U. S. COMMISSION OF FISH AND FISHERIES,
JOHN J. BRICE, Commissioner.

REPORT

OF A

Survey of the Oyster Regions of St. Vincent Sound, Apalachicola Bay, and St. George Sound, Florida.

BY

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4.—REPORT OF A SURVEY OF THE OYSTER REGIONS OF ST. VINCENT SOUND, APALACHICOLA BAY, AND ST. GEORGE SOUND, FLORIDA.

By Lieut. FRANKLIN SWIFT, *U. S. Navy.*

INTRODUCTION.

Having completed the work of supplying the aquarium of the U. S. Fish Commission exhibit at Atlanta, Ga., with specimens of the Gulf fishes, I received instructions, dated September 30, 1895, from the United States Commissioner of Fish and Fisheries, to proceed to Apalachicola Bay, Florida, with the steamer *Fish Hawk* and the party under my command, and begin an oyster survey of the adjacent waters, the waters to be covered being St. Vincent Sound, Apalachicola Bay, and St. George Sound.

The object of the survey was to determine:

(1) The positions, outlines, characteristics, and richness or productiveness of all oyster beds located in the waters named.

(2) The positions, outlines, and characteristics of all areas of the bottom in the same waters, suitable for the planting of oysters, either in their natural condition or after preparation.

Projections were furnished in three sheets covering the areas to be surveyed. These projections were made from data obtained from the United States Coast and Geodetic Survey Office, and are on $\frac{1}{20000}$ scale, giving the location of the triangulation points and showing the shore line from the original survey. A description of the triangulation points was also furnished. The work to be undertaken called for all that is required of a hydrographic party in the Coast Survey, besides all the work that is peculiar to an oyster survey.

In the former surveys in which this vessel has been engaged a large part of the work was carried on by civilian assistants sent especially by the Fish Commission, but no such assistance was available in this case, and the survey had to be made entirely by the officers and crew of the vessel. On the Coast Survey vessels there are usually several commissioned officers, who, together with the crew, are trained in hydrographic surveying; at the beginning of our work there was only one officer besides myself, Mate J. A. Smith, U. S. N., who had had any experience in hydrography. Much credit is due Mr. Smith for the ability he displayed in running the lines of soundings and in all other work connected with the survey.

Mate L. M. Melcher, U. S. N., joined the vessel November 15, 1895, and although he was inexperienced in the work at first, he soon became, by zealous attention, a very fair observer.

Some time was occupied in training members of the crew to become observers, recorders, and polemen, but by constant effort we were able, at an early date, to work two different parties. Quartermasters Charles Winters and J. W. Savage showed especial ability and zeal.

Up to December 27 I was obliged to do all the plotting myself, and in order to keep the work up to date was compelled to neglect other duties. The services of Mr. Eugene Veith were therefore secured, and his long experience as draftsman, as well as observer and recorder in the Coast Survey, especially fitted him for the work. After having plotted the results of the survey on the projections sent by the Fish Commission it was found necessary to construct a complete new sheet, embracing all the work presented in proper form for publication. Every detail of the work, including the plotting of the characteristic soundings out of 80,000 soundings, was performed by Mr. Veith in the most excellent manner.

Tidal observations were taken during the season at the main tide gauge by Mr. Hugh Brown, who was employed by the Commission for the purpose. He was a faithful and intelligent observer and gave complete satisfaction. Auxiliary tide gauges were tended by members of the crew.

Due time and attention were given to the collection of information from the oystermen of Apalachicola, and for this purpose a regular form of interrogatories was prepared. Without exception these excellent and intelligent men did all in their power to assist us, and gave us much useful information.

I am especially indebted to Mr. J. G. Ruge, of the firm of Ruge Bros., engaged in oyster-canning at Apalachicola, for much valuable information. This gentleman has been in the oyster business for years, and has made a special study of the oysters of the vicinity. The facts concerning the history of oyster beds, the oyster business of Apalachicola, the spawning habits, etc., that appear in the report after the description of the beds, were obtained mostly from Mr. Ruge. The facts and figures, however, were compiled from all sources, and were the average of all information obtained, giving due weight to each particular source.

Thanks are due to Mr. C. H. Lind and Mr. Domingo Segree, oyster-dealers of Apalachicola, for their kindness in furnishing information. Both of these gentlemen took much trouble and spent much time in our behalf without remuneration.

A good deal of bad weather was experienced during the season, and during the days that the rain or rough sea prevented the boats from working, the time was utilized in building signals, when possible, or in office work on board ship. The boats used were the ship's flatboats and steam launch, until near the end of the season, when the launch was

lost in the hurricane on the night of February 5. The launch was very old and was worn out in service, and had previously been condemned.

During February, 1896, a good deal of sickness was experienced by the party, there being sometimes as many as six men on the sick list at one time. This caused either suspension of part of the work or double labor for those who remained in good health, as the efforts of every officer and man on board were taxed to their utmost throughout the season.

The work was begun on November 12, 1895, and continued until March 28, 1896, without intermission, except from December 23 to December 28, 1895, when a run to Pensacola was necessary to replenish the coal supply. On March 17 I received instructions from the acting Commissioner to close the work in time to arrive in the Delaware for the season's shad hatching. By this time all work of importance had been finished, and there only remained to survey a few oyster beds in St. George Sound, which were of little account, as no marketable oysters are obtained from them.

A report by Mr. H. F. Moore, assistant, United States Fish Commission, upon the specimens collected from the oyster beds, is appended (pp. 218–220).

GENERAL SCHEME AND METHODS OF WORK.

The work, in accordance with the instructions given, was not to be a mere reconnoissance or examination of a few important beds, but a complete survey of every bed and area where oysters were found, as well as a thorough examination of the bottom of the whole region covered, in order to determine its suitability for oyster-planting. Therefore it was necessary to adopt a scheme of hydrographic surveying, in which the lines of soundings should be close enough together to insure the detection of every oyster reef, however small, and show the character of the bottom in every locality, and at the same time not to run the lines unnecessarily close, so that the work might be pushed on as quickly as possible. The local oystermen, although able to give the approximate location of the more important beds, could not, of course, be depended upon to give the limits of all regions where oysters were found or to give the locations of the smaller beds. These facts could only be determined by actually running the lines, keeping an accurate record, and plotting the resulting development on the projection. However, the elaborate development of the bottom, as generally required in the Coast Survey work, was not here necessary, and the ground could be covered more quickly, as far as the hydrographic part was concerned. But, in addition to the hydrographic work, there were many other considerations. Of the first importance was the question of density or salinity of the water, the determination of which alone would show to a great degree the suitability of any locality for cultivating purposes.

The questions of the physical observations on the beds and the examinations of the oysters themselves were of the greatest importance. It was necessary that sufficiently accurate current observations should

be taken to establish the approximate velocity and the general set of ebb and flood tides, as such data is essential in connection with the food supply of the oyster and the amount of silt or mud deposited on the beds.

As the spawning habits of the oyster depend to a great extent on the temperature of the water, the temperature observations were important. Information in regard to the spawning was to be collected from local sources and from a study of the specimens preserved.

The first matter of consideration was the location and establishment of the tide gauge. A position was chosen for the main gauge, which was centrally located with regard to the whole area to be covered, and at the same time in a location where the tides would be normal as far as possible, and where the density and temperature observations would give good average results for a large area. The gauge was established on the north side of Apalachicola Bay, between Green Point and Apalachicola. Auxiliary gauges were used and compared with the main gauge whenever a difference of level or difference in the time of high or low water existed. At the end of the season several different bench marks were established, that the result of the long series of observations might be useful in the future.

Density, temperature, and current observations, as well as all the usual observations required by log, were taken at the ship regularly, as well as at the main gauge, so that at many localities a long series of observations were obtained.

The triangulation points given were those determined and marked at the time of the original survey in 1858. As may be supposed, many could not be recovered, and in some cases their sites had been washed away by the encroachment of the sea. In Apalachicola Bay and St. George Sound so few were recovered that it was necessary to triangulate a considerable area, by use of the theodolite, in order to establish the signals. In St. Vincent Sound, owing to its remote position, nearly all the triangulation points were recovered. Signals were built on the triangulation points when recovered, and other signals built and located along the shore and on the reefs of the sounds.

The waters of Apalachicola Bay and the adjacent waters are very shoal, and a good deal of time was lost on that account, as the *Fish Hawk*, drawing 8 feet, could only navigate in certain channels, and then only, in some cases, at high water. St. Vincent Sound could not be reached from the eastward, on account of shoal water, and the scene of work was too far off to send the boats. Therefore, an attempt was made to get the ship into Indian Pass, which proved successful after first surveying and buoying the channel. The channel was very narrow, but deeper water was found than was shown on the Coast Survey chart. An inspection of the chart accompanying this report will show a few other channels surveyed that were apparently not necessary to the work, as, for example, the cut across Cat Point Shoal and the cut and channel to Apalachicola, but in every such case these surveys were made for convenience in navigating the ship.

The work of running lines of soundings was begun at Indian Pass and continued toward the eastward. Many of the oyster reefs of St. Vincent Sound are very narrow and small, and therefore the lines had to be run quite close together.

The scheme of sounding lines in general consisted of one system of lines running in a north-and-south direction, these lines being connected with the shore by a system of zigzagging. The lines were run from 50 to 100 meters apart, according to the nature of the bottom, and as the oyster reefs or areas of scattered oysters were discovered they were developed by additional lines, and the physical observations and close examination of oysters and beds were made, as will be explained hereafter.

The position of the boats on the lines, and at all times, was determined by the adoption of the three-point problem in the same manner as commonly employed in hydrography. Therefore the contour of the bottom and delineation of reefs are as accurately shown on the sheet as they would have been had the survey been a hydrographic one purely; and, on account of the long series of tidal observations, lasting 4½ months and including 122 low-waters, an excellent plane of reference was established for reducing the soundings to the plane of mean low water. In running the lines advantage was taken of the shoalness of the water and softness of the bottom to place and locate poles with flags for ranges. Throughout the survey the lines were run on these ranges thus established, and the accuracy of the work considerably increased in consequence.

