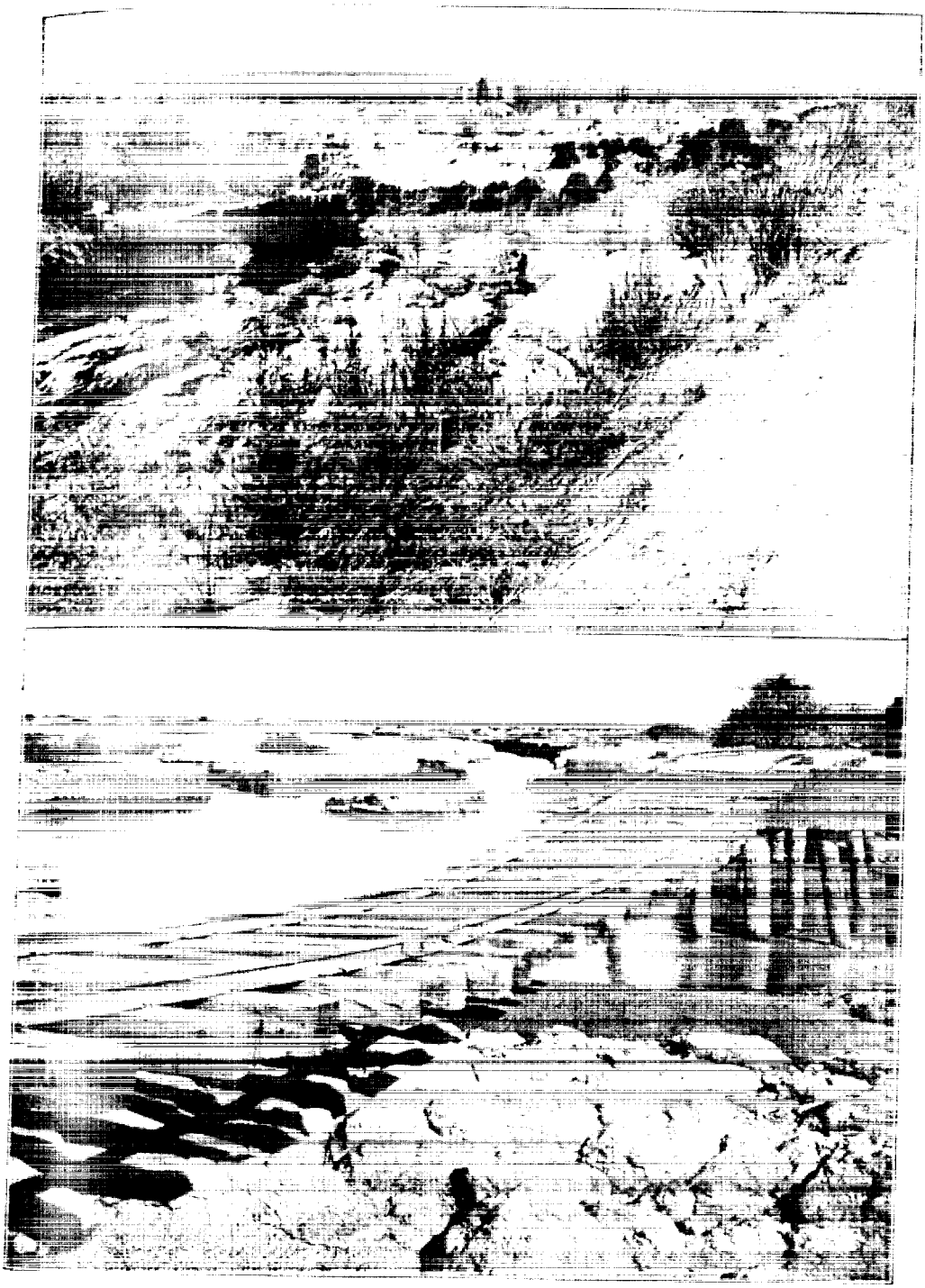
The headquarters of the irrigation company were established at a town called Calexico, adjoining the Mexican line, this name being derived by substituting the first syllable of the word "California" for the first letter of "Mexico." Settlers gradually came in and, the valley proving to be very fertile, development proceeded apace. As the demand for water became greater, however, the supply became less. The muddy waters of the Colorado River, checked by their entrance into the artificial channel, and still further checked by the obstruction of the headgate, deposited their load of mud, and constant effort was necessary to keep the heading open. The unsuccessful attempts to maintain the canal heading led to its abandonment and to the cutting of a new one near by in which no headgates were provided. This gave somewhat less trouble, but it, too, gradually began to fill and the effort at maintenance had to be continued. Several new headings were cut for the same reason, and serious losses occurred in the Imperial Valley from shortage of water during the time when most needed, owing to the difficulty of getting sufficient water into the head of the canal.

