
REPORT ON THE OYSTER-BEDS OF LOUISIANA.

BY

H. F. MOORE,

ASSISTANT, U. S. FISH COMMISSION.

INTRODUCTION.

WASHINGTON, D. C., *June 29, 1898.*

On May 6, 1897, the United States Fish Commission received a communication from Hon. Adolph Meyer, M. C., inclosing the following concurrent resolution of the legislature of Louisiana:

Be it resolved by the house of representatives of the State of Louisiana, and the senate concurring, That the United States Fish Commission be requested to investigate in the oyster-spawning season and report to this general assembly before its next session the exact season of the oyster spawning in this State and all other facts respecting the same, and whether or not the present existing laws are not injurious to the oyster industry of this State.

S. P. HENRY,

Speaker of the House of Representatives.

R. H. SNYDER,

Lieutenant-Governor and President of the Senate.

MURPHY J. FOSTER,

Governor of the State of Louisiana.

JOHN T. MICHEL,

Secretary of State.

Pursuant to this request, and in view of the importance of the Louisiana oyster industry, it was decided to undertake an investigation of the subject, and Dr. H. F. Moore, of this Commission, was directed to visit Louisiana in August and September, 1897, for the purpose of making some preliminary inquiries, and the steamer *Fish Hawk*, Lieut. Franklin Swift, U. S. N., commanding, was dispatched to the State in February, 1898, to conduct a more extensive examination of certain oyster-grounds. The accompanying report, based on the investigations thus made, has been prepared by Dr. Moore, who accompanied the vessel and was charged with the consideration of the biological aspects of the work. It was the intention of Lieutenant Swift to write the report on the reconnaissance made by the *Fish Hawk*, but before he could do so he was detached from the Commission and assigned to naval duty.

GEORGE M. BOWERS,

U. S. Commissioner of Fish and Fisheries.

REPORT ON THE OYSTER-BEDS OF LOUISIANA.

By H. F. MOORE,
Assistant, United States Fish Commission.

Within recent years several investigations of Gulf coast oyster-grounds have been made by the United States Fish Commission, but none of these related to the waters of Louisiana. Upon the receipt of the request from the general assembly for information concerning the oyster-beds of that State, the writer was ordered to Louisiana for the purpose of determining certain facts relating to the question of close seasons, and to make an examination preliminary to a more careful and extended investigation by the steamer *Fish Hawk* later in the season. A period of about fifteen days in August and September was spent in the oyster regions of St. Bernard, Plaquemines, and Terrebonne parishes, and as a result it was decided to confine the contemplated survey to the St. Bernard region as offering better facilities for the character of work which it was desired to undertake. The *Fish Hawk* was not available until February 1, from which time until February 24, when she left in order to begin her regular work of shad-hatching, the field work was prosecuted vigorously and continuously, except when interrupted by stormy weather.

Owing to the shallowness of the water the *Fish Hawk* could not be used for active duty in the survey, and she was therefore anchored as close as possible to the oyster-beds and used as a base of operation for the launches, at first off the northern entrance to Grand Pass, and afterwards, during the greater part of the work, off the mouth of Three-mile Bayou. The work was often performed at a distance from the ship, and much time was unavoidably lost in running to and from the scene of the day's operations. Should a complete oyster survey of the region be attempted in the future, it could be much facilitated by employing several light-draft vessels, which could be worked into the marshes and used as quarters for the field parties on the launches.

It was originally intended to make a thorough and complete survey of the oyster-beds of St. Bernard Parish similar to that which was made by the *Fish Hawk* in Apalachicola Bay, but this plan was abandoned when it was found that the time at the disposal of the party was to be so limited. Many of the stations established by the Coast Survey have been obliterated or washed away by the storms, and it would have required more time than was available for the entire work to erect and cut in the signals necessary to a proper survey. Contrary to

expectations, it was found that the topography in general had not undergone many important changes since the survey upon which the Coast Survey charts were based, and the several points could be identified and located with sufficient accuracy to suit the purposes of a reconnaissance.

The plan finally adopted was to run lines of timed soundings from point to point, so as to cover the intervening waters by series of intersecting zigzags. As the lines were rarely over 2 miles in length, the position of any given sounding could be approximately determined by its time, the time of beginning and ending the line being noted, and the speed of the launch being nearly uniform on each series of soundings. Most of the important beds were also located by compass bearings from charted points. The charted areas of the beds, as well as their positions, are but approximate; but it is believed that the aggregate is measurably near the truth, although individual beds might prove somewhat greater or less in extent than appeared from the hurried examination which it was possible to make. The soundings were made by means of the sounding pole devised and used by Lieutenant Swift in the survey of Apalachicola Bay, and described in his report upon the oyster-beds of that vicinity. Owing to lack of time no effort was made to determine with exactness the number of oysters to the square yard, as is done in a regular survey, and the terms "dense," "scattering," and "very scattering" are relative in their application to this field only. Dense and scattering beds are such as can be worked with profit by means of tongs. "Very scattering" beds are shown on the chart with some ambiguity—in a few places, especially in the lagoons, denoting a growth, which it hardly pays to work, sparsely distributed over the entire bottom; in other places, as in the northern part of West Karako Bay, representing small beds more or less dense, distributed at irregular intervals, and in the text described as "scattered in patches," or in somewhat similar terms. Such beds can be worked with profit.

The investigation in St. Bernard Parish was under the direction of Lieut. Franklin Swift, U. S. N., commanding the *Fish Hawk*. The hydrographic field work and the location of the oyster-beds was carried on by Mate J. A. Smith, U. S. N., and by Mr. Eugene Veith, of the steamer *Fish Hawk*.

After the *Fish Hawk* concluded the reconnaissance in St. Bernard Parish, the writer was instructed to make an examination of the oyster-grounds of Louisiana west of that region. In pursuance of the latter purpose, he left the ship at Bay St. Louis upon its departure for the north on February 25, and proceeded to several places in Plaquemines Parish, where boats were hired, and all the principal natural beds and planting-grounds were examined. At Grand Isle, on Barataria Bay, a lugger was secured and an examination made of all the oyster-grounds in the vicinity, after which a cruise was made to the westward, under the guidance of men familiar with the region, as far as Morgan City, all of the oyster regions, with the exception of the upper waters of Terre-

bonne Bay, being visited *en route*. No attempt was made to chart or locate even approximately the individual beds examined on this brief tour, but their general character, present condition, and future prospects are reported upon in the following pages.

The writer acknowledges his indebtedness to Col. F. C. Zacharie, Hon. E. McCullom, Hon. Adolph Meyer, and Hon. S. P. Henry for valuable assistance and information, and to Mr. F. F. Hansell for the use of his yacht in visiting the St. Bernard beds in August, 1897.

THE NATURAL OYSTER-BEDS OF ST. BERNARD PARISH.

General description of the region.—The area embraced within the limits of the reconnaissance made by the *Fish Hawk*, and shown upon the chart accompanying this report, does not include all of the oyster-grounds within the parish of St. Bernard. Field work was pushed into the interior waters lying southwest of Indian Mound Bay and Southwest Pass, and known to the oystermen as Treasure Bayou, Mussel Bayou, Flat Bay, etc., but the lack of a chart of this region approaching even approximate correctness has made it seem inadvisable to attempt to plot the oyster-beds found there, though they are described in general terms in the text. South of Drum Bay, in which lie the southernmost of the charted beds, are extensive areas of good oysters stretching to the parish line at Mozambique Point, but these were not examined, owing to lack of time. We were informed that notwithstanding their extent and the good quality of the oysters they were not extensively worked, on account of their inaccessibility as compared with other beds of St. Bernard Parish, and for this reason it was considered that, for the purposes of the investigation, it was not advisable to devote to their examination time which could be more profitably spent in the study of those beds which were in active use and which therefore presented problems of more immediate importance. In this connection incidental mention may be made of the gregariousness and the general lack of enterprise of the oystermen of this district, who, in the latter part of the season, often spend upward of two weeks in loading their boats in Three-mile Bay, rather than leave their fellows and familiar ground to sail 20 or 30 miles to the southward, where they claim they could secure their fares in three or four days.

The district covered by the field work extends from Mississippi Sound on the north as far as Morgan Harbor on the south, and from Chandeleur Sound to the zone where the water becomes of such slight salinity as to be fatal to oyster life. Within the limits of the reconnaissance this zone accords approximately with the meridian passing through Lake Borgne light-house, in Mississippi Sound the oysters extending a mile or two west of that limit, while in the marshes they are all east of the line. The area covered by the reconnaissance was about 200 square miles, comprising a large part of the "Louisiana Marsh." The land is low, rarely rising more than 18 inches above the level of ordinary high water, but in a few cases shell-banks have been thrown up by

wave-action, thus producing the maximum land elevations, in no case, perhaps, more than 3 or 4 feet above tide. During storms the entire land area may be flooded, and in the disastrous hurricane of 1893 it was covered by from 8 to 12 feet of water. The soil is a stiff mud or blue clay, covered with a sparse growth of coarse grasses and scattered tufts of *Salicornia*. Along the bayous there are clumps of mangrove bushes, but with the exception of several crab trees on Mudgrass Island, there is probably not in the whole dreary expanse a plant reaching a height of 10 feet, nor is there a single human habitation.

The land constitutes a low-lying archipelago of irregular islands separated from one another by shallow bays, muddy lagoons, and tortuous bayous, the area of the water being somewhat greater than that of the land. The bayous are of two classes, rather broad, short, deep passes, like Nine-mile Bayou, Three-mile Bayou, and Deep Pass, which serve as the main avenues of tidal flow to and from the interior bays, and long, narrow water courses which characteristically run lengthwise of the islands, as is seen in the cases of Door Point Bayou, Dead Man Bayou, etc. The bayous of the first class have generally a depth of from 18 to 42 feet, those of the second class from 5 to 12 feet, and all are more or less obstructed by bars across their mouths. The bottoms of the bayous are almost invariably composed of soft mud.

The bays, with the exception of several of those opening into Chandeleur Sound, communicate with the outer waters by narrow mouths. Their floors are comparatively level and, with one or two exceptions, are composed principally of soft mud, with scattered patches of hard mud and sand, usually so small in area as to be negligible in plotting the soundings. The depth of water is generally from 3 to 6 feet, although in some of the bays, particularly those to the eastward, there are channels through which a considerably greater depth can be carried.

The lagoons are very shallow, small-mouthed, blind bays, like Blind Pass and Grecque Bayou, with soft bottoms largely exposed as mud flats at low water.

Blind Pass, Nine-mile Bayou, and False-mouth Bay.—Blind Pass marks the western extension of the oyster in the marshes on the south side of Mississippi Sound. It is a shallow lagoon communicating on the north with Mississippi Sound, on the east, by a narrow but deep cut, with Nine-mile Bayou, while to the southward a tortuous bayou establishes communication with False-mouth Bay. It consists largely of a mud-flat, exposed at low water, with oysters of rather inferior quality sparingly scattered over the bottom.

Nine-mile Bayou is about $2\frac{1}{2}$ miles long to its main entrance into False-mouth Bay and has a width of from 100 to 300 yards. At its mouth there is a depth of about 18 feet, which rapidly shoals outwardly to $6\frac{1}{2}$ or 7 feet. In the bayou the depth ranges from 17 to 39 feet, the average being about 24 feet. The bottom is soft, excepting that portion lying opposite the small island at the southern end, where hard mud was found. There are no oysters in this bayou.

False-mouth Bay covers about 11.3 square miles. It connects with Mississippi Sound by means of Nine-mile Bayou, and to the eastward opens by a wide mouth into the passage between Raccoon and Mud-grass islands. The bottom is composed of hard mud of a somewhat clayey character, resembling that on the surrounding islands. The depth is almost uniform, in the northeastern part being from 3 to 3½ feet and elsewhere from 4 to 5 feet. The density in the middle of February varied from 1.0048 to 1.0066 in the several parts of the bay, the temperature at the same time ranging between 16.5° C. (61.7° F.) and 19° C. (66.2° F.). The water is less saline than elsewhere in the marsh, owing to its proximity to the main sources of fresh water, the Pearl River and the discharge from Lake Pontchartrain.

There are very few oysters in False-mouth Bay, and those discovered by the reconnaissance were found fringing the three islands shown on the chart, as a scattering growth of single oysters of fine shape, round, deep, and about 6 inches long. The amount of young growth was small, a few oysters about 2 to 2½ inches long being found attached to the old ones, to clam shells, and lying singly on the mud. A very small amount of spat was attached to the clam shells which fringe the northeast shore of the southernmost island. All of these oysters, both large and small, were extremely fat, but their flavor was insipid owing to the low salinity of the water. The oystermen state that the oysters are always fatter here than on the beds to the eastward, and that they are kept "cleaned up" by the boats which aim to carry the best oysters to the New Orleans markets. It is the custom of the oystermen to paddle around the shores when the water is clear and smooth and pick up with nippers the oysters which can be clearly seen. In December, 1897, a small bed was found in the northern part of the bay, but a number of boats went to work upon it and within a few days it was reduced to a state of practical extinction and we were unable to find any remnant of it.

An examination of the bottom by means of the dredge and tangles showed it to be remarkably clean and free from debris of all kinds. A few crabs of small size, several species of lamellibranchs, and numerous worms were the only living forms found on the hard bottom. Enemies are probably extremely rare, although it is possible that the drumfish might cause damage upon beds of planted oysters. The conch was not found at all, although it is not uncommon in the neighboring waters of Three-mile and Nine-mile bays. The boring-clam (*Martesia*) is common, but it is less abundant than in the more saline waters, and in any case it would not prove detrimental to the oyster.

It seems probable that the scarcity of oysters in False mouth Bay is due in a large part to the lack of suitable places of attachment for the spat, and if this be so there is but little doubt that productive beds might be established by planting shells, together with a sufficient number of brood oysters to furnish fry. We found here the largest area of firm bottom discovered anywhere within the limits of the recon-

naissance. In most other parts of the district the hard bottom is distributed in small patches, lying like islands in the midst of soft mud, but in False-mouth Bay the shells and seed could be deposited almost anywhere without danger of becoming engulfed. The amount of oyster food is larger than almost anywhere else in the district, the average number of diatoms in each liter of water 1 foot above the bottom being about 22,000. The extreme fatness of the oysters is also ample evidence of the abundance of food, although, of course, the amount available for each individual would become less if planting were extensively undertaken. The chief drawback to planting lies in the low salinity, which, as before stated, detracts from the flavor of the oyster, and if not corrected during the spawning season would also militate against the production of young. Without doubt, however, there is an increase in the density during the late spring and summer, when fry abound. Material to serve as cultch or collectors for the attachment of the young oysters might be obtained from the island in the extreme southern part of the bay, where the shore is covered by a mass of clam shells more or less finely broken up. The smaller particles of shells are too small for use, as the action of the storm waves in the shoal waters of the bay would tend to carry them away; but many of the shells are entire, and these, together with the larger fragments, should make excellent cultch.

Nine-mile Bay.—This body of water lies east of Pirate Point and west and northwest of Raccoon Island. It is continuous with Three-mile Bay to the eastward, and in its northwest corner it communicates with Nine-mile Bayou by a channel in which the depth varies from 10 to 21 feet.