On account of the shallowness of the water in localities where oysters were found, it was impossible to use the ship for dredging purposes. The oystermen employ tongs entirely, and tongs were found to be more serviceable than the boat dredge for our purpose. In estimating the number of oysters to the stated given area—as for instance, a square yard, the comparison generally used in former surveys—the boat was moored, and the oysters on the bed were tonged and counted within the limits covered by the bottom of the boat, and the result reduced to square yards. Any method employed for this purpose, although correct enough for the particular locality where used, would, of course, only give a rough approximation for the whole oyster region, unless an almost infinite number of such observations were made. Still this method gives a standard to which observations made in future surveys may be compared, and thus show the increase or decrease from time to time in the number of oysters on the beds.

The shoalness of the water allowed the use of poles in taking soundings and obtaining the character of the bottom. A sounding pole was constructed on board ship that was particularly well adapted for the work in hand; it consisted of the pole proper, made of juniper—the lightest wood obtainable—and a metal disk fitted on the end of the pole, connected with it by a copper wire. This wire was simply to prevent the loss of the disk in case of the breaking of the pole,

and was inlaid in a groove in the side of the pole. The disk was of brass, 3 inches in diameter, and slightly concave on its lower surface. It was attached by means of a screw cap to a 3-inch length of 1-inch piping, into which the pole was fitted and riveted.

These poles were 1¼ inches in diameter at the lower end, and slightly tapering to the upper end. They were 14 feet long, and, constructed as described, were light, well balanced, and strong. By their use the presence of oysters could be immediately detected, not only by the "feel" of the pole to the poleman, but also by the ringing sound given out on striking shells, easily heard by the officer in charge of the boat. At first, observations were taken and examinations made whenever the oysters were discovered in running the lines; later, it was found better to run the lines first, plot the position of oyster beds, and then to revisit the beds, occupying different stations previously marked out on the sheet. This latter method secured uniformity, and was more thorough, as it prevented the too hurried observations that were likely to occur. All oyster reefs and areas of scattered oysters were carefully located, the reefs composed solely of old shells, as well as those of live oysters, and whether of the raccoon type or not.

Full notes were kept in the record books of the result of the examinations—the type of oyster, shape, size, and appearance of the shell, whether single or in clusters, growth on shell, appearance of spat or young growth, flavor and condition of oyster, number of oysters to stated area, proportion of live oysters to dead shells, appearance of bed, growth and cleanliness of bed. A careful lookout was kept for enemies of the oyster, as starfish, drumfish, drills, conchs, sponges, etc., and their presence noted. At each observation point the probe was used to determine the different layers at different depths of the bed. An especially constructed probe, with a steel drill point and connected by lengths of piping, was used, and in some instances was driven to a depth of 12 feet. At each observation point specimens of oysters were preserved, and these specimens at the end of the season were turned over to a Fish Commission expert at Washington for examination, and a report made upon them. The result of the examination appears in this report.

In considering the question of bottom suitable for the planting of oysters, those areas were recorded favorable when the bottom was sufficiently hard to prevent the oyster from sinking, and, at the same time, possessing sufficient cohesion to resist the shifting action of the waves, all other conditions being also favorable. Very soft, muddy bottoms were considered unsuitable, but those of a somewhat firmer consistency it was considered possible to make suitable by covering them with layers of stones or shells.

When working in St. Vincent Sound the ship was some 18 miles from Apalachicola and it was necessary to send the steam launch to that town once a week for provisions and mail. Later, when the work had progressed to the eastward, a return to an anchorage about 3 miles

off Apalachicola was made on Saturday afternoons for the same purpose. The vessel could not, without danger of delaying the work by waiting for high water, make an anchorage nearer the town, on account of the shoal water. When the work had reached the eastern part of Apalachicola Bay, the ship was moved every day to the scene of work, that as little time as possible might be lost in going to and returning from work. These short runs were made under one boiler in order to save coal, and although the vessel was under way nearly every day an average of only six-tenths of a ton of coal was used per day.

As is usual in hydrographic work, each position of the boat was plotted on the boat sheet, in order that the officer in charge of the boat might know his exact location and direct his course accordingly.

The work was kept plotted up to date on the smooth sheet, the draftsman each day plotting the work of the day previous from the record. At the close of the season a large amount of work remained to be done by the draftsman to complete the sheet, and prepare a new one in such form that it could be photolithographed for publication.

SUMMARY OF WORK.

Area surveyed, square miles	88	Number of low-waters observed for establishing plane of reference	122
Area of oyster beds located, in acres—thick growth	1,786	Total number of observations for density	598
Area of oyster beds located, in acres—scattering growth	3,569	Total number of observations for temperature	598
Area of good planting ground located, in acres	6,859	Number of times current observations were recorded	792
Number of soundings taken	75,125	Number of specimens preserved	40
Number of angles taken	7,815	Time in which survey was made, November 12, 1895, to March 28, 1896.	
Number of miles of sounding and determinations of the bottom	914.8		

Answers to a series of questions were obtained from all oystermen and dealers.

GENERAL DESCRIPTION OF THE AREA COVERED BY THE SURVEY.

The area covered includes an extent of about 21 miles in an east-and-west direction and at its widest part about 6½ miles in a north-and-south direction. It consists of Indian Lagoon, St. Vincent Sound, Apalachicola Bay, East Bay, and the western end of St. George Sound.

Apalachicola Bay is the largest and most important of these bodies of water, and is bounded by the mainland to the northward and by St. Vincent Island, Sand Island, and St. George Island to the westward and southward. It is entered from seaward through West Pass.

The extension of Apalachicola Bay to the eastward is called St. George Sound. This sound is inclosed by St. George Island and the mainland from Cat Point to the eastward.

East Bay is a shallow body of water adjoining Apalachicola Bay to the northeastward.

St. Vincent Sound is formed by the island of that name. It narrows toward its western end and communicates with the sea at Indian Pass.

Indian Lagoon is a small, shallow body of water formed by Indian Peninsula, and having only one narrow inlet at Indian Pass.

ST. VINCENT SOUND.

General description.—St. Vincent Sound contains about 15 square miles and extends in a general east-and-west direction for about 9½ miles, and varies in a north-and-south direction for about 2½ miles at its eastern end, to ¾ of a mile at its western end. The eastern part of the sound is quite shoal. Only about 4 feet at low water can be carried from Apalachicola Bay. The western part is connected with the sea by Indian Pass, through which 8 feet can be carried at low water under favorable conditions. After entering the pass a narrow and comparatively deep channel extends about 2 miles to the eastward.

Indian Lagoon, a small, shallow body of water, nearly landlocked, is connected to the western end of St. Vincent Sound by a narrow, crooked channel. A material difference was found in the shore lines of the sound when the present survey was compared with the original, the sea having encroached on the shores of both the mainland and St. Vincent Island. At some localities the shore line of the latter had receded nearly one-fourth of a mile.

It also appeared that the oyster reefs exposed at low water, and now composed of only dead shells, have changed considerably since the original survey. A peculiar hydrographic feature of the sound is a deep hole or basin which is found about 2 miles from the western end of the sound. At this point the waters of the sound are compressed between two long, narrow oyster reefs, which make out from either shore. These long oyster reefs are dry a greater part of the time, and seem to form a natural division between the different types of oysters of the sound, as well as the sound itself. For convenience this place was designated as the Bulkhead. The sound carries off a part of the fresh water from Apalachicola River and also receives a small fresh-water supply from the various runs on the mainland and from the creeks of St. Vincent Island.

As might be expected, the densities of the sound vary considerably. The eastern part of the sound has the greatest fresh-water supply, and has an average density of 1.0106, with an average temperature of 53° F. There is probably very little difference in density at the times of ebb and flow until the Bulkhead is reached. Just to the westward of the Bulkhead the density averages 1.0197, and temperature 53° F.

At Indian Pass the water is quite salt at all stages of the tide, the average density being 1.0234, the average temperature 57° F.

In Indian Lagoon the density at the eastern part is 1.0217, the temperature 61° F.; at the western part the density is 1.0219, the temperature 60° F. These observations, however, were single ones and not the average of many, as the locality was not considered of sufficient importance to take a series of observations.

In former years a large part of the oysters brought into Apalachicola were taken in St. Vincent Sound. During the season of the survey only one vessel—a small schooner with three men—was engaged in

oystering there, while the fleet of oystermen had changed the location of their work to the eastward.

The Bulkhead forms a natural division between the oyster beds of good quality and those of the raccoon type.

Oyster beds of Indian Lagoon.—Indian Lagoon, as far as surveyed, contains five-eighths of a square mile. It is very shoal, having only about 2 feet of water at low water, and it is difficult for even a small boat to navigate it, although 4 feet can be carried in by the channel at the entrance. The lagoon, being nearly an inclosed body of water and having its entrance so near the pass and the ocean, is naturally ill-fitted to support oyster life of the highest type, and it was found that most of the oysters were of the raccoon type.

There are about 10 acres of a very scattered growth of oysters along the south shore, and the whole area between the reefs on the northern side and at its entrance contains about 20 acres. These reefs extend out from the shore for about half a mile, and are composed of dead shells, which are exposed, except at very high tide. These are, as a rule, about 2 yards in width. The whole northern shore of the lagoon is a marshy flat extending back to the woods, fringed at intervals by the reefs, as described. The oysters are found on the edges of reefs, and the intervening spaces between the reefs are composed of very soft mud. The bottom of the whole lagoon, with the exception of one small bank of dead shells near its center and a narrow strip along its southern bank, is composed of very soft mud. There is no area suitable for planting oysters, and the lagoon as a source for obtaining oysters for market is of little importance.

Oyster beds of St. Vincent Sound, between Indian Pass and the Bulkhead.—St. Vincent Sound, between Indian Pass and the Bulkhead, contains 2 square miles, and is mostly shoal, with the exception of a narrow channel extending its whole length. This channel is 20 feet deep at the pass, and 7 feet at low water can be carried to the Bulkhead, where, as before mentioned, there is a deep basin of 32 feet.

Along the shores of this part of the sound are long, narrow reefs of dead shells, dry, except at extreme high water. In some cases these reefs extend out a mile into the sound. They are quite narrow, being from 2 yards to 10 yards or more in width. The reefs forming the Bulkhead were found to have altered in shape considerably since the original survey. Besides the long reefs there are various small reefs and patches on each side of the deep channel.

The oysters are of the raccoon type and are found along the edges of the reefs, close inshore. On the north shore, near the entrance to the lagoon, there is a network of reefs of dead shells, similar to those on the north side of the lagoon. All the oysters in this part of the sound may be classed as scattering, and they cover about 10 acres. Near the center, on the southern side of the channel, is a bank of dead shells of 70 acres, and to the westward of this bank and adjoining it is an area of 84 acres suitable for planting.