After repeated failures of the effort to maintain an open canal heading, the company finally went to a point about four miles below the Mexican line, where a greater declivity from the river bank could be obtained in a shorter distance, and there cut a large channel, with the idea of obtaining a sufficient velocity of water to prevent the deposit of sediment in the canal heading. In this respect the attempt proved successful, and throughout the low-water season of 1904-05, which occurs in winter, a large supply of water was furnished through this channel, sufficient for the irrigation of about 75,000 acres of land, most of which was under cultivation in the Imperial Valley. The Southern Pacific Railroad built a branch road from Old Beach through Brawley, Imperial, and Holtville to Calexico, and began building through Mexican territory from Calexico to Yuma, intending to make this the main line and cut out some heavy grades now encountered between Pilot Knob and Yuma.

THE BREAK OF JUNE, 1905

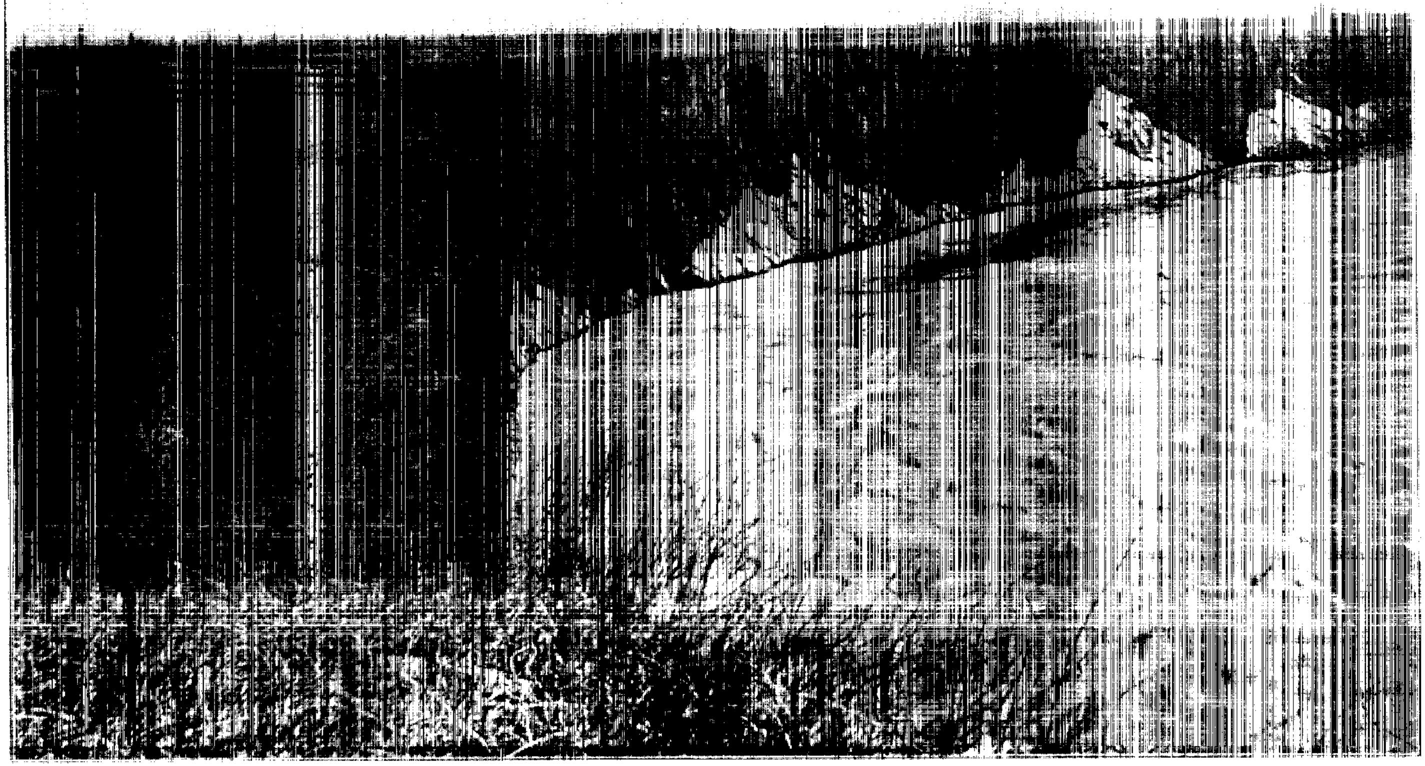
The large new heading in Mexico maintained itself without silting throughout the low-water season, but when the annual flood of May arrived the larger volume of water and the consequent increase in velocity began cutting the channel, and in June it was found that the volume of water running toward the Imperial Valley was many times that required for irrigation and was rapidly cutting the channel wider and deeper. By the end of August, 1905, the majority of the water of the Colorado River was flowing toward the westward instead of the south, and the Salton Sea was rapidly rising and submerging portions of the Southern Pacific Railroad track, which were hurriedly moved to higher ground.

