U.S. COMMISSION OF FISH AND FISHERIES,
MARSHALL McDONALD, Commissioner.
CHART
OF
MOBILE BAY
ALABAMA
SHOWING THE LOCATION
OF THE NATURAL OYSTER BEDS.
From a Survey made during Feby. & Mch. 1894,
By Party under direction of Homer P. Ritter, U.S.C.&G.S.
Assisted by W.F. Hill, U.S.F.C. and J.A. Smith, U.S.N.
Statute Miles
Nautical Miles
Feet
MOBILE COUNTY
BALDWIN COUNTY
MOBILE BAY
BON SECOUR BAY
MISSISSIPPI SOUND
DAUPHIN ISLAND
Dredged Channel to City 21 feet deep
Fowl River Pt.
White Ho.
Portersville
Isle aux Herbs
Marsh Id.
Cat I.
Mon Louis I.
HERON BAY
Cedar Pt.
FOWL RIVER BAY
Fowl R.
No detailed Survey from Cedar Pt. westward
Grants Pass
Pass Aux Herons
North Point
Little Dauphin I.
Dauphin I. Bay
Ft. Gaines
Pelican I.
Middle Ground
MOBILE BAY LIGHT
BEACON R.
Great Point Clear
Zundel's Wharf
Mullet Point
WEEKS BAY
Cypress Point
Little Point Clear
From Little Pt. Clear to Ft. Morgan Oysters are found in the bayous and along shore
Hog Bayou
Navy Cove
Pilot Town
South Bank
Ft. Morgan
Mobile Point
Edith's Hammock
Three Rivers
Shell Bank
OLD BOILER
Oysters

56′ 54′ 52′ 50′ 48′ 46′ 44′ 42′

30°30′ 28′ 26′ 24′ 22′ 20′ 18′ 16′ 14′

Great Point Clear

Zundel's Wharf

Mullet Point

Planted Oysters

Scattering single oysters

Cypress Point

Bon Secours River

Planted Oysters

Scattering Oysters along the shore

Oyster Planted Bay Oysters

Seymour's Bluff

Shell Bank Bay ou

Planted Oysters

Three Rivers

Collins Cr.

Edith's Hammock

Edith's Hammock

B A L D W I N

B O N S E C O U R S B A Y

W E E K S B A Y

P E N I N S U L A

NOTES

Projection of chart, shore-line and other information furnished by the U.S.Coast and Geodetic Survey

The 6 foot curve is shown thus ——·——·——

" *12* " " " " " ——·——·——·——

" *18* " " " " " ——·——·——·——·——

Location and extent of the Oyster Beds shown in red

Dense growth of Oysters shown thus

Scattering growth of Oysters " "

Density Obs. made Feby & Mch in blue " [2]S.1.0004 B.1.0004

Add.l " " *in December in red* " [1]S.1.0152 B.1.0173

Figures in brackets indicate number of Observations

ABBREVIATIONS

Materials in Capitals	Colors or Shades two small letters	Other qualities three small letters
M. for Mud	bk. for black	hrd. for hard
S. " Sand	wh. " white	sft. " soft
G. " Gravel	br. " brown	fne. " fine
Sh. " Shells	gy. " gray	crs. " coarse
P. " Pebbles	bu. blue	stk. " sticky
Sp. " Specks	dk. dark	brk. " broken
	lt. light	

6.—REPORT OF A RECONNOISSANCE OF THE OYSTER BEDS OF MOBILE BAY AND MISSISSIPPI SOUND, ALABAMA.

By HOMER P. RITTER,
Assistant, United States Coast and Geodetic Survey.

INTRODUCTION.

On February 1, 1894, I was detailed by the Superintendent of the United States Coast and Geodetic Survey to conduct, under the direction of the United States Commissioner of Fish and Fisheries, an investigation relative to the oyster beds of Mobile Bay and vicinity. Having received the necessary instructions, and having obtained from the office of the Coast Survey the requisite instruments, projections, charts, and other data for carrying on the inquiry, I proceeded on February 7 to Mobile, Alabama, where a tugboat had been placed in readiness for the work.

The party consisted, besides myself, of Mr. W. F. Hill, assistant, United States Fish Commission, and Mate James A. Smith, United States Navy, with the addition of a leadsman, who also acted as boatman, oyster pilot, etc. The crew of the boat comprised Capt. Barclay Spottswoods, an engineer, a fireman, and a cook.

The instrumental observations were made conjointly by Messrs. Smith, Hill, and myself; and in running sounding lines the captain of the boat acted as pilot.

Field operations began on February 10, and were continued until March 24, when the party disbanded. Soon after my return to Washington I was ordered to Alaska. During the summer the field notes were reduced and platted by Mr. W. F. Hill, who has also done considerable of the collating, measurement of the areas, and detailed description of the oyster beds.

During the time that the survey was made, extensive freshets prevailed in the streams tributary to Mobile Bay, nearly filling the entire bay with fresh water and extending far into Mississippi Sound, so that it was considered desirable to take an additional series of densities at a time when more normal conditions prevailed. Upon my return from Alaska I was therefore instructed to make another visit to Mobile Bay, where I succeeded in chartering a small oyster schooner, and from December 1 to 7 made a series of density observations distributed over the oyster-bearing portion of the bay.

INSTRUCTIONS.

The instructions issued by the Commissioner of Fisheries for the guidance of the party in conducting the observations, and which were adhered to so far as the time and weather permitted, were essentially as follows:

It will be the special object of the investigation to determine—

1. The positions, outlines, and characteristics, and the general richness of the oyster beds located in the waters of Mobile Bay and Mississippi Sound, within the boundaries of the State of Alabama.

2. The positions, outlines, and characteristics of all areas of the bottom, in the same region, which appear to be suitable for the planting of oysters, either (*a*) in their present or natural condition, or (*b*) after preparation.

It is considered most important to complete the survey in Mobile Bay first, and then to carry it through Mississippi Sound to such an extent as the time will permit.

By the term oyster bed is understood an accumulation of oysters of sufficient extent and productiveness to permit of its being worked with more or less profit by the customary methods of oystering. That any collection of oysters is entitled to be so designated may be determined by the testimony of the oystermen of the region, one of whom will be engaged as pilot, and by the actual examination of specimens obtained by tonging or by other means. All deposits of oysters, however, whether of workable extent or not, should be taken into consideration and be appropriately described and platted upon the chart. Areas of bottom suited to oyster planting and growth are generally considered to be such as are sufficiently firm to prevent the oysters from sinking into the bottom and at the same time possess sufficient cohesion to resist the shifting action of the waves, all other conditions being also favorable. Very soft, muddy bottoms are unsuitable, but those of a somewhat firmer consistency can often be rendered appropriate by first covering them with a layer of stones and shells, and such areas should be noted. In fact it will be best to so indicate upon a chart the conditions of the bottom throughout the bay, where the conditions are otherwise suitable, that all of its characteristics in this respect may be plainly brought out.

