

54.—RESULTS OF INVESTIGATIONS BY THE SCHOONER GRAMPUS ON THE SOUTHERN MACKEREL GROUNDS IN THE SPRING OF 1887.

By D. E. COLLINS, T. H. BEAN, and RICHARD RATHBUN.

The report on the investigations of the *Grampus* consists of three parts. The first is a narrative by Capt. D. E. Collins, who was temporarily in command of the vessel, stating the objects of the cruise, the equipment for fishing and research, the directions and distances sailed, the conditions of the air and water, the movements and catch of the fleet, the occurrence of mackerel and other important fishes and of the food of fishes, the success or failure of various kinds of bait and fishing apparatus. The *Grampus*, while cruising frequently with the mackerel fleet, was engaged also in independent observations at distances of from 20 to 75 miles in various directions, always returning to give the masters of fishing vessels any information which might be useful to them.

The second part, by Dr. T. H. Bean, is devoted mainly to notes on the fishes, cetaceans, and birds collected or observed during the voyage. The account consists principally of observations on the localities, movements, size, and food of the mackerel.

The third part, by Mr. Richard Rathbun, is a notice of the small surface organisms taken in the tow nets, and of the contents of mackerel stomachs. The general account of the character and distribution of the species was prepared by Mr. Rathbun; the identification of certain groups was furnished by several specialists; the amphipods, schizopods, cumaceæ, and decapods were referred to Prof. S. I. Smith; the medusæ to Mr. J. W. Fewkes; the mollusca to Mr. W. H. Dall; the insects to Mr. J. B. Smith.

REPORT UPON THE OPERATIONS OF THE UNITED STATES FISH COMMISSION SCHOONER GRAMPUS, FROM MARCH 15 TO JUNE 3, 1887. BY D. E. COLLINS.

The work of collecting fish and fish-eggs for the hatchery at Wood's Holl, Mass., closed on March 14, and the next day I received the following orders:

U. S. COMMISSION OF FISH AND FISHERIES,
Washington, D. C., March 13, 1887.

SIR: As soon as the *Grampus* can be got in readiness, you will, after taking on board at Wood's Holl any material needed for the cruise, proceed to sea. Your object will be to investigate the waters adjacent to the North Atlantic coast from Cape Hatteras

to the Gulf of Maine, obtaining as much information as possible of the appearance and movements of the mackerel, menhaden, bluefish, or other sea fishes.

Very respectfully,

J. W. COLLINS.*

Capt. D. E. COLLINS,

U. S. Fish Commission Schooner Grampus, Gloucester, Mass.

From the date of receiving the above orders to the last of March, cold, stormy weather prevailed the greater part of the time, and hindered the preparations which had to be made for the cruise. Every opportunity was improved, however, to fit the vessel for sea. On March 24 the vessel was taken upon the marine railway at Gloucester and the outside of the hull was painted; the necessary painting inside, both below and above deck, had been done while she lay in the stream, previous to going upon the railway. All other necessary preparations—such as cleaning the masts, setting up the rigging, etc.—had been made whenever the condition of the weather permitted.

In compliance with the following instructions we sailed from Gloucester at 7 p. m. on March 30, and arrived at Wood's Holl 6.20 p. m. the next day:

U. S. COMMISSION OF FISH AND FISHERIES,
Washington, D. C., March 24, 1887.

SIR: I send you here with a list of instructions for your guidance on the cruise, which you are about to make, for observing the habits and migrations of the mackerel, menhaden, and bluefish. So far as is practicable, you will attempt to carry out these instructions.

When you have completed your preparations at Gloucester for the cruise, you will proceed, as soon as the weather permits, to Wood's Holl, Mass., where you can land any material which you may have had on board during the winter for cod work, and that you think will not be needed for the coming cruise, or which might suffer from accident or deterioration if kept on board of the vessel. This material should be placed in storage in the room assigned to the vessel's use in the store-house, and such instructions as are necessary for its preservation can be left with Mr. Atkins at the station. If you think the wire hawser will not be needed, that could be put on shore also.

You will take on board for use on the trip—

- (1) The mackerel and herring gill-nets belonging to the vessel.
- (2) The bait-mill and other apparatus necessary for preparing and using "toll-bait."
- (3) The stern boat.
- (4) A supply of small towing-nets, which will be forwarded to you there. (In case these towing-nets are not at hand when you are ready to sail from Wood's Holl, it will scarcely be worth your while to wait for them.)

Your cruising-ground will be, generally, between Cape Hatteras and the Gulf of Maine, and should be mostly in proximity to the mackerel fleet, and you should continue with it as a rule, so that you may observe the work of the vessels and be able to record the appearance or non-appearance of fish in the locality where the fleet is working.

It will, however, be desirable for you to make extended observations, independent of the fleet, by running 25 to 75 miles, or even more, away from it to look for mackerel. In carrying out this clause of your instructions, you will, of course, have to be guided largely by circumstances and by your own judgment, since it is impossible to foretell the precise conditions under which you will have to work.

*Capt J. W. Collins was officially in command of the *Grampus*, but important duties made it necessary for him to be in Washington, and Capt. D. E. Collins was placed in command *pro tem*.

I suggest, however, in case you arrive on the fishing-ground north of Hatteras before any mackerel are seen by the fishing vessels, that you run some distance south or southeast of them and set gill-nets, if the weather permits. And it may be a good plan to set gill-nets where the mackerel vessels are, if they have not seen fish. By doing this you may get the first trace of the fish as they approach the coast.

Later, when the fleet gets to work, it will be well for you to leave it occasionally to run from 25 to 75 miles farther north, set nets at night, and also try "toll-bait" by day, to ascertain if the fish are moving faster than the fleet. Also, when the fleet is working inshore, you can run offshore 25 or even 75 miles, and try the same methods; or, if the fleet is offshore, run in.

By doing this and keeping a careful record of your work—such as the number and kinds of nets set, at what distance from the surface fish were most plentiful, the depth they were sunk, the occurrence of and apparent abundance of fish, the relative size of the mackerel as compared with those taken by the fleet, the number of trials made with toll-bait, location of same, results, etc.—you will add much valuable information to that we now have.

In this connection let me say that it will be desirable to give the fishermen any information that may result to their advantage; always, however, keeping a record of the fact, the name of the vessel, etc., to which this information is imparted, and, so far as it comes to your knowledge, a record of the result.

I think it will always be desirable, after making independent researches, to return to the fleet without too much delay, so as to keep open communication with the vessels and closely watch their movements.

Having opened communication with the fleet and learned something of its movements, what has been accomplished in your absence, etc., you can then make another cruise on your own account, if you see fit. You will always bear in mind that anything you can learn independent of the fishing vessels will be much more valuable than the information gained simply by watching their movements, although the latter is too important to be neglected.

It will not, of course, be necessary that trials be made very close together, and for results I think you will have to depend largely upon gill-nets. Trials with "toll-bait" made at distances of say 15 to 25 miles ought to be near enough, while gill-net experiments could be made at longer distances, say 25 to 75 miles apart, as circumstances seem to dictate.

In carrying on your work it is desirable that you should observe the following methods:

(1) Keep hourly records of the temperature during the day, and note the temperature every two hours at night, whenever practicable; also to continue to record, as you have been doing, the height of barometer and condition of the weather, state of the sea, kind of sky, etc.

(2) Note carefully the hours when mackerel appear and disappear, at night or otherwise, whether you may be in a fleet or at a distance from any fishing vessels, also the direction and rapidity of their migrations.

(3) When in a fleet, either in harbor or otherwise, obtain all possible information in regard to the appearance of mackerel, as observed by the fishermen. The date, locality, abundance of fish, number of vessels present at the time, and the catch (as nearly as it can be obtained) should be ascertained and recorded. It will also be desirable to write down the observations of the fishermen on the movements of the mackerel, and get from them statements of opinion as to the influence the weather and winds have on the movements or on the abundance of fish. These data and other facts can be kept in a book separate from the log-book.

(4) Note the appearance and approximate numbers of sea-birds, such as gulls, gannets, hawks, jaegers, etc.

(5) When in a fleet, note the numbers of vessels in sight and the area of ground they cover; that is, the distance from one side of the fleet to the other in an east and

west direction, and the same in a north and south direction; also note additions to the fleet during the day or departures from it.

(6) When making records of the presence of vessels, give your position as near as practicable (by dead reckoning or by observation) and state whether the larger part of the fleet is north, south, east, or west of you, and about how far off the most distant vessels are. This will define the positions of the fleet and show the ground it is working over.

(7) Note all movements of the fleet, whether working north or south, east or west, and the distance passed over each day or night.

(8) Note the number of seine hauls made by the vessels in the fleet, on each day you are with them, as far as practicable, and the percentage of "water hauls;" also the number of vessels getting fish. When you learn the name of the vessel note that also, and the quantity of fish taken.

(9) Note the number of vessels leaving the ground for market on any day, and their names if you know them.

(10) If you see differences in the size of the fish of various schools, on different days, always record the fact, and when practicable give the extreme and average lengths; also, when practicable, the relative numbers of males and females.

(11) If you see schools of fish "cart wheeling," note whether they are going against the sun (from right to left) or vice versa, and also what they appear to be feeding upon. Get specimens of "feed" when practicable.

(12) In setting gill-nets, it will be well, if the weather is favorable, to sink them at different depths; say, for instance, from the near surface (one or two fathoms below) to ten or fifteen fathoms deep. Note in what part of the nets fish are taken. Nets with different sized mesh should be put out so as to catch any fish that may be in the vicinity.

(13) In regard to the use of the towing-nets, it is considered important that towings should be made in the morning, at noon, and at evening, and the material contained in each collection should be properly preserved in separate bottles, and be labeled with the date, locality, and hour at which each was obtained. If this is carefully attended to, it will give us many data in regard to the food of the mackerel in the early part of the season. It may also be desirable to preserve the stomachs of a few mackerel and samples of ovaries, properly labeled, as you obtain them from day to day.

(14) The appearance and abundance of menhaden, bluefish, or other species should be noted, and specimens of any that are captured should be saved.

