

6.—REPORT UPON CERTAIN INVESTIGATIONS RELATING TO THE PLANTING OF OYSTERS IN SOUTHERN CALIFORNIA.

BY CHARLES H. GILBERT.

[Plates XXXI to XXXIV.]

ALAMITOS BAY AND NEWPORT BAY, CALIFORNIA.

The coast of southern California contains few harbors or mouths of rivers suitable for the cultivation of oysters. The proximity of the Coast Range of mountains and the limited rain-fall conspire to produce small rivers, which are dry during the greater part of the year, and at other times commonly reach the sea by filtering through the sands thrown up across their mouths by the waves.

Two of the most promising estuaries, Alamitos Bay and Newport Bay, were visited in January, 1889, by the writer, accompanied by Mr. N. B. Miller, of the Fish Commission steamer *Albatross*.

Alamitos Bay lies 3 miles east of Long Beach, a sea-side resort about 20 miles distant from Los Angeles, with which it is directly connected by rail (see plate XXXI). The bay consists of a channel, several miles in length, and with an extreme width of 400 yards, winding through the flat country which here faces the coast. Near the entrance to the bay it receives from the east the New San Gabriel River, and higher up a number of narrow channels, Croaker Strait and Mud Creek from the east, and Headquarters Creek, with three smaller channels, from the west.

At a distance of $2\frac{1}{2}$ miles from the entrance to the bay, and above the mouth of Mud Creek, the channel is about 150 feet wide and 6 feet deep at low water. At this point there is exposed, at low water, a flat of perhaps 150 acres, consisting of soft sand covered with a thin layer of mud, and said to be constantly covered at high tide. In the channel the temperature was 60° Fahr., and the specific gravity 1.022187. No native oysters are found thus far up the bay, but cockles and scallops abound. The bottom consists of sand covered with a thin layer of blue mud.

Down the channel toward the mouth of Mud Creek the width increases somewhat, and the depth varies from 5 to 10 feet for a short distance above the creek; the bottom is strewn with scattering oysters. Mud Creek has an average depth of 2 feet for about 2 miles. It contains more mud than other branches and fewer oysters, those found being mainly toward its head. No fresh water is known to flow from it into the main channels, the specific gravity at its mouth being 1.023187.

Between the mouth of Mud Creek and Headquarters Creek the depth in the channel varies from 7 to 9 feet, with a bottom of mixed sand and mud. Headquarters Creek contains an abundance of native oysters, cockles, and scallops, and the water

at its mouth shows a specific gravity of 1.021587. Two creeks entering the channel lower down also contain oysters, which are said to cover the bottom of one of them for a distance of a quarter of a mile. Along this part of the main channel, the depth varies from 10 to 19 feet, and the bottom consists of sand covered with mud.

A short distance above the mouth of the New San Gabriel River, the channel widens rapidly and becomes shallower, the depth varying from 6 to 8 feet, with a bottom of mud and sand and broken shells. Just above the mouth of the river, the specific gravity was 1.015890, and opposite the mouth 1.011948. It is evident that at high tide much fresh water must be backed up into the main channels, and our specific gravities, taken at low water, show a minimum amount of fresh water for that time of year.

The river is said to average 6 feet in depth for a distance of 5 or 6 miles, the tide backing up for the entire distance. The bottom is reported to be sand, with some mud. During the dry season the river ceases to flow in its lower course, but the bay is said to derive a constant supply of fresh water from the numerous springs flowing into it. At the time of our visit about 5 feet of water was found on the bar.

Newport Bay, distant about 10 miles from Santa Ana, is the estuary into which flows the Santa Ana River (see plate XXXII). It is a much larger body of water than Alamitos Bay. In its lower portion it is about one-half mile wide, but it narrows at its entrance and in its upper part. Near the mouth of the river, there is sufficient water on the bar at high tide to admit the passage of small steamers, but the bar is constantly shifting and is unreliable. The bottom of the bay consists of clean hard sand, with little or no admixture of mud. Near the mouth of the river, flats are exposed fully 2 miles wide, the sand of which they are composed being covered with a thin layer of mud.

From the head of the bay, a channel known as San Joaquin Bay extends eastward for 2 or 3 miles, winding among the hills. The bottom of this channel is of mud, very soft in spots, but with many banks of native oysters, which reach a large size. Near the head of San Joaquin Bay, fresh water is said to enter from springs having a constant flow throughout the year; but the amount obtained from this source is apparently small.