The distance from Yuma to the Gulf of California along the general course of the Colorado River is about 75 miles. The distance to the Salton Sea is not very much greater, but the difference in elevation between the gulf and the Salton Sea is about 280 feet. The gradient from Yuma to the gulf is about two feet per mile along the windings of the river, which is the natural gradient adopted by this river under the circumstances with which it is beset. The channel to the Salton Sea, therefore, had more than 200 feet surplus declivity, so that the water in running through that channel was rapidly eroding its bed. It cut the gorge wider and deeper near the Salton Sink and formed great falls or cataracts in the channel. The channels near the vicinity of Calexico had been so nearly obliterated with the lapse of time that



Over the Inverted Valley Which Was at First Inundated and Then Left High and Dry by the Deepening Channel

The Southern Pacific Railroad tracks were cut into and washed [illegible] before the channel had cut any depth in the [illegible]



This photograph shows the way in which [illegible] undermined and washed into the New River channel. It was taken 4½ miles northeast of the town of Brawley, California

the waters spread over a large area of the country, and as the quantity increased threatened to engulf the farms and the town of Calexico. Large dikes were hurriedly built to shut out the water, and the town was thus saved from disastrous inundation before the waters rose high enough to sweep it away. In the meantime channels formed near the Salton Sea, and were cutting deeper and deeper, the cataracts therein were advancing upstream as the water undermined them and carried the debris into the sea. As these cataracts advanced upstream they left below them. of course, deep channels, which carried all the water far below the surface of the surrounding country to the Salton Sea. In the early part of the present year the cataract in New River had reached Calexico, after which, instead of threatening to overflow this town, the water was in a gorge 45 feet below the surrounding country. Opposite Imperial the channel of New River is over 80 feet in depth and that of the Alamo nearly as deep.

The large amount of water flowing down the Alamo River was rapidly eroding this channel throughout its course. Sharp's Heading is a cheap wooden structure and has been for some time in imminent danger of washing out, which would have left the canals of Imperial Valley without water for irrigation, though domestic water might have been obtained with great effort from the deep channels of the Alamo and New rivers.

THE RETREATING CATARACT

The deep channel in the Alamo River, which passed Holtville in August, was gradually approaching Sharp's Heading, and it was recognized that when this cataract reached the heading it would be very difficult and expensive, and perhaps impossible, to maintain that heading. This, however, was not the only peril to the water supply of the valley. The channel of New River had eroded to such an extent that where the two streams separated it was estimated that four-fifths of **the** water was running down New River and only one-fifth down the Alamo. While this proportion was favorable to the regimen of the Alamo and the safety of Sharp's Heading, it was very threatening in another respect. It accelerated the rutting of the New River channel, in which was a great cataract four or five miles below the separation of the two streams, and this was, of course. advancing upstream. It was well recognized that when this cataract reached the Alamo the channel would he so deep that all of the water would run down New River and leave Sharp's Heading on dry land, without any water for the irrigation of the Imperial Valley. Threatened first with inundation, and nest with the destruction of their entire water supply, the inhabitants of the Imperial Valley have naturally been almost **in** a state of panic for several months.

THE SAFETY OF $100,000,000 IN THE BALANCE

The continuation of the flow of the Colorado River into the Salton Sea meant the gradual inundation of the entire Imperial Valley. Whether the lake would ever rise high enough to actually flow out through Volcano Lake to the Gulf of California is problematical. Volcano Lake is about 30 feet above sea-level. Taking the mean annual discharge of the Colorado River at 9,000,000 acre-feet and the evaporation at 6 feet in depth per annum, the lake would fill in 40 *to* 50 years and would flow a considerable stream perennially into the Gulf of California. Rut taking the more probable values of 8,000,000 acre-feet for the mean annual inflow and 7 feet in depth for the mean annual evaporation, the depression would never fill. It would rise to a point 8 or 10 feet above sea-level and oscillate above and below this level in accordance with the fluctuating annual discharge of the Colorado River.