(15) As opportunity offers it will always be desirable to make trials with hand-lines from comparatively shallow water down to depths of 150 fathoms or more, and a record of the trials should be made with position, the depth of water, the number of lines used, kind of bait and time spent in fishing. It will also be desirable to preserve specimens of strange fish that are caught. The possibility of catching the tile fish, in depths from 75 to 200 fathoms, renders it especially important that trials with hand-lines should be made whenever opportunity offers.

(16) Should you have a good chance to kill porpoises, particularly a species remarkable for fine white spots, it will be proper to capture specimens. If you can not preserve the body cut off the head so that the skull may be saved. By consulting the figures of the Cetacea given in Mr. True's paper, published in Fish Commission Report for 1883, you may be able to identify tolerably well any animals of this kind you may have a chance to get. The common sea porpoise (*Delphinus delphis*) is not especially valuable. If you can capture a killer (*Orca*) it is very desirable to do so, and bring the specimen in the ship to Washington. Save sharks or their heads.

(17) It is important that the Commission should be in possession of all available knowledge looking toward the safety of life and property employed in the fisheries. Therefore, if a suitable opportunity occurs to test the drag you have on board, it will be proper for you to use it in accordance with instructions contained in a previous letter.

(18) When arriving in port, telegraph your arrival, and if you have specially valuable specimens on board, wire the facts. If you learn anything important relative to the movements or abundance of fish, give the facts to the Associated Press agent in any port you may visit.

(19) Report briefly by mail the result of your work.

Very respectfully,

J. W. COLLINS.

Capt. D. E. COLLINS,

U. S. Fish Commission schooner Grampus, Gloucester, Mass.

We remained at Wood's Holl until April 3 the weather in the meantime being stormy and boisterous. At 2.10 p. m., on the above date, we got under way to beat out of Vineyard Sound, but at 4.30 p. m. anchored at Tarpaulin Cove, where there were two schooners of the mackerel fleet, which were bound to the southern fishing grounds. On the morning of the 4th we left Tarpaulin Cove with a moderate southwesterly wind, which increased to a strong breeze in the latter part of the day, and caused a sharp, choppy sea. We therefore went into Newport Harbor, where we arrived before noon. At Newport there were nine or ten schooners of the mackerel fleet waiting a favorable opportunity to make their passage to the fishing grounds.

We sailed from Newport at 3.30 p. m. April 5, with a fresh northwesterly wind, which increased toward evening; outside of the harbor we met with a sharp sea coming from the southward, and, although we reefed the mainsail, the vessel's deck was filled with water most of the time during the night. At 1 p. m. on the following day we saw Barnegat light-house bearing west $\frac{1}{2}$ north. The wind, in the mean time, had moderated considerably, and during the evening of the 6th all head sails were set. We ran along the coast, passing Five Fathom Bank light-ship at 8 p. m., being about 4 miles distant from it.

From this point we steered for the fishing grounds most generally resorted to by mackerel schooners at this season, and which are embraced within the parallels of north latitude 37 to 39 degrees, and between the meridians of west longitude 74 to 75° 25'. It will, however, be seen in subsequent paragraphs of this report that our researches were extended over a much larger area.

April 7 began with fine clear weather and moderate southwest wind, but at 9 a. m. the wind veered suddenly to north-northeast, although the weather continued clear and the sea smooth throughout the day.

In the morning two mackerel schooners were in sight steering to the southward. We ran in that direction also until 9.40 p. m., when the light sails were taken in, the head sails hauled to windward, and the vessel was hove to on the starboard tack.

During the day we saw several small flocks of sea-geese (Phalaropes) and occasionally a gannet.

There was a fresh north-northeast breeze and clear weather on the following day (April 8). At 6 a. m. a fleet of twenty-four sail of mackerel schooners was seen to the northwest of us. We filled away and

stood in that direction. When near the center of the fleet we hove to and waited the approach of several of the vessels which were steering for us, and the captains of which were apparently anxious to communicate with us. A little later Capt. Eben Lewis, of the schooner *Edith M. Rowe*, came on board. Captain Lewis, who is well known as an energetic and skillful fisherman, and who was one of the first to sail for the fishing ground this spring, said he had been cruising for nearly two weeks, and had sailed over the entire region from the position in which we then were (lat. 37° 23' N., long. 77° 45' W.) southward to the latitude of Cape Hatteras and eastward to the Gulf Stream. In all this cruising he had not seen any mackerel nor heard of any vessel getting that species. About ten days previously he had caught a school of menhaden in his purse-seine nearly in the latitude of Body Island.

During the afternoon several other vessels of the fishing fleet spoke with us, and their captains reported substantially the same facts as given by Captain Lewis. None had seen any mackerel, nor had they heard of any being taken.

During the evening the fishing fleet all headed to the northward. We beat to windward also about 6 or 7 miles, and at 1.34 p. m. hove to and threw out "toll bait" for mackerel, but did not succeed in enticing any alongside. The trial was continued for forty-five minutes, when we got under way and ran southward a distance of 22 miles, where we again hove to, and made another attempt to "raise" fish with "toll bait," but with the same result as before. We also put out hand-lines for bottom fish in the same position, but caught nothing except spiny-backed dogfish. In the evening we hove to under the mainsail, all other sails being taken in, and set one herring and one mackerel gill-net; the former was set at the surface and the latter sunk to a depth of 2½ fathoms. The main-boom was guyed out so that the vessel made a square drift, and the nets were set at a "swing" to windward, the inner end of the warp being fastened at the mainmast. The position of the vessel was lat. 37° 04' N., long. 74° 37' W.

April 9 the weather was fine and clear, with a moderate easterly wind. The nets were hauled at 5 a. m.; six river herring, or alewives, were caught in the mackerel-net, and fifteen alewives and two mackerel were taken in the herring-net, the average length of the mackerel being 12 inches.*

There were seven mackerel schooners in sight in the morning, the majority of them steering to the eastward. Captain McFarland, of the schooner *Emma W. Brown*, spoke with us. I told him that we had taken two mackerel in our nets.

At 7.30 a. m. the small surface towing-net was put out and a considerable quantity of copepods (mackerel food) were taken in it. We then filled away and ran to the southward 15 miles. A man was stationed at the mast-head to keep a lookout for schools of mackerel, but no in-

* These mackerel were the first taken of the season.

dications of the presence of fish were seen, except a few gannets that were occasionally seen passing the vessel. During the remainder of the day, with the exception of the time occupied in trials for fish, we cruised back and forth in various directions, as is the custom among fishing vessels when they have reached the locality where it is supposed mackerel may be met with. A man was at the mast-head constantly, and a sharp watch was kept throughout the day, but no fish were seen. At 6.20 p. m. a trial was made with "toll-bait" (lat. $36^{\circ} 45' N.$, long. $74^{\circ} 53' W.$), but no results were obtained, although bait was thrown for more than an hour. We then steered to the eastward for a short distance, and at 7 p. m. hove to for the night.

On the 10th the wind was south-southwest in the morning, hauling to west-southwest in the latter part of the day; the weather clear and pleasant.

At 5.45 a. m. began to throw "toll-bait" for mackerel. Put over cod hand-lines baited with salted menhaden. No mackerel were caught; spiny-backed dogfish were in great abundance, and several of them were taken on the cod-lines. Our position was lat. $36^{\circ} 29' N.$, long. $74^{\circ} 50' W.$

There were several fishing vessels in sight, but they were considerably scattered, some of them being 7 or 8 miles north of us, while others were as distant to the south, east, and west. Most of these vessels were standing to the southward. At 6.45 a. m. the captain of the schooner *Ella M. Adams*, of Gloucester, spoke with us and asked how far we had been to the southward.

The surface towing-net was put out this morning, but nothing was taken in it.

After completing the attempt to "raise" mackerel, we got under way and stood to the southward until we reached lat. $36^{\circ} 04' N.$, long. $74^{\circ} 44' W.$, where we hove to and made another trial for mackerel with "toll-bait," but without success.

A few sea-geese were seen during the forenoon, but nothing else which would indicate the presence of migratory fish.

At 11 a. m. got under way and set light sails, steering to the southward, with a look-out at the mast-head. At noon we met and spoke with the fishing steamer *Novelty*, Captain Joyce, who inquired if we had been far to the southward of the position we were then in. He had seen no mackerel himself, and had heard no news which might be considered favorable by the fishermen.

We stood to the southward nearly 45 miles without seeing any indications of schooling fish, and about dark hove to for the night. At that time ten or twelve sail of fishing vessels were near us, all of them lying to. During the evening, went on board of the schooner *Gertie Evelyn*, of Gloucester. Captain McIntire stated that he had cruised from the latitude of Five Fathom Bank, off Delaware Bay, to the edge of the Gulf Stream without seeing any mackerel.

Two of the vessels in the fleet put out their seine-boats during the evening, and it was evident that schools of surface-swimming fish had been seen; but I afterwards learned that no fish were taken.

The weather continued pleasant on the 11th, with a moderate to light breeze from west to northwest most of the day, dying away to a calm in the early part of the evening, and a light west-southwest breeze before midnight; weather pleasant and clear.

At 5.40 a. m. we hove to to try for mackerel with "toll-bait," our position being lat. $37^{\circ} 22' N.$, long. $74^{\circ} 39' W.$ At this time there were eight vessels in sight, and at 6.15 a. m. Captain McKinnon, of the schooner *Mayflower*, of Gloucester, spoke with us, and said he had seen plenty of fish in the water during the previous night. We caught no mackerel. Cod hand-lines were put out, but, with the exception of some spiny-backed dog-fish, nothing was taken. The trial for cod and mackerel lasted for nearly an hour. At 7.45 a. m. put out small surface towing-net and towed it for fifteen or twenty minutes, but took nothing in it. During the forenoon we steered from west to southwest by south, going along from 4 to 5 knots. At 10 a. m. four fishing vessels were seen standing to the westward.