North of Nine mile Bay and in communication with it lies South Bayou, a lagoon-like body of water, very shoal and with no oyster-beds. The depth of water in the bay is between 4 and 5 feet, and the bottom is composed principally of soft mud. The density on February 14 was about 1.0060, and the temperature at the same time was about 17° C. (62.6° F.). The oysters are obtained principally in the eastern part, between Raccoon Island and the opening to South Bayou, being generally single, much scattered, and of rather good shapes. These beds, like those in Three-mile Bay, are much worked, and late in the season are composed principally of cullings. There is a small bed of scattered oysters just off the southeast point of Pirate Point, which appears to have been established, or at least largely sustained, by artificial means as a result of bedding oysters for "fattening" purposes, the culled young growth and shells being carefully returned to the water to serve as seed and cultch, the product of which becomes available for market in subsequent seasons. This place is claimed by oystermen to possess remarkable properties as a fattening-ground, but as the oysters are brought from the denser waters to the eastward and exhibit their improvement within 24 hours from the time of bedding it is probable that the process is one of bloating rather than of fattening.

small bed of oysters is found in the southeastern branch of Nine-mile Bayou, about the middle of the second reach from Nine-mile Bay, on the west side of the channel. It is from 30 to 50 yards long, and extends to about the middle of the bayou. It contains some single oysters of good shape and quality and many dead shells.

Three-mile Bay.—Three-mile Bay is the most important oyster region in St. Bernard Parish, not because its beds are more extensive than those of other parts of the Louisiana Marsh, but because of its accessibility from New Orleans and the cities on Mississippi Sound. Nearly all of the boats enter the marsh at Three mile Bayou, whatever may be their ultimate destination, and it is to this place also that oyster-freighters resort to secure their fares from the luggers and other craft engaged in the active work of oystering.

Three-mile Bay lies between Three-mile Bayou (by which it communicates with Mississippi Sound) on the north and Raccoon Island on the south, its eastern and western limits being Nigger Point and Shell Point, respectively. It covers an area of about 7.3 square miles. In Three-mile Bayou the depth of water reaches a maximum of about 40 feet, the channel gradually shoaling as it enters the bay, over the greater part of which the depth ranges from 4 to 6 feet. In some places a depth of 3 feet or less is to be found, but in general such shoal spots are less common than in West Karako Bay. The average density of water during February was about 1.0065, and the temperature was about 17° C. (62.6° F.).

The bottom is composed of mud of varying degrees of softness. There are a few small areas of hard bottom, but these are principally upon old oyster-reefs, and are now used by the oystermen as beds on which to deposit their catch pending the completion of their cargoes. The softest bottom is found in the southern part of the bay near Raccoon Island, where the mud is entirely too soft to utilize for planting, but places in the center of the bay might be used, although on account of the danger of suffocation in the mud the oysters could not be planted very thickly. The amount of oyster food contained in the water is large, and, especially in the northern part of the bay near the inlet, the currents are comparatively strong. Originally, we were informed, the natural oyster-beds in this bay were dense and extensive, but as a result of the persistent "working" to which they have been subjected during the past few years the dense, well-defined reefs have entirely disappeared, and have been replaced by a scattering growth of more general distribution. The clusters are kept broken up by the process of culling, with the result that the separated oysters show considerable improvement in shape, condition, and flavor over their original state. They are usually either single or in clusters of from two to four; they are rather elongate, moderately fat, of fair flavor, and comparatively free from extraneous growths, such as mussels and algæ. On the very soft mud near Raccoon Island, in the southern part of the bay, the oysters are extremely long and in clusters overgrown with mussels.

Early in the season and until about January or February there is a rather large proportion of marketable oysters, but later these become caught up, leaving practically nothing except dead shells, spat, and young growth. This was essentially the condition of the beds at the time of our examination, and after the middle of February it took about three times as long to catch a barrel of oysters as it did early in the season, and in the latter part of the month most of the fleet which had been oystering there were forced to move farther into the interior. By the time the next season opens many of the young oysters which have been culled off will have reached a suitable size for market, and the providence of one year thus insures the plenitude of the next. Were it not for the moderate care with which the oysters are culled and the young ones and the dead shells returned to the beds whence they were taken, it is impossible that these beds should have so long sustained the demands made upon them. Were it the custom here, as it is in certain other parts of the State, to carry off the young for seed, the phenomenon of the annual recuperation of beds previously exhausted of their marketable stock would not be witnessed.

Not all of the boats cull their catch as carefully as they should. Those which carry their oysters to New Orleans and other markets for sale as "shell stock," from motives of self-interest exercise due care, for imperfectly cleaned and separated oysters bring a lower price than those which are well culled and free from extraneous growths of barnacles, mussels, and young oysters. The chief difficulty is with those boats which catch oysters for the canneries, located principally without the State, where the presence of small oysters is not objectionable.

It is reported that dredges have worked in Three-mile Bay, but the conditions are such that it is probable that this practice was never extensive.

West Karako Bay.—West Karako Bay embraces about 9 square miles, included between Crooked Island and the land masses embracing Johnson Bay and its connections, and between the Raccoon Islands and Shell Island. Its greatest extent is east and west. The bottom resembles that of Three-mile Bay, being composed principally of soft mud with patches of hard mud at wide intervals. The depth over most of the bay ranges from 4 to 6 feet, but there is a maximum depth of 8½ feet in the channel running from Dead Man Island to the cut north of Shell Island, and there are also a number of shoal spots upon which the depth is less than 3 feet, these shoals usually being covered with oysters. The average density of the water is about 1.0065.

The oyster-beds in this bay are more extensive than in Three-mile Bay, and there are also several well-defined reefs which can be characterized as dense. One of these lies south of Dead Man Island and two others lie west of Shell Island, about opposite its northern and southern points, respectively. The oysters on these reefs are of moderate size and in clusters of from 6 to 20. North, northeast, and east of Dead

Man Island, as far as the mouth of Picnic Bayou, are patches of scattered oysters in clusters. No attempt is made to indicate either their size or location on the chart, although they are shown *in toto* over the area mentioned. There are other beds of scattering growth, the limits of which are better defined, and these are plotted with some approximation to correctness. All of these oysters are of the same general character, being in clusters of from 6 to 20, rather thin-shelled and elongate, approaching in general the raccoon type, and in some parts of the bay they appear to be more or less imbedded in the mud. They are to some extent clothed with brown alga, especially in that part of the bay lying east of Dead Man Island, and many of the clusters bear a few mussels and barnacles. The amount of young growth is large. At the time of the examination most of these oysters were but moderately fat, and some of them were quite poor. They show many of the features exhibited by virgin beds, and their quality would doubtless be improved by more extensive working, provided that proper culling methods were practiced. West Karako Bay is resorted to by a number of boats, especially by those engaged in taking oysters for the canneries, and late in the season, after the beds of Three-mile Bay become depleted of their more desirable oysters, some of the oystermen engaged in the "shell trade" also work there.

Johnson Bay and Johnson Bayou.—Johnson Bayou is about 2 miles long, communicating at its southern end with an intricate series of bays and lagoons lying north of West Karako Bay. At the entrance from Mississippi Sound the depth of water is about 6 feet, but inside it deepens to 12 or 14 feet toward the west bank. The bottom is composed of very soft mud. It contains a very scattered growth of oysters throughout its length.

Johnson Bay is the easternmost and largest of the several bodies of water communicating with the bayou. It contains about 1.3 square miles. The bottom is principally soft mud, and the density was about 1.0062 during the first week in February.

There is a scattering growth of good oysters all around the shores, and a few also occur in the middle, where there is also an old, exhausted reef, the crest of which is dry at low water. It is about 150 yards long and 100 yards wide, and it constitutes the most extensive area of hard bottom in the bay. It could be utilized to advantage for planting. At the time when this bay was examined there were seven schooners oystering there, the captain of one of which stated that the oysters were much scarcer than formerly and that it took him from 10 to 17 days to get a load of 120 barrels. The oysters are gathered by small boats, of which each schooner has several, which go into the small bayous and alongshore, where they pick them up in the shoal water.

In the southern part of the irregular bays west of Johnson Bay there is a bed of scattered oysters on the soft mud in a depth of from 1 to 3 feet. They are generally in clusters of from 3 to 15, mostly of medium size, with a good growth of young oysters and some spat,

and more or less overgrown with mussels. It is stated that there is a scattering growth all over the irregular lagoons to the northward. The density on the bed examined was 1.0066.

East Karako Bay, Northwest Jack Williams Bay, and Picnic Bay.—East Karako Bay lies between Shell Island and Deep Pass, the former separating it from West Karako Bay and the latter placing it in communication with the waters of Chandeleur Sound. It embraces about 7.4 square miles, its greatest extent being in a north-and-south direction. In the northern half of the bay the depth varies from 2½ to 4 feet, the bottom being composed principally of soft mud, often mixed with sand. Along the southern side of the island in the northern part, there is considerable hard mud and sand interspersed with soft mud, and also a few patches, more or less limited in extent, in other places. In the southern half of the bay the water averages somewhat greater in depth, being from 4 to 7 feet. A channel runs from the northern point of Shell Island toward the mouth of Deep Pass, the water reaching a maximum depth of 16 feet near the point projecting into the southern end of the bay, and there is also some deep water near the upper entrance to Deep Pass. In this part of the bay the bottom is composed of soft mud almost exclusively. The amount of oyster food is very great.

In East Karako Bay there are about eight oyster reefs which are either awash or exposed on their crests at low water. On and near these crests the bottom is invariably hard, being composed of a macadam of sand and ground-up clam and oyster shells closely compacted, with entire shells lying upon the surface. As a rule these ridges are long and narrow in their exposed portions.

Near the crests of the reefs there is usually a scattering growth of young oysters about 2 to 2½ inches long, together with a few large ones, and considerable quantities of spat are attached to the dead shells, which, from the combined action of the sun and waves, are usually bright and clean and admirably suited to serve as cultch. The young-growth oysters are usually single or in small clusters, and are well-shaped and flinty-shelled. Away from the crests of the reefs the bottom becomes gradually softer, finally merging with the surrounding mud, and as the bottom changes there is also seen a modification in the characters of the oysters. They occur in larger clusters, usually containing from 6 to 10 adult individuals; the shells lose their flintlike appearance and become dark brown and more or less overgrown by a dark-brown seaweed, which appears to be especially abundant in the southern part of the bay. These oysters are invariably flat, thin-shelled, and the largest of them are usually not more than 5 inches long. Excepting a bed off the long point on the eastern side, all of the oysters in East Karako Bay are inferior in fatness and flavor and are rarely taken by the oystermen. They mark the extreme condition toward which those in West Karako Bay indicate a tendency, and no doubt represent the primitive state of most of the oyster-beds of this region. If these beds were

worked, there would doubtless result an improvement in the quality of the oysters, due to the breaking up of the clusters and the thinning out and better distribution of the individuals. It would be distinctly advantageous if many of these oysters could be gathered as seed and planted elsewhere, under restrictions advocated in the recommendations attached to this report, thus producing not only an improvement in the character of the plants, but also in the environment of those left upon the natural beds.

There are several places in the bay where the growth is quite dense, and over considerable areas there is an average of from 6 to 8 clusters of from 3 to 8 adult oysters each per square yard. Surrounding these, and more or less connecting one dense area with another, there are scattered clusters lying on the soft mud. The comparatively few oysters taken from the beds in this region are used exclusively for steaming, and the alga, which often grows in luxuriant tufts on the shells, detracts from the value of the oysters for this purpose, as it is extremely difficult to prevent its filaments from becoming mingled with the "meats."

Northwest Jack Williams Bay is a northern extension of East Karako Bay, and it bears the same general characteristics as are found in the northern part of the latter. Its density is about 1.0110, the depth of water is from $2\frac{1}{2}$ to $3\frac{1}{2}$ feet, and the bottom is largely composed of soft mud. Two beds of oysters were found—one in the center of the bay, where there are scattered clusters on the soft mud, and another around a shell island in the eastern part, the latter resembling the exposed reefs described above. There is also a scattered growth along the southwest shore.

Picnic Bay extends westward from the bay just described, and at the strait connecting the two is a small bed of oysters which extends for some distance into the southern part of Drum Bayou. There are also a few oysters scattered all over the bay, the mud there being very soft, with a number of dead shells imbedded beneath the surface. They are long, narrow, and sharp-edged, and grow in clusters, bearing mussels, barnacles, and tunicates. The shells frequently contain dark vesicles filled with black mud. The density in this bay was several degrees lower than in the neighboring water, being but 1.0070. The depth rarely exceeds $2\frac{1}{2}$ feet.

Drum Bayou and Turkey Bayou.—Drum Bayou is a long, narrow channel leading from Mississippi Sound southward to Picnic and Northwest Jack Williams bays, and giving off a branch westward to Turkey Bay. The depth of water ranges from 5 to 10 feet, with about 3 feet on the bar across the mouth. The density is about 1.0105 and the bottom is mostly soft mud. There are some large single oysters in the channel, together with many dead shells and some young growth, and at low water occasional large clusters of raccoon oysters are exposed along the banks. The oysters in the channel are rather long and narrow, but at the time of examination were in fair condition and of good flavor. The creek leading into Turkey Bayou possesses the same gen-

eral features as the main stream, but has a depth of from 1 to 3 feet. It contains oysters of fair quality, both single and in clusters of from 3 to 10, some of them being very large.

In Turkey Bay, the large lagoon discharging through Turkey Bayou, the depth of water varies from 2 to 6 feet, the bottom being generally soft and muddy and the density about 1.0076. There are three areas of scattered oysters, one lying in the channel between the eastern shore and a small island, another being about a quarter of a mile from the entrance to Turkey Bayou, and the third beginning opposite the channel opening to the westward and extending southward for about three-eighths of a mile. The latter bed is the largest of the three, and near the mouth of the creek there are some oysters, of good size and quality. This creek also contains a scattered growth of oysters, which becomes dense in the branch running to the northward, where the oysters are large and fine.

Grand Pass, Bayou Grecque, and Shrimp Bay.—Grand Pass (Oyster Bay) has an area of about 1.8 square miles. It opens on the north into Mississippi Sound and on the southeast toward Chandeleur Sound. The depth is generally between 2½ and 5 feet, but deeper water occurs on the west side of the small island in the northern part of the bay, where soundings of from 12 to 16 feet were found. Excepting in the vicinity of the oyster-reefs and in places along the shore, the bottom is composed of deep soft mud. The density during the first week in February averaged about 1.0100 and the temperature was about 10.5° C. (50.9° F.).

There are eight oyster-reefs in the eastern part of this bay, several of them being partially exposed at low water. A scattering growth of marketable oysters also occurs in the shoal water along the eastern shore, and on the middle third of the western shore we found a corresponding development of young growth. In the latter locality every shell or other hard body in the water has young oysters attached to it in clusters, and there is no doubt but that by exposing suitable cultch around the edge of the marshes, as is done at Bayou Cook and Whale Bay, important and productive spatting-grounds could be established and a supply of seed thereby secured which would be independent of the natural beds. It is stated that considerable quantities of oysters were to be found formerly in the center of the bay, but that they had been exterminated by the dredges which operated there. At present there are practically no oysters and very few shells to be found away from the shores and reefs, but there is, of course, no indication of the means by which they were caught up if they ever existed in other parts.

Oystering here appears to be confined to the vicinity of the exposed reefs and the shoal water along the eastern shore. The oysters at the time of our examination were rather poor in shape, of moderate size, and inferior in flavor and fatness. They are usually found in small clusters. The conch is the most troublesome enemy with which the oysters have to contend in this vicinity. It is rather more common

and destructive here than in the waters farther removed from Mississippi and Chandeleur sounds.

In the extreme southern part of the bay there is a very scattering growth and in the mouth of Jack Williams Bayou there occurs a bar of raccoon oysters, partially exposed at low water. Raccoon oysters also occur along the shores between tide marks throughout the length of the bayou and in the small, muddy ditches opening into it, and in the channel are scattered clusters of oysters which are fairly fat and superior in flavor to those which are found on the beds of Grand Pass.