The bottom of this location is hard mud and is smooth and clean. The whole planting area extends along the southern edge of the channel for 1½ miles and reaches nearly to the Bulkhead. The velocity of the current in the channel is about 2 knots an hour, setting in the direction of the channel, and the current on the planting area is somewhat less. The density here is 1.0197, which is considerably higher than appears on the best oyster-grounds to the eastward, in Apalachicola Bay and elsewhere. The average temperature for the time of observations was 53° F.—the highest 57° F., the lowest 48° F.

Considering that the Bulkhead acts as a barrier to shut off, not only the supply of fresh water, but also the source of food, it may be said that this planting ground would probably not give as favorable results as other grounds to be described later. This portion of the sound is therefore not of great importance, either as a source of obtaining oysters for market or as planting ground, for, except in the localities mentioned, the bottom is very soft mud and the water is not entirely suitable for oyster life.

Oyster beds of St. Vincent Sound from the Bulkhead to its eastern limit.—St. Vincent Sound between the Bulkhead and its eastern limit covers an area of about 13 square miles, and is about 7 miles long, with an average width of nearly 2 miles. It is generally shoal, and only 4½ feet can be carried through it into Apalachicola Bay.

The fresh-water supply is furnished by the various runs and creeks on both shores and by Apalachicola River to the eastward; the amount of salt water is regulated by the barrier formed by the Bulkhead. The current runs with a gentle flow throughout its length and gives an abundant food supply. The temperatures are not abnormal. About half of the bottom is either hard or soft sand, or hard mud. All the conditions are therefore quite favorable to oyster life, and it was here that in former years a good part of the main supply of oysters was found by the oystermen. Doubtless the only reason that they do not exist now in great numbers is that the supply proved too small for the demand, and thus the overworking of the beds gradually brought about their present condition. However, it seems from the quantity of young growth found, and from the general appearance of the beds, that if they were left undisturbed for a few years they would recover their former productiveness. This is likely to occur, as practically the beds are not worked at present.

Of the thick growth of oysters found in this area, there is a bed containing 50 acres on the north side, just east of the Bulkhead. Near the center of this growth there is a long, narrow reef of dead shells, exposed at nearly all tides and extending in a NW. and SE. direction. The oysters bordering this reef are found more closely together than the outlying ones; they are all single oysters and are of good quality. There is another area of dense growth, of about 13 acres, near the mouth of the large bayou on the north shore of St. Vincent Island. The oysters here are of good quality and are large, single oysters.

The area for 3 miles to the eastward of the Bulkhead, included between the 3-foot curves of either shore, are covered with patches of dense growth of oysters. There are, in all, 19 of these patches, making a total of 38 acres. Of these there are several containing only about 1 acre, and the largest contains 5 acres.

All these small clusters of dense growth of oysters have the same characteristics. The oysters are found surrounding reefs of dead shells, which are usually awash at high water. The reefs are narrow and crescent-shaped, with their concave surface to the eastward, and invariably run in a north-and-south direction. They shoal off gradually on the eastern side and rise abruptly from the deep water on the western side. The oysters extend out, as a rule, about 30 yards to the eastward and about 20 yards to the westward of the reef. They are found singly and are in excellent condition and of good quality. In many instances spat and young growth were noticed. The reefs all arise from a soft, muddy bottom to a height of 8 or 9 feet, in some cases, while over a few of the eastern outlying patches there is a depth of about 2 feet at low water.

The scattered growth of oysters in this part of St. Vincent Sound covers considerable area, there being 1,590 acres. The largest extent of the scattered growth occurs on each side of the sound, inside the 3-foot curve and nearly opposite the area of patches of dense growth before mentioned. Scattered oysters are also found all along the south shore from the Bulkhead to St. Vincent Point, although, except in the locality just mentioned, they form only a narrow band. They are also found some little distance up the bayous of St. Vincent Island. On the north shore they extend as far to the eastward as the beds in the middle of the sound. The oysters are found on bottoms of hard mud and hard and soft sand. They occur in bunches of from 5 to 8 in each bunch, and are good-sized and well-conditioned, except close inshore, where they are smaller and poorer.

On the south side of the sound, just to the east of the Bulkhead, is an area of 162 acres, where there was formerly a bed of oysters, but where now only shells can be found. As no drills, starfish, drumfish, or other enemies of the oyster were discovered, it is probable that the loss of the oysters of this bed, as well as of the bed to the westward of the Bulkhead, was occasioned by one of the various hurricanes which have recently swept this region, the oysters being smothered by the mud deposited, which had been stirred up by the unusual currents and heavy seas.

Planting ground.—In addition to the areas of scattered oysters, there are, in this part of the sound, 1,405 acres of excellent planting ground. The strip along the northern shore extends from the scattered area to Green Point, and makes out from shore about a quarter of a mile, and out to a depth of about 4 feet at low water. This strip covers 665 acres.

The only attempt at oyster cultivation in the area covered by the survey was made by Mr. J. G. Ruge, of Apalachicola, on the north

shore of St. Vincent Sound, just to the eastward of the thickest section of the scattered oyster area. There is a good scattered growth there at present, which probably resulted from this planting. Mr. Ruge was unsuccessful, owing, as he states, to insufficient protection by the State law. The planting ground along the St. Vincent Island shore covers 740 acres, and extends from the wide belt of scattered growth to Silva's Bar, and out to a depth of about 5 feet at low water.

The whole eastern portion of St. Vincent Sound is well fitted by nature for the cultivation of oysters. The density and temperatures are favorable, the bottom is smooth and uniform in depth, and the locality is well sheltered from violent storms; it is generally deep enough not to be affected by the freezes which occur during the heavy northers in winter, when the surface of the water is far below mean low-water level. This locality is free from enemies of the oyster, as far as known, and it is not likely to be affected by freshets in the Apalachicola River. Probably the whole eastern part of the sound might be placed under cultivation by covering the soft mud of the bottom with shells or other suitable substances, to which the spat might attach itself.

APALACHICOLA BAY.

General description.—The whole bay covers an area of 63 square miles. It extends about 10 miles in an east-and-west direction and about 6½ miles in a north-and-south direction. It is connected with the sea by West Pass, Sand Island Pass, and New Inlet. The latter two, on account of their shoal water, are of little importance. Through West Pass 13 feet can be carried at low water, and after entering the bay the channel deepens to 16 feet, and this depth can be carried to a position northwest of New Inlet. With the exception of this deep channel, the bay is generally shoal, the depth decreasing as the northern shore is approached. The most noticeable hydrographic feature of the bay is an oyster reef, composed mostly of dead shells, which practically divides the western part of the bay. This reef is called St. Vincent Bar, is very narrow, and extends out from St. Vincent Point in an easterly and southerly direction for about 4 miles. The ship channel is around the south end of this reef, but there is a boat channel through the reef, with 4 feet at low water, about half a mile from St. Vincent Point. Between St. Vincent Bar and Apalachicola are found all the oyster reefs of the western part of the bay. These beds were formerly productive, but are not at present worked.

The central part of the bay is devoid of oyster beds, and only a few beds, mostly of scattered oysters, are found in the eastern part, until St. George Sound is reached.

By far the greater part of the bottom of the central portion of the bay is soft mud. There is a dredged channel to Apalachicola, and also one into St. George Sound. The latter body of water adjoins the bay to the eastward, and a line drawn from Cat Point, south, forms the division. The bay adjoins St. Vincent Sound at a line between Green

Point and St. Vincent Point. The northeast extension of the bay is called East Bay, and is very shallow. It is unimportant as far as oyster interests are concerned. The same is true of Shoal Bayou and Alligator Bayou, the latter being very nearly dry at low water.

Apalachicola River enters at Apalachicola and furnishes the main fresh-water supply to the bay. The shore to the eastward, as far as East Bay, is cut up by the different mouths of the Apalachicola and other rivers. It was noticed that the north part of the bay, near the mouths of the rivers, had shoaled considerably since the original hydrographic survey, and in one case, noticeably, there had been an increase of depth in a locality where there had formerly been a shoal reef. As this occurred in a part of the bay which is a thoroughfare for vessels bound for Carrabelle, and as the channel was not known previous to the survey, this newly discovered channel is of great hydrographic importance. This channel is about 1½ miles north of Cedar Point and nearly in line with Cedar Point and Cat Point. Through it 8 feet can be carried at mean low water, which is half a foot more water than could be carried by the buoyed channel. This new channel should undoubtedly be buoyed.

Many other changes will be noticed by comparing the accompanying map with the Coast Survey chart. This map may be used with the greatest confidence by the navigator, as the hydrographic survey was carried on with the greatest care and exactness.

Densities.—The observations at the mouth of Apalachicola River, extending over a period of two months, gave an average density of 1.0043 and temperature of 53° F. The highest temperature was 62° F., the lowest 48° F. The density between Apalachicola and Green Point (mean of 295 observations) was 1.0057 and the temperature 54°, with maximum 69° and minimum 32°. At a position 1½ miles off shore from the latter locality, the density was 1.0106 and temperature 53° F., with maximum 57° and minimum 49°. Other densities and temperatures are shown on the map, but are not the result of such extended observations.

It must be borne in mind that, as the survey was carried on during the latter part of the winter and early spring months, the densities and temperatures are, of course, quite different from what they would have been in the summer. The densities probably show a maximum freshness, as during the dry summer months they would show a maximum saltness. This was exemplified by the long series of observations taken during the survey, the difference between the first and latter part of the observations being very marked. For days during the latter part of the survey the water was entirely fresh.

An apparent discrepancy exists between the densities shown in the southwest part of the bay and the others near the source of fresh water, the former being lower, or fresher, than the latter. This is accounted for by the fact that during the time the offshore observations were taken, the water at the north shore stations was perfectly fresh. As before stated, there was only a short series of observations taken at the

southwest stations, on account of the short space of time available. The ebb and flow of the tides, as well as the force and direction of the wind, seemed to affect the densities to a very small degree at the main station, which was about half way between Apalachicola and Green Point. Off the mouth of the river the density was affected by the wind considerably, a northerly wind bringing low densities.

Observations were taken to establish the relation between the surface and the bottom densities and temperatures, and it was found that no appreciable difference existed; therefore, in taking the observations, a mean depth was generally used. This uniformity is explained by the fact of the shoalness of the water. In the eastern part of the bay the density and temperature observations were carried through considerable periods, and the results may be thoroughly relied upon. The densities decrease from the southern shore towards the northern shore, until, in East Bay and in Shoal Bayou and Alligator Bayou, the densities show the water fresh. In these bodies of water no oysters are found.