A few phalaropes were seen during the forenoon. At 1.15 p. m. changed course to south $\frac{1}{4}$ west and steered in that direction about 9 miles. At 2 p. m. saw six fishing vessels, all steering southward. At 3.25 p. m. hove to to try for mackerel with "toll-bait" in 23 fathoms of water (lat. $36^{\circ} 58' N.$, long. $74^{\circ} 49' W.$). No mackerel were caught in a trial of about forty minutes. Got under way again at 4.02 p. m., heading to the eastward, and soon after saw fifteen fishing vessels to the eastward of us, manœuvring as if a school of fish were seen. At 5.25 p. m. we saw the seine-boat of the schooner *David A. Story* out looking for mackerel, but no fish were taken, as I learned when I went on board of that vessel.

At 6.15 p. m. took in all sails excepting the mainsail. Hove to, and at 6.30 set two gill-nets from vessel (lat. $36^{\circ} 51' N.$, long. $74^{\circ} 34' W.$ by dead reckoning).

At 5.25 a. m., April 12, we hauled the gill-nets and took in them one menhaden, but four other fish of that species which had been entangled in the twine fell out into the water and were lost before we could reach them.

Soon after hauling the nets the head-sails were hoisted and we stood to the northward on the starboard tack.

At 7.45 a. m. we spoke with the schooner *Nellie M. Davis*, of Gloucester, and Captain Malanson came on board of the *Grampus*. He stated that he had caught 100 barrels of menhaden in one set of his purse-seine during the previous night. The principal part of the fish, however, he threw away, saving only a few barrels which were salted for mackerel bait. Specimens of the fish were secured from him, and we preserved them in alcohol.

Shortly after separating from the *Nellie M. Davis* we spoke with the schooner *Robert J. Edwards*, of Gloucester. Her captain reported seeing menhaden abundant in the water during the previous night.

Throughout the day on the 12th we worked to windward, making a northerly course. The fishing vessels in sight were going in the same direction. At 6.30 p. m. all sail except the mainsail was taken in; we hove to on the starboard tack and set two gill-nets in 22 fathoms of water, our position being lat. $37^{\circ} 32'$ N., long. $74^{\circ} 52'$ W.

During the 13th the wind was easterly, increasing from a moderate breeze at daylight to a very fresh breeze in the evening.

At 5.20 a. m. hauled gill-nets. Only two butterfish were caught. After the nets were in we got under way and worked to the eastward. In the afternoon the wind had increased so much, being accompanied by a rough sea, that the mainsail and the head-sails were taken in and the vessel was hove to under the foresail.

April 14 the wind continued easterly, with a rough sea, during most of the day. At 10 a. m. we got under way and headed north-northeast close hauled by the wind. We continued in that direction throughout the day, having a man stationed aloft to look out for schools of fish. The prevailing easterly wind and rough sea were considered unfavorable conditions for fish to school at the surface.

We saw no fishing vessels until 4.30 p. m., when a schooner was seen to windward heading to the southward. Soon after four or five other fishing schooners were seen standing toward us from the southward.

We made no attempt to "raise" mackerel with "toll-bait" during the day, since there was little probability of attracting them to the surface with an easterly wind blowing. During the day we made an average course north-northeast (magnetic) and sailed a distance of 45 to 48 miles from the position left in the morning. At 7 p. m. the head-sails were hauled to windward and the vessel was hove to for the night.

From the 14th to the 18th of April the weather continued fine, and during that period we were almost constantly cruising between parallels $36^{\circ} 20'$ and $38^{\circ} 50'$ north latitude, and the meridians $73^{\circ} 50'$ to $75^{\circ} 25'$ west longitude.

On the night of the 17th, about 10 p. m. (lat. $36^{\circ} 45'$ N., long. $74^{\circ} 50'$ W.), two schools of fish were seen "firing" in the water, which we supposed to be mackerel. Gill-nets were set in the immediate vicinity of those schools, but no fish were taken in them. The failure to catch any specimens was probably due to the unusual amount of phosphorescence, which caused the nets to resemble sheets of fire. With the exception before named we saw no indications of schooling fish in our cruising during the period before mentioned.

We were in almost daily communication with vessels of the mackerel fleet between the 14th and 18th, and since the researches of these schooners extended over practically the whole area north of Hatteras, and the information obtained of them was to the effect that they had

seen no mackerel, the inference was that fish of that species were far from abundant up to the date mentioned.

The remarkable scarcity, too, at this time, of whales, porpoises, sea birds, etc., which usually accompany schools of migratory surface-swimming fish, and the almost total absence of those forms of crustacea which constitute the principal food of the mackerel, had the effect to make the belief general among the captains of the fishing schooners that mackerel would be unusually late in their appearance off the coast, if, indeed, they came on in any considerable abundance.

April 18 began with an easterly wind, hauling southerly and freshening as the day advanced, with falling barometer and threatening weather.

At this date our supply of water was nearly exhausted, and the water still remaining in the tanks was so thick with iron rust that it was nearly unfit for use. I therefore determined to run into Hampton Roads for the purpose of filling the water tanks, since it was evident that I could do so without losing much time, as the weather would prevent investigation if the vessel remained at sea. We arrived at Hampton Roads at 6.20 p. m., and anchored.

On the 19th there was a fresh breeze from the northward, with rain squalls. During the day the fishing steamer *Novelty* and three of the mackerel schooners arrived at Hampton Roads for shelter. In the evening I went on board of the *Novelty* to learn as much as I could regarding the observations made by Captain Joyce, who has the reputation of being one of the most observant and successful captains engaged in the mackerel fishery. He told me that he had cruised from near Cape Hatteras northward to the Capes of the Delaware and eastward as far as the Gulf Stream. In all this cruising he had not taken any mackerel, and he expressed the opinion that they were yet south of the region which had been passed over by the fishing fleet; he also expressed some lack of confidence as to the appearance of fish on the coast in considerable abundance.

In compliance with instructions, we lay at Hampton Roads until the 22d of April; and on that day Dr. T. H. Bean, ichthyologist of the U. S. Fish Commission, joined the vessel to make the cruise with us, and we received on board some apparatus which had been brought from Washington by Capt. J. W. Collins, who made a temporary visit to the vessel.

There was considerable wind on the 22d, increasing from a gentle breeze in the morning to a fresh breeze, with rainy, threatening weather in the latter part of the day.

We got under way at 10.35 a. m., passed Cape Henry at 3 p. m., and headed out to sea, close hauled by the wind on the starboard tack. At midnight hauled down head sails and hove to for the night.

The weather was rainy and foggy on the 23d, with a very fresh south-east by east to south wind. It was too rough to do any fishing or make

other observations. At 9 a. m. lowered mainsail and hove to on the starboard tack, under foresail and forestaysail.

A few sea-geese (Phalaropes) were seen toward evening, but, although the weather cleared at 5.10 p. m., no vessels were seen.

The wind continued fresh from south-southwest to north, with a rough sea, on the 24th, until the latter part of the day.

At 5 a. m. we saw a fleet of fishing vessels, most of them to the north of us, all lying to under foresails. At 5.45 a. m. the schooners *Augusta E. Herrick* and *Nellie M. Davis* spoke with us. From them we obtained the information that several fishing schooners had caught small fares of mackerel on the nights of the 20th, 21st, and 22d. As far as could be learned these fish were all small in size, and were marketed at New York. They were taken in lat. $37^{\circ} 25' N.$ and long. $74^{\circ} 29' W.$, approximately. The fish were caught in an area of several miles in extent, and the position given above would, perhaps, be about the center of the region where the mackerel were found.

The wind having moderated about noon we got under way at 12.45 p. m. and headed to the eastward. At 5.35 p. m. hove to, to "raise" mackerel with "toll-bait" (lat. $37^{\circ} 34' N.$, long. $74^{\circ} 26' W.$), but caught nothing except dogfish. We then lowered and furled the foresail and set one mackerel and one herring gill-net, the former being sunk 3 fathoms below the surface, and the upper edge of the latter floating at the top of the water.

The nets were hauled at 5.35 a. m. on the 25th, but nothing was caught in them. We then got under way and put out the large towing net, which was towed for thirty minutes; a few young fish and a small quantity of copepods were taken in the net. We then stood to the eastward about 5 miles, when we tacked ship and headed to the northward.

At 3.15 p. m. I spoke with the fishing schooner *Howard Holbrook* (lat. $37^{\circ} 48' N.$, long. $74^{\circ} 06' W.$, approximately), and soon after I went on board of her. Her master, Captain Keene, said that on the night of the 10th of April he saw several schools of fish "firing" in the water, which he believed to be large mackerel, but as none of these fish were taken he could not be certain as to the species. These schools were seen in lat. $37^{\circ} 50' N.$, long. $73^{\circ} 13' W.$, approximately.

At 4.50 p. m. we hove to under foresail, the wind at that time blowing a fresh breeze, with threatening weather. During the night the wind blew a moderate to strong gale, and the sea was very rough. At 6.30 p. m. the foresail was double-reefed, and we lay to under that sail during the night.

There was a moderate gale, decreasing to a fresh breeze, during the forenoon of the 26th, with a sharp tumbling sea. At 12.50 p. m. we hoisted the head-sails and mainsail and headed NW. by N., close-hauled by the wind. At this hour there were eight schooners of the fishing fleet in sight. At 3 p. m. I went on board of the schooner *Common-*

wealth, of Gloucester, to obtain information. At 5.30 p. m. we hove to, to try for mackerel, and also put out codfish lines. Excepting a few spiny-backed dogfish nothing was taken.

I had intended to set gill-nets in the evening, but there was too much sea and wind to do so.

At 7 p. m. Capt. B. A. Williams, of the schooner *G. P. Whitman*, of Gloucester, came on board. I learned that he had left Gloucester on the 8th of April, but had not caught any mackerel up to date. He told me that he had recently cruised 90 miles east from the Capes of the Delaware, while three other vessels, in company with him at the time, continued the search for mackerel about 30 miles further in the same direction, but no fish were seen.

During the afternoon we saw several flocks of sea-geese, a few menhaden, and four or five sea porpoises.

On the 27th the weather was much finer, with a south to southwest wind, generally moderate and variable in force.

At 5.40 a. m. the surface towing-net was put out for about an hour, and a small amount of material was taken in it.