Either result, however, would have been destructive of enormous interests. It would have submerged 150 miles of

the railroad track of the Southern Pacific road, and would have required extensive alterations of its alignment in the vicinity of Yuma. The rapid erosion of the channel leading to the Salton Sea would advance upstream slowly but surely. It has already cut the channel at Yuma two or three feet below the former level. This cutting would be continued until the *zoo* odd feet of excess fall in the channel had been distributed up the Colorado River, eventually, perhaps, as far as The Needles. It certainly would have cut a deep channel up to Parker—so deep that it would probably have been entirely impracticable to dam antl divert the Colorado River at any point below Bill Williams Fork, and thus it would have become impossible to irrigate the great valleys of thr Colorado River. These valleys aggregate about 400,000 acres. It is estimated that there are 300,000 acres. of fertile irrigable land in the Imperial Valley and twice as much more in the Colorado delta in Mexico. The lands referred to are now settled by a population of 12,000 to 15,000 people, most of whom would have had to abandon their homes.

It may be said, therefore, that during the past year the fate of 700,000 acres of fine irrigable land, in a semi-tropical climate, the homes of over 12,000 people, and 150 miles of railroad track have been trembling in the balance. It is impossible to assign definite values to all these elements, but $100,000,000 would not be an overestimate.

The railroad company spent immense sums of money in repeated removals of its track, as the shores of the Salton Sea grew higher and higher, and also experienced great difficulty in preventing the destruction of its bridge across the Alamo River, as the channel cut deeper antl wider. The railroad company appreciated the gravity of the situation in the summer of 1905 antl made a large loan to the irrigation company for the purpose of damming the channel. Repeated efforts to do this were unsuccessful, and the control of the irrigation company passed into the hands of representatives of the railroad company. About one year ago the construction of a dam across the new channel was in progress, antl strong hopes were entertained by the railroad people of the success of the attempt, when a very large and unexpected flood came down the river, which carried away the works antl left the situation more threatening than ever. As soon as the water subsided sufficiently the efforts were renewed and continued throughout the spring of 1906 without success. When high water came in May the company was obliged to abandon its efforts until after the flood season. The heavy discharge of the river during May, June, and July nearly all went down the Alamo and New rivers and cut the channels larger and larger. The railroad south of the Mexican line was entirely washed away, the former site finally becoming a deep channel.

THE DESTRUCTIVE CATARACTS

The cataract in New River advanced upstream past Calexico, took away some of the buildings of that town, antl nearly all of the buildings of the Mexican village of Mexicala, and continued to advance eastward at a threatening rate. The Alamo River cut back similarly, antl in August, 1906, the cataract had passed the town of Holtville antl caused the temporary shutting down of the power plant at that place. In the endeavor to prevent the destruction of valuable buildings and farms, the people macle strenuous attempts to guide the cutting of the water by the use of dynamite to assist the cutting where it would do less damage than if left to its own inclinations. It is not apparent, however, that any great benefit resulted from these attempts. During the high-water season of 1906 the irrigation company made two plans for the diversion of the destructive waters. One of these, the success of which was relied upon, was the construction of large headgates at the foot of Pilot Knob, substantially

originally planned by the engineers. was planned to dig a channel from the river above these headgates large enough and deep enough to divert the water without very much obstruction and carry it to the Alamo River below its junction with the Colorado. This would leave the new channel dry and permit a dam to be built there and levees along the river to close the disastrous break. This work, however, required a very large amount of excavation, estimated to cost nearly a million dollars. The headgates were built, but no sufficient machinery was available for the excavation, and the construction of a mammoth dredge was undertaken at Yuma. This dredge, mounted upon an enormous pontoon, was to have a capacity of lifting about six tons of material at once, and is now finished and at work.

Realizing the large amount of time that would be required for this excavation, and in the face of the heavy cost of repeatedly moving its tracks onto higher and rockier ground along the Salton Sea, the company concluded to make a preliminary attempt to dam the new channel by constructing a by-pass around the proposed dam site, through which the water could flow as the darn raised it higher and higher. Wooden headgates were built in the by-pass, and in August the construction of the dam was commenced.

DESPERATE ATTEMPTS TO REGAIN CONTROL

At this period the situation looked very gloomy; every condition was unfavorable; the river, instead of corning down to its normal low water, was discharging nearly twice as much water as it ordinarily does at that time of year. The large amount of construction in progress in the Southwest made it extremely difficult to obtain and keep laborers in the hot climate and primitive surroundings of a construction camp. The great heat also made it extremely difficult to employ animals to advantage in excavation or transportation of material. The heavy demands made upon rolling stock made it very difficult and expensive for the railroad company to transport materials for this construction; but, in spite of all these difficulties, the officials, with commendable energy, poured money and men into the breach with an unstinted hand, with the determination to make this effort successful. It was recognized that the work was daily becoming more difficult; the channel was cutting deeper and deeper, and if the river were not controlled during the present low-water season it probably never could be, as another high-water season would cut the channel so deep that, without rock foundation or any means of holding a large structure, it would be impossible, or at least enormously expensive, to accomplish the work the following or any subsequent year.