In connection with this subject, however, it is of prime importance to determine the density or salinity of the water, the observations upon which may alone be sufficient to show the unsuitableness for oyster growth of any portion of the bay or sound. Density and temperature observations should therefore be made over the entire bay and sound, to the extent of ascertaining with certainty the conditions of their waters in this respect in all parts during the continuance of this survey; and from local authorities information should be sought concerning the greater influx of fresh waters during freshets in rivers tributary to the bay. Officers of the United States Engineer Corps now stationed at Mobile may be able to furnish this information. The minimum density in which oysters are considered to grow to advantage in Chesapeake Bay is about 1.0100 or 1.0110.

This survey will be regarded as in the nature of a reconnoissance, and the work should be pushed as rapidly as seems to you expedient. It will be best, however, to make collections of oysters from time to time, by means of tongs or such other methods as are available, and the specimens preserved for transmission to Washington. Specimens of any natural enemies of the oyster which you may discover or which the oystermen may point out should also be preserved for future study.

It is not considered advisable to spend more time in those parts of the bay where oysters do not occur or could not be made to grow than may be regarded by you as necessary to establish those facts. From information now at hand it seems probable that the existing beds in the bay are confined to the lower part of the bay, and chiefly to the eastern and western sides. It is therefore possible that your work will be mostly limited to those localities, so far as the bay is concerned, and that you may be relieved from a detailed consideration of other parts of the bay, after they have been subjected to a rapid examination.

Mate James A. Smith, United States Navy, and Mr. W. F. Hill, assistant, United States Fish Commission, who will be members of your party, have both had considerable experience in this character of oyster investigations, and they will be able to advise you as to many details which have not been explained in these instructions.

It is requested that the results of the investigation be presented in the form of a chart and descriptive report suitable for publication. The chart should show, by means of colors, the distribution of oysters in the bay and sound (their relative abundance being indicated by differences in intensity of coloring), the areas of bottom suitable for oyster-planting, and all other areas which may be considered as offering no opportunity or advantages for oyster growth.

METHODS USED AND SUMMARY OF WORK.

The areas and location of the oyster beds were determined by the ordinary methods in use in hydrographic surveying. A chart projection of the locality to be examined was obtained from the Coast and Geodetic Survey before starting for the field. On this projection there had been platted triangulation points, shore lines, and other data from Coast Survey records. Upon arrival in the field some of the triangulation points were found and signals erected thereon; and such additional intermediate signals as were needed were put up and located by triangulation (sextant). In the

execution of the survey there were erected seventeen of these tripod signals, which with flag pole were about 20 feet high. These signals, together with known triangulation points, such as Mobile Bay Light, Fort Morgan Light, Sand Island Light, and others, enabled us to locate ourselves in any part of the bay at all times.

Most of the signals were erected by Mr. James A. Smith, whose general executive ability and long experience in hydrographic surveying were of much value in the successful execution of our work.

The method of procedure was generally as follows: After having obtained from the local oystermen the approximate position of the oyster beds, or "reefs" as they are locally designated, the locality in the immediate vicinity was subjected to a careful examination by running a series of sounding lines covering the entire area. The soundings were taken with a pole whenever the depth permitted it. In addition, a chain let off from the bow of the tug and dragging along the bottom was found to be of great assistance, the lack or the intensity of the rumbling of the chain invariably indicating whether it was passing over mud, sand, broken shells, or live oyster beds. As often as necessary the position of the boat was fixed by measuring with sextant the angles between three or more of the triangulation signals. In this manner a sufficient number of points marking the outline and extent of the oyster beds were determined. Frequent stops were made and samples of the bottom dredged up and examined.

During most of the time that the survey was in progress, tidal observations were made in the bay at Shellbank Bayou. From these observations a mean low-water plane was established, to which the soundings shown on the chart have been reduced.

In determining the density of the water, United States Fish Commission hydrometers Nos. 7114, 7164, 7145, and 7152 were used. They are of the type described in Appendix 16, Coast and Geodetic Survey Report for 1874, except that in those now used the centigrade thermometer has been substituted in place of the Fahrenheit and the hydrometer graduated to give densities referred to pure water at 4° C.

In obtaining the water from places other than the surface the Haskell hydrophore, or water-specimen cup, was used and found to give satisfaction. This instrument, devised by Mr. E. E. Haskell, formerly of the Coast Survey, enables one to obtain the specimens of water with the certainty that the water brought up comes from the level to which the instrument had been lowered.

The examinations were made from February 10 to March 24, 1894, and December 1 to 7, 1894. The following is a summary of the field work:

Number of days on which field work was done	23
Number of days during which field work was prevented by stormy weather and other causes	26
Number of soundings and determinations of bottom	3,220
Number of angles taken	1,400
Number of density observations	394
Number of temperature observations	591
Number of signals erected	17
Number of days of tidal observations	23
Area examined roughly, square miles	200
Area examined more minutely, square miles	50
Area of natural oyster reefs located, acres	3,105
Number of miles of sounding lines and determinations of bottom	177
Number of specimens collected	35

GENERAL REMARKS.

The results of this survey, which must be regarded more in the nature of a reconnoissance, are shown upon the accompanying chart. The investigations were confined principally to the waters of Mobile Bay and the eastern end of Mississippi Sound. The location and extent of the natural oyster beds are shown, as is also the density of the water in the different parts of the bay, showing what it was during a heavy freshet and also after the succeeding protracted drought. The depth of water and nature of the bottom are also indicated wherever examined. The sounding lines as run are given, thus showing what areas have actually been gone over and where to make future examinations if desired. As most of the information obtained by us will be found in the detailed description of the various localities examined, I will preface them with only a few remarks. From the most reliable information we could gather, and which is borne out by our investigations, the northern limit for oyster growth in Mobile Bay is a line extending from Fowl River on the west to Great Point Clear on the east.