At 7.10 a. m., got under way and steered to the northward. At 9.30 a. m. (lat. $37^{\circ} 43'$ N., long. $74^{\circ} 15'$ W.), hove to, to try for mackerel; also put out hand-lines for bottom fish in 36 fathoms of water. No mackerel were taken, and, although dogfish were numerous and proved exceedingly troublesome in stripping the hooks of bait before the gear reached the bottom, we caught six large hake, in the stomachs of which we found an abundance of fish food.

At 5.25 p. m. hove to, to try for mackerel, a few miles north of the previous position. No mackerel were taken. On the cod hand-lines we caught one pollock of about 20 pounds in weight, and found hake fairly abundant. From the stomachs of these fish there were taken sea-bass, alewives (or river herring), squid, mackerel, and sea-robins. The apparent abundance of food, and the character of the bottom, would suggest the possibility of this locality being a good feeding ground for the common hake.

During the afternoon the small towing-net was used and a considerable quantity of copepods were collected. Shortly after sunset the large towing-net was towed thirty-five minutes, and two young pollock and a few young hake were taken in it. At 7.45 p. m. hove to for the night.

During the most of the 28th the weather was pleasant, but in the afternoon the wind increased to a very fresh breeze accompanied by threatening weather.

At 8.15 a. m. there were thirty-one fishing vessels in sight, most of them being to the northward of us, and the majority "jogging." We spoke with the *Ossipee*, of Gloucester, and her captain reported leaving Delaware Breakwater on April 27, in company with sixty sail of the fishing fleet. We "tried" for mackerel with "toll-bait" (lat. $37^{\circ} 40'$ N., long. $74^{\circ} 13'$ W.), but without success. We then steered to the

southwest until 1.40 p. m., when we began to shorten sail, and at 2.45 p. m. hove to. The wind increased to a moderate gale before evening and continued to blow hard throughout the night with a very rough sea.

The weather continued too rough for fishing during the 29th, and we lay to under double-reefed foresail and reefed riding sail.

April 30 began with a moderate gale from west-northwest, decreasing to a fresh breeze at noon and a gentle breeze during the evening.

During the early part of the day the vessel was headed to the northward under foresail, jib, forestaysail, and riding sail. At 11.50 a. m., tacked ship to the westward and hoisted mainsail. At 3.45 p. m., hove to and "tried" for mackerel (lat. $38^{\circ} 17' N.$, long. $74^{\circ} 28' W.$, approximately), but caught no fish.

While we were lying to, the fishing schooner *Melissa D. Robbins*, of Portland, spoke with us. Her captain told me that the steamer *Novelty* and the schooner *Mollie Adams* had taken fares of small mackerel on April 26, but I could not learn the precise locality in which these fish were caught.

At 4.30 p. m., got under way and stood to the southward 3 miles, when we hove to for the night and set gill-nets. Previous to setting the gill-nets, we put out the large towing-net and caught in it four young pollock and a number of sea-fleas. At sunset sixteen fishing vessels were in sight.

May 1, fine weather prevailed, with light variable wind in the early part of the day, increasing to a stiff breeze from west by north at 8 a. m.

At 8 a. m. we hauled the gill nets, but found no fish in them. We then got under way and ran to the southward, having a lookout at the masthead to watch for schooling fish. In company with us were twenty-four fishing-vessels, sailing practically on the same course, and spreading over a considerable area. So far as could be determined by the movements of these vessels, no indications of schooling fish were seen by any of them. At 3 p. m. tacked ship and headed north by east. The fishing fleet, which had increased to the number of forty-four sail, all tacked about the same time to the northeast. During the day we sailed southwardly to lat. $37^{\circ} 12' N.$, long. $74^{\circ} 44' W.$, without seeing any indications of the presence of surface-swimming fish.

At 6 p. m. the large towing-net was put out and towed for about forty-five minutes. Two small hake and one young pollock were taken in it. Our position at this time was lat. $37^{\circ} 36' N.$, long. $74^{\circ} 31' W.$ We then headed to the northward.

On May 2 the wind was from west-northwest to south, varying in strength from a moderate to fresh breeze.

I decided to run into Delaware Breakwater for the purpose of obtaining a supply of provisions, which we were in need of, and at 1.25 p. m. we arrived off Lewes and anchored. Immediately after I reported our arrival by telegraph to headquarters at Washington.

We remained at Delaware Breakwater until May 5. The prevailing wind in the interim was from the eastward and unfavorable for going to sea.

On May 3 the schooner *M. S. Ayres*, of Gloucester, passed the breakwater on her way to Philadelphia, having on board a fare of 70 barrels of fresh mackerel, which had been caught on the nights of the 1st and 2d of May, southeast by south 60 miles from Cape Henlopen. The captain said that only one other vessel of the fleet of forty sail of schooners caught any fish at the time that he took his.

May 5 began with pleasant weather and moderate easterly winds, but in the afternoon a dense fog came on and the wind veered from northeast to east. We got under way at 11 a. m., and, leaving the breakwater, we headed offshore for the fishing ground, steering a southeast course after passing Cape Henlopen, until 7.25 p. m., when the head sails were hauled down and we hove to for the night.

The following day (May 6) the wind was from the southeast in the morning, veering southerly as the day advanced.

At 8.25 a. m., hove to, to "try" for mackerel with "toll-bait" (lat. $38^{\circ} 09' N.$, long. $74^{\circ} 06' W.$); caught no fish.

At 8.50 a. m., got under way steering southeast, which course was continued until 11 a. m., when it was changed, and until 5.35 p. m. the vessel made a course nearly north-northeast. Only one fishing vessel was seen during the day, and she was heading in a southerly direction. At 5.35 p. m., hove to, to "try" for fish, but did not "raise" any (lat. $38^{\circ} 43' N.$, long. $73^{\circ} 48' W.$). We then hoisted the head sails, and put out the large towing-net, which was towed for forty minutes. There were several specimens of young hake and pollock and other forms of marine life taken in it.

May 7, the wind was southeasterly, varying from a light to fresh breeze, the weather generally clear with intervals of fog and haze.

At 1 a. m., set one mackerel and one herring gill-net (lat. $38^{\circ} 52' N.$, long. $73^{\circ} 40' W.$). Hauled the nets at 5 a. m., but found no fish in them. At 10 a. m., in lat. $39^{\circ} 12' N.$, long. $73^{\circ} 22' W.$, tried to "raise" mackerel with "toll-bait," but failed. At 3 p. m., made another attempt with the same results, in lat. $39^{\circ} 20' N.$, long. $73^{\circ} 08' W.$ Hand-lines were also put out in the last-mentioned position and one codfish was caught. At 5.30 p. m., got under way and steered west-southwest, which course was changed to southwest later in the day. At 11.45 p. m., hove to for the night with head sails to windward.

May 8, there was a moderate breeze from south-southeast.

At 4.45 a. m., filled away and steered a SW. $\frac{1}{2}$ S. course. At 10.28 a. m., hove to for mackerel, but "raised" nothing. During the morning a steamer, which resembled in appearance the fishing steamer *Novelty*, passed us to the northeast.

At 1 p. m. we spoke with the fishing schooner *Neponset*, of Boston, and her captain said that he had recently spoken with the steamer

Novelty, the latter being bound for New York with a fare of fresh mackerel, taken recently in lat. $37^{\circ} 48' N.$, long. $74^{\circ} 35' W.$ This position is given as approximate, and may vary a few miles from the exact position where the fish were taken.

During the latter part of the day we continued our course to the southwest, the four fishing vessels which were in company with us steering in the same direction. In the afternoon the weather was foggy with a moderate south-southeast wind. Between 8.20 and 9 p. m. we saw five schools of fish "firing" in the water; the bright phosphorescence caused by the movements of the fish in the water made their presence very clearly defined. By their movements I concluded the fish were mackerel. The position where these fish were seen was lat. $38^{\circ} 08' N.$, long. $74^{\circ} 18' W.$

We continued on our southerly course until 1 a. m., on the 9th, since I was anxious to ascertain, as far as possible, the extent of area covered by the schools of fish we had seen on the previous evening, but the prevalence of foggy weather during the night prevented us from seeing schools of fish at any considerable distance from the vessel, and it is probable that if the conditions had been more favorable we might have seen many more schools than we did.

At 1 a. m. we hove to. At 5.20 a. m. made a "trial" for mackerel with "toll-bait" but caught none.

At 6 a. m. got under way and steered to the southward. At 7 a. m. sixteen fishing-vessels were seen; most of them were headed to the eastward. Soon after we spoke with the fishing schooner *Margaret Smith*, of Portland. Her captain said that he had seen an abundance of mackerel during the past eight days; the first in the latitude of Cape Henry, and about 50 miles offshore, and later he saw them in greater or less abundance, both night and day, on the ground which he had crossed over. He had, however, he said, found them extremely "wild," and difficult to catch with a purse-seine.

We next spoke with the schooner *Ralph Hodgdon*, of Gloucester. Her captain told me that he had seen several schools of mackerel, during the previous night, in the vicinity of the position we were then in (lat. $37^{\circ} 48' N.$, long. $74^{\circ} 15' W.$), and he had also seen four large schools of fish that morning. He "shot" his seine around one of these schools, but did not catch any fish.

Captain Greenlow, master of the schooner *Carrie E. Parsons*, with whom I had an interview, said that this body of fish, which had so recently been seen, he believed to be the same that he met with on May 1 in lat. $36^{\circ} 47' N.$, long. $74^{\circ} 53' W.$ Since he met with these mackerel on the 1st, he said that he had cruised northwardly to his present position, a distance of about 60 miles, and during that time had seen large schools of fish nearly every day.

He also declared that sea-geese (Phalaropes) were so numerous during that time (May 1 to 8) that they were often exceedingly troublesome to

the fishermen, since, when the mackerel would come to the surface, a large flock of these birds would light upon the water and frighten the fish, thus making it exceedingly difficult to effect a capture in the purse-seine.