From the southwest part of Grand Pass a tortuous, narrow, and in some places deep, bayou leads south to a series of shoal lagoons, the entire chain constituting Grecque Bayou. The lagoons have an average depth of about a foot, with a few holes 2 to 3 feet deep in places, and extensive mud-flats around the margins. The bottom is usually very soft. The density varies from 1.0107 in the ponds near the entrance to 1.0119 in those at the end of the chain, the flow of water through the long, narrow communication with Grand Pass being apparently insufficient to compensate for the increased evaporation on the shallow mud-flats. Over the greater part of these lagoons there is a very scattering growth of large and rather good oysters on the mud, and there is also a scattering fringe of raccoon oysters on the edge of the marsh. The oysters in Bayou Grecque are taken by small boats and carried to the schooners in Grand Pass.

Shrimp Bay and Southeast Jack Williams Bay.—Shrimp Bay lies southeast of Grand Pass, with which it has direct communication by means of the upper part of Jack Williams Bayou. Its depth varies from 1 foot in the northern and eastern parts to about 4 feet at the southern end, where it opens into Southeast Jack Williams Bay, together with which it has an area of 1.7 square miles. Its density on February 3 was 1.0096. This bay contains five oyster-reefs, exposed at low water, with a scattered growth of oysters surrounding each. Near the reefs the bottom is hard from the accumulation of ground-up shells and sand, but elsewhere it is soft, and in the northern half of the bay with a hard substratum of dead shells about a foot beneath the surface. This portion of the bay appears to have been at one time an extensive oyster-bed, which has been largely destroyed by an accumulation of mud thrown down, some of the oystermen claim, by the great storm of 1893, and the reefs, which have been already mentioned, and several patches of oysters along the northeast shore, are now all that remain. There are also oysters in the bight on the eastern side of the bay, scattered more or less sparsely over the mud-flats and near the small islands forming an exposed bar.

Upon the reefs the oysters are small and of the clustered raccoon type, but in the slightly deeper waters surrounding them there are some single oysters of good shape, but not very fat. In Southeast Jack Williams Bay, which consists of a larger western and a smaller eastern arm, there are very few oysters, although the presence of shells

beneath the surface of the mud indicates the submergence of beds formerly existing there. In the eastern branch there are a few shells lying on the surface of the mud, and in the lagoon at its southern end there are raccoon oysters along the banks and a few clusters in the channel in about 5 feet of water.

In the bay the depth is from 2 to 3 feet, the bottom being composed of soft mud. The density in the eastern arm was 1.0107 and in the western 1.0094.

Cranetown Bay.—This bay, which lies between West Karako Bay and Southwest Pass, has an area of 2.7 square miles and a depth of between 3 to 6 feet, except near the mouth of Elephant Pass, a broad bayou having a maximum depth of 30 feet, by which it communicates with Chandeleur Sound. The bottom over most of the northern and eastern parts of the bay consists of soft mud, except upon and near the exposed crests of the reefs, but toward the middle of the west shore there is a considerable area of hard mud and sand. Being in such intimate connection with the outer waters via Deep Pass and Elephant Pass, it is not surprising to find that the water here is denser than on most of the other oyster-beds of St. Bernard Parish, ranging from 1.0139 to 1.0163. The amount of oyster food, as measured by the number of diatoms, is small. The currents are rather strong.

In the northern part there are several dense beds of oysters, which have their crests bare or awash at low water. Surrounding these, as well as on the west side, there is a scattering growth of oysters in clusters. In general character these beds resemble those of East Karako Bay, the oysters being inferior both in shape and flavor. Near the crests of the reefs there is a considerable quantity of young oysters in small clusters attached to dead clam and oyster shells.

On the northeast shore, in the small bay between Deep Pass and Elephant Pass, there is a bed of scattering oysters in small clusters. These are of fair size and fatness, and in general somewhat superior to the other oysters in the vicinity. A scattering growth of rather large oysters and many dead shells are found in the mouth of the bayou opening into the southwestern part of the bay. These are the fattest and best oysters in the vicinity.

Kerchimbo Bay lies west of Cranetown Bay, with which it communicates by the bayou just mentioned. It opens southward into Southwest Pass, westward by an artificial cut into East Karako Bay, and northward into the same bay by a bayou containing a few good-sized oysters and many dead shells. The depth of water is about $3\frac{1}{2}$ feet, excepting near its upper end, where there are barely $2\frac{1}{2}$ feet in the channel. It contains several old reefs composed of dead shells and a scattering growth of rather poor oysters of medium size. According to the testimony of the oystermen there are good oysters scattered all over Kerchimbo Bay, but the reconnaissance did not discover them.

Southwest Pass.—This is a long, narrow body of water stretching from Cranetown and Kerchimbo bays on the northeast to the entrance

to Drum Bay on the southwest. It is about 9 miles long and its width varies from $\frac{1}{2}$ to $1\frac{1}{4}$ miles, the average being about $\frac{3}{4}$ mile. The area is about 7.9 square miles and the depth is generally between 3 and 4 feet, although deeper water is found near the island in the center and some of the oyster-beds are in a depth of less than $2\frac{3}{4}$ feet. There is considerable hard bottom, and in the southern two-thirds hard mud is the predominating characteristic. The density is somewhat greater in the northern part of the bay, where it averages about 1.0120 as compared with an average of 1.0084 in the southern part, this difference appearing to be due to the closer communication with the exterior waters in the north and with the interior bays and bayous, by way of Oatfish Pass, in the south. The water contains a fair amount of oyster food, more than Drum Bay but less than either East Karako or Indian Mound bays, which lie to the north and west, respectively. There are good marketable oysters distributed throughout practically the entire length of Southwest Pass. In most cases the growth is scattering, but north of the island, near the center of the bay, is a reef, on which there is a dense growth of small oysters in clusters, together with a few good ones of medium size and some dead shells. This appears to be an old reef, from which the marketable oysters have been nearly all removed, but its condition is such that it will again be productive within a year or two. There is a scattering growth of oysters, in clusters of from 3 to 5, extending eastward from the denser portions of the bed.

A scattering growth also occurs near the shores of the island, and just south of it there are small patches distributed over the bottom, none of them being extensive enough to be called a bed, but constituting in the aggregate quite a large body of oysters. In the southern half of the pass there is a growth along shore on both sides of the channel, where the oysters are in clusters, much scattered, and all of fair quality. These beds appear to be rather extensively worked, and it is said that large quantities of oysters have been taken from there to the markets and that prior to the Nita crevasse in 1890 they had been almost exterminated by excessive tonging.

Drum Bay.—Drum Bay lies southeast of Southwest Pass, with which it communicates by a broad pass at the western end. Including the waters as far east as Keelboat Pass, the bay embraces about 12 square miles. North of Drum Bay, and separated from it by a long, irregular island, there are two shallow bays having together an area of about 1.7 square miles. The water in Drum Bay is from $3\frac{1}{2}$ to 6 feet deep, the general depth being greater to the eastward, where, between the two islands lying northwest of Keelboat Pass, there are 19 feet of water in one place. In the composition of the bottom hard mud predominates, but it is interspersed with areas of soft mud. The density varies from 1.0101 near the western pass to about 1.0150 in the eastern part, near Keelboat Pass. The amount of oyster food, as determined by an examination of the water, appears to be small.

There are oysters scattered all over this bay as far as the entrance to Chimney Bay. There is one very dense bed about $\frac{1}{2}$ mile long and $\frac{1}{4}$ mile wide lying near the center of the bay, and northwest of it lies a smaller reef, where the oysters are equally dense. Upon these beds the oysters are in clusters of from 3 to 10, of the raccoon type, poor in shape, condition, and flavor. These beds are not worked and there are about 18 inches of water on their crests at low tide. There is a scattering growth of oysters over a large part of the bay to the westward of the reefs just described, especially along the shores, and lying across the narrowest part is a bed of clustered oysters of fair quality. The best oysters, so far as flavor and condition are concerned, are found on a small bed northeast of the entrance to Chimney Bay, but the growth there is very scattered and the bed is apparently nearly exhausted.

A dry shell-reef lying north of this bed is now extinct as an oyster-ground, being composed entirely of dead shells, and it is stated that a bed of excellent oysters formerly existed between the two islands to the eastward, but that it was exterminated a number of years ago by tonging. No indication of it now remains.

In Julius Pass, in some parts of Scow Pass, and in Chimney Bay there are, according to the statements of the oystermen, a few scattering oysters, but except the former these waters were not examined. There is a scattering growth in the two bays north of Drum Bay, where the water is very shoal and the bottom muddy. The amount of young growth in Drum Bay is fair. The clusters are overgrown to a slight extent with algæ, barnacles, and mussels.

California Bay.—In the head of California Bay the depth varies from 3 to 5 feet and the bottom is composed almost entirely of hard mud. Excepting at the mouth of Dead Man Bayou, there are no oysters, but several beds of dead shells were found. At the mouth of the bayou there is a scattering growth of fine, large, single oysters of excellent flavor and fatness. Formerly such oysters were found throughout the bayou, and we were informed that in the winter of 1896–97 about 2,000 barrels were carried away from this place, and our soundings and examination showed that practically none are left.

Fox Bay contains a few scattering oysters near its eastern end, and there is a small bed in Redfish Bend near Elephant Pass.

Indian Mound Bay.—This is the largest body of water in the Louisiana Marsh and it contains more good, marketable oysters than any other of the bays within the limits of this reconnaissance. It lies between Crooked Island and Catfish Pass and between Mudgrass Island and the long island forming the western side of Southwest Pass. Its area is about 21 square miles and its depth averages about 4 feet and ranges between 3 and 5 feet. Its density is least in the northwestern part and greatest in its southern part, as may be seen from an inspection of the chart; the average for the entire bay was about 1.0070, somewhat greater than in West Karako Bay and less than in either East Karako Bay or Southwest Pass, with all of which it is in communication. The amount of oyster food in the water is large.

Practically the entire shore of this bay is fringed with oyster-beds, and there is besides a scattering growth around the islands in the middle. In the northeastern part, between Crooked Island and Mudgrass Island, there is a dense bed about $\frac{3}{4}$ mile long by $\frac{3}{8}$ mile wide. The oysters on this bed are of good size, single and in clusters, and quite fat, although the flavor at the time of examination was poor, owing to the low salinity of the water. In the northeast corner of Indian Mound Bay, there is another bed of dense growth extending in a northeast and southwest direction for about $1\frac{1}{4}$ miles, with a maximum width of about $\frac{5}{8}$ mile, and running off westward into a scattered growth of considerable extent. This bed constitutes the largest single body of good oysters in the region covered by the reconnaissance. They grow principally on the mud bottom, in clusters of from 3 to 10, their upper valves being dark with broad coriaceous edges, which usually indicate rapid growth, the lower valves being flinty and sharp-edged. Notwithstanding the denseness of this bed, the oysters are generally fat and in good order, and the flavor is excellent. There is some growth of alga on the clusters here, but it is much less luxuriant than on the beds of Karako Bay. Taking into consideration the abundance and character of the oysters on this bed, it is but little frequented by the oystermen, not more than two or three vessels being seen upon it at any time during our visit. South of this bed is another dense body of oysters of somewhat similar character, but smaller in extent. On both beds there is an abundance of young growth and spat.

Near the middle of the northern part of the bay lies another dense bed, fringing a long, narrow reef exposed at low water. The oysters here are mostly in clusters and covered with a considerable growth of alga, mussels, and barnacles. Most of the other oysters in this bay are more or less scattering, but in the extreme southern part, just north of Catfish Pass, there is a dense bed of good oysters surrounded by a considerable area of more scattered growth. Several vessels were oystering here, and a considerable quantity of oysters is caught late in the season, after the beds of Three-mile Bay and vicinity have become somewhat exhausted.

North and west sides of Mudgrass Island.—These shores are largely composed of very soft, deep mud, a condition which has a very palpable effect upon the character of many of the oysters, which assume an extremely narrow, elongated form, and grow in inverted pyramidal bunches, the lower members of which are immersed in the mud. On the north shore there are three areas of dense growth. Two of them are situated near the northwestern point of the island, on moderately hard mud, the oysters being large and single or in small clusters, with an abundance of spat attached. The third bed lies in a deep bay near the western end of the north shore, close to the point the oysters being of fair shape and quality, but on the soft bottom which constitutes by far the greater part of the bed they are long, narrow, and sharp-edged as described above.

Near the middle of the west side of the island, lying in a cove, is a dense bed of rather good, large oysters on hard bottom. There are few barnacles here, but mussels are abundant. The rest of the oysters on the west side of the island are of the kind described as characteristic of the soft bottom.

Treasure Bay, Mussel Bayou, and vicinity.—The waters included under this heading, except a portion of Treasure Bay, are not shown upon the accompanying chart, inasmuch as a proper survey has never been made. They embrace an intricate system of shallow bays and bayous lying southwest of Indian Mound Bay. The bottom is almost everywhere composed of a very soft, deep mud, and the density of the water is low. The oysters are usually long, narrow, clustered, and rather poor in condition and flavor. The shells are covered with great clusters of large mussels and some barnacles, the growth of the former being more luxuriant than at any other place in the Parish of St. Bernard. Immediately south of Dutchman Pass there is a rather dense bed of oysters lying in a bight behind a small island. Upon the denser parts of this bed the oysters are rather small and are in clusters, but near the edges, in the deeper water, there is a scattering growth of single oysters of excellent shape and flavor and very fat. A limited amount of young growth is found upon these single oysters, but the denser growth near shore is well covered with spat. The bottom in the vicinity of this bed is composed of hard mud.

Mississippi Sound.—There are probably beds of oysters scattered here and there on the shoals throughout such parts of Mississippi Sound as fall within the limits of St. Bernard Parish, but with the exception of those near the entrance to Lake Borgne and in the vicinity of Isle à Pitre they are rarely or never worked by the oystermen and were not investigated by the *Fish Hawk*. Scattered oysters cover the whole stretch between Lake Borgne Light and St. Joseph Island, but as they lie within the limits of the State of Mississippi they are not represented on the chart. In the deep waters lying between Lake Borgne Light and Half-moon Island many small beds of oysters are found in depths of from 7 to 25 feet, most of them being in less than 15 feet. These beds, being small and numerous, could not be definitely located without the consumption of more time than was at our disposal, and they are therefore indicated only in the most general way on the accompanying chart. Upon most of these the growth was a scattering one, but there was one bed lying in 8 to 10 feet of water which was quite dense. There is another dense bed lying on the northeast side of Half-moon Island, close inshore and in a depth of from 3 to 7 feet, where all of the oysters were small, apparently the result of last year's spatting, and in dense clusters. They will probably be fit for use in the canneries next season, but unless broken up and transplanted they will never be suitable for the "shell trade." This is evidently an old bed recently rejuvenated.

About 2 miles east of Half-moon Island lies a bed known as Grand Bank. It is in from 9 to 13 feet of water and extends about north and south for about $1\frac{1}{4}$ miles, with an average width of about $\frac{3}{8}$ mile. The oysters here are in bunches, rather scattering, and of small size. It is stated that this bed was formerly very productive, but that it has been ruined by steam-dredges.

On the south side of Half-moon Island there is a scattering growth beginning near shore and extending out for a distance of about a mile. The oysters here are not uniformly distributed, but occur in patches usually of small size, although there is one large bed, triangular in shape and measuring about $\frac{1}{2}$ mile in base and altitude.

South of Grassy Island is a circular patch of scattering growth about $\frac{1}{2}$ mile in diameter. About $\frac{3}{4}$ mile southwest of the same island lies a smaller but somewhat denser bed.

A dense bed, circular in shape and about $\frac{1}{2}$ mile in diameter, occurs southwest of Round Island, in about $6\frac{1}{2}$ to 7 feet of water, and from the southwest side of the island a very scattering growth extends for about $\frac{1}{2}$ mile, where it merges with a well-defined bed.