The location of the oyster beds as shown on the chart indicates that in the bay the greater part of the natural oyster beds lies between the 6-foot and 12-foot curves. From all the information we could obtain the local impression seems to be that few if any oyster beds exist beyond the 12-foot curve. On account of this information and the limited time at our disposal, which was still further curtailed by almost continuous stormy weather, all of which restricted the investigation to the localities close along shore, this large area could not be gone over. On the Coast and Geodetic Survey chart of Mobile Bay the bottom of a large part of this area is designated as soft, though portions of it are shown to be sticky mud, and even shells and shelly bottom; this seems to indicate that close examination might discover oyster beds not now known.

EASTERN SHORE OF MOBILE BAY.

On the eastern shore our investigations were confined to the survey of the oyster reefs pointed out to us by the local oystermen, and some sounding lines run in passing from one locality to the other. The known reefs are few in number, of small size, and considerably depleted, due doubtless to excessive fishing. The total acreage of the reefs surveyed by us on this side of the bay amounted to less than 500 acres; but the oysters are generally large and of fine quality. They do not grow so much in bunches as those found on the western reefs.

Oyster planting is carried on to a considerable extent in the southeastern part of this side of the bay, especially in and around the mouth of Bon Secours River and in Oyster Bay.

Bon Secours River and Oyster Bay are said to have very little space suitable for oyster-culture which is not already occupied. At the mouth of Fish River and at several places on the south shore, such as Shellbank Bayou and Collins Creek, the culture of the oyster has been undertaken by some progressive people and, so far as reported, with good results.

By an inspection of the accompanying chart it will be seen that that portion of the bay lying to the eastward of a line drawn from Fish River to Shellbank Bayou Reef contains the principal natural oyster beds which are at present worked. The lines of sounding show just how closely this area was gone over during our investigation. It will be seen that the beds are distributed quite evenly over this whole area and

there seems to be no apparent reason why those particular spots should offer any special advantages to the growth of the oyster. The bottom, although generally soft, contains areas which are of somewhat firmer consistency. From an inspection of the densities it will be seen that during the freshet which prevailed during the early part of the year the density of the water was uniform over this part of the bay and that the densities which were taken the following December (after a protracted drought) likewise show the salinity of the water to be uniform. The depth of the area lying outside of the 6-foot curve varies from 7 to 10 feet, of which a considerable part is about 8 feet. Between the 6-foot curve and the shore are areas of hard sandy bottom. This area contains 19,000 acres, and a large part of it may be classed as suitable for oyster-culture.

In the large area which lies to the north and northwestward of the section just described—taking that portion which lies between the shore and the 12-foot curve—no oyster reefs are said to exist, except the one in the vicinity of Great Point Clear. It would be interesting to make a more minute examination and determine from actual survey if oysters exist, and to what extent, over this area containing over 37,000 acres.

The bottom of a large portion of this area which lies outside of the 6-foot curve is soft; but sticky bottom, hard mud, and even sand frequently occur. The observed densities taken in this section do not vary much from those at the places where the oysters are found. If there are no more oyster reefs it may be simply due to the lack of something suitable on which the spat could catch during the spawning season.

WESTERN SHORE OF MOBILE BAY.

On the western side of the bay the natural oyster beds are found to be much more extensive than those on the eastern shore. The beds are larger, and at present in a more flourishing condition. They may be somewhat favored in the struggle for existence by locality, lying as they do more in the pathway which the fresh waters from the large tributaries at the head of the bay are said to take. This may be the source of an abundance of food, although at times this fresh-water supply may become a danger by continuing too long.

At present oyster beds are found all along this side of the bay, and they extend from Fowl River to Grant Pass, a distance of 12 miles, and then for 4 miles more in a southeasterly direction and parallel to the northern shore of Little Dauphin Island.

From the accompanying chart it will be seen that they are almost entirely confined to the area lying between the 6-foot and the 12-foot curve. That the 6-foot curve defines the inshore limit of these beds is probably due to the fact that this is about the outer limit of the sandbar which skirts the entire shore in this part of the bay. The outer edge of this bar is from one-half to 1 mile from shore. It is only along the outer edge that this sandy cordon is continuous, for in many places between here and the shore are found areas of mud of various degrees of hardness.

The area between the shore and the 12-foot curve, from Fowl River to the eastern end of Little Dauphin Island, comprises about 25,000 acres, 5,000 acres of which lie between the shore and the 6-foot curve. The actual location and extent of the natural beds or "reefs" are shown on the chart. As far as surveyed they amount to 2,245 acres.

MISSISSIPPI SOUND.

After finishing the survey of the reefs in the vicinity of Grant Pass, but a few days more being at our disposal, a trip on the sound as far as Portersville was made. A number of density observations which were taken on the way showed that the water was fresh at this time as far as Portersville, and we were told that it extended much farther to the westward. The general shallowness of the oyster-bearing portion of this part of the sound, the wide distribution of the oysters, the necessity of doing most of the work from small boats, and the close distinction to be made between the natural and the plant beds—as it is claimed that a large part of the present plant beds is located upon sites of depleted natural beds—precluded any detailed survey being made at the time.

A survey of this region to be of practical value must be one of considerable detail and will have to be made when the contemplated oyster investigations in these waters are continued, but a few remarks as to the general extent of the oyster-grounds are here given. The distance, measured on a straight line, from the western end of Grant Pass to a point where the Alabama State line strikes the sound, is 15 miles. The water area embraced between that line and the shore north of it may be roughly estimated at 35,000 acres; two-thirds of this area has less than 6 feet of depth and the remaining third averages less than 9 feet.

That much of this area may be considered suitable for oyster-culture is borne out by the circumstance that oysters are growing in all parts of it. To the above area may be added no less than 10,000 acres of marsh, which if the occasion should demand might, with comparatively small outlay for dredging, be changed into canals or basins, which would make ideal oyster gardens. It will then be possible to exclude the voracious drumfish; and the catch of the spat of the oyster can be controlled, and not subjected, as at present, to chance conditions of wind, waves, and currents.

Between the above-mentioned line and the islands south of it the area of that part of the sound which lies in Alabama amounts to something over 55,000 acres. Little is known of the bottom of this region. The depth does not go over 17 feet and a quarter of the area is less than 12 feet. Much valuable information in regard to oysters in this vicinity was obtained from Mr. John J. Delchamps, a gentleman of wide information and experience, whose study of the oyster extends over many years. At my request he has written a short article on the subject, and I have taken the liberty to insert it in this report. (See page 339.)

EASTERN SHORE—DESCRIPTION OF AREAS EXAMINED.