At 11 a. m. we filled away and stood to the northward. At 3 p. m. had a "trial" for mackerel with "toll-bait," but caught nothing. We then continued our course to the northward until 8 p. m., when we hove to and set two gill-nets in lat. $38^{\circ} 10' N.$, long. $74^{\circ} 11' W.$ The wind at this time was east-northeast, with foggy weather.

Before setting the gill-nets, the small surface towing net was put out and a large amount of copepods was taken in it. It was evident that "mackerel feed" was abundant.

On May 10 there was a moderate to fresh easterly wind and foggy weather until late in the day, when the fog cleared.

At 4 a. m. hauled the gill-nets. Fourteen mackerel were caught in the herring gill-net and seven mackerel in the mackerel net. These fish ranged from 11 to $12\frac{1}{2}$ inches in length. Specimens were saved and the remainder of the fish carefully eviscerated and their stomachs were preserved in alcohol.

A mackerel shark, which was entangled in the net, was also taken in this haul. The fish was skinned by Dr. Bean, who preserved the skin for the National Museum.

At 6 a. m. hove to to "try" for mackerel with "toll-bait," but without success.

The continuance of foggy weather and a fresh easterly wind, which prevailed during the greater part of the day, made it so difficult to make observations that, after finishing the trial for mackerel, we lay by joggng with head sails to windward. At 4.10 p. m. the fog cleared, and eight fishing schooners were seen to the southeast of us. Soon after we filled away to the northward, close hauled by the wind.

At 6.40 p. m. put out the large and small towing nets and towed them for half an hour. In the small net some copepods were taken, while specimens of young pollock and hake were obtained in the larger net.

On the 11th, fog prevailed during the greater part of the day, with calms and light to moderate variable winds.

At 6.15 a. m. hove to to "try" for mackerel with "toll-bait," but caught nothing.

When the weather cleared in the afternoon we saw twelve fishing-vessels and one barkentine. The former were mostly to the southwest of us, the most distant vessel about 6 miles away; they were heading to the northeast.

At 2.30 p. m. I went on board of the schooners *Warren J. Crosby* and *Mollie Adams*, both from Gloucester. Each of these vessels had taken small catches of mackerel, principally mixed fish, during the previous night. Captain Jacobs, of the *Mollie Adams*, had taken a small school of large-sized mackerel, some individuals measuring from 13 to 15 inches

in length. He expressed his belief that six or seven vessels of the fleet had obtained fares of mackerel during the night and had sailed for market. During the latter part of the day we steered a northeast course. At 7.30 p. m. we hove to and set two mackerel gill-nets and one herring gill-net in lat. $38^{\circ} 30' N.$, long. $73^{\circ} 55' W.$

During the evening we saw torches burning on board of several fishing vessels to the northwest, which indicated that those vessels had taken catches of mackerel, or were among the schooling fish.

The following morning (May 12) the wind was easterly, blowing a moderate breeze; the weather clear and pleasant.

At 4.30 a. m. hauled the gill-nets and found one mackerel in the herring net, and a few small dogfish. As soon as the nets were on board we got under way and stood to the northward in the direction of a fishing vessel which we saw "lying to" under her mainsail, and the crew of which were busy dressing fish. The vessel proved to be the *Warren J. Crosby*, of Gloucester, and her captain reported catching 70 barrels of mackerel during the previous night. These mackerel, he said, ranged from 11 to 13 inches in length. Shortly after we spoke with the schooner *Lizzie Maud*. Her captain reported leaving New York the day before. Up to that time, he said, about twenty-five vessels had landed fares of mackerel at that port, most of the fish being taken between the parallels of 37° and $38^{\circ} 40'$ north, from 15 to 25 miles offshore. All vessels landing fish reported that the body of fish from which they obtained their catches covered an area of about 25 to 30 miles north and south, and about 15 miles from east to west, and had occupied that position for nearly ten days. At 8 a. m. twenty-seven sail of fishing vessels were seen, most of them "jogging." Put out the small towing net and collected some crustacea and a lot of minute shells which were floating in the water. We made a trial with "toll-bait" for mackerel in the evening (lat. $38^{\circ} 40' N.$, long. $73^{\circ} 55' W.$) but got no fish. In an interview with Captain Chase, of the schooner *Clara S. Cameron*, he said that the body of mackerel seen by him this spring exceeds in amount anything he has experienced while engaged in the southern mackerel fishery.

At 6.57 p. m., put out the large towing net and took a quantity of crustacea and small floating shells, our position being lat. $38^{\circ} 40' N.$, long. $73^{\circ} 55' W.$ The vessel was headed to the northwest during the night, and a lookout was stationed at the mast-head to watch for fish. Saw nine schools of fish between 9 and 10 o'clock p. m.

On the morning of May 13 the wind was west-southwest, hauling to northwest and northeast later in the day. At 7 a. m. our course was southwest by south $\frac{1}{2}$ south, seven fishermen in sight, steering in the same direction. We sailed 57 miles in this direction, and saw three fishermen ahead "haul to" and drop their seine-boats; soon after we saw five large schools of fish. The seine-boat of the schooner *Henry Morganthau*, of Portland, was seen taking mackerel. The *Morganthau*

soon "hove to" alongside of her boat to "bail out" the fish from the seine. I went on board of her. The catch was estimated at about 200 barrels; and the fish ranged from $11\frac{1}{2}$ to $13\frac{1}{2}$ inches in length. Two other vessels made hauls of mackerel later in the evening. The position in which these fish were taken was lat. $37^{\circ} 48' N.$, long. $74^{\circ} 13' W.$ We afterwards learned that other schooners took fish in about the same locality, as well as 20 miles to the westward. We hove to for the night at 8 p. m., with head sails to windward.

On the morning of May 14 the wind was moderate from east-southeast, veering to northeast by east at 4.30 a. m., and increasing to a fresh breeze. At 11.20 a. m. there were forty sail of fishing vessels to the southwest of us. On account of the extremely rough weather no trials for fish were made during the day.

May 15 the wind was light and variable. We spoke with the schooner *Lizzie W. Smith* and told her captain of the recent catches of mackerel. At 7 a. m., made a "trial" for mackerel with "toll-bait" (lat. $38^{\circ} 01' N.$, long. $74^{\circ} 18' W.$), but got nothing. We then got under way and steered northwest by the wind; later, we changed the course to northeast and ran 32 miles in that direction. At 8.50 p. m., spoke with the schooner *Edward E. Webster*, of Gloucester. Her captain reported taking a fare of 125 barrels of mackerel that evening, in lat. $38^{\circ} 41' N.$, long. $74^{\circ} 16' W.$ We ran 12 miles farther to the northeast from this position and saw thirty-two large schools of fish. After leaving the fleet we saw only two fishing schooners. We hove to for the night at 11 p. m.

On the following day (May 16) the wind was from northeast to northeast by north.

Being short of supplies, we set all light sails at 12.30 p. m., and headed for Delaware Breakwater, where we arrived and anchored at 8.05 p. m. There were four mackerel schooners, several coasting vessels, and the U. S. cruiser *Hamilton*, at anchor at the Breakwater.

On May 17 there was an easterly wind and heavy swell. After obtaining the necessary supplies for the vessel, I went on board of the menhaden steamer *Nellie E. Rawson*, and learned from her master, Captain Steelman, that the first catch of menhaden this year was made on the previous day, the 16th instant, and that the fish were fifteen days later than usual. I was also informed by Captain Valiant, who commands another menhaden steamer, that small bodies of menhaden had been moving northward past the Delaware since the 2d of May.

Both captains said that during August of last year quantities of mackerel, 7 or 8 inches in length, were seen between Hereford Inlet and Barnegat. In the afternoon two other fishing-vessels anchored at the Breakwater.

May 18 began with a moderate wind from southeast to east-southeast, which increased to a fresh breeze in the afternoon. A fishing-schooner arrived in the afternoon and reported a rough sea and foggy weather outside.

I learned from Captain Thomas, of the fishing-schooner *Maud S.*, that on May 10, in latitude $37^{\circ} 07'$ N. and about longitude $74^{\circ} 40'$ W., he took 47 barrels of mackerel. These fish were apparently a part of the same body of mackerel seen on that date in latitude $38^{\circ} 10'$, which would convey the idea that the schooling fish covered something over a degree of latitude.

On May 19 the weather was clear and fine. At 9 a. m., got under way, but on account of light wind we were compelled to anchor again; 1.20 p. m. got under way with a light east-southeast wind which hauled to south-southwest, and after passing Cape Henlopen we steered east by south $\frac{1}{2}$ south. Passed eight schools of menhaden between 6.40 and 8 p. m., about 18 miles off shore. Put out the small towing net in the evening and took an abundance of crustacea and other objects which we supposed to be fish eggs.

May 20 began with a gentle breeze from south-southwest to southwest, with foggy weather. Put out the small towing net and collected a lot of crustacea and some fish eggs. At 6.15 a. m., hove to and "tried" for mackerel with "toll-bait," also put out hand-lines baited with fresh clams for bottom fish, but got nothing. Our position was lat. $38^{\circ} 42'$ N., long. $70^{\circ} 31'$ W. Got under way again at 7.55 a. m.; saw fish schooling some distance from the vessel at 11 a. m., but could not determine the species. Changed our course to northeast by east at 2 p. m. The fog lifted at 5.50 p. m., and we saw fishing-vessels to the northeast of us. Put out the large and small towing nets and took some small fish in the former and an abundance of crustacea in the latter (lat. $38^{\circ} 50'$ N., long. $74^{\circ} 06'$ W). At 8 p. m. the fog set in and the vessel was hove to for the night, with head sails to windward.

The following day (May 21) the wind was from southwest to west, accompanied by foggy weather until 3 p. m. Got under way at 3.25 a. m., steering northeast by east. Spoke with a pilot-boat at 11 a. m., and was informed that there were plenty of mackerel off shore 14 to 20 miles southeast of Barnegat. We ran on the northeast by east course, 16 miles; changed to north-northeast, and sailed 14 miles, and then stood to the north by west for 13 miles. Spoke with the fishing-schooner *Margaret Smith*, of Portland, at 5 p. m., steering to the eastward, and told her captain what I had learned from the captain of the pilot-boat; she afterwards changed her course to the northward. Between 9.30 and 10.30 p. m. we passed through about twelve schools of fish. At 10.30 p. m. hove to for the night under mainsail, and set one mackerel and one herring gill-net at the surface (lat. $39^{\circ} 40'$ N., long. $73^{\circ} 38'$ W).