Off the north point of Le Petit Pass Island is a bed of scattering oysters, and on the east side there is another bed, a portion of which is covered by a dense growth. About midway between Le Petit Pass and Nine-mile Bayou there lies a crescentic bed, beginning $\frac{3}{4}$ mile from shore and stretching in a general northeast direction for about $1\frac{1}{2}$ miles. Upon all of these beds the oysters are poor in size, shape, and flavor, being in clusters of the raccoon type, and fit only for use in the canneries. At the time that these beds were visited there were a number of vessels working upon them with tongs, and between Half-moon Island and Lake Borgne a steam-dredge was engaged in scraping the bottom. The oystermen claim that the dredges have caused much harm in this vicinity. The water here is always comparatively fresh, owing to the discharge from the Pearl River and Lake Pontchartrain, and apparently the oysters are sometimes killed by the low salinity, an explanation which would account for the existence of beds composed entirely of young growth on old, dead shells. In the latter part of February the average density of the water north of Half-moon Island was 1.0012, and south of the island it was 1.0028. This was without doubt lower than normal, as the readings were taken immediately after a period of heavy rainfall. It is doubtful if the oysters could withstand such a low density for any considerable period, and they probably do so for a limited time only by tightly closing their shells against the admission of the objectionably fresh water. It was noticed that certain marine animals, notably species of worms, were either dead or dying on the beds north of Half-moon Island.

There is a small bed of oysters just at the mouth of Turkey Bayou, and a considerably larger bed, now almost exhausted, lies about $\frac{1}{2}$ mile offshore, midway between Drum Bayou and Grand Pass.

Lying south and southwest of South Shell Bank and stretching as far as the north of Grand Pass there is an extensive oyster-bed known as Cabbage Reef. It receives its name from the abundance of the seaweed ulva, known to fishermen as "sea cabbage." The growth on this bed is very scattering and it appears to be rarely worked by the oystermen, although formerly it was an important oyster-ground. It is stated that the oysters here were nearly exterminated by the conchs, and that most of those not so destroyed were covered with mud and sand during the great storm of 1893. Practically continuous with this bed there is a moderately dense growth skirting the north shore of Isle à Pitre and extending more or less into the bayous, as far as the edge of the deep water lying to the westward of Deep-water Point. Most of these oysters, both along shore and on Cabbage Reef, are of moderate size and in clusters of from 5 to 15. There are but few mussels or barnacles, but there was in February a moderate growth of seaweed, which is said to become more extensive later in the season. Young growth and spat are abundant. East of Deep-water Point there are no oysters excepting a scattering growth in a salt pond, now closed but formerly an open lagoon.

Chandeleur Sound.—There are now, according to the testimony of the fishermen, very few oysters to be found in Chandeleur Sound, although there were formerly beds of considerable extent in several localities. No detailed examination of this region was made, although the shores were explored in a few places.

There appear to be very few, if any, oysters on the outer shore between Isle à Pitre and Door Point, but there were formerly some more or less extensive beds between Door Point and Pelican Point, as well as in the neighborhood of Brush Island and outside of Deep Pass. In Live Oak and California bays, around the shores of Martin, Sam Holmes, and Mitchell Islands, there are beds of old shells where there were formerly productive oyster-reefs frequented by oystermen. The general opinion of oystermen is that these beds have been exterminated by the conchs.

THE NATURAL OYSTER-BEDS OF PLAQUEMINES PARISH.

East of the Mississippi the oyster-beds of Plaquemines Parish stretch from Mozambique Point to Bird Island Sound. Formerly the oysters in this region, especially near Mozambique Point, were large and rather desirable in quality, but in 1897 most of them were killed by the *Bohemia crevasse*, and at the time that the beds were examined it was found that Quarantine and California bays contained practically no adult oysters, although there were a number of dense reefs of young growth, many of which had their crests exposed at low water. The fishermen state that the beds are now numerically far richer than before the crevasse—a statement which an examination shows to be extremely

probable. Nearly every old shell on these reefs bore young, and many of them were completely covered by oysters from 1 to 3 inches long.

In their present crowded state it is not likely that these will develop into good oysters, either as regards shape or condition, for as they increase in size many of them will be killed by the growth and crowding of their fellows, and the remainder will show in their poorness and irregularity the bad effects of their severe struggle for existence.

It would be of great advantage to have some of the superfluous oysters removed. If half of those now on the beds were taken up, the clusters broken, and the single oysters planted on suitable bottom, there would result not only an improvement in those planted, but also in those left upon the beds. This is one of the instances where it would be advisable to depart from a general policy of prohibition of the removal of small oysters from the natural reefs. Some of these oysters were taken to the planting-grounds west of the river while the canal was still open, subsequently to the crevasse; but that avenue is now cut off, and the voyage around the Delta is so long as to make it more advantageous for the planters to go to Timbalier for their seed. It is not at all unlikely, however, that planting could be carried on with some advantage on the east side of the river, where it is now extremely limited in extent.

South of Bird Island the heavy discharge of fresh water from Cubits Gap so reduces the normal salinity as to prevent the growth of oysters, and in Garden Island Bay, where natural reefs formerly existed, the oysters were exterminated by the Pass à Loutre crevasse. The only natural reefs now existing in the vicinity of the Delta are a small one in East Bay and another in West Bay, near Southwest Pass.

West of the Mississippi River the natural reefs of Plaquemines Parish are limited in extent and of but little importance as compared with the planting interests. There are a few oysters of volunteer growth in August Bayou and in Cyprian Bay. In Chi Charas Bay there are said to be several reefs, which give employment for a term each season to from 30 to 40 boats. These beds are overfished, and are said to have decreased greatly during recent years, although it is probable that they were never very extensive.

In Bayou Cook the natural beds were long ago exhausted, and in Bay Adam, where there were originally a number of reefs, practically no oysters are now taken from them, although occasionally some are caught. In Bastian Bay there are still some natural reefs from which oysters are taken each season, but these also are said to be much less productive than formerly, and doubtless will before long become extinct.

In that part of Baratavia Bay lying within the limits of Plaquemines Parish there are now no productive natural reefs, and even the remnants of those previously existing are fast disappearing through the destruction and dissolution of the dead shells.

THE NATURAL OYSTER-BEDS OF JEFFERSON PARISH.

This parish includes within its limits the major part of Barataria Bay, formerly a productive oyster region, but now exhausted. Several days were spent in examining these waters, but with one exception not a reef was found which was not extinct from an economic point of view and fast approaching that condition biologically. The exception noted is in Rayou des Islettes, where there are a few fine large oysters in a hole 25 feet deep, where they can not be reached by the tongs of the oystermen. The reefs are all in the southern half of the bay, the northern half having never produced oysters within the recollection of the inhabitants, probably owing to its low normal salinity. A large area of marsh and swamp land drains into this bay and as its mouth is almost closed by islands the influence of salt water from the Gulf of Mexico is not sufficient to counteract the influx of fresh water in the north.

That this region was at one time an important one is evidenced by the number of extinct reefs which are to be found, as well as by the testimony of the inhabitants. None of these beds appear to have been very extensive, and in this feature they resemble, in general, those in other parts of the State, but their number makes the total area not inconsiderable. It is not necessary to indicate the location of these reefs other than to say that they are scattered through Caminada Bay, Bay Coquette, Tambour Bay, Bay Joyeuse, Bay des Islettes, Champagne Bay, along the shores and islands of Grand Lake, which is the main body of Barataria Bay, and in Cat Bay, or Bay Devise, as it is called locally. All of these reefs are of the same character. They are for the most part composed of dead oyster-shells, with occasionally a large single oyster of fine flavor and shape. There is practically no young growth, for which there appear two probable reasons—the dearth of adult individuals to furnish the spawn and the absence of suitable cultch for the attachment of the young.

The dead shells are worm-eaten and corroded by the boring-sponge and the clam-like *Martesia*s. They are fast disappearing and passing into solution, and with their disappearance there will pass practically all that distinguishes the reefs from the surrounding bottom, thus making more and more remote the possibility of the recuperation of Barataria Bay as a natural oyster-ground. It took nature many years to erect these reefs upon the soft and muddy bottoms of the bay, but a few years suffice for their destruction. Already, in Champagne Bay and elsewhere, the shells upon the surface of the mud have disappeared, and the location of the old reef is marked only by the shells which have sunk into the ooze or have been buried beneath the sediment deposited by the water. In the section of the report dealing with matters relating to oyster-planting there is pointed out a method of utilizing these extinct reefs.

The cause of the destruction of these reefs appears to have been overfishing in some form or other, more probably that species of improvi-

dence which results from lax enforcement of the culling laws. There is no reason for believing that the beds were exterminated by oyster enemies, although there is no doubt they did some harm, and no crevasse has occurred during a period which would allow it to be offered in explanation of the facts observed. Crevasses, and enemies, with few exceptions, leave the shells upon the beds to serve as cultch and assist nature in her efforts at recuperation; but the overzealous oysterman, raking seed from the natural beds, sometimes leaves not even the shells. It is stated that for six or seven years oystering was here carried on in a destructive way by men engaged in planting on other parts of the coast. It is claimed that not only the small oysters but even the shells were carried off, and the present condition of the beds lends color to the belief that the statement is true, at least in part.

What has already occurred here is now taking place elsewhere, and it behooves those interested in the oyster business of the State to correct a condition which will before long result in irremediable damage.

THE NATURAL OYSTER-BEDS OF LA FOURCHE PARISH.

The oyster regions of La Fourche include portions of Caminada and Timbalier bays. The few oyster-beds at one time existing in the former are now extinct and in the same condition as those in Jefferson Parish. The two bays are connected by a canal, which furnishes the main avenue of communication between Timbalier and the planting-grounds of Plaquemines and the markets of New Orleans.

At its western end the canal opens into Little Lake, in which there is an extinct reef of small size, now utilized as a bedding-ground when the oysters in Timbalier Bay are too salt. It is not improbable that this reef was destroyed by the fresh water discharged into the lake by the canal leading from Bayou La Fourche, the density here being but 1.0044.

The most important oyster region in the parish is on the northeast side of Timbalier Bay, in the vicinity of Jacks Camp, Camp Malnommé, and Bayou Landry. At each of these places, but especially at the first, there are considerable villages composed of the rude camps of the oystermen built upon piles on the sea marsh. In the immediate neighborhood of the camps the oystermen have their bedding-grounds, upon which the oysters are stored until the cargo of the boat has been completed.

There are reefs all over this part of the bay, the oysters being of moderate size and good flavor. The density is about 1.0160. Upon all of these reefs there is a good growth of young oysters, from 1 to 3 inches long, about 50 per cent of the old oysters and dead shells having young growth attached. A hurried examination of these beds indicates that they are in a fairly satisfactory condition and not in danger of extermination unless through neglect of proper culling. There appears to be no doubt that their productiveness has decreased during the past four or five years, and from the estimates of a number of the oystermen

it seems that the average daily catch per man has fallen off at least 60 per cent, and probably more. One important factor in producing this diminution is that large numbers of young oysters are taken from the natural reefs and planted in other parts of the State. During certain months of the year this business is quite extensive, and the drain on the natural reefs is very considerable.

It is immaterial for what purpose these young oysters are taken—whether for transplanting to distant beds or to be thrown upon the shell pile, the effect upon the reef is the same. In one case, of course, they are wasted, and in the other they serve a useful purpose, but in either case the natural beds are rendered less productive and placed one stage nearer extinction. It can be readily seen that if this removal of the young continues, whatever may be the reason or pretext, the time must soon arrive when there will be neither young nor old, neither marketable oysters nor seed, upon the natural reefs. It was in all probability some such cause as this which led to the extinction of the reefs in Barataria Bay. There are said to be 200 boats licensed to fish on the natural reefs of La Fourche Parish, but many of them have lately moved into Terrebonne Parish on account of the partial depletion of the beds near Jack's Camp. There are no oysters excepting raccoons south of Grand Point, although there are some young oysters of good shape in Champagne Bay just eastward of the mouth of Bayou La Fourche.

THE NATURAL OYSTER-BEDS OF TERREBONNE PARISH.

Terrebonne Parish contains the most important oyster-grounds of the State, and there are 600 boats of all kinds licensed to fish within its borders. The oyster-producing waters extend from the eastern part of Timbalier Bay almost to Atchafalaya Bay, where the influx of fresh water places a limit upon the growth of the oyster-beds.

In the northern part of Timbalier Bay there is a newly discovered oyster-bed lying in a small bay. These oysters are of rather inferior shape, being somewhat of the raccoon type, as is often seen on beds which have not been worked. There were 9 or 10 boats fishing here. In Pass Felicity there are a number of beds of oysters somewhat like those found in the vicinity of Jack's Camp. In the southern part of Lake Felicity there are beds of long, thin-shelled oysters growing on the soft mud along the shores. The young growth here is but moderate in quantity. It is stated that the oyster-planters to the eastward carry away shells and oysters, large and small, from these waters. Along the northwest shore of Lake Felicity there is a reef, upon which the oysters are in small clusters, of good size and shape, and with an abundance of young growth. In this lake mussels are often quite troublesome, overgrowing and crowding the oysters, and making it difficult to cull them. The density is 1.0100.

There are oysters on the northwest shore of Lake Barré, especially in the places known to the oystermen as Mud Bayou, Hatchet Bayou

(Bayou la Hache), and Muddy Bayou. There are a good many reefs, but very few oysters, in Bay Jocko, which lies between Timbalier Bay, Terrebonne Bay, and Lake Barré. No very definite information in regard to this region was obtained. The northern part of Terrebonne Bay was not visited, but the following general information concerning it was derived from reliable sources. Oyster-reefs are scattered over the northern two-thirds of the bay, both along the shore and out in the middle, but there are not many as far south as Point-of-Marsh. The water varies from 2 feet to 22 feet in depth over the oyster-beds, but the latter depth is unusual. The water is said to be fresher than in Timbalier Bay, a statement which seems probable in view of the discharge of Bayou Terrebonne and Little Caillou Bayou into the bay, and which is confirmed by the readings taken in corresponding parts of the two bodies of water. In the western part of Timbalier Bay the density was 1.0179, while at Point-of-Marsh, the corresponding part of Terrebonne Bay, it was but 1.0128.

It is stated that fifteen years ago there were no oysters above Bayou Lagraille, nor in some of the small bayous of Lake Barré, and their presence there now is supposed to be owing to changes in the drainage due to the cutting of timber along the bayous and the washing of the islands. The topographical changes in the region between Timbalier and Terrebonne bays are quite extensive and rapid, and islands were observed there in all stages of destruction, some of them cut into pieces, others barely showing above the water, and still others whose former positions were marked merely by shoals or by dead brush projecting above the surface. It appears probable that these changes might have produced considerable alteration in the hydrographic characters, and thus have changed the adaptability of the waters for oysters.

Some of the oysters from this bay were examined and found to be of fair size and shape and good quality and condition. In general they somewhat resemble those from Jack's Camp, in Timbalier Bay.

The drumfish is the principal enemy of the oyster in Terrebonne Bay, the waters being too fresh to be very suitable for the snail (*Purpura*). Mussels are sometimes troublesome in the fresher waters.

The testimony in regard to the relative abundance now and in the past is contradictory, but it seems probable that while there may have been an extension of the area over which the oyster is found, there has been at the same time a diminution in numbers upon the beds which have been worked. Young oysters for planting purposes are now taken extensively from Terrebonne Bay to Bayou Cook and vicinity, and the beds in Terrebonne Bay are being worked more extensively than formerly, owing to the partial depletion of the beds in Timbalier. In the vicinity of Point-of-Marsh are some extinct oyster-reefs with a few dead shells, sponges, and other forms commonly abounding in such places.

In Pelican Lake, lying immediately west of Terrebonne Bay, there are considerable quantities of raccoon oysters on the flats. These are not fit for the markets, but could be utilized with profit in planting. Some of the natural reefs here appear to be approaching exhaustion,

although there still remain on them some rather good oysters of elongated form. The old shells are much sponge-eaten, and badly suited to catch young spat.