The currents.—The currents of the bay are moderate in velocity, but are sufficient to furnish an abundant food supply to the oysters. On account of the shoal water they depend for the direction of their set on the winds. Heavy easterly or northerly winds drive the waters of the bay before them, without regard to the ebb or flow of the tide, and sometimes cause currents of considerable velocity. The heavy northers drive the water out through the passes with considerable velocity, and southerly gales cause strong northerly currents in them, in both cases without regard to the normal ebb and flow of the tides.

At a position about 1½ miles southeast of Green Point, the ebb current runs to the westward and the flood current to the eastward, the velocity in each case varying from half a knot, in light breezes, to 1½ knots or more in strong winds.

Off the beacon, at the entrance to the dredged channel to Apalachicola, the current is just the opposite in the corresponding directions of ebb and flood; here ebb current sets to the eastward and flood to the westward. In calm weather each current runs about half a knot an hour. There are times when a greater rise and fall of the tides give a southerly and northerly direction to the ebb and flow respectively. In strong westerly gales the current runs from 3 to 4 knots an hour to the eastward, as long as the wind continues strong.

Off buoy No. 8, between Cat Point and the beacon, the flood runs to westward and the ebb to eastward.

At a position about three-fourths of a mile to the southward of Cat Point, the flood runs to the westward and the northward, and the ebb to the eastward and southward; the currents have an average flow of about 1 knot an hour. These, of course, are the average currents under normal conditions.

On the southern side of the bay, off Cedar Point, the flood runs to the westward and the ebb to the eastward, each with an average velocity of half a knot per hour. The same general rule seems to apply to the

current, with regard to direction of ebb and flow, all along the shore of St. George Island as far as New Inlet. Over the oyster bed known as East Hole the appearance of a mossy growth on the beds would seem to indicate eddying currents at this part of the bay, but this theory was not established by observation on account of lack of time. At a position between the central part of St. Vincent Bar and West Pass, the currents run to the eastward during flood and to the westward during ebb. Flood current has a velocity from 1 to 2½ knots and ebb from ½ to 1 knot per hour.

As in other parts of the bay, the winds govern the currents very perceptibly.

The tides.—The mean rise and fall of the tides, established by continuous observations lasting during the period covered by the survey, was 1.8 feet, but it must be borne in mind that the tidal observations were taken during the winter and early spring, and that a somewhat different result might have been obtained from a series of observations during the summer.

The tides are very much affected by the winds, and this is particularly noticeable during the heavy northers, when the water is driven out of the bay and the tide is very much below the level of mean low water, being in some cases as much as 1.1 feet below. This very low water is usually accompanied by cold, and sometimes by freezing weather, which is very destructive to such parts of the oyster beds as are exposed. Heavy southerly gales cause unusually high tides, and hurricanes and freshets cause disastrous floods.

As is well known, there is usually but one tide in twenty-four hours on this part of the Gulf coast, and the tides are very irregular. At times during the survey the tide would be low for several days together, and then, again, would be high for a considerable period. In fact, the tides are affected by the winds to such an extent as to sometimes almost obliterate the effects of the lunar influences.

WESTERN PART OF APALACHICOLA BAY.

Silva's Bar.—The dense growth of oysters on this bar covers 16 acres, and the scattering growth, surrounding the bar proper, contains about 200 acres. The bar has from 2 to 3 feet of water on it at low water, and extends nearly north from St. Vincent Bar for about three-fourths of a mile, being about 100 yards in width. The scattering growth extends out half a mile beyond the bar, and is over one-fourth of a mile in width.

The oysters of this bar are of excellent quality, and there is only one other bed—Cat Point Bar—which can be compared with it. These oysters also compare very favorably with the best northern oysters. They are most plentiful on the northern portions of the bar, being found here, in number, about 20 to the square yard, and are about equally divided in bunches and single oysters. They average from 3 to 5 in a bunch. The whole area of oyster bottom is quite clear, with very little vegetable growth. The oysters are covered generally with barnacles

and mussels, and in some cases with vegetable growth to a small degree. By using the probe on the bed proper, it was found that it was about a foot thick, after which a strata of hard sand was met with, and then soft mud. Considerable quantity of young growth, in different stages of development, was noticed, but no collection of spat. No enemies of the oyster were discovered. The bottom covered by oysters consists of hard sand.

St. Vincent Bar.—This bar is a very long broken one, consisting, for the most part, of dead oyster shells, and extending about 1 mile in an easterly direction and about 3 miles in a southerly direction. Oysters are only found at the northern end, and are not sufficiently close together to be designated as dense growth. The area of scattered oysters covers about 200 acres, and the area of the old bed lying to the southward, consisting only of shells, covers 335 acres. At the northern end of the reef there is a shell bank, out of water about 1½ feet at high water, and extending out from St. Vincent Point half a mile; then comes the boat channel before alluded to, and then another shell bank extending half a mile. From this point, the reef is broken up into patches which are exposed at high water.

A marked peculiarity of this long reef is that it is very steep-to on its southern and western sides, and shelves off gradually on the northern and eastern sides. The oysters are found almost entirely on the latter or shelving side, but they do not extend along the reef more than 1¾ miles. The oysters occur in bunches of from three to six, and are also found singly. They are all of good size and excellent quality, with the exception of those that are on the tops of the reefs, awash at low water, which approach the raccoon type. A good growth of young oysters, in different stages of advancement, was found all along the reef where there are oysters, and the bed seemed to be improving.

No oysters of any marketable value are found on the reef beyond the limit already mentioned. There are, however, some oysters of young growth which give promise, if undisturbed, of forming a bed, in course of time, of some commercial value. Of the enemies to the oyster, one single drill was found at the end of the bar, and this was the only drill found in this part of the bay.

The probable loss of this oyster bed, which in former years was one of the most productive, is due probably to the very severe hurricane which occurred several years ago. At that time the bar was completely covered up by mud, and only of late years has it begun to clear. During the hurricane the southern portion of the bar was more exposed than the northern portion and the beds to the northward, which accounts for the fact that oysters are still found in the latter localities.

It is generally supposed that a swift current is favorable to oyster life; the whole length of St. Vincent Bar is favorably placed in this respect, as the current over it, banked up by the reef, has considerable velocity. The densities here are more influenced by the flow of the tide than in any other locality in this vicinity.

As before remarked, there is apparently no reason why the whole of St. Vincent Bar should not again become a productive bed, and the general appearance of the young growth bears out this opinion.

The shell reefs north of the end of St. Vincent Bar.—A number of shell reefs, with no live oysters on or near them, are found about 1½ miles north of the end of St. Vincent Bar. These former oyster beds are similar to the southern part of St. Vincent Bar in regard to there being no oysters of full size found on or near them. They consist of one large reef with 4 feet of water on it at low water, containing 23 acres, and three other smaller ones, containing altogether 13 acres. They all rise abruptly out of from 8 to 10 feet of water. On these beds the shells occur in clusters of from 8 to 10, and vary in size from ¼ inch to 4½ inches in length. The inside of the shell presents a clean appearance, as if the shell had been buried and only lately uncovered; this applied to the smaller as well as to the larger shells. The outsides of the shells were covered with barnacles, and a good many oyster crabs were noticed. A few live oysters of young growth, about half an inch in diameter, were found on many of the shells, but this growth seemed to be confined to the ridges of the reefs proper. The old shells are very closely packed, and a good many are covered with a coating of mud. The probe showed these beds to be about 3½ inches in thickness. Under the beds there is a layer of soft mud for a depth of 2 feet, and then hard sand for about a foot or more. No vegetable growth was found on the beds, and no enemies of the oyster could be discovered. Undoubtedly the loss of these beds was due to the same cause that destroyed St. Vincent Bar—namely, the hurricane before spoken of. The appearance of the beds indicates that they had been buried and only lately uncovered. It is likely that these beds will recover, if not molested.

South Lump.—This is the name given to an oyster bed which lies half way between the end of St. Vincent Bar and Tow Head Island, near Apalachicola, and about half way between them. It contains 35 acres of quite a dense growth of oysters, which are, for the most part, small in size. The reef runs east and west, and is five-eighths of a mile in length, and a little more than an eighth of a mile wide at its widest part. It has over it a depth of from 3 to 6 feet at low water, with a ruling depth of 4 feet. The depth of water surrounding the reef is from 8 to 9 feet at low water, and the reef is more shelving on the north than on the south side. This bed, like the others surrounding it on the north side, was formerly very productive, but it, like the others, was so overworked that it became depleted a few years ago. Since that time, these beds have been left to recuperate, and it seems probable that, if left undisturbed, they will soon recover their former productiveness. At present among the old shells are found some full-grown oysters—about two to a square yard—while all over the bed young oysters are found of all sizes, all in a healthy condition. No enemies to the oyster were discovered. The bed is 2 feet in thickness, and underlying the bed it is hard sand.

Oysters between South Lump and central part of St. Vincent Bar.—A cluster of beds, surrounded by a scattered growth of oysters, occupies a space about half way between South Lump and the central part of St. Vincent Bar. The reefs proper consist of one large crescent-shaped reef, containing 18 acres of dense growth, and two small ones to the east and west of the large one, containing respectively 4 and 3 acres. The large area of scattered growth lies to the westward and northward of the reefs, and contains 145 acres. On the beds there are 4 to 5 feet of water, and the water surrounding them and on the scattered growth is about 7 to 8 feet in depth. There are some full-grown oysters in bunches of from 2 to 4, but the beds consist principally of young growth in all stages of development, most of which seems to be in good, healthy condition.

With regard to the young growth a peculiar circumstance was noted in a few instances: Among the shells tonged up were found attached small shells of 1½ years growth, which had died and were filled with mud. Where the old shells were taken up the mud had a disagreeable odor of tar gas, or something resembling it, which may have caused the death of the oysters. The thickness of the bed was 1 foot, with soft sand underneath. The full-grown oysters are of good flavor and in good condition. They are found on the beds about 8 to the square yard. The young growth was plentiful, there being about half a bushel to 4 square yards.