Great Point Clear.—In this locality there is an oyster reef which lies 2¾ miles SSW. of Great Point Clear. It contains 53 acres, of which 30 acres are "rank" (a term which is used to express dense growth) and 23 acres are scattering. The depth of water ranges from 8½ to 10½ feet. The bottom consists of soft mud, with occasional patches of hard mud and sand; no grass found. The changes in depth over the reef were found to vary but little, no more than a foot.

Two density observations taken here, one February 16 and one March 16, give a mean of 1.0009 for the surface and 1.0032 for the bottom. During the early part of the following December the density for this locality was about 1.0160. The above densities and those following in this report have all been reduced to a standard temperature of 15° C.

The temperature of the water at both surface and bottom on February 16 was 11° C.; on March 16 the surface was 22° and the bottom 19°. During the early part of December there was a uniform temperature of 17° top and bottom.

The condition of this oyster reef can hardly be said to be flourishing. Although comparatively little oystering is done here at present, there is little indication that the reef is extending its limits; rather, judging from the condition of the specimens of oysters we caught and its situation near the northern limitation of oyster life in the bay, the tendency may be to diminish the extent of these grounds.

The quality of the oysters was fair; some were quite fine and fat, but of course at that time very fresh to the taste. Oysterman Robert Cook, who showed us the locality of the reef, said that most of the oysters on this reef were soft-shelled and did not well stand shoveling. The growth of mussels was very abundant and their presence must be deleterious to the growth of the oyster. Several borers, locally known as conchs, whelks, or drills, were brought up with the specimens we obtained by tonging; also several "oyster fish," though the latter are probably not injurious.

Great Point Clear Reef to Cypress Point.—From Great Point Clear Reef to Cypress Point is a distance of about 10 miles. We were informed that there were no known oyster reefs in this locality at present. Years ago there had been a reef off Mullet Point, but it is now extinct. Our time being short and bad weather threatening to further curtail it, the investigation of the bottom of this area was limited to a single line of soundings, which was run from Great Point Clear Reef to Cypress Point without discovering any reef. Abreast of Mullet Point an area of mud and shells was passed over, and this may have been the old reef.

Mr. Dorval Weeks, who lives at the entrance of Weeks Bay, told us that twenty-five years ago oysters grew in that bay, though none were growing there now; he also said that several attempts had been made in late years to plant them there, but with poor success. Lately Mr. Weeks has started a plant bed just south of the mouth of Fish River. This plant bed is about 1,000 yards long and 200 yards from shore and is doing well at present.

That a more minute investigation in this locality would discover a number of beds of small extent is quite likely; in fact we were told such lumps have been found, but the finder generally keeps the knowledge to himself.

Fish River Reef.—This oyster reef lies 1¼ miles W. by S. of Cypress Point. The reef contains about 83 acres, 19 of which are rank and 64 are scattering. The depth of water ranges from 7 to 10 feet. The bottom is soft mud, with some sticky and some hard areas. No grass was found. The area covered by the oysters generally is found to be from 1 to 3 feet higher than the surrounding terrane, doubtless due to the fact that the reef has built itself up.

The mean of two density observations taken on February 27 and March 16 give 1.0036 for surface and 1.0043 for the bottom density. The mean of four taken half a mile west of Cypress Point during the period between February 24 and March 16 give 1.0049 for surface and 1.0050 for bottom. Density observations taken in this locality on December 4 gave at a point south of the reef 1.0187 both for top and bottom, and at a point north of the reef 1.0171 for surface and 1.0176 for bottom.

On February 17 the temperature of the water in this locality was 12°; February 24 it was 11.5°; February 27 it was 8.5°, and March 16 it was 23°; the surface and bottom varied no more than half a degree. On December 4 the temperature was 18°.

This reef is said to be much overworked, and judging from our investigation such seems to be the fact. There were evidences of a good set of young oysters from the preceding summer, but the greater portion had been killed, and that, too, after obtaining quite a fair size, the shells being about an inch in diameter. A great many dead and broken shells, perforated by borers and covered with barnacles, were found on this reef.

Some of the oysters caught were of remarkably fine size, of good shape, and fat, but fresh, the latter quality of course being only temporary.

The enemies observed were mussels, barnacles, small crabs, and drills; the mussels thickly covered the oysters and the barnacles were plentiful. Almost every oyster was found to have a small crab living on the outside of the shell. Quite a large number of little conchs were found. The broken shells may indicate that the drumfish was a visitor to this reef, although it is said that this fish prefers to attack the oyster when single and seldom in the reef, as the oysters are then not so easily accessible. The planted oysters are more scattered, and then the drumfish becomes quite a serious enemy. I was told by one of the oystermen from the western side of the bay that recently he had taken 25 barrels of oysters from a reef, culled them, and then bedded them previous to taking them to market, and in one night the entire lot was destroyed by a school of drumfish.

Some good-sized oysters were found along the shore near Cypress Point. They were in good condition and were picked up at low water while going ashore to erect a signal.

Bayou Cour Reef.—This reef lies 2¼ miles S. ½ E. of Cypress Point. It contains 68 acres, 12 of which are rank and 56 are scattering. The depth of water ranges from 4 feet in the central portions to 9 feet at the edges of the reef. Sticky mud with frequent patches of hard and shelly bottom and occasional areas of soft mud characterize the bottom and for a considerable distance around it. The formation of this reef, like the previous one, is simply the result of a gradual accumulation of oysters and dead shells built up by the bivalves themselves and is now elevated above the surrounding bottom. This elevation is now about a foot near the edges and becomes as much as 5 feet at places near the middle of the reef. No grass was observed on this reef.

Two observations taken here on the 20th and 27th of February give 1.0063 for the top and 1.0075 for bottom. On December 4 it was 1.0189 for the top and 1.0187 for the bottom.

February 20 the surface temperature was 16°, bottom 14.5°; February 27, surface 12°, bottom 10.5°; on December 4 the surface temperature was 18° and the bottom 17.5°.

The condition of this reef, the quality of the oysters, enemies observed, etc., are about the same as found on Fish River Reef.

Bon Secours Reef.—This reef lies N. by W. 1½ miles from the mouth of Bon Secours River. It contains 38 acres, of which 12 are rank and 26 are scattering. The depth of water ranges from 4 to 7½ feet. The bottom is sticky mud, patches of soft mud, and shelly places. The surface of the reef is uneven and its general elevation is about 2 feet.

A mean of two density observations taken on March 1 and 16 gives surface 1.0043 and bottom 1.0046. Three observations taken here on December 4 give 1.0189 for surface and bottom.

In March the temperature of the water ranged from 13° to 22°. In December the water had a uniform temperature of 18.5°.