In Wilson Bay there were formerly several very good beds upon which the oysters fattened early in the season, but these have now been exhausted by overfishing. A few men fished here early during the past season, but they soon found the work unprofitable and abandoned the grounds for more favorable fields.

In Pass des Isles there are a few reefs of good oysters, and in the small bayous leading off from it raccoon oysters abound. The reefs in Lake Chien, which were productive eight or ten years ago, are now practically exhausted, and many of the men who fished there have gone to Sister Lake. Here also there is no doubt that the extinction of the beds was due to overfishing, coupled, perhaps, with laxness in culling, especially on the part of those engaged in planting. There are still many raccoon oysters in the bayous opening into the lake, and these are now used as seed by the planters.

In Grand Bayou de Large there are about twenty camps between the Gulf and Sister Lake (Lake Caillou, in part), and there are oysters all along this stretch, in water varying in depth from 8 to 22 feet. Several men are engaged in planting. This bayou appears to be the Bayou Grand Caillou of the published charts and maps, but, if so, it is very incorrectly laid down. It is difficult to identify many of the bodies of water between Timbalier Bay and Oyster Bayou or Four League Bayou, as the mapping of this region was either extremely faulty in the first instance or else the topography has undergone most remarkable changes. On some maps lakes are shown where none exist; on all of them important bodies of water are not shown at all, and many of those indicated are incorrect, both in position and topography.

Lake Barré, which is about 8 miles long and 3 or 4 miles broad, is not shown at all on some of the maps published under both United States and State authority; there is no lake east of Lake Felicity; Lake Chien (southeast of Sister Lake) is not shown on any map which I have seen; Sister Lake (Lake Caillou) is entirely wrong in both outline and position, and King Lake, which is practically a bay of Sister Lake, is, with its connections to the westward, not shown at all. It will therefore be impossible to indicate very definitely the positions of the places mentioned, and they will be called by the names used by the oystermen rather than those used on the maps.

In Sister Lake there are oyster-reefs at intervals along the shores, in addition to those in the center of the lake, the oysters being generally of good quality, the best coming from a reef near the discharge of the lake into Bayou de Large. When first discovered they were rather inferior in shape and condition, but, as is usually the case, the oysters have improved in both respects, owing to the breaking up of the clusters and the thinning out of the dense growth. It is stated that a man can take from 4 to 8 barrels of oysters per day in these waters,

and there appear to be no immediate grounds for apprehension of failure. Several of the oyster-reefs in Sister Lake are sometimes overgrown with mussels to an extent that renders tonging upon them unprofitable. The density is about 1.0120.

Bay Voisin leads from the southeast corner of Sister Lake to King Lake, an L-shaped body of water, with one limb running east and west and the other approximately north and south. There is one bed of raccoon oysters in King Lake, and there are also some very fine oysters there and in Bay Voisin, but they are getting somewhat less abundant than they have been. Some of the oystermen predict a rapid depletion of the beds, owing to the attacks of snails, which are said to be becoming more common than formerly.

In Lake Washa there are numerous reefs of rather inferior "coony" oysters, covered with barnacles and bearing evidence of having formerly borne large numbers of mussels, of which only the byssi now remain. These reefs have not been extensively worked heretofore, but during the present spring (1898) a number of boats were fishing for Morgan City canneries, and several of the men engaged indicated their intention of getting seed from this lake for the purpose of planting in Jack Stout Bay and Bayou. If this be done and the young oysters be taken promiscuously in the usual manner, we may expect the usual results. The density here is about 1.0092.

In Banana Bayou, which is that part of Bayou de Large of the maps lying between Sister Lake and Lake Washa, there are young oysters growing over practically the entire bottom, and they are frequently found attached to branches of trees and brush along the banks. This bayou is said to have derived its name from the fact that the oysters found here when the bed was first worked were elongate and in clusters like bananas. The lower end of Bayou de Large, together with the branch which discharges King Lake, is known to the oystermen as Taylor Bayou. It contains some oyster-beds, but none of importance.

Big and Little Bays Genope (or Genoble?) lie immediately to the westward of Bayou Taylor and have an independent communication with the sea. They are both very shallow and have a narrow channel running through them. Here are found dense reefs of raccoon oysters, exposed at low water, when they are gathered into piles to be loaded on the boats when the tide rises. These raccoon oysters are used principally for planting in Bayou Jack Stout, Bayou Provençal, and Indian Bay, all of which lie on the east side of Bayou Taylor.

In Oyster Bayou there are a number of natural reefs of raccoon oysters, both along the banks and in the middle of the bayou. The number of good round oysters is small.

There are a few beds of inferior oysters near the southern end of Four League Bay and near the mouth of Blue Hammock Bayou. Last year (1897) there was a set of spat in Blue Hammock and the young ones are now being secured for planting purposes. Oysters have existed here before, but were killed off by fresh water.

West of Atchafalaya Bay the oyster-beds are few and unimportant. The set of the currents of fresh water discharged from the Atchafalaya is westward and their volume is such that the water of Atchafalaya Bay, East Côte Blanche Bay, West Côte Blanche Bay, and some parts of Vermilion Bay is too fresh to support oyster life. In some parts of Vermilion Bay and Marsh Island there are a few inferior oysters and it is reported that there is a bed of considerable size in the open waters of the Gulf off Southwest Pass. There are said to be a few insignificant beds in Calcasieu Pass and perhaps some at other inlets west of Vermilion Bay, but in general the character of the coast line is not such as to favor the growth of oysters, as the sounds, bays, and bayous which are the favored home of the oysters are lacking.

NATURAL OYSTER-BEDS—SUMMARY.

There are no oyster-beds in Lake Borgne, owing to the low salinity of the water. Beginning at the islands at the western end of Mississippi Sound, there are scattered beds as far as Isle à Pitre. There are now few, if any, oysters in Chandeleur Sound, although they formerly existed there. The cause of their extermination was not fully determined. In nearly all of the interior bays and bayous intimately connected with Mississippi and Chandeleur sounds there are more or less extensive beds, most of which have not yet been worked to their full capacity, and some of which contain virgin beds of great productiveness, although the oysters are usually rather inferior in quality. In several places the productiveness of the beds has been considerably reduced and in others, *e. g.*, Three-mile Bay, the present supply is entirely dependent upon the care with which the oysters are culled. There is no immediate prospect of the extermination of these beds, owing to their great extent, the chief danger being that the concentration of effort upon a comparatively limited area and the taking away of large numbers of young oysters to the canneries may in time prove destructive. The safeguard is to enforce proper culling laws.

In Plaquemines Parish, east of the Mississippi, there are extensive beds of young oysters, practically untouched by the hand of man, stretching from Mozambique Point to Bird Island Sound. From Bird Island Sound around the Delta to Barataria Bay there are no natural reefs of importance, those formerly existing there having become nearly or entirely extinct, some by reason of overfishing and breach of the culling law and others as the result of crevasses.

In Barataria Bay and its contiguous waters the reefs are commercially extinct and apparently beyond hope of redemption by natural means, principally, if not entirely, as a result of destructive methods of fishing. These reefs have probably no future value except for planting, and unless soon utilized will eventually become of no greater value than the surrounding bottom.

In Timbalier Bay and Lake Felicity the beds are still quite productive, but are already showing signs of approaching depletion to an

extent that has induced some of the oystermen to resort to other waters. In Terrebonne Bay there is probably as yet no great decrease, but between Terrebonne Bay and Atchafalaya Bay many of the more limited beds have been exterminated or reduced to a condition where it is unprofitable to work them; other places are still productive, but not to the same extent as formerly.

OYSTER-PLANTING IN ST. BERNARD PARISH.

Notwithstanding the extent of the oyster business in the parish of St. Bernard, no oyster-planting is carried on there, nor, apparently, has any effort been made in that direction. The oystermen working on the natural reefs habitually set apart certain circumscribed areas of hard bottom upon which they bed their oysters until they have caught enough to make a cargo. Toward the end of the season, when many of the beds become more or less depleted by the drain which the steady prosecution of the industry entails, it frequently requires as long as fifteen days for the crew of a vessel to catch a full load. Under such circumstances oysters taken during the earlier part of the trip would spoil before the boat was ready to sail, and to avoid this it is customary to "bed" the culled oysters every few days in a place whence they can be conveniently removed when the cargo is completed. The oysters are bedded very thickly on these grounds—often, it is said, to a depth of a foot—so as to allow of their recovery with a minimum expenditure of labor when the load is completed, and were this done on soft bottom the oysters beneath would be driven into the mud and suffocated; and for this reason the beds are almost invariably placed upon the reefs, which often afford the only hard bottom to be had. The beds are small—averaging, perhaps, about 50 feet square—and are usually marked and sometimes inclosed by stakes to keep off the drumfish, which often prove destructive. For the same purpose many of the beds are surrounded with old seines, which prove effectual barriers, or by lines with pieces of rag attached, which scare the fish away.

A few of the oystermen fishing in the salter water at the eastern end of the parish sometimes set down their catch in the fresher water near Three-mile Bayou to "fatten," as they say, but in reality to undergo a process of bloating, due to the osmotic interchange of fluids within and without the tissues. The reverse process has been occasionally practiced at times when the discharge of fresh water through Lake Pontchartrain and the Pearl River has been of sufficient volume to reduce the salinity over the oyster-beds and render the oysters too insipid for market. By transplanting the oysters for a short period to the denser water of Chandeleur Sound it was found possible to improve the flavor to an extent which rendered the oysters salable. Certain of the oystermen residing on the shores of Mississippi Sound sometimes find no immediate market for their catch, and by bedding the oysters temporarily near their residences where they can not be stolen, are able to wait until the market improves and better prices prevail.

The nearest approach to planting as it is practiced elsewhere in the State—at Bayou Cook, for instance—is done by a man who has been bringing oysters from Grand Pass (Oyster Bay) and bedding them near Pirate Point for a few days. The culls and shells are thrown down on the bottom adjoining, and this has resulted in the formation of beds which he reserves for his private use.

Such is the present extent of planting, if it may be so called, in the parish of St. Bernard. A very large part of the bottom in this region is probably unsuitable in its natural state for oyster-culture, but were the profits sufficient to warrant it there is no doubt that much of it could be improved in a manner to make it available, as will be pointed out hereafter.

There is some bottom, not on the natural reefs, which is suitable in its natural or unimproved condition, but the patches of hard bottom are usually small and scattered, and, in the absence of anything more than a mere reconnaissance, such as the time at the disposal of the party made possible, the exact locations of these places can not be indicated. There are a number of such places in East Karako Bay, however, where both the bottom and density are favorable, and other localities are indicated in a general way on the chart.

In False-mouth Bay the bottom consists of a firm clay mud similar to the soil of the surrounding marshes and apparently well adapted to oyster-culture. There are no natural-bed oysters in this region excepting a few near Shell Signal and around some of the islands at the southern end of Nine-mile Bayou.

It is stated by the oystermen that but few oysters have ever existed here, a condition brought about apparently by the absence of suitable places of attachment, as practically no shells or other hard bodies were found on the bottom. It seems probable that, by sowing shells with some brood oysters to furnish spat, successful culture might be here carried on, the only drawback being the low salinity of the water, which, at the time of our visit, February 12 and 14, 1898, ranged between 1.00514 and 1.00664, and rendered the oysters insipid, notwithstanding their fatness. This density was probably nearly normal for the season, but, as elsewhere in the region, it is subject to great fluctuation according to the rainfall and the prevailing winds, and in summer, between April 1 and September 15, it is considerably higher than at the time our observations were made.

OYSTER-PLANTING IN PLAQUEMINES PARISH.

East side of river.—In that portion of the Parish of Plaquemines east of the Mississippi River, oyster-culture is not extensively carried on, but in the vicinity of Quarantine Bay, in Bayou Tortillon, and in the northern part of Bird Island Sound near the Salt Works Canal, there are a few men engaged in the industry. Oysters are taken from the natural beds, separated from the clusters, and replanted on private beds. The principal advantage which this region possesses appears to

lie in the fact that the oysters here become fat earlier than those on the west side of the river, and they are, therefore, more in demand in the markets of New Orleans upon the opening of the season in September. In 1897 the oysters at Salt Works were found to be through spawning and quite fat during the last week of August, while many of those examined at Bayou Cook the day before were still spawning and inferior as to condition.

The oysters now (March, 1898) on the private beds in Quarantine Bay were obtained from the vicinity of Mozambique Point and Rivière aux Chênes, and were planted during the summer of 1897. During the spring of that year all of the private and natural beds in California Bay and Quarantine Bay were destroyed by the fresh water discharged from the Mississippi River by the crevasses occurring at Bohemia and at the several canals opening into the bays under discussion.

The principal enemy with which the planters here have to contend is the drumfish, which has become so troublesome as to compel the erection of close and rather expensive stockades for the protection of the bedding-grounds. Formerly these protections were built with rails about 6 inches apart, but they are now constructed of pickets close together, entering the mud at the bottom and nailed to stringpieces at the top.

Whale Bay and Grand Pass.—Oyster-planting began here about 1885, the pioneer and most successful operator being Louis Espongar, who in that year began to transplant oysters from the natural beds in Garden Island Bay, between South Pass and Southeast Pass. He appears to have been the first man to appreciate the importance of planting cultch to catch the spat, and carefully collected oyster shells and other suitable materials for that purpose, even, it is stated, stipulating the return of shells when he sold his oysters unopened to the residents of Port Eads.

After some years others began to establish private beds in Whale Bay, until 1892 depending for their seed oysters upon the natural beds existing in Garden Island Bay. In 1892, however, the water from the Mississippi River broke into the head of Garden Island Bay at what is known as the Pass à Loutre crevasse, flooding the bay with fresh water and killing the oysters. This gap has until the present time resisted all attempts at its closure, and the oysters have never reestablished themselves. Deprived thus of the only extensive near-by source from which to obtain their seed oysters, the planters had to choose between establishing spatting-grounds and depending upon the young oysters attaching to the cultch, or making the long and sometimes stormy trip to Timbalier or the coast north of Bird Island Sound, the nearest places in which seed oysters could be obtained in sufficient quantities for their purpose.

It was found that the destruction of the oysters in Garden Island Bay had left large quantities of shells available for use as cultch, and the experience of Mr. Espongar dictated the use of these as the easiest

and most economical way out of the difficulty, and large quantities were therefore carried to Whale Cove and laid down on the spatting-beds. In this way was established the methods of oyster-culture now in vogue.

Since the preparation of the Coast Survey charts of this region the topography has greatly changed, the marshes formerly existing in the northern and western part of the bay being now cut up into numerous small islands and channels. The dam built across the head of Grand Bayou has resulted in the complete closure of the mouth of the bayou, which is now in its southern half, separated from Whale Bay merely by a chain of narrow islands with passes between. It is upon these islands, both in the bay and along the shores of Grand Bayou, that most of the planting is done.

The area of bottom naturally available for oyster-culture appears to be extremely limited, being confined to narrow strips along shore and varying in width in different localities, in Grand Bayou extending from shore to a distance of from 25 to 50 feet. Outside of this zone the bottom is generally soft—often extremely so—and it is never utilized for planting. Under the laws of the State each planter is entitled to hold 10 acres in his own right, but for the reasons stated it usually happens that a large proportion of his holding is useless for his purposes. There are about six men planting here, and their holdings probably amount to between 100 and 125 acres, some of them occupying bottom in the names of friends or members of their families. Most of them appear to be anxious to increase their acreage, but they claim that the entire available area is now occupied. Notwithstanding this demand for extension, no effort has been made to improve the bottom in such a manner as to render it suitable for planting. It seems probable that this might be done by covering the mud with a thin layer of sand, such as can be readily obtained at the mouth of Grand Bayou and at other places in the vicinity. As is well known, this method has been employed with great success elsewhere, and a large amount of valuable oyster-land in Connecticut was useless until similar measures were adopted. The problem is an economic one and hinges upon the question whether or not the price obtained for oysters from this region is sufficient to warrant the expenditure. As the sand costs nothing, the only expense would be for labor and transportation, neither of which would be a large item under the conditions here prevailing.