The area of scattered growth has a bottom of uniform depth, averaging about 7½ feet at low water. The area is covered with old shells imbedded in the sand, to which the young oysters are attached. There are some full-grown oysters, but most of them are of medium and small size. They are in bunches, with small oysters and spat attached, and all are covered with barnacles and mussels. Of the small oysters there are about 3 bunches to a square yard, the bunches varying in the number of oysters in each. As the bottom all along the western and southern edges of this area as far as St. Vincent Bar is suitable for oyster growth, there is no reason why the bed should not expand, in time, to a much greater size. It is fair to suppose that if the beds are not worked for two years they will improve to such an extent as to be again in condition for harvesting.

Oyster reef northwest of South Lump.—A long, narrow oyster reef is found three-fourths of a mile northwest of South Lump, and between it and Green Point. The whole reef contains 5 acres of dense growth and 19 square acres of scattered growth, and extends in a northeasterly and southwesterly direction for three-fourths of a mile, being quite narrow. It has from 4½ to 5 feet of water on it at low water, and rises abruptly from a depth of 7 feet. The foundation of the bed consists of old worn-out shells, on which are found some full-grown single oysters, especially on the eastern part of the reef. Young oysters and spat are found in considerable abundance all over the reef. The number of full-grown oysters is 4 to a square yard, and of the small growth 1 bushel

to a space of 4 square yards. The oysters are of good flavor and fat. The young growth occurs in bunches of from three to six. No vegetable matter was found, or enemies of any kind noticed. The bed is 6 inches deep, with soft sand underneath.

This bed in a few years will become one of excellent productiveness.

The reef north of South Lump.—A long, narrow oyster reef, to which no name has been given by the oystermen, begins at a point about half a mile north of South Lump, and extends in a northwesterly direction for over a mile. The reef itself, except at its middle portion, is very narrow, and has only 4½ to 5½ feet of water on it at low water. It rises abruptly from a uniformly soft muddy bottom, on which is a depth of from 7 to 8 feet at low water. The area covered by oysters extends beyond the limits of the reef itself, and measures 67 acres. This bed has the same characteristics as the others in this locality. There is a good growth of young oysters attached to the old shells, and rather fewer full-grown oysters than are found on the neighboring beds. Observations gave about three full-grown oysters to a square yard, and half a bushel of young growth to 4 square yards. The oysters here were rather fresh in flavor, but this was probably due to the low density which existed for some time just before the observations were made. The bed, like the others hereabouts, gives good promise of productiveness.

There is a small outlying patch of about 5 acres lying about an eighth of a mile east of the bed just described, and it has the same characteristics.

Thigpen Bar.—This oyster bed is located near the mouth of the Apalachicola River, and is about half a mile west of the entrance of the dredged channel. It is a narrow bar running in a northwest-and-southeast direction for over half a mile, and the whole oyster area covers 13 acres. There are only 3 feet of water at low water on its shoalest parts, and it has about it 5½ to 6 feet of water and muddy bottom. On this bed there are full-grown oysters of excellent quality, as well as a fine growth of young oysters in different stages of development. The large oysters are found singly and in bunches of from two to five. The full-grown oysters are found about nineteen to the square yard. The depth of the bed is 1 foot, with hard sand underneath.

Thigpen Bar, in common with all the oyster beds of the northern part of the bay, has not been worked for several seasons by the oystermen, as it had been agreed to allow these beds to remain undisturbed for a time, to give them a chance to recuperate from their state of depletion, brought about by the too great demand of a few years previous. It would appear at present that this bar ranks next to Silva's Bar in point of quality of its oysters. It is, however, of small extent.

It seems somewhat strange that this excellent bed of oysters should exist in such close proximity to the entrance of the dredged channel to the river, but it must be remembered that this extrance is fully 2 miles from the mouth of the river, and a very small part of the fresh water

of the river is confined to the channel, but overflows in all directions after leaving the mouth. Also, it should be remembered that there is a tidal current at the bar, which tends to remove any deposit of silt which may be brought down by the river.

During the latter part of the survey the dredging of the cut at the entrance of the river was in progress, and all the mud removed was dumped on the west side of this bar. Whether or not this deposit of mud will destroy the bed remains to be proved.

Oyster bed near Thigpen Bar.—A small detached bed lies just east of Thigpen Bar and northwest of black buoy No. 5. It covers 7 acres and has the same characteristics as Thigpen. At the east end of the reef there are only 3¾ feet of water at low water, and this shoal spot is exactly in line with the dredged cut.

Area of good planting-ground.—The area suitable for cultivating oysters includes a long strip extending in a north-and-south direction nearly from the end of St. Vincent Bar to Green Point, and in an east-and-west direction from the edge of the reef to the first cluster of outlying oyster beds. It is 4 miles in length and averages about a mile in width, covering an area of 2,440 acres. In this area there is, opposite Silva's Bar, a small circular space of nearly three-eighths of a mile in diameter where the bottom is soft mud, and therefore unfit for cultivation. The lower half of the southern portion of the planting area has a bottom covered with shell, which, no doubt, some time ago was an area of scattered oysters, and which will become one again in the course of time. All the northern part of the area has a bottom which consists almost entirely of hard sand.

THE EASTERN PART OF APALACHICOLA BAY.

Norman's Bar.—This name is given to the oyster bed lying nearly 1¼ miles to the westward of Cat Point. The bed, although not at present of dense growth of oysters, is quite extensive and covers an area of 285 acres. It extends in a NNW. and SSE. direction for 2½ miles and is about one-fourth of a mile wide, except in its southern extremity, where it gradually narrows. There is a depth at low water of 4½ feet on the central part of the reef, with a depth of 5½ and 6 feet to the westward and eastward of the reef. At all the other parts of the reef there is only a slight decrease in the depth of water from the waters surrounding it. The bed contains no marked ridge, and has a uniform bottom consisting of hard sand.

A peculiarity of this bed is that its crust is thicker than any of the beds thus far spoken of in the western part of the bay, and the old shells comprising it seem to be more closely packed. The probe, with a sharpened steel point, could hardly be driven through the closely packed mass of old shells, and it was found to be 3 to 3½ feet in depth. Soft sand was found underneath.

Over the old shells composing the bottom of the bed is found a scattering growth of oysters, mostly small in size and unevenly distributed, those in the southern portion being more plentiful and of better size and quality than those found at the northern part. At the southern portion the oysters are found in bunches of from two to five, with a good growth of young oysters in different stages of development attached. The oysters here are found about nine to the square yard. Some grass was found growing on them and a few black crabs were noticed.

On the middle portion of the reef the oysters occur in bunches of from three to eight, but fewer bunches are found, the average number of oysters being three to the square yard.

At the north end of the reef the oysters are still more scattering. The oysters on the middle part of the reef seem to be about 2 years old. Some spat was noticed on the shells at the northern part of the reef. The oysters at the north end of the reef were of poor quality compared with those at the southern end. This is to be expected from a study of the densities shown on the map.

Norman's Bar has not been lately worked to any extent, as it had previously been overworked. If the bar is undisturbed for a year or two it can then be worked profitably; the bed can undoubtedly be kept in a productive condition if worked moderately and the undersized oysters culled and thrown over.

The North Lumps.—There are three small detached beds of oysters lying nearly in line between Godley Bluff and the north end of Norman's Bar. The total area of these beds is 10 acres. They lie in about 4 to 5 feet of water, and the eastern, or inshore one, has but 2 feet on it at low water. The middle one has 2½ feet on it, and the western one 4½ feet at low water; the latter lies in about 5 feet of water.

The oysters on the beds are found in quite dense growth, there being thirty to the square yard; they are of good size and fatness, but, owing to the freshness of the water, have the peculiar insipid taste noticeable with oysters growing in water of low density. The thickness of the crust is about 3 feet.

Oyster beds westward of Norman's Bar.—Two small beds lie one-fourth of a mile to the westward of the north end of Norman's Bar. The northern one of these two beds is half a mile long and very narrow; it lies nearly half a mile north of the other, and contains 7 acres. The southern one is circular in shape and contains about 4 acres. The least depth of water on these beds is 3½ feet at low water. The oysters are in bunches of from three to four. They are of medium size, with young growth and spat attached, and, as usual, covered with barnacles and mussels. They are found on the bottom about fifteen to a square yard. As may be expected from their location, they are not of good flavor.

Beds to northward of buoy No. 8.—Two long, narrow beds extend to the northward from buoy No. 8 (present location), and lie on a line

between the middle part of Norman's Bar and the entrance to the dredged channel to Apalachicola. The northern reef is particularly long and narrow, having a length of nearly three-fourths of a mile and an average width of only about 50 yards. It covers 15 acres. The southern reef is nearly three-eighths of a mile long, and contains 8 acres. It is separated from the northern by a distance of one-fourth of a mile, the bottom between the two being hard sand and shell.

There is a detached bed, containing 4 acres, lying 200 yards east of the south end of the southern reef, and just northwest of the present position of buoy No. 8. The depth of water on the two long beds is 5 to 5½ feet at low water and on the smaller one 6½ feet.

The oysters of these beds all have the same characteristics—they form a scattered growth, and occasionally are found singly, but more often in bunches. The single ones are the largest, and are of fair quality. There are a large number of small oysters, and it is probable that these beds will rapidly improve if they are worked moderately, and the undersized oysters culled and thrown back on the beds.

Pelican Bar.—This bar lies about half a mile from the southern shore, and about 2 miles to the eastward of Cedar Point. It is nearly three-eighths of a mile long, and contains 10 acres of a moderately dense growth of oysters. It has, on the eastern side, a scattered growth, containing 38 acres. It is very shoal, having only 1 foot of water at low water. The oysters are mostly small, the greater part of marketable oysters having been taken in former years, and the small ones not having had time to grow. They are found in bunches of three to ten. Nearly all have a growth of brown and green grass on the shell. Considerable spat was noticed. No enemies were found. Like other beds, Pelican Bar will improve if worked in moderation.

Oyster bed near Pelican Bar.—A small bed lies about WNW. of Pelican Bar, distant nearly half a mile. The bed is three-eighths of a mile long and one-eighth of a mile wide, and covers altogether 24 acres, of which 7 have a dense growth. The oysters of dense growth are found about seventeen to the square yard, being in bunches of from two to four. Those of the scattered growth have about six to the square yard. The oysters are small and not fat, but of good flavor. Numerous young were noticed, and there was a good collection of spat. On some of the oysters a vegetable growth was found, and all, as usual, were covered thickly with barnacles and mussels.

As the bottom all about this bed is favorable for oyster life, it will probably improve and spread if it is given proper treatment.