A railroad was built from the main line to the proposed dam site and continued across the river on piling; a large camp was constructed and laborers assembled; huge pile-drivers and dredges were brought to the ground, and piles were driven at intervals across the channel where it was proposed to build the dam. At points about 500 feet apart in the river and along the located line of the trestle, two bulkheads were built, one composed mostly of rock and brush on the south side, and the other almost entirely of fascines, on the north side. A mat 100 feet long, up and down stream, was placed on the bottom between these abutments, the piles of the trestle pinning the mat to the bottom. Over part of this mat a second mat was placed.

Immediately after the construction of the railway across the river the operation of building the remaining 500 feet of dam between the two abutments was begun. Steam shovels loaded 40-yard automatic dump cars at quarries four miles away, and train-loads of these cars were run out on the trestle and dumped into the river upon the mat. Gradually the river rose, until on October 10 the difference in elevation of the water above and below the dam was six feet, and practically the whole river was flowing through the gates.

The engineers in charge had detected catting in front of and below the gates, and in anticipation of their failure had built a trestle across the river above the gates, with the intention of dumping in enough rock to partially close the gates and relieve the situation there. At 3.15 on Thursday, October 11, a large part of this gate, known as the Rockwood gate, went out. The river rapidly scoured a deep channel, lowering the surface of the water above the dam until there was only a difference in elevation of about three feet. Work was immediately begun on repairing the trestle below the gates, which had been injured both by the increased flow and by the timber carried away from the gate. From all the available quarries within a radius of from three to four hundred miles, rock was hurried to this point and dumped rapidly from the lower trestle. At the same time the trestle which had been started above the gates was strengthened, and as soon as it was in shape cars were run out on that and rock dumped in. In the meantime part of the material that had been dumped between the two abutments in the river and over which the overflow had taken place was removed and gradually the channel through the Rockwood gate was filled up.

When this was entirely filled, so as to throw the entire flow of the river over the central portion of the dam, the filling of this portion was again resumed. Large blocks of granite weighing several tons, as well as smaller material, was hauled out as rapidly as trains could bring it and gradually the gap was closed.

The river during all this time did not go below about 9,000 second-feet, adding materially to the difficulties expected.

On November 1 there was an eleven-foot difference in the elevation between the water below and above the dam and about one-half the water in the Colorado was going down its old channel. By noon of November 4 the dam was high enough so that practically the entire flow of the Colorado River was returned to its old channel, and since this time the work has steadily gone on raising the dam and riprapping its upstream and down stream slope.

Great credit is due to Mr Epes Randolph, general manager, and Mr H. T. Corel;, engineer in charge, for the energy and skill with which this work was handled.

HOW SOON WILL THE LAKE DRY UP?