At the present time all shells and other available materials—tin cans, stones, bones, etc.—are strewn along the shores of the marsh below the level of high water and out from the shores to the depth of a foot or 18 inches. Much of this material is thrown among the grasses and sedges, where it is never covered by more than a few inches of water, even at high tide. It is stated, and undoubtedly upon good grounds, that in this extremely shoal water the young oysters are less susceptible to the attacks of enemies, and it is also claimed that they grow more rapidly than when they are in deeper water.

In shoal water, and especially when they are in clusters, the oysters grow in poor shapes; and for this reason the planter, as soon as the oysters are of sufficient size, usually at the end of the first year, breaks up the clusters into single oysters, which are then planted in the deeper water. They reach a marketable size—from 5 to 6 inches—in from 2 to 2½ years from the time of planting the shells, and are very fat and of remarkably fine flavor. It is estimated that about 100 bank barrels, or 300 bushels, of oysters can be produced annually from each acre of bottom; that is to say, the usual crop is 300 barrels every three years.

Cultch and seed oysters being greatly in demand, the culling is done with extreme care, all shells and young oysters being carefully saved and returned to the natural bed.

It is rather surprising to find oysters of such fine quality in such close proximity to the mouth of the Mississippi River, where it might be supposed that the water would be entirely too fresh for their welfare. The density fluctuates with the direction of the winds, but is usually conditioned by the stage of water in the river, being lowest during the freshets of winter and spring and highest during the low water of the summer months. March 4, 1898, when the river was at a moderate level after a period of high water, the density on the oyster-beds was between 1.0109 and 1.0116, corrected to a temperature of 15° C., or 60° F. The temperature was between 11.5° C. and 13° C., or 52.6° and 55.6° of the Fahrenheit scale, a temperature lower by several degrees than was found elsewhere upon the oyster-beds at that time, a condition probably due to the influence of the cold water from the Mississippi River.

The principal enemies of the planted oyster in this vicinity are the conch (*Purpura*), the drumfish, and the stone-cracker, a species of ray. The conch is very troublesome at times and the drumfish causes damage during the summer months, but is much less destructive than at Bayou Cook. The stone-cracker appears here but occasionally, but its visits are very disastrous in proportion to its numbers. It seems to be unknown to the oystermen elsewhere.

The oystermen at Balize have planted oysters in the small bay immediately west of the mouth of Southeast Pass. This place was not visited, but the conditions doubtless resemble those obtaining in Whale Bay.

Bayou Cook and vicinity.—The most extensive planting-grounds in Louisiana are the series of lakes, bays, and bayous lying between Bay Jaque and Bastian Bay, a large part of the best oysters found in the markets of New Orleans coming from this region. It is estimated that there are upward of 500 men engaged in the several branches of the business in this region.

In Bay Pompadour, the farthest inland of the chain of lakes connected with Bay Jaque, there are neither planted oysters nor natural reefs, owing principally to the low salinity of the water. There are a few natural-bed oysters, but no planted ones in August Bayou, which

leads from Bay Pompadour to Cyprien Bay, but in Cyprien Bay itself, and in Schofield Bay and Skipjack Bay, which open into it from the south and southwest, there are a number of planted beds on which are raised oysters of excellent quality. There are apparently no planted beds in Chi Charas Bay, but in Bayou Coquette, Bay Coquette, and Bay Jaque the industry is of some importance, although of but comparatively recent growth.

Both young oysters and shells are planted, the former being at present the more important branch of the work. Most of the seed oysters now on the beds were obtained in the vicinity of Quarantine Bay during the period when the open canals after the crevasse of 1897 permitted direct communication with the river. It is probable that hereafter the planters will use shells more extensively, rather than make the long journey to Timbalier or Terrebonne for seed, these being now the nearest natural beds having direct communication by water.

It is estimated that about 300 bank barrels (900 bushels) of seed oysters are planted per acre of bottom, and under good conditions these are said to increase about 100 per cent in $1\frac{1}{2}$ to 2 years. I was informed that in one instance, where 475 barrels had been planted on a certain piece of bottom, 480 barrels were taken up in the following year, and it was estimated that an equal quantity still remained.

The quantity of shells planted per acre could not be ascertained, owing to the practice of spreading them along the shores in the shoal water, as has been described in connection with the subject of planting at Port Eads. The bottom suitable for planting occurs in patches here and there, and there is apparently no large area of hard bottom not interspersed with soft mud.

The principal enemy of the oyster here is the drumfish, and the bedding-grounds are inclosed by rude rail fences to prevent its inroads.

In the markets of New Orleans the oysters from Bayou Cook have the best reputation of any grown in the State, and a large number of oysters grown elsewhere, many of them equal to the genuine, are put upon the markets and sold as Bayou Cooks.

Bayou Cook itself connects Bay Adam with Bastian Bay, and is about 3 miles long, broad at the two ends, but narrowing in the middle third of its length. The currents flowing through the bayou are moderately strong, it being the main channel for the ebb and flow of the tides affecting Bay Adam. It covers a bottom of considerable area, only a small portion of which is utilized in the methods of oyster-culture in vogue, although the oystermen state that all bottom naturally suited to the purpose is now in use. The bottom on the planting-grounds is usually, if not invariably, a hard mud, soft mud being avoided because the oysters sink in it and are lost, and the sand in the bayou being of a shifting character and liable to bury the beds during storms.

It is stated that in 1893 many hundreds of barrels of oysters were destroyed in this way, some of the oystermen prior to that time not appreciating the unstable character of the bottom. The hard mud, as

a rule, occurs in patches near the shores, the channel generally having a soft bottom, and in places being too deep for the tongs used in catching the oysters.

Although it is claimed that all of the suitable bottom in the bayou has been taken up and is now in use for planting, no attempt has been made to improve the soft bottom by covering it with a stratum capable of furnishing a support for the oysters. A few shells are planted along the shores in the manner practiced at Port Eads, but seed oysters from the natural beds are much more extensively used. The seed is brought principally from Timbalier and Terrebonne bays, which entails a voyage of about 50 miles at least, the payment of tolls in the canal, and the payment of a license fee in the parish in which the oysters are taken from the reefs. During the autumn of 1897 much seed was brought from Quarantine Bay, but as soon as the breaks in the levee were closed this source of supply was cut off. The taking of seed oysters from the natural beds is a source of much complaint among the oystermen fishing for the markets, who claim that the boats engaged in the business pay but little attention to the requirements of the culling law and that large and small oysters alike are removed from the beds.

From 300 to 400 bank barrels (900 to 1,200 bushels) are planted on each acre of bottom, the oysters being spread as closely as possible without being in actual contact. They are planted in the usual manner, by being thrown broadcast from the boat with shovels or scoops. It is stated that oysters here reach a marketable size in about two years from the time at which they fix themselves to the shells, and that seed 3 inches long is ready for the market in one year from the time of planting.

The principal enemy of the oyster in Bayou Cook is the drumfish, which causes some damage during the summer, but is especially destructive during the months of September and October. Oysters which have been long bedded are not much damaged by the drumfish, but those which have been cleaned and laid down in preparation for market are especially liable to attack during the first few days. After that, probably either because they settle down slightly in the mud, or because they become coated with sediment and are therefore less conspicuous, they are not much molested. The oystermen all erect barriers around the bedding-grounds where the cleaned oysters are deposited.

The conch or snail is not very destructive in Bayou Cook, excepting near the entrance to Bastian Bay. Stone-crabs sometimes kill the oysters, especially those less than 3 inches long.

In Bay Adam the conditions are practically as in Bayou Cook, except that there is less current flowing over the beds and they are more exposed to storms. The planting-grounds are around the shores of the lake, especially in its southern half, and, as nearly everywhere on the coast of Louisiana, the area of naturally suitable bottom is comparatively small and much scattered. In Bayou Chute, which establishes

communication between Bastian Bay and the extreme southern part of Bay Adam, oyster-planting is also carried on to a considerable extent. In these places the drumfish is less troublesome than in Bayou Cook, but great damage is done to the beds by the conch or snail.

It is estimated that about 500 men are employed in oystering in the Bayou Cook region, practically all of whom are engaged in operations pertaining to planting and the transportation of the planted oysters to market. Most of these are alien-born, being principally natives of the Slavonic provinces of Austria, but there are also some native-born planters, usually creoles. In Cyprian Bay, Bay Coquette, and vicinity, most of the planters are creoles or other natives.

OYSTER-PLANTING IN JEFFERSON PARISH.

In Barataria Bay the oyster industry amounts to practically nothing, owing to the extermination of the natural beds and the almost complete neglect of oyster-culture. A few oysters are planted for home consumption near Grand Isle, and one or two men at that place plant a few for the markets, but the entire production for all purposes is very small. A few oysters from Timbalier are planted on a small bed in Bay Coquette, near the mouth of the canal, in La Fourche Parish. In Bay Devise, shown on the Coast Survey Charts as Cat Bay, one, or perhaps two, persons have planted oysters on what appears to have been formerly a natural reef, although it has not been productive for several years. In the few cases cited seed oysters are brought from Timbalier Bay, and it is stated that except at Grand Isle it is impossible to secure a set of oyster spat upon shell or upon cultch. The oystermen think that it is possible to do so at Grand Isle for some mysterious reason connected with the drainage of fresh water from the island, but it is probable that a set could be obtained anywhere in the southern half of Barataria Bay and its connected waters if there were but enough adult oysters to furnish the young. As there are practically no adult oysters, except those on the few planted beds mentioned, over the greater part of this region, it is useless to expect young oysters to grow. The belief of some of the oystermen that young oysters are generated spontaneously under certain peculiar conditions of admixture of fresh and salt water is a biological absurdity.

The general conditions for oyster-culture appear to be good, and it is quite probable, indeed almost a certainty, that self-perpetuating beds might be readily established by bringing adult oysters from the Timbalier or other natural beds and planting them upon suitable bottom in any part of Barataria Bay south of the mouth of Champaign Bay, and probably for some distance north of that point. In the upper parts of the main bay, which is locally known as Grand Lake, and in Hackberry Bay, Creole Bay, Bay Batiste, and their connections, it is probable that the water will prove too fresh in which to raise oysters of good quality, if, indeed, they could be grown at all.

After establishing the planted beds of brood oysters there should

be no difficulty in securing a set of spat on shells or other cultch laid down in the vicinity, or the shell-beds might be first established and the brood oysters scattered over them in the proportion of 25 to 40 barrels per acre. There are perhaps several hundred thousand barrels of shells on and around the small islands on the western side of Grand Lake. These are clean and bright and in excellent condition for planting, and moreover may be obtained for the labor of loading them on the boats, which may be run close against the bank, so that the labor of loading may be reduced to a minimum. These shells are small, averaging 1 or 2 inches in diameter, and as comparatively few spat would probably attach to each, the labor of culling would be much less than if large oyster shells are used, when often a hundred young attach to a single shell and the oysters grow in large clusters.

The amount of bottom suitable for oyster-culture is comparatively limited, especially if we except from consideration the extinct oyster reefs. What should be done with the latter is a matter worthy of consideration. As they now are, they are worthless to everybody. It is only here and there that an adult oyster can be found, and even the few old shells remaining upon them are fast disappearing, owing to the attacks of boring organisms, worms, sponges, and lamellibranchs, which are rapidly bringing about their disintegration and decay. In the course of time the shells will become dissolved and entirely disappear, and eventually, with the deposit of sediment, the bottom will become almost, if not quite, as soft as the surrounding mud. The young oyster, as has been frequently pointed out in the publications of the Fish Commission and elsewhere, is extremely minute at the time it settles down from its free-swimming existence, and a very slight deposit of silt or slime is often sufficient to prevent its attachment to the hard bodies which are its only salvation. The shells upon these old reefs are now more or less completely covered with slime and sediment, whereas upon a thrifty reef there are always many comparatively clean shells to be found.

Each year that passes makes it more and more improbable that these reefs will ever become rehabilitated, and even now the condition of the shells is such that it is doubtful if oyster fry would find them suitable places for attachment, and the time will certainly come when all hope of nature again establishing beds must be utterly abandoned. In their present condition, however, they appear to be very well adapted to planting purposes, and it appears to be good economics to permit their use for this purpose rather than to still hug the almost certainly vain hope that nature will again step in and renew her bounties, and, waiting thus too long, lose the opportunity to make some salvage from the wreck which wasteful and improvident methods have already wrought.

Under a proper system of private culture these same reefs, now worthless, could probably be made to yield a product far greater than they ever did under the joint administration of nature and the natural-bed oystermen. It is a just and proper regulation that prohibits plant-

ing on the natural reefs or that forbids their alienation from the use of the public, but a law which practically says "once an oyster-reef always an oyster-reef" is contrary to the best interests of a State and her citizens.

OYSTER-PLANTING IN LA FOURCHE PARISH.

In Timbalier Bay most of the planting is done in the northeastern side, in the vicinity of Jack's Camp and at Camp Malnommé. In Little Lake no oysters are planted, but an extinct oyster-reef there is sometimes used as a temporary bedding-ground where oysters are freshened during periods of excessive salinity in the more open waters. In Bayou Landry and in Jack's Camp Bay one association of individuals is said to hold 120 acres of planting-ground, of which 60 acres are affirmed by the oystermen to be upon productive natural reefs which were regularly worked up to the time that the grounds were staked off as a private reservation under the laws relating to planting. It is impossible to form an opinion as to the merits of a controversy of this character without a careful investigation, as the decision hinges largely upon a question of veracity between the contending parties. This incident emphasizes the necessity for more definite laws regarding the occupation of the natural reefs for planting purposes.

Just what constitutes a natural reef is a matter which will receive a variety of interpretations, and some authoritative definition, even although it may be somewhat arbitrary, should be promulgated for the guidance of those intrusted with the enforcement of oyster regulations. The importance of making legal recognition of the fact that oyster-reefs may, under certain conditions, cease to be such, beyond reasonable hope of redemption, is pointed out in the discussion of the prevailing conditions in Baratavia Bay. On the other hand, the contention and dissatisfaction among the oystermen at Jack's Camp shows there is danger in a too lax interpretation of laws prohibiting the individual occupation of natural beds to the exclusion of the public. Without expressing any opinion as to the merits of the special case cited, it may be emphatically pointed out that the State should safeguard from invasion those beds which it holds in common for the use of its citizens, as otherwise the favored few are permitted to reap the benefits which justly belong to the many.

A number of persons in addition to those associated in the case above cited are also engaged in oyster-culture on a small scale at Jack's Camp and Camp Malnommé. The practice is confined almost exclusively to the planting of seed from the natural beds, but some of the men spread a few shells along shore in the vicinity of their camps and afterwards transfer the young oysters to their beds in deeper water. The set of spat so obtained appears to be sufficiently abundant to amply warrant the further development of this practice, especially as the natural reefs are less productive than heretofore.

OYSTER-PLANTING IN TERREBONNE PARISH.

In Terrebonne Bay there are but few men planting oysters as compared with the large numbers engaged in fishing on the natural reefs. In the parish of Terrebonne, which includes the greatest and most productive oyster region in the State, there were but 32 oyster-planters to whom licenses had been granted in 1898, although it is stated that next season there will be a very material increase in the number, there being about 50 applicants now waiting for the survey of their beds. Of the 32 planters whose claims are registered there are not over 15 in Terrebonne Bay, the rest of them being in the bays and lakes lying to the westward. Most of the planting consists in the bedding of seed obtained from the many natural reefs in the bay. Comparatively few shells are planted, notwithstanding that at least 100,000 barrels are piled around the oyster-canneries at Houma, where they could be obtained for little or nothing and carried on the boats returning from that place to the oyster-beds. Most of the planted oysters are in the bayous and coves in the northern part of the bay. They are said to reach marketable dimensions when about 3 years old.