This bed and Pelican Bar have been very little worked recently, owing to the fact of there being so few marketable oysters on them, the supply of large ones having been exhausted in former years.

Oyster bed east of Pelican Bar.—A small bed lies about east from Pelican Bar and distant a little over half a mile. It has an approximate area of 7 acres. There are only 2½ feet of water on it at low water.

The oysters on this bar have the same characteristics as Pelican Bar and the bar westward of Pelican Bar.

Area of scattered growth along the south shore.—All along the north shore of St. George Island, from a point 1 mile east of New Inlet, is a narrow strip of oyster growth, more or less scattered, extending out from the shore about an eighth of a mile. Scattering oysters also are found in the small inlets, creeks, and bays along the shore. These oysters are all of inferior quality and are mostly of the raccoon type, those close inshore being exposed at low water. They are not taken for marketable purposes.

Area of old beds where no live oysters are now found.—Between Cedar Point and Norman's Bar, and about WNW. from Pelican Bar, is an area of 285 acres which is covered by old oyster shells, and which was formerly a good oyster bed. This extinct bed extends 1½ miles in a northwest-and-southeast direction, and has a general width of nearly three-eighths of a mile. No oysters are found on this area. The loss of the bed is attributable to the hurricane which destroyed St. Vincent Bar. The present position of buoy No. 8 is in the northern portion of this area, and the channel to Carrabelle, that always has been used, crosses it just south of the buoy. A much better channel, with 8 feet at mean low water, was developed by the survey. It lies just south of this area above described.

Good planting-ground in the eastern part of Apalachicola Bay.—The area best suited for oyster cultivation in the eastern part of Apalachicola Bay extends from the shore of St. George Island, just east of Pelican Bar, to the extinct bed before mentioned, and terminates somewhat beyond it, at a long, narrow oyster bed. It practically covers a long spit or shoal that makes out from St. George Island in a general northwesterly direction for over 4 miles. The planting-ground also covers the area about Pelican Bar and the small oyster beds to the westward and eastward of it. The extinct bed can be included in this planting-ground. The bottom consists almost entirely of hard sand, except over such portions as are covered with shell. The density, temperature, and currents are all favorable to oyster-culture.

Adjoining this ground and extending along the southern shore of the bar to within a mile of New Inlet is another large area that also may be considered suitable for planting, although in a somewhat less degree than the area just described, on account of the greater density of the water. The ground makes out nearly half a mile from shore, except off Cedar Point, where it spreads out for a distance of 1¼ miles. The whole area of ground suitable for planting, inclusive of the extinct bed, is 2,673 acres.

Between Pelican Bar and Norman's Bar is a comparatively small area of hard bottom suitable for planting; it contains 82 acres. Its general direction is east and west for nearly three-fourths of a mile, and it is one-fourth of a mile wide. It is surrounded by soft mud.

Another planting area, containing 175 square acres, surrounds the

North Lumps. It extends east and west for 1 mile and has a width of three-eighths of a mile. This latter area can not be considered as a very advantageous place for cultivating, on account of the low density.

ST. GEORGE SOUND.

The only oyster beds of any importance in St. George Sound, at present, are the large beds at the west end of the sound. There are other beds to the eastward of the limits of the survey, and some of them were formerly productive, but at present none are worked. It is to be regretted that lack of time prevented including these few beds in the survey. The area from Cat Point southeast to St. George Island, for an average width of nearly three-fourths of a mile, forms one large, continuous oyster bed, although different names are given to different parts of the area. It is here that the oyster fleet, consisting of about 32 vessels, has recently been concentrated, and during the season of the survey practically all the oysters brought into Apalachicola were obtained on these beds.

The following is a description of these beds in detail:

Cat Point Bar.—This bed extends from Cat Point southward for about 1½ miles, and is nearly three-fourths of a mile wide, except at its northern part. It adjoins Platform Bar to the southeast, and is separated from Bulkhead Bar by the dredged cut. It contains 485 acres of dense growth of oysters, and 77 acres of scattered growth between the shore and denser growth. It has a least depth of water of 2 feet, while the ruling depth is 3½ feet.

The oysters of this bed, especially those found near the 3-foot curve off Cat Point, are of the very finest quality, and it is probable that no better flavored oysters can be found in any part of the country. They are not only exceptionally good in flavor, but are large and fat. At this part of the reef the oysters are found singly and in bunches of from two to five. The number to the square yard is 19. Numerous young are found attached to the shells, as well as a few barnacles and mussels. No drills, conchs, or other enemies could be discovered, and there was no vegetable growth found on the oysters. The probe showed that the crust of the bed was about 1 foot thick, with hard sand underneath.

About the center of the bed the oysters are even more plentiful, there being as many as 60 to the square yard. There was found a fine growth of young oysters attached, aggregating four to five young on each bunch. All over the bed old worn-out shells are found, and mussels and barnacles in quantities, but no vegetable growth. At the southern part of the bed observations showed the oysters to be quite as numerous as in the middle part, and of good size and excellent quality. Everywhere is a numerous growth of young, but no spat was noticed. The bed seems at all places to have the same thickness of crust. The scattered growth extends from the shore out to the dense growth. The oysters here are not of as good quality as those farther

offshore. Close inshore are several raccoon beds which are dry at low water.

Platform Bar.—This is the name given to the southeast extension of Cat Point Bar, and only the western part of this bar is shown on the map. The part included by the survey covers 130 acres. There are very few large oysters on this bed, but there is a fine growth of young oysters, in different stages of development, attached to the old shells, and in bunches of from three to ten. On the old single shells a quantity of spat was found. Very few barnacles were seen, and no mussels. There were no enemies or vegetable growth discovered. The number of bunches of young oysters to the space of 1 square yard is about seven, and these young oysters, when full grown, will make a fine bed. The crust of this bed is 2 feet thick.

Bulkhead Bar.—This oyster bed lies to the southward and westward of the dredged cut, and covers only a comparatively small space when compared to the large beds of East Hole and Cat Point bars. The number of acres of dense growth included is 210, and extending out from its western edge is an area of scattered growth containing 59 acres. The bed contains good single oysters and oysters in bunches of from two to seven, and the average of the observations in different parts of the bed gives thirty-three oysters to the square yard—rather less than was found on Cat Point Bar. At the same time fewer young oysters were found than on Cat Point Bar, and the oysters, although fairly fat, had a somewhat fresh taste. No spat was noticed here, nor was there any vegetable growth. The probe showed the crust to be about 2 feet thick. Underneath was a layer of soft sand 5 feet thick, and then hard sand.

The ruling depth of water on the bed is 4½ to 5½ feet, while the water on the scattered growth to the westward is 7 feet, all at low water. The scattered growth runs out to the westward until it nearly meets the eastern end of Norman's Bar.

East Hole Bar.—This is the name of the large oyster bed of dense growth that extends from Bulkhead Bar in a SE. direction to the shore of St. George Island. It is nearly 2 miles long, with an average width of three-fourths of a mile, and covers 720 acres. It has a depth of water at low water of from 4 to 5 feet, except along its eastern edge, where it has 8 or 9 feet. The oysters on the northern half of the bed are found almost entirely in bunches, usually two to five oysters in each bunch. They average about thirty-five to the square yard. There is a good growth of young in all stages, but no spat was found. On nearly all the bunches of oysters were patches of brown or green grass, from 4 to 9 inches in length. There was the usual collection of barnacles and mussels. No enemies were observed.

The oysters are of fair quality and in rather poor condition. The southern portion of the bed contains a thick growth of full-grown oysters in bunches of from three to eight, with young growth attached of all ages, from tiny spat to a size of 2 inches. A few of the full-grown

oysters were found to be of the raccoon type. Besides barnacles and mussels each bunch had more or less brown grass attached. The grass here was from 3 to 10 inches long. The oysters are not of good quality or of good flavor. The average number of large oysters found in a square yard was about half a bushel; thickness of the crust was 1½ feet.

The same general conditions exist as in the northern part of the bed. The thick growth of full-grown oysters extends to the 3-foot curve, when the growth becomes scattering and the oysters merge into the raccoon type.

The grass which has been spoken of as growing on nearly all the oysters of East Hole Bar affects their market value considerably. It is said by those interested in the canning business that, in the steaming process, algæ become mixed with the juice and appear, in the cooked oyster, as small particles of coarse hair; it is said, also, that the gills become discolored. These appearances, however, must be due to the preserving process to which the oysters are subjected, as Mr. Moore's examination of specimens from this bed, given in his report, shows that the algæ could not permeate the body of the oyster.

As a good part of the oysters brought into market are for canning purposes, it follows that the oysters of East Hole are of little value for this use, and the locality is therefore avoided to a great extent by oystermen, especially by those collecting oysters for the canning factories. The fact that the oysters of East Hole are covered with algæ to such an extent is probably due to the small velocity and eddying nature of the currents over the beds; thus, the growth, instead of being carried away by the current, is retained on the bed by the eddies. No grass is found on Cat Point Bar, for the reason that the currents there are sufficiently strong to sweep the beds of all such matter.

GENERAL REMARKS ON THE AREA SURVEYED.

The oysters of the locality surveyed were first taken for the local market in 1836, but were not taken in any quantities until 1850. During the war the beds were left undisturbed, and improved so much that at the end of the war they were in very good condition. After the war the oyster business was again taken up, but it was not until 1878 that it was carried on at all extensively. During the winter of 1893–94 the beds of St. Vincent Sound and Apalachicola Bay were nearly destroyed, and since that time practically no oysters have been taken from those

NOTE.—Mr. J. G. Ruge, of the firm of Ruge Brothers, who have the largest canning business of Apalachicola, makes the following statement in regard to the vegetable growth on the oysters of East Hole vicinity:

"The growth consists of two varieties, one of which is coarse and wiry in appearance and red or black in color. This variety does not injure the oyster for canning purposes. The other is much finer, and is a soft, black, hairy growth, called by local fishermen "whiskers." This variety affects the oysters seriously when steamed, as the meat absorbs numbers of particles of it, and, notwithstanding the steamed oyster may be washed and rewashed, after processing, on opening the cans, myriads of fine hair particles may be readily observed. If these cans are left open for several days and the oysters exposed to the air, they turn a dark green color."

places. The Bulkhead and Cat Point bars have lately furnished about all the oysters brought into market, although some few have been taken at Porter's Bar, to the eastward.