The condition of this reef seemed to be fairly good at the time of our investigation. It does not seem to have been overworked as much as the one northward of it, as the rank oysters are found to be more in proportion to area. There were found a great many dead shells and a few shells of young oysters. The young oysters were not plentiful, but this may have been due to the violation of the culling law, which requires that the oysters should be culled on the reef and the cullings (oysters not coming up to the requisite standard in size) thrown back into the water. The purport of this law is to prevent the extinction of the reef, but many local oystermen claim that by knocking off the young oysters and throwing them back into the water on the reef you make it easier for the drumfish to consume them, while if the reefer took the young oysters and planted them in his oyster garden the general prosperity of the industry would be increased even if the natural beds suffered.

The quality of the oysters from this reef was found to be very fine both as to size and condition, being fat and well-shaped.

The enemies observed were the same as on the neighboring reefs.

Bon Secours River and Oyster Bay.—In this locality the planting of oysters is carried on to a considerable extent. We were told that in Bon Secours River and Oyster Bay there remained very little space suitable for oyster-culture not already occupied. In the river the oyster gardens occupy the space between shore and the channel. They are situated on both sides of the river and extend from its mouth for a distance of nearly 3 miles. Oyster Bay has an area of a trifle over 1 square mile and is said to be equally as thickly planted. As in our investigation actual survey was confined to the natural reefs, the number of acres under cultivation can not be given. The bottom area of the river as far as planted, together with that of the bay, amounts to about 1,000 acres.

The planted oysters from this locality are considered very fine in the local market. The drumfish is said to be very destructive to the plant beds, so much so that in many instances brush fences are used to prevent their unwelcome visits; these fences are simply underbrush stuck in the mud around the oyster beds. This method, of course, is limited to shallow water and small areas.

Shellbank Reef.—This oyster reef, which derives its name from its proximity to a collection of oyster-shell heaps on the shore, lies N. by W. ¼ W., distant 1 mile from the mouth of Collins Creek. It contains 188 acres, 90 of which are rank and 98 scattering. The depth of water ranges from 4 to 10 feet. The bottom consists of soft and sticky mud and hard shelly lumps. This reef is similar in formation to those already described and is in the nature of a nearly flat mound, which rises in places to an elevation of 5 or 6 feet. There are also several outlying lumps.

One observation taken on February 22 and three on March 1 give a mean density of 1.0054 for top and 1.0062 for bottom. The density observation taken December 3 showed 1.0192 for top and 1.0205 for bottom.

During the latter part of February and the first days of March the temperature of water varied from 12° to 15°, with no change for difference in depth. On December 3 it was 18° for top and 19.5° for bottom.

This reef, we were informed by residents of this locality, was being rapidly depleted by excessive fishing and other causes, drills mostly, and is of much less extent than in former years; however, its condition seems to be as good as or better

than any of the territory in the eastern part of the bay. The evidence, from the specimens obtained, points to the fact that the drills cause considerable depredation. The specimens show that fine oysters grow on this reef; they were fat, well formed, and large. The oysters from this reef always command a good price in the Mobile market; and this fall, when 75 cents per barrel was being paid for western "reefers," the "Shellbank" oysters brought $1.75 per barrel.

Shellbank Reef to Fort Morgan.—No detailed survey was made in this section of the bay, for we were told that westward from Shellbank Reef as far as Fort Morgan there were no oyster reefs of importance. Up to within a few years there was a reef a little to the northeastward of Little Point Clear, but drills and sanding up have nearly destroyed it. Years ago it had an area of about one-fourth of a square mile.

From Little Point Clear to Fort Morgan oysters of fair quality are found in the bayous and along the shore. Some are of the variety locally called snapper or slough oysters, having a white shell. Although not generally in the market, they are said to be good oysters.

Planting is done to some extent in the bay north of Collins Creek, and is reported to give fair results. Shellbank Bayou and Collins Creek are also planted, the plants in these places being very fine. Some exceptionally fine specimens were shown us by Hon. H. P. Hanson from his planted beds in Collins Creek.

WESTERN SHORE—DESCRIPTION OF AREAS EXAMINED.

Fowl River.—In the area lying between the mouth of Fowl River and Mobile Bay Light a number of reefs of scattering oysters and oyster shells were found, separated from each other in some instances by a considerable distance. Altogether they cover about 100 acres, scattered over an area of several square miles. The depth of water here ranges from 5 to 14 feet. Soft mud, mud and shells, and patches of hard shelly places characterize the bottom.

During February and March the water was entirely fresh in this neighborhood and extended from the shore nearly to the light-house. In the early part of the following December a density observation taken near the shore gave 1.0116 for surface and 1.0117 for bottom, while another taken nearer the channel and just north of the beds gave 1.0118 and 1.0182, respectively.

During the first time that observations were made in this locality the temperature of the water varied all the way from 12° to 22°, depending on time and location, surface and bottom generally the same. On December 6 it was 17°.

The specimens obtained from these beds were mostly mud-covered shells, and, as well as could be judged, the beds were several inches under the mud. The proximity of these beds to the channel, which is being continually dredged, and the dumping of the mud taken from this channel near by are responsible for the depletion of these beds.

White House Reef.—This oyster reef, which received its name from a house standing on shore just west of the reef, lies between Mobile Bay light-house and Point Juliet. The reef is 3 miles long, extending NNE. and SSW. It varies in width from a few yards to 1,300 yards. Its nearest approach to the shore is at its southern extremity, which is 1½ miles offshore; its northern end is about 3 miles from shore. This reef contains 881 acres, of which 286 are rank and 595 are scattering.

The depth of water ranges from 7½ to 12 feet, with a general average of about 10½ feet. The bottom is about the same as that of the other oyster beds in the bay, except

that here there are numbers of patches of soft mud which are higher than the places upon which are found the oysters. These are doubtless scow loads of mud dredged from the channel and dumped here. I should say that the reef has become fully a third smaller from the above cause.

Two density observations, about a fourth of a mile apart, taken on March 13, gave 1.0007 for surface and 1.0035 for bottom for one and 1.0007 and 1.0016 for the other. Several other density observations were taken in this neighborhood, all indicating the water to be very fresh during the then prevailing freshet. The observations taken in December showed an average of about 1.0120 for this locality.

In March a temperature of 19° was found; in December about 17°.

The indications are that this reef is in good condition. Many young oysters were found attached to the larger specimens. The northern part of this reef is affected more or less by mud dumped in the neighborhood; but I presume that by the time the mud has become somewhat hardened the growing will go on again, for this whole western shore of the bay seems to be a favorable locality for oyster growth, judging from the wide extent of the reefs. The reef is separated into two parts by a short distance of mud bottom on which no oysters were found growing. As this mud is higher than the surrounding oyster-ground it presumably has been dumped there.