The wind on May 22 was moderate from southwest to west-southwest, with foggy weather. Hauled the nets and found three male and one female branch alewives in them. At 8 a. m., used the small towing net (lat. $39^{\circ} 43'$ N., long. $73^{\circ} 49'$ W.), took a small quantity of *entomostraca*. Surface annelids were taken in a dip-net about the same time. At 8 a. m., we stood to the northwest, and at 9.45 a. m. hove to and "threw"

"toll-bait" for forty five minutes, also used the hand-lines; caught no fish. At this time the weather was so foggy that we hoisted the jibs and hove to with head sails to windward.

During the afternoon the foresheet was eased off and the hand-lines put overboard. Dr. Bean caught a hake weighing 6 or 7 pounds. The fog partially cleared in the afternoon, and at 5.30 p. m. we spoke with the schooner *John G. Whittier*. Her captain wanted information in regard to the fleet and mackerel. Soon after we filled away and stood on a northwest course for 11 miles. We then hove to and "tried" for mackerel with "toll-bait" (lat. $39^{\circ} 34'$ N., long. $73^{\circ} 55'$ W.), but "raised" no fish. The small towing-net was used (lat. $39^{\circ} 45'$ N., long. $73^{\circ} 49'$ W.) about 8 p. m., and we took an abundance of crustacea and young hake and pollock. We hove to for the night at 9 p. m., with head-sails to windward. A dense fog set in, which lasted until 5 a. m. the following day. We saw five schools of fish between midnight and 4 o'clock a. m., all of which were working to the northeast.

We filled away at 4.20 a. m. on May 23 and steered north-northeast, 5 miles, then ran 15 miles in a north by east direction, changed the course to northwest by north, and sailed 4 miles; then stood to the northeast for 18 miles; changed again to north-northeast, ran 12 miles, and changed to northeast by east and stood in that direction 13 miles. Saw several fishing-vessels to the northeast of us at 11.20 a. m. At 1.55 p. m. spoke with the schooner *Porter S. Roberts*, of Gloucester. Captain Greenleaf reported having cruised from the latitude of Cape Henry to his present position without seeing fish. At 12.35 hove to and "tried" for mackerel in lat. $40^{\circ} 06'$ N., long. $73^{\circ} 28'$ W., but did not succeed in getting fish. After this we got under way and stood to the northward. Spoke with the fishing-schooner *Joe Hooker*, of Boston (lat. $40^{\circ} 17'$ N., long. $73^{\circ} 10'$ W.), and her captain reported seeing a large body of fish in this vicinity last evening. At the time of speaking with the *Hooker* thirteen sail of vessels were in sight, extending some 10 miles east and west and 4 or 5 miles north and south. At 8.03 p. m. hauled the head-sails to windward and "jogged" on the starboard tack.

May 24 began with a very fresh south-southwest wind. At 6.15 a. m. kept off and steered east-northeast 30 miles, when we hove to and "tried" for mackerel (lat. $40^{\circ} 41'$ N., long. $72^{\circ} 09'$ W.). Finishing the trial we got under way and continued our course to the northeast. At 3 p. m. sighted Montauk Point, bearing north by west, about 5 miles distant. We then changed the course to southeast by east, four fishing-vessels being seen in that direction. During the afternoon spoke with the schooner *William H. Foy*, of Gloucester. Her captain reported having cruised to the eastward of Block Island, but did not see any mackerel. At 4.18 p. m. hove to and "tried" for mackerel about 13 miles south-southeast from Montauk Point. This trial, as well as all others up to this date, proved fruitless. The wind being from the

south and the weather threatening we headed the vessel for Fort Pond Bay (in company with eight fishing-schooners, which were running in for shelter), where we arrived and came to anchor at 8 p. m.

May 25 began with an easterly wind, foggy and rainy weather. Went on board of the menhaden-steamer *Victor* in the forenoon and learned from Capt. Henry C. Fish that the first fish taken by the menhaden steamers of this vicinity were caught on the 12th of May, off Barneгат, and others were taken off Shinnecock on the 16th instant. He stated that menhaden were numerous off Montauk, but in very small schools. It was his opinion that the main body of fish had not then made its appearance; usually they reach Long Island Sound about the middle of June and pass northwards as far as Buzzard's Bay. There were twenty-nine steamers, he said, engaged in the menhaden fishery in that vicinity.

Captain Chase, of the schooner *Clara S. Cameron*, reported having seen large bodies of fish southwest $\frac{1}{2}$ south, 45 miles from Shinnecock, on the evening of the 23d; the fish were swimming too deep to ascertain the species.

The fog disappeared at 6 a. m. on May 26, the wind being moderate from south by west to southwest. Got under way at 7 a. m., and headed toward Montauk. Made towing with small tow-net at 8 a. m., and found crustacea and fish eggs very abundant. While in a calm off Great Pond we put out the hand-lines and caught a large sea bass. Montauk Point bore abeam at 10.50 a. m., and we shaped our course so as to pass 5 or 6 miles to the southward of Block Island. We saw a school of pollock south by east, 5 miles from Block Island. "Tried" for mackerel with "toll-bait" south by east, 5 miles from the western point of Block Island, but notwithstanding that this trial continued for half an hour no fish were "raised." It became evident, at this time, that the weather would be very unfavorable for the continuance of the investigation during the rest of the day, and I decided to run into Newport; accordingly we came to anchor in the outer harbor at 7.45 p. m. I telegraphed to Wood's Holl to have the vessel's mail forwarded to Newport.

May 27 began with a moderate wind from south-southwest; weather foggy until 7.30 p. m. Went on board of the fishing-schooner *Hattie Evelyn*, of Gloucester, during the evening, and was informed by Captain Cromwell that he saw large bodies of mackerel on May 18 in lat. 39° 21' N., long. 73° 39' W. He followed them to lat. 39° 56' N., long. 72° 46' W., and there lost sight of them. The vessel's mail arrived at 6 p. m.

On the following day (May 28) there was a moderate wind from north-northeast, which increased to a fresh breeze at noon, with threatening weather, mist and rain at intervals. About twenty fishing vessels had arrived in the harbor for shelter at 8 p. m. Went on board of the schooner *Elsie Smith*, of Portland, Me. Her captain reported having secured, on May 27, 50 barrels of mackerel south-southeast of Block

Island about 15 miles. At the time he took his fish there were eighteen other fishing vessels present, of which twelve secured fares. The mackerel ranged from 10 to 13 inches in length.

Captain Thomas, of the schooner *Mary H. Thomas*, informed me that he was among the fleet on May 27, and secured two schools of mackerel and alewives mixed. I learned from Captain Harty, of the schooner *I. J. Merritt*, that about 40 miles southeast $\frac{1}{2}$ south from Block Island he saw twelve schools of fish, but did not attempt to take them no account of threatening weather. He also said that he had recently marketed a catch of 194 barrels of salt and 125 barrels of fresh mackerel, which he caught on May 21 and 22 while cruising from southeast of Barnegat to southeast of the light-ship off Sandy Hook. There seemed to be a large body of fish, which, he thought, were working to the northward.

The low barometer and threatening weather continued throughout the whole of the 29th.

Got under way at 5 a. m. on May 30 and headed to sea, accompanied by fifteen sail of the fishing fleet, the wind at that time being moderate from north-northeast. Put out the small towing-net when outside of the harbor, and secured a large amount of fish-eggs. Young pollock, hake, and lumpfish were abundant. At 1 p. m. the wind was from the south and the vessel heading southeast, close hauled on starboard tack. About this time the lookout at the mast-head reported one of the accompanying vessels dropping her seine-boat for fish.

At 1.30 p. m. saw six schools of fish, and worked up near them and threw "toll-bait," hoping to determine the species by this means. Position, lat. $41^{\circ} 12' N.$, long. $71^{\circ} 09' W.$ Later we hoisted out a dory and sent two men to ascertain the species. They reported alewives at the surface, but thought it probable that mackerel were mixed with them. Subsequently we saw several schools of fish swimming with their heads out of the water, which we thought to be mackerel. Sent two men in a dory equipped with hand-lines and "toll-bait," and instructed them to throw bait in the center of the schools and secure as many specimens as possible. They were unsuccessful, however. This position was about 10 miles west-southwest from Gay Head. We used the towing net here and got a lot of small crustacea, such as is usually called "seed," or "mackerel feed," by the fishermen. At 7 p. m., when about 9 miles southwest $\frac{1}{2}$ west of No Man's Land, we put out the large towing-net for thirty minutes, and secured five young hake. The vessel was hove to for the night at 7.35 p. m. During the day we noticed that a large portion of the fleet had their jibs down and seine-boats out, which indicated that fish had been captured.

In the early morning of May 31 the weather was foggy, with an easterly wind, which increased to a fresh breeze at daylight. At 5 a. m. the fog cleared, and soon after we filled away, steering northeast $\frac{1}{2}$ north, for Vineyard Sound.

Having received orders directing me to report at Wood's Holl on or

about June 1 the vessel was headed for that place and anchored off the Fish Commission wharf at 1.30 p. m. Later in the evening the vessel was hauled alongside of the wharf.

During the day (June 1) we landed the collections made on the cruise and prepared them for shipment to Washington; also put ashore some nets and other apparatus for storage in the Fish Commission building. Took on board halibut trawls and buoys, to be used on the contemplated trip to the Gulf of St. Lawrence.

June 2 the weather was rainy and foggy. At 10.30 a. m. hauled out into the stream and anchored.

My orders directed me to report at Gloucester after landing the material collected on the cruise. Accordingly got under way at 8 a. m. on June 3, with the wind from south by west to southwest by south blowing a moderate to fresh breeze. Passed the Highlands of Cape Cod and hove to at 11 p. m.; weather very foggy. The fog cleared at 2 a. m. on June 4, and we continued our course for Gloucester, where we anchored at 4.40 a. m.