In Pelican Lake, a branch of Pelto Bay, there are several camps with bedding-grounds protected by stockades or fences. On the flats there are a great many raccoon oysters which are worthless in their present condition, but which might be utilized with profit for planting purposes. Such oysters when culled and planted upon good bottom undergo great improvement both in shape and condition, and in a year should be fit for market and hardly distinguishable from those which grew under good conditions from the start.

In Wilson Bay the oysters are said to get fat early in the season, and as the natural beds there are nearly exhausted it is quite probable that this would prove a good field for an attempt at planting.

In Lake Chien planting began about five years ago, when the natural reefs were approaching depletion, and there are now three or four private oyster-beds. Most of these are on the original natural reefs, which afford about the only hard bottom in the lake. A few shells are planted, but most of the seed is obtained from the raccoon oyster-beds in the surrounding bayous. When placed in deeper water, these inferior oysters improve very much in shape and flavor and are ready for market in about a year from the time of planting. They are said to get fat in September, but at the time the lake was visited (March, 1898) they were but moderately fat, although of very fair flavor. Both drumfish and snails are here very troublesome at times.

At Bayou de Large there are several men engaged in oyster-planting, small oysters being planted one year and marketed the next; and in Sister Lake and King Lake, both included in Lake Caillou as shown on the charts, some of the men engaged in oystering on the natural reefs have small planting-grounds.

Jack Stout Bayou and Bayou Provençal are considered the best

planting-grounds in this vicinity, as the oysters get very fat there early in the season. These bayous lie to the eastward of Bayou Taylor, which leads to the sea from the southwestern end of King Lake.

The maps of this part of the coast are extremely imperfect, and it is impossible to say which of the charted bayous are those now under discussion.

Seed oysters are obtained from Big and Little Bays Genope (or Genoble?) and from Lake Washa (Mauchas) and planted on the old reefs or on hard mud, the former being considered best for the purpose. When ready for market they are taken up, cleaned, and rebudded upon hard, clean bottom for from 3 to 7 days to wash and purge of dirt before being sent to market. Oysters are planted on a small scale in other bayous in the vicinity. Very little use of cultch is made by the planters in this region. They depend almost entirely upon the natural reefs for their seed, and instead of assisting the perpetuation of the natural oyster supply they aid in its destruction. At the mouth of Taylor Bayou there are great banks of shells on the outer coast readily accessible and well adapted for use as cultch. If this material were utilized properly, it would soon become unnecessary to obtain seed from the natural beds, and the problem of perpetuating the reefs would present a much more hopeful aspect.

SPAWNING OF THE LOUISIANA OYSTER.

If we may judge from the size of the spat which is found adhering to hard bodies on the oyster-beds, a set occurs during almost every month of the year, but the principal spawning season is between April 1 and September 15, although, for reasons which are not explicable by the facts at command, there appears to be considerable local variation in the time at which the climax is reached. The investigations made, although they are not entirely conclusive, point to the fact that the oysters west of the river in general ripen before those on the east side. During the last week in February the oysters of St. Bernard Parish showed no indications of the near approach of the spawning season, only an occasional individual emitting a few ripe eggs, while a week or ten days later a considerable proportion of those west of the river, in Plaquemines Parish, were decidedly "milky."

The same variation in the time of cessation of spawning was noticed. During the last week in August the oysters in Bayou Cook were still spawning rather copiously, those in Bay Adam had evidently just concluded, while those at Salt Works Canal were found to be fat and well conditioned, indicating that spawning had been over for several weeks, as it is not until the bulk of the spawn has been discharged that the oysters begin to fatten. In St. Bernard Parish they were found to be spawning freely at Three-mile Bayou and at Grand Pass on the 31st of August.

The oystermen say that spawning begins, or as they state it "the oysters become milky," when the water begins to decrease in salinity

under the influence of the spring freshets, and that it ceases with the influx of salter water in the fall. A change in the salinity of the water may perhaps stimulate reproduction, but it happens that the water is more and not less dense during the summer, when the oyster is spawning copiously, than it is in winter when only sporadic cases of sexual activity prevail.

The following table shows in condensed form the conditions prevailing at several places during the latter part of August, 1897:

Locality.	Date.	Density.	Remarks.
Grand Pass, St. Bernard Parish.....	Aug. 31	1.0176	Spawning freely.
Three-mile Bayou, St. Bernard Parish.....	do	1.0123	Do.
Salt Works, Plaquemines Parish.....	Aug. 25	1.0151	Not spawning.
Bay Adam, Plaquemines Parish.....	Aug. 24	1.0078	Do.
Bayou Cook, Plaquemines Parish.....	do	1.0108	Spawning.

It will be seen that there is no relation shown between the density of the water and the cessation of spawning, and that the relative as well as the absolute densities at the different seasons are not determining factors is seen when we consider the geographical relations of Bayou Cook and Bay Adam. No increase in salinity could take place in the latter, where spawning had ceased, without having a prior effect upon the former, where spawning still continued. At the same time it is apparently a well-established fact that in certain places, e. g., Salt Works, Wilson Bay, Bayou Provençal, and others, the oysters cease spawning and become fat very early in the season. Closer investigation would doubtless show that this was not due to one, but to a variety of causes, embracing density, temperature, and amount of food matter available.

The young fry of the oyster, which freely swims in the water, is often wafted long distances and widely distributed by the currents, a fact which accounts for the establishment of new beds and the frequent rejuvenation of old ones which have been destroyed. An instance of the latter, in Quarantine Bay, is noted in another connection in this report. In order that these minute fry may succeed in establishing themselves, it is necessary that they should find some clean, solid body to which to fasten, a fact that must be borne in mind when considering the question of oyster-culture and the use to be made of exhausted beds, such as are found in Baratavia Bay.

RATE OF GROWTH OF LOUISIANA OYSTERS.

In the waters of Louisiana the oyster reaches a good marketable size within three years of the time of its fixation, this fact being established not as the result of more or less loose estimates, but from authentic data established by experience. It is rarely possible to determine with accuracy the age of oysters upon the natural beds, but occasionally circumstances arise which make such determinations

nearly accurate. A case of this kind occurred in Plaquemines Parish in 1897, when the oysters in Quarantine Bay and its vicinity were killed by a crevasse, which occurred about March 15 and lasted until July, when the water again became salt enough to support oyster life, and a heavy set of spat fell upon the dead shells. On March 2, 1898, when these beds were examined, much of this spat had grown to a length of from 2½ to 3 inches, and, assuming that the water became suitable for oysters as early as July 1, these oysters could not have been older than 8 months.

In Bayou Schofield some oyster shells, put down about July 1, were taken up about August 15, and were found to bear spat, some of which was an inch in length. Shells planted in Bay Coquette in September, 1897, were taken up March 5 and found covered with young oysters, most of which were from 2 to 2¼ inches in length, although there were a few as small as ½ inch.

At the same place, oysters grown on shells planted September, 1896, and culled and rebedded when about 1 year old, had grown to a length of about 3½ inches by the 5th of March, 1898, when they could not have been more than 18 months old. They were of excellent shape and fine flavor. In July or August, 1895, a piece of rock about 6 or 8 inches in diameter was thrown upon the planting-ground in Bayou Schofield, being removed 23 months later. It is now in the possession of the United States Fish Commission and is covered with a growth of 40 or 50 oysters, all of which are over 4 inches, some of them being as much as 6 inches in length, but all rather inferior in shape owing to the crowding to which they were subjected. Tabulating these results we have the following as illustrating the normal rate of growth of oysters on favorable bottom in Louisiana:

Locality.	Age.	Length.
Bayou Schofield	Not over 6 weeks.....	¾ to 1 inch.
Bay Coquette.....	Not over 6 months.....	2 to 2¼ inches.
Quarantine Bay (natural reef)	Not over 8 months.....	2½ to 3 inches.
Bay Coquette.....	Not over 18 months.....	3½ inches.
Bayou Schofield	Not over 23 months.....	4 to 6 inches.

It will be noticed that the length of some of the oysters 8 months old was but ½ inch less than those 18 months old, but owing to the improvement in shape, due to the broadening and deepening of the shells, the animals in the latter were from 4 to 6 times as voluminous as the former. Had they not been culled from the shells and separated from one another the improvement would not have been so great, a statement illustrated by the 23-months-old specimens from Bayou Schofield. There are very few places in the North where the rapidity of oyster growth rivals that attained in Louisiana, a condition brought about by the abundance of oyster food induced by the favorable temperature and the richness of the waters in the chemical elements necessary for the production of vegetation.

DESTRUCTIVE AGENCIES.

Conch, Snail, Borer.—The mollusk which is known by these names on the coast of Louisiana is the *Purpura floridana* of naturalists. It causes considerable damage at times to both the planted and the natural beds, especially those located nearer the sea where the prevailing density of the water is higher, as it appears to be much more susceptible to the effects of fresh water than the oyster itself. There is a difference of opinion among the oystermen concerning the manner in which this mollusk destroys the oyster, some contending that it bores a hole in the shell like the northern drill, and others that it injects between the lips of the shell a substance which possesses the power of paralyzing the oyster and causing the shell to gape so as to permit access to the interior. Some of the oystermen pointed out what they considered to be the borings of this snail, but they were merely the bottoms of the chambers made by *Martesia*, the upper portions having disappeared by the delamination of the shells.

During the entire period of the investigations, although many bushels of oysters and dead shells were examined, not a single drilled oyster shell was noted, although several *Polinices* shells showed the handiwork of some boring gasteropod.

A number of specimens of *Purpura* were kept in aquaria with oysters, but in no instance did they molest them in any way. The theory that they inject a poisonous fluid into the oyster can be set aside as improbable, and there can be little doubt that they destroy their prey after the manner of their relatives, among which can be numbered the destructive drill, *Urosalpinx*, of Chesapeake Bay. This form, by means of its rasp-like tongue, bores a small hole in the shell of the oyster, through which it introduces its proboscis and extracts the soft parts. *Urosalpinx* feeds upon small oysters only, but the conch of the Louisiana oyster-bed, owing to its greater size and strength, could doubtless attack much larger individuals with success. It is said that extensive beds are sometimes practically depopulated by this animal, and the oystermen of St. Bernard Parish hold it responsible for the destruction of the oysters of Chandeleur Sound and for the present rather sparse population of Cabbage Reef. It is found everywhere on the oyster-beds of Louisiana excepting the less saline waters. It breeds in spring, its eggs being inclosed in vase-shaped capsules, attached to hard bodies in the water. Its numbers could doubtless be materially reduced were the oystermen to carefully destroy all animals and their eggs which they may take in the course of their work. Apparently little attention is paid to this matter, and most of the snails caught are thrown back on the beds with the culls and dead shells, to continue their destruction and to perpetuate their kind.

Drumfish.—The drumfish is one of the most destructive enemies of the oyster, and in Louisiana its depredations are especially annoying, inasmuch as they are largely confined to planted beds of single oysters.

On the natural reefs, where the oysters grow in clusters, the denseness of the growth and the sharp edges of the shells make it difficult for the fish to wreak much destruction, although the smaller clusters of young oysters are frequently eaten, being crushed and swallowed, shell and soft parts alike. The lips of drumfish caught on and near the oyster-beds are lacerated from contact with the knife-like edges of the young oysters. The oystermen working on the natural reefs often suffer considerable loss by having eaten the culled and cleaned oysters which are temporarily bedded, and frequent cases are reported of the loss of 30 or 40 barrels of bedded oysters within a single day. To prevent these inroads on the bedding-grounds the oystermen encircle them with old seines supported on pickets, or lines to which rags are attached are used to frighten the fish away, and in some places substantial stockades are constructed.

The drumfish is troublesome on nearly all of the planting-grounds in the State, but it appears to be especially so at Bayou Cook. The damage done to planted beds is usually wrought very soon after the separated and culled oysters are laid down. After several days have elapsed the oysters seem to be immune, probably either because they have sunk slightly in the mud on which they are planted or because they become more or less covered with sediment, which makes them less conspicuous. If the drumfish can be kept off for a week or two there appears to be but little danger of an attack thereafter, but if for any reason the oysters are rebudded the same difficulty is encountered as before.

To prevent depredations on the beds fences and stockades are erected, differing in dimensions only from the more substantial structures on the bedding-grounds. The drumfish operates in water of all densities, often occurring in that which is almost fresh and where the conch would never occur. It is most abundant and destructive during the months of September and October, but does some damage during every season except winter.

Stone-cracker.—The oystermen of Port Eads complain of the depredations of a large ray, known as the stone-cracker. Judging from the description of its general appearance and the large size which it is said to attain ("about 25 feet across") this appears to be the devil ray or devil-fish, *Manta birostris*, which is not uncommon on the coast of Louisiana. A planter at Port Eads states that he lost 300 barrels of oysters in two weeks through the depredations of this fish, and that he was at first unaware of the agent which caused this destruction, but finally saw 5 or 6 of them in the act. This species is not reported as an oyster enemy at any other place on the coast of Louisiana.

Stone-crab.—The stone-crab, *Menippe mercenaria*, is said to sometimes kill a good many oysters, especially the young ones under 3 inches long, breaking off the edges of the shells and extracting the contents. This enemy was reported from Quarantine Bay, Bayou Cook, and Bayou Coquette, and their connected waters. As a rule, it does not

occur in sufficient numbers to cause very great damage, but one man stated that he had had almost an entire lugger-load of oysters, from 2 to 3 inches long, destroyed by an unknown enemy, which had crushed the thin edges of the shells. The appearance of specimens of shells taken in Quarantine Bay and said to resemble those just mentioned leads to the suspicion that the destruction was wrought by the crab under discussion, the entire distal-halves of the shells being wrenched and crushed.

Boring-sponge.—Upon the oyster-beds of Louisiana occurs a boring-sponge closely related to, if not identical with, the *Cliona sulphurea* found on the oyster-beds of the North. *Cliona sulphurea* in its mature stage forms large yellow masses sometimes more than 6 inches in diameter. During the investigations in Louisiana waters none of these massive forms were found, but many of the dead shells and some of the living ones were honeycombed by the galleries of the young sponges, which sometimes projected, as mushroom-shaped papillæ, nearly a quarter of an inch above the surface of the shells. This was particularly the case on the extinct reefs of Baratavia Bay and other places west of the Mississippi River, where it occurs usually associated with the coral, *Astrangia danae*, exactly as it does in places on the Atlantic coast. It is thought that this sponge does little harm to the oysters of Louisiana, but, in connection with the boring mollusk *Martesia*, it performs an important function in cleaning the reefs of old shells, which it corrodes and dissolves as its galleries extend. By the combined action of these forms the old reefs are practically eradicated in the course of a short time, and unless they become restocked with spat within 3 or 4 years they are placed beyond the possibility of natural rejuvenescence by the destruction of the cultch. It is rather remarkable that this sponge does not attack the shells on the shell-banks, such as are found in Baratavia Bay.