The quality of the oysters was good. They were fat and of nice flavor. The specimens caught had a good many young oysters attached, which in the lower part of the reef were growing nicely. While passing over this reef in December a hasty examination seemed to indicate that the young oysters had not suffered from the preceding drought in the early part of the year. Some perforated dead shells were noticed. The washing over of mud from the dredging dumps is probably of more injury to this reef than anything else. Many of the specimens taken had a coating of mud.

White House Reef to Birmingham Reef.—No oysters exist, so far as we could learn during our limited stay, south of Point Juliet until Birmingham Reef is reached. A distance of about 3 miles intervenes between Birmingham Reef and White House Reef. A series of sounding lines was run in passing from one reef to the other, but it will be seen by an inspection of the map that this area covered by our lines lies outside of the 12-foot curve, so that we can not say from actual examination whether or not there are any oysters there.

A number of density observations were taken in this locality during March, at different places along the 6-foot curve, showing that the fresh water extended at that time this far down the bay. In December the density of the water was found to be 1.0120. Depth of water and character of bottom are also identical with the locality just north of it.

Birmingham Reef.—This oyster reef lies about 2 miles E. by N. of Cedar Point. It is divided into two large beds and three smaller ones; in all containing 267 acres, 211 of which are rank and 56 are scattering. The depth of water over the reef varies all the way from 6½ to 12½ feet, the changes often being quite abrupt. The bottom is soft mud, with frequent hard shelly lumps.

This reef has gradually raised itself to a height of 5 or 6 feet above the surrounding bottom, the slopes at its edges being often quite abrupt. In considering this reef there has been taken into account all that portion which lies between the 6-foot curve and the wreck buoy.

On March 14 the density here was found to be 1.0018 for surface and 1.0065 for bottom. On December 5 it was found to be 1.0152 and 1.0173, respectively, for top and bottom.

In March the temperature of water was found to be 20° on top and 18° on the bottom; in December 17.5° for top and bottom.

The condition of this reef was good; the oysters were of good size, well flavored, and appeared to be in fair marketable condition. No enemies noted here.

Locality of Cedar Point.—A fair-sized oyster reef lies just northeast of Cedar Point, about half a mile from shore and extending toward Birmingham Reef, with which it may be connected, as the intervening patches of oysters shown on the chart seem to indicate. Its area is 139 acres, 87 of which are rank and 52 are scattering. The depth of water ranges from 2½ to 9 feet, with an average of about 5½ feet. The character of the bottom, condition of reef, quality of oysters, etc., are the same as for Birmingham Reef.

The mean of four density observations taken in March gives 1.0005 for top and bottom. The observed temperature was 15.5° to 16°. No density observation at this particular spot was taken in December.

Cedar Point Reef.—A reef of scattering oysters lies east some 300 yards off Cedar Point. It covers an area of about 45 acres. The depth ranges from 4½ to 7½ feet. The character of the bottom, condition of reef, and quality of oysters are the same as in the preceding reef, of which it may be considered a part. The reef was found to be overworked, its situation near the shore and largely in shoal water making it convenient for oystering.

Cedar Point to Pass Drury.—In the southwestern part of Mobile Bay, extending from Cedar Point to Pass Drury, a distance of over 4 miles, is found an extensive oyster reef, or rather a series of reefs which are practically connected. They begin about a third of a mile south of Cedar Point and extend from the shoals (which are occasionally bare at low water and which lie just north of Grant Pass) across the northeast end of Grant Pass and Pass aux Herons; thence in a southeasterly direction and parallel to the northern shore of Little Dauphin Island as far as Pass Drury. The width of the reef varies from about a third to half a mile and contains 813 acres 301 of which are rank and 512 are scattering. The depth ranges from 2½ to 14 feet.

The bottom is hard and shelly, with occasional patches of hard mud. Toward the eastward the reef becomes somewhat sandy, which has given the name of sand oysters to those taken from that locality.

A density observation taken in March in Pass aux Herons gave 1.0005 for surface and 1.0029 for bottom. A few days later one taken abreast of Pass Drury gave for surface 1.0056 and for bottom 1.0074. On the following 1st of December observations taken in the same localities made the surface density in Pass aux Herons 1.0173, the bottom being 1.0174. Near the southeastern end of Little Dauphin Island the surface was 1.0189 and the bottom 1.0227.

From March 8 to 15 the temperature of the water varied from 15.5° to 20.5°. On December 1 it was 17° in the pass and 18° in the bay.

The condition of the reef is good, though the portion lying in the vicinity of Grant Pass is somewhat depleted, probably due to excessive oystering. We were told that a great many of the oysters on this end of the reef had been killed by a storm in the fall of 1893. We found numbers of shells which had apparently been killed only recently. On the eastern portion of the reef the oysters were growing very rank

and we were informed that not much oystering was going on there; that, although very fine, the oysters were not well liked in the local market on account of the sand which was liable to get on them in opening. They were also said to "open" (become fat and fit for market) much later in the season than those nearer the pass. At the time we were here the oysters appeared to be of good size, fat, and palatable.

Grant Pass and vicinity.—Extending across Grant Pass and lying on both the north and south side of it is an oyster reef covering about 237 acres, 64 of which are rank and 173 scattering. On the south this bed extends to and across Pass aux Herons channel and onto the flats for some distance. To the northward the same is true; here it extends for some distance toward Cedar Point, increasing the area of this reef to about 400 acres. The depth of water over this area ranges all the way from 2 to 9½ feet, with an average depth of less than 6 feet.

The character of the bottom is largely hard and shelly, with areas of soft mud. The greater portion of the area is shoal, except where it is crossed by Pass aux Herons and Grant Pass.

We were told that the present condition of this reef was not flourishing. No doubt excessive fishing is the prime cause. While taking observations on this reef in December I was shown a number of fresh oyster shells with drill holes made by the "conch," and was informed by the local oystermen that these "conchs" were found to be more numerous this fall than had been noted heretofore, and that they sometimes found the oysters on large areas of the reef killed in that way. They also said that the "conchs" or "drills" are seldom found in the gullies, and that the "drill" seems to prefer hard shells to soft ones.

When culling oysters on the reef the oystermen generally separate the conchs from the cullings before throwing the latter back on the reef. The conchs are then destroyed. A persistent adherence to this rule must be of some benefit to the reef.