Aside from springs, the fresh-water supply of Newport Bay is precarious, being wholly derived from the Santa Ana River. During the dry season, the water of this stream is drawn off for irrigation purposes and it becomes dry in its lower course for at least seven months in the year. At the time of our visit, in the midst of the rainy season, the temperature of the water was 60° Fahr., and the specific gravity at medium high water off the mouth of the river 1.024000. At two points farther down the bay the temperature was the same, and the specific gravity 1.023000 and 1.024000. Later, off the mouth of the river, at low water, the specific gravity was 1.01540.

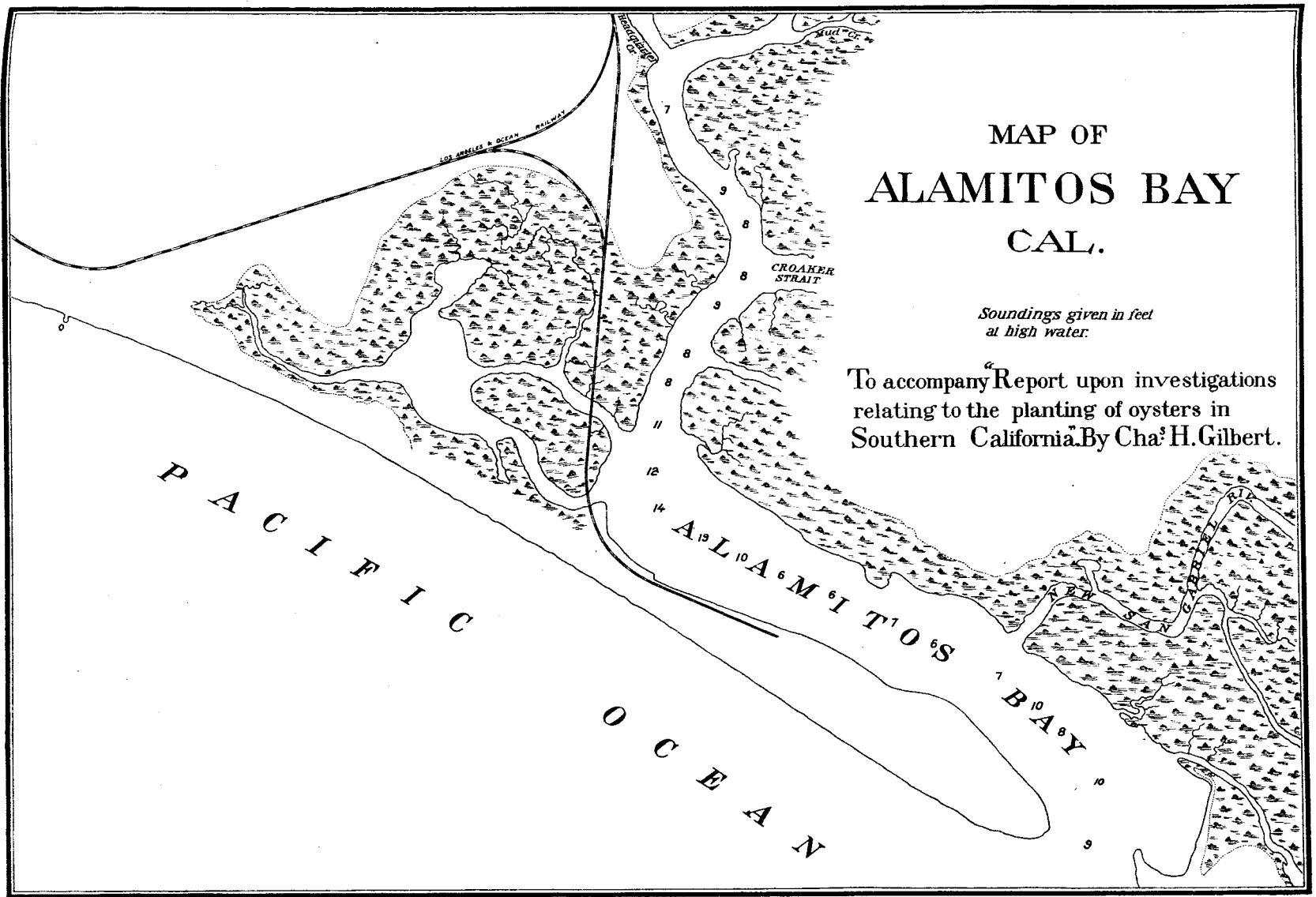
On the wide sand-bar lying between the western shore of the bay and the ocean beach, a well dug into the sand to a depth of 9 or 10 feet furnishes fresh water for a sportsman's hotel located at that point. Salt water is, of course, struck at a depth of a few feet more. On this bar a pond of salt water produces native oysters of large size, said to be of good flavor.