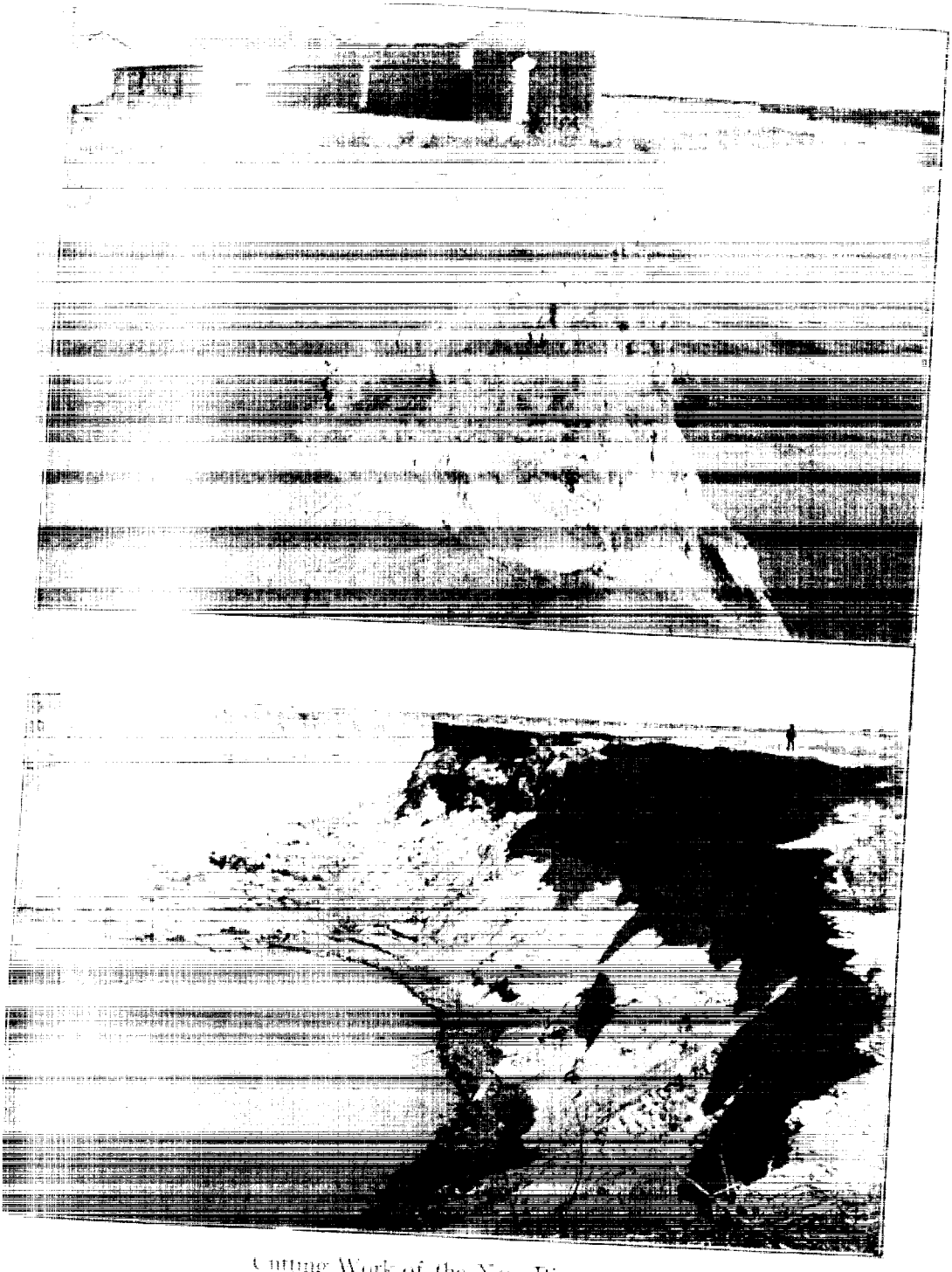
The area of the present Salton Sea is over 400 square miles, and its depth about 90 feet. If the river discharges no water into the sea, it will probably dry up in about 10 or 12 years.

Levees must be built along the entire western bank of the Colorado River from Pilot Knob to high ground far into Mexico, probably 15 to 20 miles, because if high water ever overflows this river again and reaches the deep channel which now exists there, it will rapidly erode the channel back to the river and the disaster of 1905 will be repeated.

In order to prevent the Imperial Valley being deprived of water for irrigation, it is necessary to build a new canal from the headgates at Pilot Knob to the channel of the Alamo River. This can doubtless be completed in a few months, and some water is already flowing through the old Imperial Canal, which is approximately along the same line, so there is no danger to the people of the Imperial Valley.

Some persons have suggested that the existence of the Salton Sea during the past year has had a tremendous effect upon the climate in that vicinity in Arizona, and even as far east as Texas and New Mexico. Much publicity has been given to this idea, it having been caught up by newspapers as something worthy of a story.