The destruction of the beds in St. Vincent Sound and Apalachicola Bay was due somewhat to their being overworked, but principally to the following causes: The freshet of 1893, the hurricane of October 8, 1894, a very severe freeze in the latter part of December of the same year, and another very heavy hurricane on February 13 and 14, 1895. There had been previously (in January, 1886) a heavy freeze that killed many oysters, so that few were taken the following season, and in 1888 a freshet seriously affected the beds.

It seems to be the general opinion that the beds are deteriorating at Platform, Bulkhead, and Cat Point bars, where oystering is going on at present, and the reason assigned is that the beds are overworked, the demand being too great for the supply. As far as known, there seem to be no enemies of the oyster on the beds, unless the boring clam mentioned by Mr. Moore in his report and the algæ found on the oysters of the East Hole Bar may be called enemies. Mr. Moore's examination of the specimens revealed the fact that the barnacles and mussels, which have been spoken of as being found in great numbers on all the beds, grow with such rapidity and wedge themselves between the shells of the oysters so closely that they must in many instances cause the death of the oyster.

The oysters are affected by long-continued dry weather, becoming salty in taste, and in freshets they become white and milky. Both conditions affect their sale. Heavy gales bury them completely, but otherwise very little deposit of mud or silt is noticed. During the heavy freezes the oysters that, after being frozen, are covered up by water, recover, but those left uncovered die.

Of the beds to the eastward of the limits of the work, Porter's Bar was formerly said to have oysters resembling northern oysters, but it now has very few oysters on it, owing to the fact of its having been covered up in a hurricane. There are very few, if any, oysters on Sneed's Bar or Silva's Bar at present.

The oysters are said to grow better in a depth of water of about 4 feet at low water than at any other depth, and they thrive and grow faster in a tideway than in still water.

Tongs are used entirely in getting oysters, and it is contrary to the State law to use a dredge of any kind. It is estimated in tonging that the average proportion of dead shells to live oysters, taken on the beds worked at present, is about two-thirds of shells to one-third of oysters, and the proportion of the larger to the smaller oysters is one marketable oyster to two small ones. The number of oysters to the bushel brought into market is about 140 to 165. The best age for market is from three to five years, and flavor is not taken into account in the market price, but only size and fatness. It is found that about 2 per cent of the oysters have oyster crabs in them.

The oyster shells are thick and heavy, thus making great bulk to proportion of contents as compared with Chesapeake Bay oysters. As already stated, the oysters formerly on Porter's Bar were an exception to the rule. For canning purposes the Chesapeake Bay oysters yield 50 to 70 ounces of cooked meat to the bushel, and the oysters brought into the Apalachicola market yield 30 to 40 ounces to the bushel. The highest yield known in a day's work was 72 ounces of northern oysters, and of Apalachicola oysters 43 ounces, to the bushel.

MEASURES FOR IMPROVEMENT OF THE BEDS.

There is no room for discussion concerning the comparative harmful effects of the use of the tongs and dredges in Florida waters, as the use of the latter is prohibited by State law. A copy of the laws is appended to the report, and a study of them will show that good laws have been enacted by the legislature to protect the natural beds. It is probable, however, that an improvement would be made by prohibiting the taking of oysters after April 15, or even earlier, as the warm waters of the Gulf cause an early spawning season. It is doubtful whether the law regarding the taking of small oysters and the culling of the oysters—especially the latter—are strictly complied with by the oystermen, yet it is of the greatest importance that they should realize that this law should be strictly obeyed if they wish to maintain the productiveness of the beds and thus insure themselves a livelihood in the future.

In spite of the fact that the demand appears too great for the supply, it seems probable that the beds will at least not deteriorate if the laws be enforced regarding the restriction of tonging during the spawning season, culling at places of tonging and throwing back undersized oysters, and allowing no dredging.

An improvement of the beds would be made by breaking up the clusters of oysters where feasible.

OYSTER BUSINESS OF APALACHICOLA.

During the period from 1836 to 1861 a few thousand barrels of oysters in the shell were shipped each season to Georgia and Alabama. During the war no business whatever was done, but at its close the shipments were resumed and continued to the present time, business having increased in later years.

Before the beds in Apalachicola Bay and St. Vincent Sound were practically destroyed, and at the time the oyster business was at its height, 120 to 150 vessels were employed each season in taking oysters. At present there is a fleet of 12 vessels obtaining oysters for canning purposes, and 20 for raw and shell shipment. There are usually three men, or two men and a boy, in each vessel, although there are some few boats with only one or two men. A profitable day's work in favorable weather, for two men in a boat, working—as is usually done—day and night throughout the twenty-four hours, is 20 barrels.

An idea of the comparative productiveness of the beds at present and formerly is obtained from the fact that under ordinary circumstances three men can now take 100 bushels of oysters in two days and two nights, and formerly the same men could take 100 bushels in twelve hours daylight. At present $1 to $1.25 is paid for a barrel of oysters, including the barrel. Oysters brought to market and not used for canning are shipped in shell to Columbus, Ga., Jacksonville, Fla., Atlanta and Macon, Ga., and are in the raw-shucked state shipped to Chicago and Louisville. Canned oysters are shipped to the Western States mostly. The proportion of the whole catch to that part consumed in Apalachicola is very small.

The canning of oysters was first tried in Apalachicola in 1860, but the experiment was a failure, owing to the lack of knowledge of the degree of heat necessary to preserve the oyster. Canning was taken up again in the fall of 1883 and carried on until 1885, with indifferent success, but in the first year mentioned sufficient experience had been gained to demonstrate the fact that a different number of units of heat were necessary to preserve the oysters than had been used for the Chesapeake oysters. In 1886 the canning plant fell into the hands of the present operators, Ruge Brothers, and was carried on with varying success; in 1887 a second plant was started by the same firm. Mr. T. W. Bamberger, in 1889, started a small plant, which was operated several seasons. In 1891 the Green Point Canning Company built a large plant, and operated one year at a loss. This plant was bought by Ruge Brothers, and merged into their first company. It was run by them one season and has since been idle. The fact that the canning business can not be carried on to any extent for any length of time is due to the fact that the supply of oysters is insufficient to satisfy the demand, notwithstanding the fact that the packers have used every means they could to preserve the oyster beds by refusing to take oysters under proper size, or out of season, or not properly culled, as well as in alternating the use of different beds each season. The oysters and spat have been seriously affected by gales, freezes, and freshets.

The canning business in Apalachicola has been injured during the last four years by the fact that the packing of oysters at Fernandina, Brunswick, Savannah, and Biloxi, has been done at less cost and with lower freight rates than at Apalachicola.

The output of the canning factories of Apalachicola has been as follows: In 1893–94 the Ruge Brothers Canning Company, 63,000 bushels or 400,000 one-pound cans. In the same season T. W. Bamberger & Company's factory's output was 13,000 bushels or 100,000 one-pound cans. In 1895 one plant only was running, and in 4½ months canned 13,000 bushels, or 100,000 cans. Owing to the scarcity of oysters, the Ruge Brothers' plant will not at present operate, as it will take from three to four years for the oyster beds to recuperate sufficiently to supply enough oysters to run the canning factories to full capacity.

THE CULTIVATION OF OYSTERS.

As before stated, planting was tried experimentally on the north side of St. Vincent Sound, and enough was done at the time to show that it could be made a decided success, if the laws of the State regarding planting could be enforced. As it was, no protection whatever was given, and the experiment proved unsuccessful for that reason. The State laws protect the planters, but there appears to be no attempt to enforce the laws, and the moral sentiment among the oystermen is not in favor of such protection. This is due to a misunderstanding of the subject by the oystermen; the law makes a distinction between the cultivated beds and natural beds, and relates wholly to the cultivated beds, but the oystermen have the idea that any protection given the planters is of the nature of a monopoly, and is an encroachment on their rights. Of course such is not the case, as the laws protecting planters do not in any way interfere with oystering as now carried on on the natural beds. All the oyster cultivation would be carried on entirely away from the natural beds, and in some cases in localities quite remote from them. The chart shows exactly where oysters may be cultivated, and any intelligent person by using a compass may locate himself with sufficient accuracy to find the limits of the planting ground; in this connection a sounding pole will be of great assistance, as by it he can judge of the character of the bottom as well as the depth of water. By closely studying the limits of the planting area a person can select certain natural ranges which will help him locate himself.

The whole question of oyster cultivation is of the greatest importance to the people of Apalachicola and vicinity, as undoubtedly, if the law is enforced and the planters protected, it may be made a great industry, and it is only necessary to cite as an example the great success met with by the oyster cultivators of Long Island Sound in order to show what a great business may be developed. But first the oystermen must be brought to a realization of the fact that the protection of oyster cultivation does not in any way infringe upon their rights, and that on the contrary it is directly for their best interests. All have equal rights, and any man having sufficient thrift and energy may, without much doubt, better his condition by undertaking the cultivation of oysters and uniting with others to respect the laws.

The cultivation of oysters would be more easy on account of the number of oyster shells brought into Apalachicola. By simply spreading these shells over the areas of planting ground, the spat would attach itself to the cultch, and only a little care in cleaning and spreading would be required to form, in time, a productive bed. It should always be borne in mind, as has already been mentioned, that oysters grow and thrive much better in a current than in still water, as they have a better food supply. In transplanting the clusters should be broken up and each oyster should be thoroughly cleaned of barnacles and mussels.

It is almost certain that if the question of oyster cultivation were taken up in the proper way by the people of Apalachicola and vicinity, excellent results would be obtained. No better flavored or conditioned oysters can be found anywhere than those at Cat Point Bar and at Silva's Bar, and by using the seed from these bars it can be safely prophesied that oysters of the cultivated bed will excel those of the natural beds. There is little doubt that if the oysters on East Hole Bar, where the vegetable growth renders them unfit for canning purposes, were transplanted to other localities, they would lose the peculiar characteristics so injurious to them, and become, like the Cat Point oysters, excellent in quality.

SPAWNING SEASON AND SPAWNING HABITS.

The spawning season, as near as may be ascertained, extends from April 15 to July 15, but these limits of time vary with the temperature to a considerable degree. However, it is probable that in these waters the oysters spawn, to a greater or less degree, all the year around. This is borne out by the fact that during the season of the survey spat was noticed from the beginning of the work in November to the end of March, and oysters in all stages of growth were observed. It is considered that the oysters reach a spawning age at the end of three or four years, according to the temperature. Depth of water of course affects the temperature, and the current the food supply of the mother oyster. If freshets occur during the spawning season the mud or silt kills the spat.