Between Alamitos and Newport Bays, lie Anaheim Bay and the mouth of Los Bolsos Creek. The former is said to have a considerable amount of fresh water rising into it the year round, but has no stream entering it. The mouth of Los Bolsos Creek is an estuary as large as Alamitos Bay, and probably has a more constant supply of

MAP OF ALAMITOS BAY CAL.

*Soundings given in feet
at high water.*

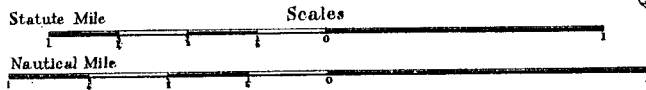
To accompany Report upon investigations
relating to the planting of oysters in
Southern California. By Cha^s H. Gilbert.



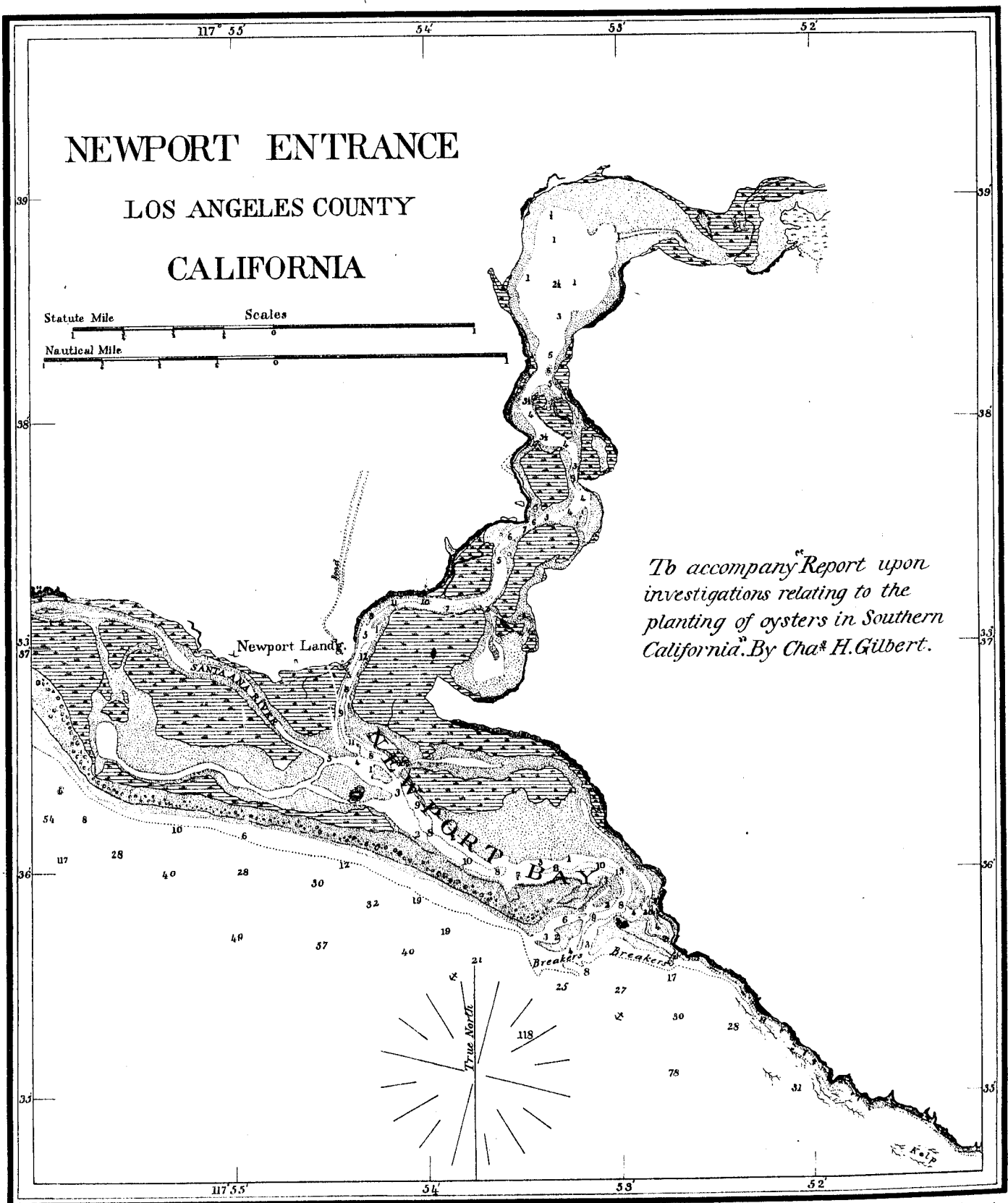
NEWPORT ENTRANCE

LOS ANGELES COUNTY

CALIFORNIA



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fresh water. The bottom is said to be sand overlaid with mud, and to be covered with native oysters.