Martesia cuneiformis.—This form is extremely abundant on the coast of Louisiana, especially upon the oyster-beds of St. Bernard Parish. It is a small species of boring-clam, which, during infancy, bores into the oyster shells, excavating a tiny cell from which it does not again emerge. As the clam increases in size the cell is enlarged, eventually becoming an egg-shaped cavity half an inch in its major axis and communicating with the exterior by a small pore about $\frac{1}{16}$ inch across. Often these are so closely arranged as to be almost in contact, and the oyster shell is so weakened that the outer part will scale off with a slight blow. This delamination appears to often take place naturally, the bases of the ovate chambers showing on the remaining parts of the shell as a collection of rounded pits, often mistaken by the oystermen for either incipient or abortive borings of the snail, *Purpura*. These animals can not be classed as true enemies of the oyster, and, in fact, they do it practically no injury, as the chambers rarely penetrate the shell, and even then are readily closed, and the delamination spoken of is not sufficiently profound to seriously injure the shell. The oyster

shell is used solely as a protection and a place of abode and without design upon the fleshy parts of the oyster, the food of the *Martesia* being found in the incurrent streams of water passing through the external orifice of the chambers.

Algæ.—Two species of algæ, which have not been identified, are found upon the oyster-beds of Louisiana. One of these is a species of *Ulva*, a green form with expansive fronds, its appearance well meriting its popular names of “sea lettuce” and “sea cabbage.” This is quite abundant in some places during the summer, but seems to die down in winter. It appears to cause no serious annoyance to the oystermen as it is readily removed from the shells. The second is a species of *Floridæa*, which maintains a luxuriant growth throughout the winter. It consists of purplish-brown, slender-branching filaments, growing in dense tufts upon the shells. While it in no manner injures the oysters, except so far as it serves as a basis for the collection of mud and silt, it is a source of great annoyance to oystermen on account of the difficulty of its removal, and it not infrequently happens that fishing on a bed is temporarily abandoned because of its abundance. If oysters are sent to the markets or canneries with this seaweed attached the filaments almost certainly become mixed with the meats and fluids and render the opened product almost worthless.

Crevasses.—Practically the entire oyster region of Louisiana is so situated with respect to the Mississippi River as to be subject to the influence of crevasses occurring at almost any part of its course south of the mouth of the Red River. In 1890 great damage was caused by the Nita crevasse, which discharged through Blind River into Lake Maurepas, and thence via Lake Pontchartrain and Lake Borgne into Mississippi Sound. This affected the oysters in St. Bernard Parish and Mississippi Sound as far as Biloxi.

In the spring of 1897 the river broke through the levee at Bohemia, and, in a minor degree, at other places on the east bank of the river, and killed all the oysters in the vicinity of Quarantine and California bays; and several years ago the Pass à Loutré crevasse, which has not yet been closed, produced a similarly disastrous effect in Garden Island Bay. Instances might be multiplied, but those noted are probably the most striking ones occurring within the last few years.

The effects of a crevasse are twofold; it deposits mud and freshens the water, both of which are more or less disastrous to the oysters. Crevasses occur during periods of high water, when the river is carrying large quantities of materials scoured from its watershed, and when this sediment-laden stream strikes the salt water, either at its mouth or through a temporary discharge resulting from a crevasse, its velocity is checked and the mud in suspension is deposited, while at the same time the salt water precipitates certain materials which have entered into actual solution. When these materials are thrown down upon the oyster-beds the oysters are smothered and the shells buried.

In some cases the deposit of mud may be slight or the swiftness of the currents of fresh water pouring out to sea may actually exert a scouring action, carrying off the deposit of sediment which is normally thrown down in the comparatively still waters of the bays and bayous, and leaving the shells exposed and clean, even though the animals be killed by the abnormal freshness of the water.

When the deposit of mud is excessive the prospects for recuperation are poor, as the young oysters, even though they be wafted on the currents into the devastated region, can find no place for attachment. On the other hand, when the oysters are killed by the fresh water the shells are often left in excellent condition to serve as cultch, and oyster fry carried in from afar finds abundant facilities for fixation. This appears to have been the case in St. Bernard Parish after the Nita crevasse, and was certainly so in Plaquemines Parish after the breakage in the levees at Bohemia. In the latter instance, soon after the subsidence of the water, the spat began to set thickly upon the shells, and at the time of our investigation there was a very dense growth of young on all of the beds examined, although hardly an old one was to be found.

As was found by conversation with oystermen at many places, there is a general belief among them that a crevasse will always rehabilitate an exhausted oyster region, owing to the production of oyster spawn by the interaction of the fresh and salt waters. This idea is based upon false reasoning from the facts just set forth. It is extremely improbable, for instance, that the beds of Baratavia Bay would be again rendered productive by a crevasse, because there are but few oysters in the vicinity to furnish the spawn, and the cultch, or material to which the young could attach, has been almost destroyed by boring organisms of several kinds. Without these the influence of the crevasse is of no avail, as its benefits are in all probability due entirely to the mechanical effects of the currents to which it gives rise.

RECOMMENDATIONS.

In consideration of the observations and conclusions set forth in the foregoing report the following recommendations are made:

1. That no oysters be permitted to be removed from the natural beds for any purpose whatever during the period from April 15 to October 1.

This regulation is intended not so much to protect the spawning oysters, which would, of course, result incidentally, as to protect at least some of the young oysters from injury at a time when they are exceedingly delicate and when, owing to their small size and fragility, it is almost impossible to cull them from the marketable oysters as defined by the culling laws. By allowing them an additional month's growth, under the favorable conditions obtaining in Louisiana, a larger number should have reached a size permitting of their detachment from their places of fixation.

2. No oysters, wheresoever caught, should be sold or exposed to sale within the close season as fixed in the preceding section.

This prohibition is regarded as the most feasible method of enforcing the close season in the absence of a large and expensive oyster police. If all States should adopt legislation along this line it would solve the question of the enforcement of close seasons. It is similar to the regulation which has been found most efficient in protecting game and fish. It would doubtless cause some inconvenience and loss to dealers and restaurateurs who now sell oysters, presumably from without the State, during the close season, but it is doubtful if they would suffer to a greater extent than they would under a strict enforcement of section 7, Act No. 121, General Assembly, 1896.

3. It should be illegal to remove from the natural beds, for any purpose whatever, shells or oysters under 3 inches in length. All oysters caught on the natural beds should be culled upon the beds whence they are taken and all shells and oysters less than 3 inches long, as measured from hinge to tip or nip of shell, should be promptly returned to the beds.

Regulations in regard to culling oysters are considered the most important and efficient measures which can be adopted for protecting the natural beds, as close seasons can not be relied upon to prevent their extinction. It has often been demonstrated that it is quite possible to utterly "clean up" a bed within the limits of a short close season, and the writer knows of cases in Louisiana in which beds of limited extent were practically bared of oysters within two or three days by a small fleet of boats, each anxious to get the largest possible share of desirable oysters recently discovered. If all the oysters be caught up in two days, two weeks, or two months, it is useless to close the beds during the rest of the season. If, however, the culling law be strictly enforced there will always be a crop of young oysters growing up to take the place of the old ones carried to the markets, and if the minimum limit be placed at 3 inches, as recommended, there will always be some of these capable of spawning. In August, 1897, oysters of that size were found to be sexually active on the beds of St. Bernard and Plaquemines parishes.

The minimum limit here recommended is one-half inch greater than that provided for in the present laws of Louisiana and most other States. It is believed that this increase is highly essential to the welfare of the natural reefs, and as oysters less than 3 inches long bring but a small price in the markets, it is regarded as unjustifiable to sacrifice the future for an insignificant gain in the present. As a matter of fact, many of the oystermen voluntarily reject all the oysters under the size recommended, and there is no good reason why all should not be compelled to do so. By increasing the cull limit two ends are gained—a larger number of oysters must be left on the reefs and a larger proportion of these will be capable of spawning during the following period of reproductive activity. The law would be incomplete and unsatisfactory, however, were it to prevent the taking of young oysters for the market and yet allow them to be taken for use as seed.

The provision of section 8 of the oyster act of 1896, "that nothing in this section shall deprive the police juries of the parishes in which natural oyster beds or bars are situated of the privilege of granting permission for the removal of shells or small oysters to other parishes in the State for planting purposes," is one which would allow the utter destruction of the natural beds, however wise and stringent the rest of the law might be. The culling law as it stands defeats its own ends. Whatever the purpose to which young oysters may be devoted, their removal must be injurious to the parent beds. Nature takes cognizance of immediate rather than mediate results, and does not inquire into motives when her laws are infringed upon. It is an interesting fact, and one not without significance, that the natural beds first exhausted in Louisiana are those nearest the most extensive planting-grounds.

Doubtless the curtailment of the present privilege possessed by planters of taking young oysters from the natural beds would bring forth a protest, but this should not stand in the way of a rational administration of the oyster laws. The regulation here suggested does not prevent the taking of oysters for seed, but only prescribes the size of seed which it shall be legal to take from the natural reefs, and there is still a reasonable profit to be derived by bedding oysters not less than 3 inches long. The planter's profit arises not only from an increase in quantity due to growth, but also from a great increase in the value bulk for bulk—the larger oysters are more valuable than the seed, while the planted oysters, owing to their generally superior shape and condition, are more highly valued than the natural growth.

It is, moreover, much to the planter's interest to have the natural beds preserved, and any reasonable measure, such as is here suggested, should receive his support. The extermination of natural beds means increasing difficulty in procuring seed, either large or small, a point well illustrated by the experience of Bayou Cook planters, who since the destruction of the Baratavia Bay beds have been compelled to go to Timbalier Bay, involving the payment of canal tolls and increasing the distance by about 20 miles.

Even should the proposed regulation practically prohibit oyster-planting as now carried on, it would be preferable to enforce it rather than to permit the extermination of the natural beds, for that in itself would result in the destruction of both. This conclusion is justified when it is remembered that there is another and more valuable method of oyster-culture open to the planters, the system of planting cultch, which will be described hereafter. The planting of seed oysters does not greatly increase the productiveness of the oyster lands. It improves the size, shape, and flavor of the plants, and to a limited extent increases the oyster output by saving some which would perhaps fall victims to the vicissitudes of life on the natural beds, but in the main it merely transfers the immediate source of the product from the public to private beds without lessening the drain upon the former.

4. All boats or vessels engaged in culling should be at anchor on the natural beds.

This proviso is intended to aid in the enforcement of the preceding one requiring culling upon the reefs. It will prevent the practice, more or less common, of saving time by culling the oysters while under way to market, with the result that the culls often fall upon unsuitable bottom and are destroyed, whereas they would have been saved had they been culled on the reefs.

5. Every effort should be made to induce the oystermen to adopt the practice of exposing shells or other cultch for the purpose of catching the spat or young oysters. This method of culture is now carried on to a limited extent in some parts of Plaquemines Parish, as may be seen by reference to that section of this report which deals with the subject of oyster-planting. It not only results in an improvement in the quality of the oysters, as in seed-planting, but also in a very important increase in the quantity. If generally adopted it would result in saving millions of oysters which now perish in the soft mud and ooze for lack of places for attachment, and every oyster so saved is an oyster added to the product of the State.

By this method of oyster-culture the planter makes himself independent of the natural reefs; he raises his own seed oysters and there is no necessity or supposititious necessity of carrying away the young growth from the public beds. At the same time there is a reduction in the quantity of natural-reef oysters needed for the markets, part of this demand being satisfied by the oysters from the planted beds, and finally these planted beds would directly benefit neighboring natural beds, especially if these be somewhat exhausted, by furnishing large quantities of fry to aid in their recuperation. From every point of view, therefore, it is advantageous to encourage the planting of cultch, but unless private enterprise be sufficiently keen to appreciate its opportunities it is difficult to see how Louisiana planters can be induced to undertake it. Probably the best means for bringing this about would result naturally from the curtailment, as heretofore recommended, of the present too liberal policy in regard to the taking of seed from the natural reefs. If the men be not allowed to take small oysters and shells promiscuously, and if they be compelled to cull off the oysters less than 3 inches long, precisely as if they were taking them for the markets, it will doubtless make them more alive to the advantages of planting shells. It is hoped that this, with the aid of more liberal regulations in regard to planting recommended hereafter, will induce an increase in the acreage of planting beds and promote the use of cultch rather than seed from the natural beds. It is believed that after one or two men have demonstrated the advantages of the method suggested the others will not be slow to follow. In many places, as has been pointed out in the section dealing with oyster-planting, there are large quantities of shells available on the spot, and when this is not the case shells, broken tiles, or other suitable materials may be brought,

with but little labor or expense, by the boats returning from the markets.*

The recommendations which follow are mainly aimed to offer all reasonable facilities and inducements for the extension of the system of oyster-culture advocated above.

6. It is suggested that provision be made for granting to the oyster-grower permanent tenure of his beds. He should be permitted to hold them, subject to the rights of navigation, under provisions similar to those under which he might hold lands above tide. The first cost should be nominal, say \$1 per acre and the cost of making the survey; and the tax thereafter should not be more than a fraction of the annual rental now levied on the leased lands. It would, perhaps, be advantageous to allow the planter the option of purchasing under the above conditions or of leasing on liberal terms. The end to be kept in view is to induce persons to undertake oyster-culture, and not the immediate production of a large revenue for the State or parish. It is believed, however, that under more liberal provisions a larger number of persons would engage in the industry, and that both directly and indirectly this would result in an increase in the revenue derived from the oyster industry, besides adding to the individual prosperity of the citizens of the State. In March, 1898, there were but 32 grants of oyster-lands in the parish of Terrebonne—which has the most extensive oyster-lands of any parish in the State—yielding not over \$80 yearly each to State and parish under present laws. This is a small matter, indeed, to stand in the way of regulations fostering what is likely to prove a great industry, and which at the same time would do much to perpetuate the value of the public oyster-lands.

7. The area which may be purchased or leased by each applicant should be increased from 10 to at least 25 acres, and doubtless it would be good policy to remove the limit entirely. The policy of restriction is unreasonable and illogical, and few would advocate it with reference to lands above tide, its consequences there being obvious. If it be considered, however, that a limit to individual holdings be desirable, it should be remembered that when the shells are planted it will take about a year longer for the oysters to reach a marketable size than if yearling seed from the natural beds be used, and that the planter therefore requires a larger area upon which to produce a given annual crop.

8. It is recommended that a definition be made of the meaning of the term "natural oyster reef or bed" as used in the oyster laws, and that this definition be drawn with due regard to the fact that a reef may cease to be such, either as a result of oystering or in consequence of the operation of purely natural causes. The reasons for this recommendation are set forth on pp. 85 and 86 of this report, where they are considered in connection with certain concrete cases which fell under the observation of the writer. It is recognized that a definition of

*The methods usually employed are explained in detail in "Oysters and Methods of Oyster-culture," in Report U. S. Fish Commission for 1897.

what constitutes an oyster-reef must be to a certain extent arbitrary in character, and the following is offered as tentative and is designed especially for the conditions prevailing in Louisiana:

A natural oyster reef, bar, or bed is an area of not less than 500 square yards of the bottom of any body of water upon which oysters are found or have been found within a term of five years immediately preceding the time at which the questions concerning said bottom are decided, in quantities which would warrant taking them for profit by means of tongs.

The reasons for the several provisions of the definition are as follows: The minimum limit of 500 square yards is placed in order that small or insignificant patches of oysters within the limits of otherwise available planting-grounds shall not, under the provisions of the oyster law, debar an applicant from having such bottom assigned to him as a private planting-ground. The term of five years is established because it is believed that within that time, under the conditions existing in Louisiana, a depleted oyster-reef will either have become regenerated or else be beyond hope of redemption by natural agencies, and there will be no reason for further exempting it from occupation as planting-ground. The final provision is to prevent an extinct reef from being regarded as a natural bed for the purposes of the oyster act, merely because it contains a few scattered oysters which could not be taken for the markets with profit.

9. It is suggested that the oyster laws might in some places be enforced better, as they certainly would be, throughout the State, more uniformly, if their administration were placed in the hands of a State fish commission appointed for that purpose. There are some parts of the State in which the oyster fishery is apparently subject to no supervision whatever, except that now and then the vessels engaged in it are called upon to pay a tax.