Temperature of air and water.

[These temperatures all taken at the surface.]

Date.	Air.	Water.	Date.	Air.	Water.	Date.	Air.	Water.
1887.	°	°	1887.	°	°	1887.	°	°
April 7, 1 a. m.	38	40	April 28, 11 a. m. ...	50	48	May 15, 5 a. m.	54	54
April 7, 7 a. m.	42	42	April 28, 3 p. m. ...	52	47	May 15, 12 m.	57	55
April 7, 4 p. m.	48	46	April 29, 7 a. m. ...	50	47	May 15, 6 p. m.	55	55
April 8, 1 a. m.	45	47	April 29, 2 p. m. ...	50	45	May 16, 4 a. m.	52	54
April 8, 1 p. m.	47	46	April 29, 8 p. m. ...	46	45	May 16, 8 a. m.	55	52
April 8, 8 p. m.	45	48	April 30, 11 a. m. ...	50	45	May 16, 2 p. m. ...	57	54
April 9, 12 m.	54.0	49	April 30, 4 p. m. ...	49	45	May 17, 4 a. m.	52	58
April 9, 2 p. m.	53	51	May 1, 4 a. m.	47	46	May 17, 4 p. m. ...	60	59
April 9, 8 p. m.	48	49	May 1, 4 p. m.	52	49	May 20, 9 a. m.	65	57
April 10, 6 a. m.	49	48	May 2, 10 a. m.	53	48	May 20, 12 m.	68	57
April 10, 1 p. m.	53	47	May 2, 1 p. m.	55	49	May 20, 3 p. m. ...	69	60
April 10, 6 p. m.	50	45.5	May 3, 4 a. m.	55	51	May 20, 6 p. m. ...	56	59
April 11, 1 a. m.	50	45	May 3, 2 p. m.	62	51	May 20, 12 mid.	57	53
April 11, 11 a. m.	52	47.5	May 4, 9 a. m.	55	50	May 21, 5 a. m.	57	57
April 11, 4 p. m.	58	50	May 4, 1 p. m.	55	55	May 21, 10 a. m. ...	60	57
April 12, 12 m.	50	45	May 5, 6 a. m.	55	50	May 21, 2 p. m. ...	68	58
April 12, 7 p. m.	47	45	May 5, 1 p. m.	55	56	May 21, 8 p. m. ...	60	58
April 13, 6 p. m.	48	44.5	May 5, 6 p. m.	52	51	May 21, 12 mid.	62	60
April 13, 10 p. m. ...	50	50	May 5, 10 p. m. ...	52	56	May 22, 3 a. m. ...	61	59
April 14, 5 a. m.	49	49.5	May 6, 2 a. m.	52	51	May 22, 6 a. m. ...	61	60
April 14, 1 p. m.	50	45	May 6, 11 a. m. ...	55	50	May 22, 12 m. ...	60	60
April 14, 12 mid.	48	49	May 7, 2 a. m.	54	52	May 22, 7 p. m. ...	62	61
April 15, 5 a. m.	48	46	May 7, 11 a. m. ...	55	51	May 23, 5 a. m. ...	61	59
April 15, 1 p. m.	48	48	May 7, 5 p. m.	58	51	May 23, 6 a. m. ...	60	60
April 16, 8 a. m.	47	48.2	May 8, 12 m.	58	54	May 23, 12 m. ...	60	60
April 16, 8 p. m.	50	51	May 8, 8 p. m.	55	52	May 23, 8 p. m. ...	60	60
April 17, 1 a. m.	49	50	May 9, 3 a. m.	58	52	May 24, 3 a. m. ...	60	57
April 17, 4 a. m.	49	49	May 9, 9 a. m.	55	55	May 24, 11 a. m. ...	63	57
April 17, 6 a. m.	50	59	May 9, 4 p. m.	60	56	May 24, 3 p. m. ...	65	54
April 17, 8 a. m.	46	45	May 10, 5 a. m. ...	55	54	May 24, 8 p. m. ...	55	51
April 17, 12 m.	50	50	May 10, 10 a. m. ...	57	54	May 26, 5 a. m. ...	60	60
April 17, 7 p. m.	46	47	May 10, 3 p. m. ...	59	54	May 26, 2 p. m. ...	56	52
April 18, 10 a. m. ...	54	44	May 11, 7 a. m.	55	53	May 26, 8 p. m. ...	65	52
April 18, 5 p. m.	60	52	May 11, 12 m.	59	55	May 30, 4 a. m. ...	52	54
April 23, 11 a. m. ...	50	45	May 11, 3 p. m. ...	62	56	May 30, 9 a. m. ...	55	55
April 24, 2 a. m.	52	48	May 11, 8 p. m. ...	60	54	May 30, 3 p. m. ...	55	55
April 24, 2 p. m. ...	50	46	May 12, 2 a. m. ...	56	55	May 31, 2 a. m. ...	51	52
April 25, 4 a. m. ...	49	47	May 12, 12 m. ...	60	55	May 31, 11 a. m. ...	53	55
April 25, 3 p. m. ...	48	45	May 12, 3 p. m. ...	60	56	May 31, 1 p. m. ...	55	55
April 26, 8 a. m. ...	45	49	May 13, 4 a. m. ...	57	55	June 3, 10 a. m. ...	60	58
April 26, 11 a. m. ...	50	53	May 13, 11 a. m. ...	60	55	June 3, 12 m. ...	52	52
April 26, 3 p. m. ...	50	45	May 13, 5 p. m. ...	58	55	June 3, 2 p. m. ...	63	48
April 27, 4 a. m. ...	48	46	May 14, 5 a. m. ...	54	55	June 3, 4 p. m. ...	63	50
April 27, 10 a. m. ...	48	46	May 14, 10 a. m. ...	56	54	June 3, 7 p. m. ...	56	50

Table showing position, method of investigation, and results of trials for fish.

Date.	Hour.	Lat. N.	Long. W.	Locality.	Method of investiga- tion.	Time occu- pied.	Results.
1887.							
Apr. 8	1.34 p. m.	37 23	74 45	Off Va.	Toll-bait ..	45 minutes..	Nothing.
8	5.12 p. m.	37 04	74 37	do	do	do	Do.
8	5.12 p. m.	37 04	74 37	do	Hand-lines ..	do	Two spiny-backed dog-fish.
8	6.30 p. m.	37 04	74 37	do	Gill-nets ..	Over night..	Twenty-one ale- wives and two mackerel.
9	6.20 p. m.	36 45	74 53	do	Toll-bait ..	1 hour	Nothing.
10	5.45 a. m.	36 29	74 50	do	do	do	Do.
10	5.45 a. m.	36 29	74 50	do	Hand-lines ..	do	Dog-fish.
10	10 a. m.	36 04	74 44	do	Toll-bait ..	do	Nothing.
11	5.40 a. m.	37 22	74 39	do	do	do	Do.
11	5.40 a. m.	37 22	74 39	do	Hand-lines ..	do	Dog-fish.
11	3.25 p. m.	36 58	74 49	do	Toll-bait ..	40 minutes..	Nothing.
11	6.15 p. m.	36 51	74 34	do	Gill-nets ..	Over night..	One menhaden.
12	6.30 p. m.	37 32	74 52	do	do	do	Two butter-fish.
17	10 p. m.	36 45	74 50	do	do	do	Nothing.
24	5.35 p. m.	37 34	74 26	do	Toll-bait ..	do	Dog-fish.
24	7 p. m.	37 34	74 26	do	Gill-nets ..	Over night..	Nothing.
26	5.30 p. m.	37 23	74 01	do	Toll-bait ..	30 minutes..	Do.
26	5.30 p. m.	37 23	74 01	do	Hand-lines ..	do	Dog-fish.
27	9.30 a. m.	37 43	74 15	do	Toll-bait ..	do	Nothing.
27	9.30 a. m.	37 43	74 15	do	Hand-lines ..	do	Six hake.
27	5.25 p. m.	37 43	74 15	do	Toll-bait ..	do	Pollock and hake.
28	8.30 a. m.	37 40	74 13	do	do	do	Nothing.
30	3.45 p. m.	38 17	74 28	Off Del	do	do	Do.
30	7.15 p. m.	38 17	74 28	do	Gill-nets ..	Over night..	Do.
May 6	8.25 a. m.	38 09	74 06	do	Toll-bait ..	30 minutes..	Do.
6	5.35 p. m.	38 43	73 48	do	do	do	Do.
7	1 a. m.	38 52	73 40	do	Gill-nets ..	Over night..	Do.
7	10 a. m.	39 12	73 22	do	Toll-bait ..	30 minutes..	Do.
7	3 p. m.	39 20	73 08	do	do	do	Do.
7	3 p. m.	39 20	73 08	do	Hand-lines ..	do	One codfish.
8	10.28 a. m.	38 25	74 06	do	Toll-bait ..	do	Nothing.
9	5.20 a. m.	37 46	74 15	do	do	do	Do.
9	3 p. m.	38 18	74 11	do	do	do	Do.
9	8 p. m.	38 18	74 11	do	Gill-nets ..	Over night..	Twenty-one mack- erel and one mackerel shark.
10	6 a. m.	38 18	74 11	do	Toll-bait ..	30 minutes..	Nothing.
11	6.15 a. m.	38 11	74 23	do	do	do	Do.
11	7.30 p. m.	38 30	73 55	Off N. J.	Gill-nets ..	Over night..	One mackerel and dog-fish.
12	p. m.	38 40	73 55	do	Toll-bait ..	30 minutes..	Nothing.
15	7 a. m.	38 01	74 18	Off Del	do	do	Do.
20	6.15 a. m.	38 42	74 31	Off N. J.	do	do	Do.
20	6.15 a. m.	38 42	74 31	do	Hand-lines ..	do	Do.
21	10.30 p. m.	39 40	73 38	do	Gill-nets ..	Over night..	Four alewives.
22	9.45 a. m.	39 39	73 41	do	Toll-bait ..	30 minutes..	Nothing.
22	9.45 a. m.	39 39	73 41	do	Hand-lines ..	do	Do.
22	4 p. m.	39 39	73 41	do	do	do	One hake.
22	7 p. m.	39 34	73 55	do	Toll-bait ..	do	Nothing.
23	12.35 p. m.	40 06	78 28	do	do	do	Do.
24	10 a. m.	40 41	72 09	do	do	do	Do.
24	4.18 p. m.	.....	.....	S. SE. Montauk.	do	do	Do.
26	a. m.	.....	.....	Off Great Pond	Hand-lines ..	do	Sea-base.
30	1.30 p. m.	41 12	70 09	Off Block Island	Toll-bait ..	do	Nothing.