With the possible exception of False Bay, near San Diego, which has not been reported on, the four bays above mentioned are probably the only ones in which the experiment of oyster-culture could be tried in southern California with any prospect of success. Of these, Alamitos and Newport Bays are the most easily accessible, and the conditions at Alamitos Bay seem on the whole the most favorable. Before making any practical experiments in this direction, it would seem advisable to obtain reports from these bays during the dry season, in order to test the amount of fresh water entering them at that time.

THE OYSTER BEDS OF THE GULF OF CALIFORNIA.

The edible oysters of the Gulf of California are found only along the eastern shore of the Gulf, south of Guaymas (see plate XXXIII). Here, in lagoons near the mouth of the Yaqui River, farther south in the vicinity of Agiabampo and Altata, and probably at other points, extensive natural beds are found.

Two lagoons north of the mouth of the Yaqui River were explored by the writer March 31 and April 1, 1889, during the investigations of the steamer *Albatross* in the Gulf of California. Owing to the inaccuracies and incompleteness of the charts of this part of the coast, I was unable to ascertain whether or not the two lagoons were connected with each other, or even to make sure of their proper designation. They are referred to in this report as the Upper and the Lower Algodones Lagoons. The Upper Algodones, the northernmost of the two, is a broad sheet of water separated from the Gulf by a sand-spit, through which are one or more narrow tide-ways. The water is everywhere shallow, and the bottom is composed of such a mixture of fine sand and mud as prevents extensive shifting by currents.

The oyster beds are mostly in the form of hummocks with circular or oval outlines, each having usually in the center a heap of dead shells raised two or three feet above high-water mark (see plate XXXIV). The living oysters are almost wholly confined to the areas exposed at low water, the channels between the hummocks being bare, even when but 2 or 3 feet deep. The oysters are firmly grown together in masses of considerable size, the lowermost ones being usually dead and partly buried in sediment. Deeper within the banks other shells were found buried in the sand and mud, some of these having probably been smothered by the superimposed oysters and still retaining their vertical position and cohering in masses.

The heaps of dead shells in the center of the beds I was unable to account for, unless indeed, as was suggested to me, they were merely heaps of refuse shells left by the Indians, who formerly found here an important source of food. This theory was sustained by the fact that the shells of the heap were all single valves, and of large size.

A few other beds observed seemed newer than those described, and covered uniformly flats exposed at low water. These beds were sometimes of larger extent, were without definite shape, and did not contain the central heap of dead shells. Other exposed flats, lying side by side with the oyster-beds and apparently offering precisely the same conditions, were wholly bare.

The Lower Algodones Lagoon, the opening to which lies but a few miles north of the Yaqui River, consists of numerous winding channels, running a long distance

into the level low lands which here front the coast. The oysters were here found under the same conditions as those in the upper lagoon, growing along the shores, or forming hummocky islands dotting the shallower portions of the lagoon.

I was unable to learn that any fresh water flowed directly into either of the lagoons; there was, however, much difference in the amount of fresh water which they contained, the upper lagoon having almost the same density as sea water, its specific gravity being 1.026508. The lower lagoon contained much more fresh water, the specific gravity being 1.022808. Whether this was owing to the state of the tide, different in the two cases, or to the proximity of the river to the lower lagoon, I was unable to decide.

The Yaqui River is a deep swift stream, reaching the Gulf through a single well-defined channel, which widens but little towards its mouth. Even during the dry season it discharges a large volume of water into the Gulf, the specific gravity at our anchorage, 3 miles distant from the shore (1.006808), showing the water to be only slightly brackish. This volume of fresh water may spread far enough along the coast to be backed by the tide into the lower lagoon. No oysters were found in the river, which was explored for a distance of about 4 miles.