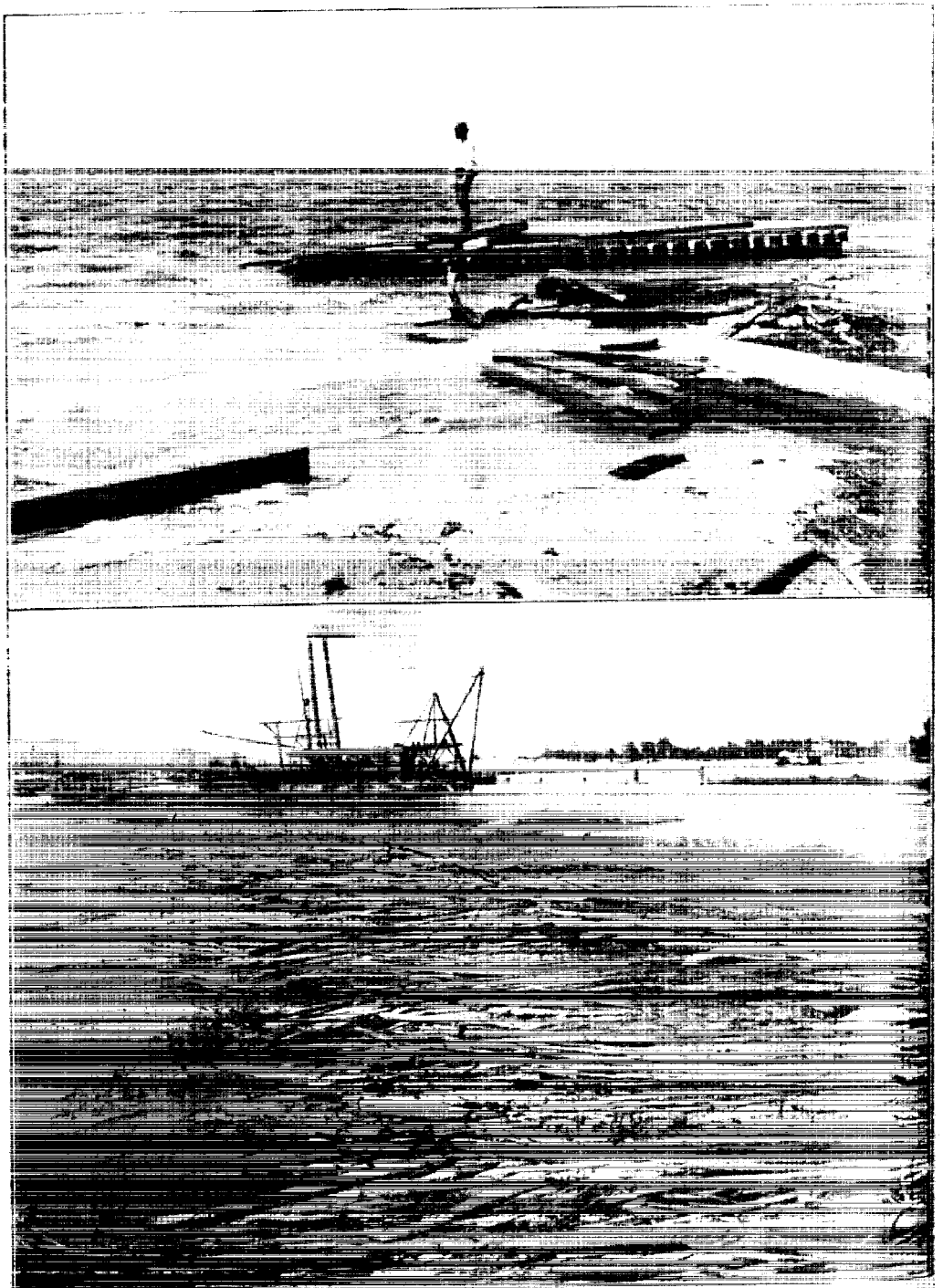
The absurdity of any such idea may be inferred when we notice that only a short distance to the southward of the Salton Sea occurs the great inland Gulf of California, which is hundreds of times larger than the Salton Sea, and yet there is no very marked influence upon the



Cutting Work of the New River

...graph shows how the Mexican town called Mexicala was partly destroyed by the ... River cutting into the town at this point

... washed banks in the big bend of the New River, 5 miles northwest of the town of ..., California. These banks are from 60 to 80 feet in height and are constantly ... into the river bed and washing away, consequently widening the river and cutting ... into the farm lands



The Great Salton Sea, 205 Feet Below Sea-level at this Point, Near the Salton Station on the Southern Pacific Railroad

Brush dam at the headworks of the California Development Company's dam in the Colorado River, just below the old river bed

climate. Besides being so much larger, the Gulf of California is somewhat nearer Arizona, New Mexico, and Texas and is separated from them by fewer mountain chains. If any influence could be exercised by the Salton Sea, hundreds or even thousands of times as much influence would he exercised by the gulf itself; yet no such influence can be detected in that vicinity.

Those who hold to this idea apparently ignore or neglect the fact that the same causes that have led to the creation of the Salton Sea have led to the cutting down of the bed of the Colorado River and the prevention of its nortcal annual overflow at Yuma and all points below there. The great delta, therefore, which is annually overflowed under normal conditions has received no such overflow since the river has been running into the Salton Sea, at least during the past high-water season, and this fact itself would counteract any influence that might have been exerted by the evaporation from the surface of the Salton Sea.

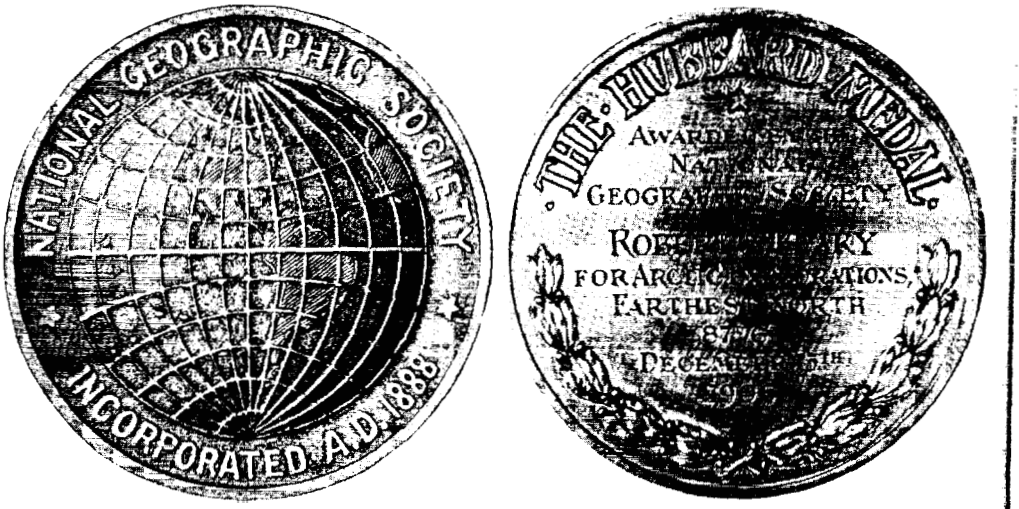
Climate is the result of great cosmic influences so great and extensive that the Salton Sea would he a neglible quantity beside them.