The quality of the oysters in this neighborhood was found to be good, their size and shape varying somewhat in the different localities of the reef.

Dauphin Island Bay and vicinity.—West of the entrance to Dauphin Island Bay are two small reefs containing about 15 acres each; one is composed of scattering oysters, the other about half rank and half scattering. From the mouth of Dauphin Island Bay to Pass aux Herons the bottom was examined with the above result and a few additional patches of scattering oysters were noticed. In this bay oysters have been planted and are said to be doing well; it is said that toward the eastern end they do not thrive so well, owing to a prevalence of water of high degree of saltness. Quite a fine specimen of oyster from the reef at the mouth of the bay was given us by Mr. Marshall, who lives on Little Dauphin Island; also a specimen showing the type of oysters growing in the bayous connecting this bay with Mobile Bay. The latter are of the "coon oyster" variety (long and slender) and some grow to such length that they are locally called "cow horns."

The bottom of the bay is mostly sticky mud; near the mouth areas of shelly bottom and sand are met with.

The mean of eleven observations taken at various times from March 8 to 21 gives a density of 1.0051 for surface and 1.0093 for the bottom; the lowest found was 1.0032 and the highest 1.0136. Six observations taken December 1 and December 4 give for surface 1.0182, bottom 1.0181.

It will be noticed that in the densities taken in December the water at the bottom was a trifle fresher than that at the surface. By an inspection of the densities shown on the chart it will be seen that this occurs in a number of instances. In our observations it was of frequent occurrence (especially at low-water stage), showing the prevalence of fresh-water springs in various parts of the bay. Whether this has anything to do with the distribution or the well-being of the oysters in this locality can hardly be determined from the limited number of our observations, and is here only pointed out as a possible field for investigation. Below is given a statement from the field notes showing that the phenomenon (fresher water at the bottom) was not due to an accidental reading of the hydrometer.

Dauphin Island Bay (middle) abreast Marshall's Store.

Date.	Time.	Temperature of air.	Temperature of water.		Observed density.		Depth.	Remarks.	Densities reduced to standard temperature, 15° C.	
			Surface.	Bottom.	Surface.	Bottom.			Surface.	Bottom.
1894.		° C	°	°			*Feet.*			
Dec. 1	8.30 a. m....	21.0	16.5	16.5	1.0176	1.0176	4.5	Water clear...	1.0179	1.0179
4	4.50 p. m....	17.0	17.0	17.0	1.0178	1.0176	5.0	Water clear, tide west.	1.0182	1.0180
5	7.30 a. m....	15.0	16.0	16.0	1.0182	1.0180	4.5	.....do	1.0184	1.0182
5	8.30 a. m....	14.0	16.0	15.5	1.0182	1.0180	5.0	.....do	1.0184	1.0181
5	9.00 a. m....	16.0	16.0	16.0	1.0180	1.0180	5.0	.....do	1.0182	1.0182
5	10.10 a. m...	15.5	16.0	16.0	1.0178	1.0181	5.0	.....do	1.0180	1.0183

Natural oyster reefs in Mobile Bay, Alabama.

Locality.	Area in acres.	Density of water during freshet, March, 1894.		Density of water, end of drought, December, 1894.		Depth of water.	Character of bottom.
		Surface.	Bottom.	Surface.	Bottom.		
						Feet.	
Great Point Clear Reef...	53	1.0009	1.0032	1.0160	1.0160	8½ to 10½	Soft and hard mud; sand.
Fish River Reef.....	83	1.0036	1.0043	1.0187	1.0187	7 10	Soft and sticky mud.
Bayou Cour Reef.....	68	1.0063	1.0075	1.0189	1.0187	4 9	Soft and sticky mud; shelly.
Bon Secours Reef	38	1.0043	1.0046	1.0189	1.0189	4 7⅛	Do.
Shellbank Reef.....	188	1.0054	1.0062	1.0192	1.0205	4 10	Do.
Mobile Bay Light to Fowl River	100	1.0000	1.0000	1.0118	1.0182	5 14	Do.
White House Reef.....	881	1.0007	1.0035	1.0120	1.0120	7⅛ 12	Do.
Birmingham Reef.....	267	1.0018	1.0065	1.0152	1.0173	6½ 12½	Do.
Cedar Point NE. ½ mile...	139	1.0005	1.0005	.....	.....	2½ 9	Do.
Cedar Point E. 300 yards..	45	1.0067	1.0071	.....	.....	4½ 7½	Do.
Cedar Point to Pass Drury	813	*1.0005 †1.0056	*1.0029 †1.0074	*1.0173 †1.0189	*1.0174) †1.0227)	2½ 14	Hard, shelly, and sand.
Grant Pass.....	400	.....	.....	.....	.....	2 9½	Hard, shelly, sand, and mud.
Dauphin Island Bay and vicinity	30	1.0051	1.0093	1.0182	1.0181	3 7	Do.
Total.....	3,105						

* West. † East.

NOTE.—The above densities have been reduced to the standard temperature of 15° C. Fresh water = 1.0000; standard sea water = 1.0260.

NOTES RESPECTING OYSTERS OF MOBILE BAY AND SOUND IN MOBILE COUNTY, ALABAMA.

By JOHN J. DELCHAMPS.

From Cedar Point to Dauphin Island is a little over 2 miles, Grant Pass being midway. Within that distance are found a dozen sorts of oysters which, though all of the same variety, are yet so different in size, shape, etc., as to be recognizable at sight by oystermen, who tell at once from what flat, reef, or gully they were fished. Their differences are due to locality, depth of water, character of ground, and currents; so that oysters from one spot and removed to one only a few yards distant will in time assume the look and character of those native to the latter. Such varieties are "Oyster Pass," "sharpers," Dutch Island "gullies" and "flats," "Grant Pass oysters," "Pass Heron flats" and "Pass Heroners," "redfish gullies," "west-edgers," "new reefers," "sand reefers," "Dauphin Island Bay oysters," the last mostly classed now as plants but inferior.

Westward we find "Halfmoon" and "East and West Heron Bay" plants, the first of the class to fatten well in the fall; "Fowl River Bay plants," very fine also, but owing to circumstance of locality fattening later; thence westward, "Coden," "Portersville," "Bayou Batre," and "Little River" plant beds; none west of Fowl River Bay very extensive. Further on is Grand Bay, which is large and said to have a good many oysters, but of an inferior quality and therefore little visited by oyster boats.