VALUE OF THE SURVEY HYDROGRAPHICALLY.

As was pointed out in the beginning of the report, the chart may be used with confidence, as the configuration of the bottom is shown with as much accuracy as in the Coast Survey charts. The curves of different depths are all delineated, and the characteristic soundings shown with sufficient frequency. No hydrographic survey of this locality had been made for a number of years, and a good many changes in the bottom had occurred, especially about the mouth of Apalachicola River. Since the time of the original survey two new channels had been dredged, which are shown on the chart, and it was important hydrographically that these channels should be located and their depth of water shown.

The most important development is the discovery of a new channel in the thoroughfare between Apalachicola and Carrabelle. The channel gives more water than the one formerly used, and should be buoyed. This subject has already been alluded to. The chart shows an increased depth and a decided hydrographic change at Indian Pass, and it seems likely that this pass will become of importance when the increased depth is generally known. At present a vessel of the *Fish Hawk's* draft, 8 feet, can enter the pass.

Indian Lagoon, although of not much importance, was surveyed for the first time.

REPORT UPON SPECIMENS COLLECTED FROM THE OYSTER BEDS OF ST. VINCENT SOUND, APALACHICOLA BAY, AND ST. GEORGE SOUND, FLORIDA, DURING THE WINTER OF 1895–96.

By H. F. MOORE, *Assistant, U. S. Fish Commission.*

With very few exceptions, the specimens of oysters submitted for examination are thick-shelled, in crowded clusters, and covered with barnacles and mussels. In some instances the growth of foreign organisms has been so vigorous and rapid as to seriously hamper the development of the oysters, and it was manifest that death had sometimes resulted, or was about to follow, from this cause, as well as from the mutual crowding of the oysters themselves. If the specimens received are fair samples of the character of life upon the beds, there must be considerable mortality from this cause alone. Were the clusters broken up the oysters would be more abundant and better in shape and quality.

Mussels and barnacles grow with great rapidity and wedge themselves between the shells of the clusters in such a manner as to effectually prevent the opening of the valves, and the oyster's death from starvation and suffocation soon follows. The oyster will live, however, if it be permitted to open its shell ever so slightly, but the difficulties of its existence are reflected in its poor and "watery" appearance, a condition which is difficult to recognize in alcoholic specimens.

It is not possible to say much concerning the fleshy portions of the specimens, as not only are the animal parts more or less shrunken by the action of the alcohol, but it is rarely possible to open the oyster without mutilation. In a number of cases the shells are rather deep and capacious, indicating that in their fresh condition the "meats" were plump and fleshy.

A few calcareous worm tubes and several small tufts of hydroids are attached to some of the clusters, but in general the collection is characterized by an absence of such organisms, which, when abundant, sometimes cause harm by collecting sand and débris which smothers the oysters.

The old shells, both living and dead, are usually more or less corroded and partially disintegrated by the attack of a species of boring lamellibranch, not yet identified, but apparently related to, if not identical with, *Martesia smithii* Tryon. This species can not be regarded as parasitic in the sense of feeding upon the oyster, but it causes harm by weakening the shell and harassing the tenant in a manner not unlike that of the boring sponge. This boring clam begins to burrow when it

is still quite small, and it makes a depression of corresponding size. Through the external opening food and oxygen are taken, and as the animal grows the size of its domicile is enlarged until there is formed an egg-shaped chamber communicating with the exterior by a short canal of much smaller diameter, the organism thus becoming imprisoned in a cell of its own making.

In the process of excavation the shell of the oyster is often penetrated, but the mantle is thus stimulated to lay down a layer of shelly matter over the inner opening and the leak is promptly repaired. Where there are many such burrows, the drain upon the oyster in making repairs may cause a deterioration in the quality of its flesh, as has been observed where the boring sponge is troublesome.

Another cause tending to produce irregularities is the inclusion of mud and sand between the shell and the mantle. The layer of shell deposited over the foreign material produces blister-like excrescences, which when broken open were found to contain offensive-smelling mud.

The collection contained no organisms which are known to feed upon the oyster.

The specimens from all stations showed evidence that good conditions for spatting must have prevailed during the preceding spawning season. In nearly every lot there were a number of young oysters, varying from ¾ inch to 2½ inches in length. In most cases they were so closely crowded that many of them would have failed to reach maturity and the survivors would surely have been unshapely. In one case the interior of one old shell, the valves of which still held together, contained about 15 oysters ranging in size from 1¼ to 1¾ inches, and in several instances the strong growth of the young had killed the old oyster to which they were attached.

A careful examination was made of the specimens from East Hole. The oysters of this bed are covered by a vegetable growth when taken, and are said to be permeated by hair-like substances when prepared for canning. Neither in the flesh nor in the intestines of these specimens was there any filamentous matter, though the alimentary canal contained considerable sand and gritty material which might be noticed when the oysters were eaten.

So far as could be judged from the alcoholic specimens, the oysters from this bed were "poorer" than those from other places, and in consequence the radial muscles of the mantle stood out in relief. It seems hardly possible that the oystermen could mistake these muscle fibers for filaments of a parasitic organism, but I am assured that the so-called hairs can not be connected with the alga which is found attached to the shells. This plant is not at all parasitic and makes use of the oyster shell merely as a solid place of attachment, as the young spat utilizes the old shell for the same purpose. The filaments of this seaweed may be sometimes carried into the shell by accident, but even then they would not become imbedded in the flesh.

The mantles of these oysters were somewhat darker than those from

other beds, but the difference was not very marked and the color does not appear to be developed to an objectionable degree. This dark color is due to causes perfectly natural and harmless, and is not in any measure the result of disease or parasitism. A dark pigment is produced in such parts of the body as are exposed to the light, but is usually confined to the edges of the mantle, the other portions being shaded by the shell.

EXTRACTS FROM THE FLORIDA STATE LAW IN REGARD TO OYSTERS AND THE OYSTER FISHERY.

Appointment of commissioners.—The governor, with the consent of the senate, is hereby authorized to appoint three competent persons, to be known as the commissioners of fisheries, who shall continue in office for the term of two years, and until their successors are appointed.

Supervision of fish and oysters, and laws for their protection.—The commissioners of fisheries shall have general supervision of the fish and oyster interests of this State, and are hereby authorized and instructed to make annual investigation of the oyster waters and oyster beds, both natural and cultivated, of this State, and by conferring with the commissioners of oysters in other States, and personal inspection in this State, make such report to the governor, with recommendations of the best course to pursue to increase the yield and give a revenue to the State. They are also authorized to enforce the existing laws made for the protection of fish and oysters in the coast and inland waters of this State, and to prosecute all violators of such law when coming under their cognizance. And for the better performance of this duty they may appoint fish wardens residing at convenient localities, whose duty it shall be to inform them of such violations.

Commissioners to report to the governor.—The commissioners shall make an annual report to the governor of the work accomplished by them, with such suggestions as to the propagation and protection of fish and oysters as they may deem proper, which report shall be transmitted by the governor to the legislature.

Exclusive right to plant oysters.—Any person desiring to plant oysters in the public waters of this State shall apply to the county commissioners of the county in which the water is situated, setting forth his determination to plant oysters in a certain locality, describing the same as near as possible, and the said commissioners may grant exclusive rights to such person for such locality or any portion thereof, with such boundaries as they may deem proper.

Forfeiture.—Any person obtaining from the county commissioners such grant or exclusive right and failing to utilize the same by planting oysters therein within one year thereafter shall forfeit such grant.

Marks of boundaries.—It shall be the duty of all persons planting oysters as provided above in this chapter, to mark the boundaries and limits of the beds of oysters so planted by them, by stakes or buoys, as may be prescribed by the county commissioners, at intervals of not more than fifty yards apart, clearly defining the limits of their claim, said stakes or buoys not to obstruct or interfere with the navigation of any of the navigable waters of this State, and to keep such stakes or buoys standing and in good order and repair, otherwise no penalty shall be incurred or right protected under the provision of this chapter.

Riparian rights. Transfer of oyster beds.—The provisions of this act shall give no exclusive right or privilege to any persons to plant oysters upon the submerged lands of another without the consent of the owner thereof; but all persons shall

have the right to plant oysters in the bays and harbors of this State, but the riparian owner shall not be disturbed thereby in the use of the land a reasonable distance out from medium tide for the purpose of erecting wharves, warehouses, or other permanent improvements thereon; and any owner or lessee of any artificial oyster bed shall have the right to sell, lease, dispose of, or transfer his or her interests therein, which sale, lease, or transfer may be recorded in the same manner as any other transfer or conveyance of property, and all rights and interests therein shall descend according to the rules of descent as prescribed by law.

Limit of bed in front of public lands.—No oyster bed so located in accordance with the provision of this chapter shall extend more than one-eighth of a mile along the bank or shore of any waters, bayous, rivers, or sounds in front of the public or unoccupied lands of this State.

Not to include natural oyster beds.—All the existing natural or maternal oyster beds in the waters of this State are exempt from the provision of this act, and they remain for the free use of the citizens of this State.

Carrying away planted oysters.—Whoever unlawfully, without permission of the owner, takes up and carries away by any means, or in any manner catches, interferes with, or disturbs the oysters of another, lawfully planted upon the beds of the bayous, rivers, bays, sounds, or other waters within the jurisdiction of this State, shall be deemed guilty of larceny, grand or petit as the case may be, and shall be punished accordingly.

Using dredge, etc., for oysters.—Whoever uses a dredge or drag net for the purpose of gathering or catching oysters from any of the natural oyster bars in any of the waters within the jurisdiction of the State shall be punished by imprisonment not exceeding sixty days, or by fine not exceeding one hundred dollars.

SECTION 1. That from and after the approval of this act, it shall be unlawful for any person or persons to take oysters for any purpose from any beds or reefs in this State except for home consumption from May 1 to October 1 in any year.

SECTION 2. That during the time that it is lawful to take oysters, to wit, from September the first to May the first of the following year, the oysters that are taken from the beds or reefs shall be culled at the places from which they are taken, and the culls and oysters less than two and a half inches in length shall be returned to the beds from which they are taken.

That whoever violates the provisions of sections 1 and 2 of this act shall be punished by fine not exceeding fifty dollars for each offense, or by imprisonment in the county jail not exceeding thirty days, or both such fine and imprisonment, in the discretion of the court.

Approved May 30, 1893.