CONDITIONS WORSE THAN BEFORE

A few days after this address was delivered, the Colorado River worked its way around the dam, which had been built at cost of so much labor and money, and plunged on again to the Salton Sink. The flow of water has been unusually great for this time of year, which complicates the situation. The cataract of the New River has now advanced a long way above Mexicala and is rapidly approaching the Alamo. If the cataract once joins the Alamo the entire Imperial Valley will be cut off from water, and left high and dry until the new Salton Lake has risen sufficiently to inundate the entire region.

Some perplexing questions as to who is responsible for the damages will arise, for the company whose carelessness caused the break is chartered under the laws of Mexico, while all the capital and all the stockholders are American. The break, furthermore, occurred in Mexican territory.

The Southern Pacific Railway is making Herculean efforts tu turn back the river, but the situation has become very desperate.



The Hubbard Medal of the National Geographic Society, the First Award of Which was Made to Commander Peary December 15, 1906

Not only the people in the Imperial Valley are threatened, but also the Laguna Dam above Yuma, which has been built at a cost of one million dollars. The great cataract, which resembles Niagara Falls and is 1,500 to 1,800 yards wide and has a fall of 90 to 100 feet, is working backward at the rate of one-third of a mile a day. If not checked it will reach and destroy the Laguna Dam, and ultimately deprive of water every farm along the Colorado River up to the Grand Canyon, causing a damage of approximately one billion dollars.

HONORS TO PEARY

An account of the presentation of the Hubbard Medal to Commander Robert E. Peary, U. S. Navy, by President Roosevelt, on behalf of the National Geographic Society, at the annual dinner of the Society, December 15, 1906, with the congratulatory addresses of President Roosevelt, the Italian Ambassador, and the Secretary of the Navy, and Mr Peary's responses.

ABOUT 400 members and guests of the National Geographic Society united to pay honor to Commander Robert E. Peary, U. S. Navy. on the occasion of the annual banquet of the Society, December 15, 1906. Ten nations were represented by members of the diplomatic corps and 20 states by Senators and Representatives. A number of members came from New York and Philadelphia to attend. The feature of the evening was the presentation of the Hubbard Medal to Mr Peary by President Roosevelt on behalf of the Society. The medal was specially struck for the occasion, being made by Tiffany & Co., of New York, under the direction of Mr George F. Kunz, a member of the Society. On one side it bears the seal of the Society, an3 on the reverse the following inscription: "The Hubbard Medal. Awarded by the National Geographic Society to Robert E. Peary for arctic exploration. Farthest north, 87° 6'. December 15, 1906." % blue sapphire star, from Montana, marks the point of farthest north attained by Mr Peary.

The members were received in the parlors of the New Willard by the President of the National Geographic Society and Mrs Moore, Commander Peary (illness prevented Mrs Peary from being present), and the Secretary of the Navy, from 7 to 7.30; after which the company adjourned to the banquet hall. After an invocation by Dr Edward Everett Hale, Chaplain of the U. S. Senate, the guests took the places assigned to them at the twelve long tables, which had been decorated by Small & Sons. The U. S. Marine Band played throughout the dinner. President Roosevelt arrived after the dinner had been served and while Dr Cook was speaking.

The first toast of the evening was drunk to the President of the United States, and while the guests were standing the toastmaster, President Moore, asked all to join in a moment of silent memorial to the first President of the Society, Gardiner Greene Hubbard.

In his introductory remarks President Moore called attention to the fact that the National Geographic Society numbered in its ranks the best men of the best nations of the world. He declared that there were present at the dinner some of the men who had achieved the greatest discoveries in science, the greatest lawmakers, the highest representatives of the church. He said that from small beginnings the Society had grown until it now numbered 18,000 members, and he added: "We arc not modest in our ambitions; we wish to know all about the earth, and the waters under the