Leaving the Sound we find in Mobile Bay proper, extending from near Dauphin Island and east of Grant Pass, an extensive reef; then from the Birmingham Shoal, a mile or so northeastward from Cedar Point, some 8 or more miles northwardly, there extend reefs or a succession of reefs distinguished locally as "Birmingham," "White House," "Austin," and "Middle Light," the oysters on all of which are about identical.

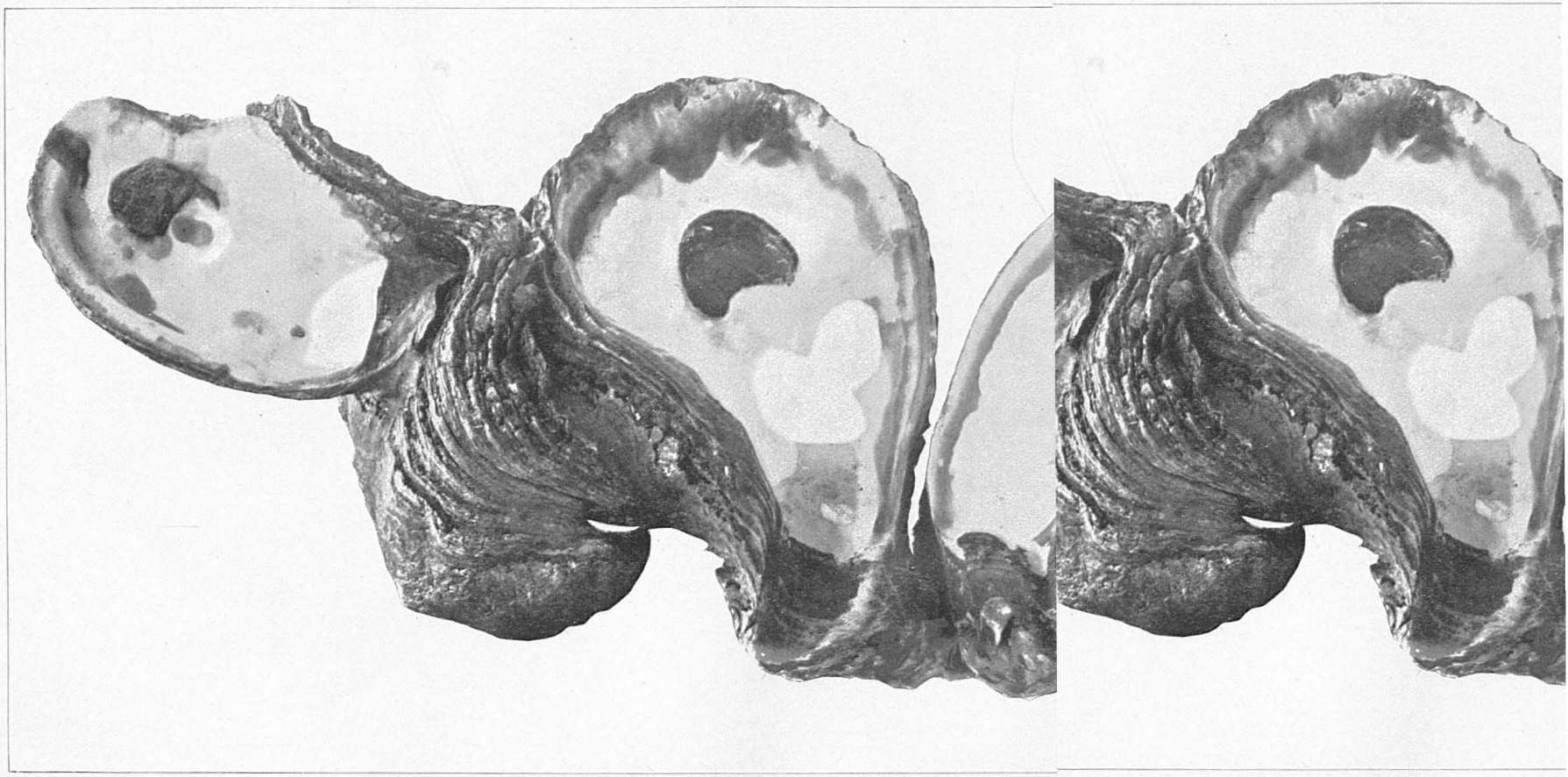
It is only of late that these reefs, long known, have grown to be of importance and to yield many for market. Most of them are outside the bar and in water 10 to 12 or more feet deep, requiring 14 to 16 foot rakes for catching. The growth is doubtless due to a succession of favorable seasons; a like succession of long-continued floods of fresh water would probably prove very injurious. These oysters are in character intermediate to the "gullies" and "sharpers," and like the last are very good for planting. Some of these are covered with mud dumped by scows from the dredges at work on the ship canal. It is not unlikely that when that mud has settled and hardened somewhat these reefs will be benefited and the oysters improved.

Oyster-planting here has never been carried on to any large extent. Unfortunately, just as a few enterprising persons were embarking in the business some four years ago, our State legislature passed a law which proved an effectual bar thereto, and two years after passed a new law retaining if not emphasizing the obnoxious features of the first.

The best time for oyster-planting is from May to October, when they are chiefly in spawn; it is also the time when oystermen are mostly idle. Oysters for seed or planting should be taken up in the rough and planted unculled, as much in bunches as possible. Those sought for seed would be mostly "sharpers," small oysters in bunches, unmarketable ones.

If the State would foster and encourage this industry the result would be that, by taxing plants as well as reefers, it would within a few years realize a handsome revenue at 5 cents a barrel.

The enemies to the oyster are the drumfish, which grinds up and devours many single ones and universally the small culled-off ones the State orders scattered on the reefs whence taken, and the whelks, which bore through the shell and destroy the oyster. This is the first year that I have heard serious complaint of their destructiveness. As there must be a cause for every effect, I assume the reason of their prevalence to be the long continuance of salt water, unbroken for months by any heavy rains and consequent rise of our rivers.



SHELLS OF SPECIMENS OF CULTIVATED OYSTERS FROM PLANT BEDS OF MAJ. F. S. PARKER, SITUATED AT MOUTH OF FOWL RIVER, ERS FROM PLANT BEDS OF MAJ. F. S. PARKER, SITUATED AT MOUTH

Length of oyster, right-hand specimen, 5$\frac{3}{4}$ inches; width, 4 inches; thickness,"2 inches. Caught in December, 1894. r, right-hand specimen, 5$\frac{3}{4}$ inches; width, 4 inches; thickness,"2 inches. Caugh

Bull U. S F C. 1895. Oyster Investigations in Mobile Bay. (To face page 340.)