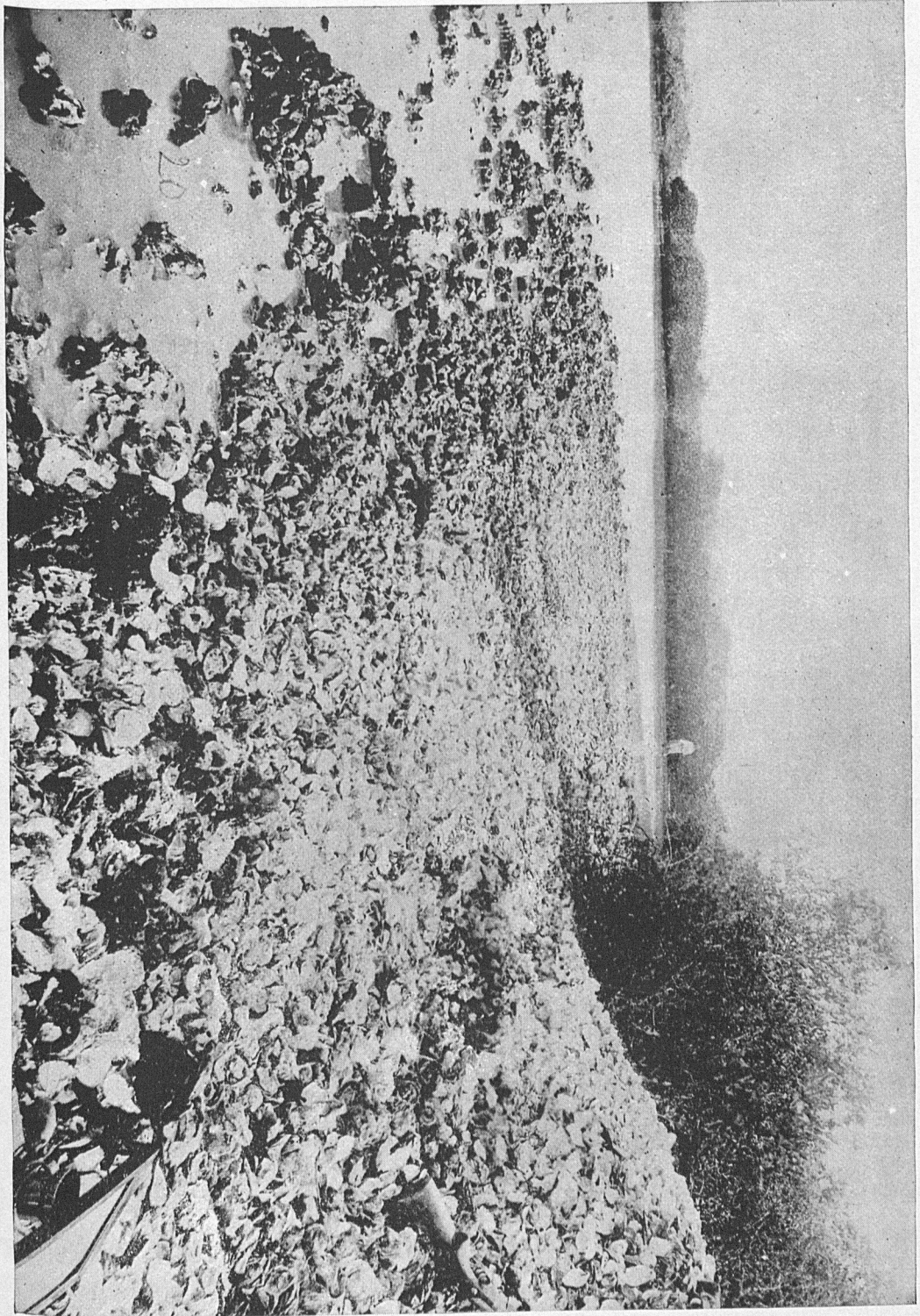
The Gulf oysters we found to be large, fat, and of excellent flavor, being uniformly pronounced by our ship's company to be equal to the best Eastern product. They are now used only to supply the very limited demand at Guaymas. The Indians gather them by the boat-load, selecting only the larger ones, carry them to Guaymas, and preserve them until wanted by depositing them in the bay. We were informed that the oysters deteriorated after being kept in the bay four or five weeks, but this was denied by others.

As to the propriety of attempting to transplant the oysters to the coast of California, I am in some doubt. The fact that almost the entire littoral fauna of the Gulf differs from that found to the northward seems to indicate the existence of dissimilar conditions which would militate against success. The temperature in the lagoons along the Gulf during the winter and early spring is about 70° Fahr., as compared with 60° in the bays of southern California. And during the rainy season in the Gulf, the amount of fresh water found in those shallow lagoons must be much greater than was found by us in the dry season, and probably more than could be looked for at any time in southern California.



Rogers. Apr 30.

Enlarged from Hydrographic Chart.



DEAD OYSTER SHELLS IN THE CENTER OF OYSTER BED. (See page 97.)