NOTES ON THE CRUISE OF THE GRAMPUS ON THE SOUTHERN MACKEREL GROUNDS DURING THE SPRING FISHERY OF 1887, BY TARLETON H. BEAN.

The first voyage of the *Grampus* was made during the latter part of March and the early part of April well to the southward, and resulted in the discovery of the first mackerel of the season April 8, off Smith's Island, in Chesapeake Bay, north latitude $37^{\circ} 14'$, west longitude $74^{\circ} 39'$. Besides mackerel, the gill-nets captured alewives and menhaden, and collections of the minute crustaceans, on which mackerel are known to subsist, were taken in towing-nets. At the end of the first voyage the *Grampus* came to Fortress Monroe, where the writer joined her, April 20, to make further collections of marine fishes and of the surface invertebrates upon which the fishes feed, with especial reference to the mackerel, the bluefish, and the menhaden. It was also part of our duties to seek new fishing grounds and to collect birds and other associates of the mackerel.

The vessel was temporarily commanded by Capt. D. E. Collins, who has obtained the information given below with reference to the movements of the fleet and the localities in which catches of mackerel were made. The *Grampus* was supplied with towing-nets, gill-nets, lines of various kinds, and with toll-bait for luring fish. She had also a very liberal outfit of apparatus for general collecting, including nearly everything carried by sea-going exploring vessels, with the exception of the beam trawl.

The instructions to the *Grampus* involved her cruising primarily with the fishing fleet after the mackerel had been located, but she was expected also to look independently outside of the limits occupied by the fleet to ascertain whether or not mackerel could be found in advance of the fishing centers, or in any other direction outside, inside, or behind the position of the fleet.

During the early portion of the fishing season the vessel extended her researches southward almost to Cape Hatteras, but she caught no mackerel until the 8th of April, off Chesapeake Bay. The investigation was continued northward to Vineyard Sound, closing at Wood's Holl, May 31.

AREA INVESTIGATED BY THE GRAMPUS.

From April 22 to May 2 the cruising ground was from north latitude $37^{\circ} 16'$ to $38^{\circ} 24'$, west longitude $75^{\circ} 20'$ to $73^{\circ} 56'$. From May 5 to May 16 we sailed over the region from north latitude $37^{\circ} 45'$ to $39^{\circ} 20'$, west longitude $74^{\circ} 36'$ to $73^{\circ} 19'$. From May 19 to May 31 we were cruising offshore between Five Fathom Bank light-ship (entrance to Delaware Bay) and Vineyard Sound, keeping generally within the area occupied by the fleet.

BAD WEATHER ENCOUNTERED.

From April 22 to May 2 we encountered very bad weather, which operated unfavorably to the mackerel fishery. During all this time there was but one day when the conditions were favorable for the schooling of fish at the surface. The schools that we observed during this time were almost invariably too deep to be seined, and it is quite probable that the great mass of the fish passed northward unobserved. In the region traversed by us the schooling fish were seen principally at night, and we could not tell with certainty whether they were mackerel alone or a mixture of several species.

Our last cruise was marked also to a large extent by bad weather, cold easterly and southeasterly winds, with fog. The result of this unpropitious weather was a very light catch and an unprofitable fishery.

THE FLEET.

During our first cruise we observed as many as fifty sail all in sight at the same time. The majority of these vessels had been on the grounds fully six weeks, and yet their catch up to the 1st of May scarcely amounted to a good fare for a single vessel. During the second cruise we never saw more than fifty vessels at one time, and the bulk of the fleet were rarely in the centers of abundance of fish. On the 11th of May we counted fourteen vessels, extending in a semi-circle from southeast to northwest, the most distant ones being 6 or 7 miles from us.

May 12, in latitude $38^{\circ} 34'$, longitude $74^{\circ} 15'$, we counted forty-four sail.

May 13, in latitude $37^{\circ} 48'$, longitude $74^{\circ} 13'$, there were eleven sail in sight, several of which caught mackerel measuring from 11 to $13\frac{1}{2}$ inches, in quantities ranging up to about 200 barrels.

May 14, at noon, in latitude $38^{\circ} 09'$, longitude $74^{\circ} 25'$, forty sail were counted from aloft.

May 15 the *Grampus* was on her way to Delaware Breakwater, and during that evening, before the moon rose, we sailed through great masses of fish about 15 miles to the southward of Five Fathom Bank light-ship. We had left the majority of the fleet far to the southward, and only two vessels were catching fish as we came along. We then went into Delaware Breakwater, where we were detained several days, and after starting upon the final cruise we saw only occasional fishermen until in the evening of May 23, in latitude $40^{\circ} 19'$, longitude $73^{\circ} 06'$, thirteen sail were in sight all jogging. On this day we spoke a pilot-boat, which reported a fleet May 20 of about twenty-five sail 30 miles southeast from Barnegat in the midst of an abundance of fish; but foggy weather interfered with the fishing. We then cruised along in the waters off Long Island, lying to at night and using our nets whenever the weather permitted.

May 24 we were obliged to make a harbor in Fort Pond Bay, eastern

end of Long Island, where we were detained until the 26th by fog. Eight vessels left in company with us. After passing Montauk these vessels sailed about east-southeast, and were joined by several coming from the westward. We saw two seiners anchored at Block Island and ten in the harbor of Newport.

May 29 there were about twenty mackerel fishermen in Newport Harbor, several of which left with their boats on deck, probably bound home.

May 30 there were about twenty-seven sail among the fish, 10 or 12 miles east-southeast from Block Island.

May 31 there were twenty-one sail in the vicinity of No Man's Land and Martha's Vineyard, mostly working towards Vineyard Sound. Some vessels, however, abreast of No Man's Land had their jibs to windward. At 10.15 of this day as we were tacking through Vineyard Sound I counted 16 fishermen jogging to the northwest of No Man's Land, while several others were working through Vineyard Sound.

NOTES ON FISHES.

LOPHIUS PISCATORIUS.

April 23. A few young examples were caught in a purse-seine by Capt. Sol Rowe, 30 miles off Hog Island, in company with *Prionotus*, *Olupea*, *Squalus*, and young *Scomber*.

May 12. In north latitude $38^{\circ} 40'$, west longitude $73^{\circ} 53'$, a young individual about a centimeter long was taken at the surface.

May 30. See under "Fish Eggs" an account of the egg-masses seen in Narragansett Bay.

HIPPOGLOSSOIDES, sp.

May 22. In about north latitude $39^{\circ} 45'$, west longitude $73^{\circ} 49'$, four young examples of a flounder which appears to be *Hippoglossoides platesoides* were taken at the surface at 8 in the evening; the largest is 17 millimeters long, its dorsal fin has about 80 rays, and traces of several cross-bands on the sides are plainly visible as in young *Aphoristia*; the tail is somewhat produced and tapering.

CITHARICHTHYS, sp.

April 27. Some specimens were found in stomachs of hake in north latitude $37^{\circ} 43'$, west longitude $74^{\circ} 15'$.

HIPPOGLOSSUS VULGARIS.

Captain Williams, of the *G. P. Whitman*, says that he knows of the capture of this fish off the Delaware coast.

CORYPHÆNOIDES RUPESTRIS.

A single specimen was found floating alive at the surface in north latitude $36^{\circ} 50'$, west longitude $74^{\circ} 33'$, by Capt. Sol Rowe, of the schooner *William H. Foye*.

POLLACHIUS VIRENS.

April 27. Two young individuals were taken in the towing-net in north latitude $37^{\circ} 43'$, west longitude $74^{\circ} 15'$. A large example weighing about 20 pounds was caught in the same locality, in the evening, by Captain Collins. In its stomach was a large squid.

April 30. Four young examples were taken in north latitude $38^{\circ} 12' 45''$, west longitude $74^{\circ} 26'$.

May 1. At 6 p. m., in north latitude $37^{\circ} 36'$, west longitude $74^{\circ} 31'$, a young example was caught in the large tow-net.

On the 6th of May, in latitude $38^{\circ} 43' N.$, longitude $73^{\circ} 48' W.$, young examples were obtained in the towing-net, and in the evening of May 10, in north latitude $38^{\circ} 11'$, west longitude $74^{\circ} 02'$, young specimens were caught in the same net. On the evening of May 22, in about north latitude $39^{\circ} 45'$, west longitude $73^{\circ} 49'$, a young example was taken in the towing net.

May 26 a school of pollock was seen at the surface by the *Grampus*, between Montauk and Block Island. A large one was caught on a blue-fish drail.

Young specimens caught in dip-net, May 30, under floating rock-weed.

GADUS MOERHUA.

May 7. A single fine cod was caught from the *Grampus*, using menhaden for bait, in about north latitude $39^{\circ} 20'$, west longitude $73^{\circ} 09'$.

Capt. D. E. Collins has seen cod in the well of the *Grampus* swinging on their heads as a pivot.

PHYCIS, sp.

May 1. At 6 p. m. two young individuals were taken in the towing-net, in north latitude $37^{\circ} 36'$, west longitude $74^{\circ} 31'$.

May 6. In north latitude $38^{\circ} 43'$, west longitude $73^{\circ} 48'$, young hake were taken in the towing-nets.

May 10. One young example was taken in north latitude $38^{\circ} 06'$, west longitude $74^{\circ} 13'$, and in the evening in north latitude $38^{\circ} 11'$, west longitude $74^{\circ} 02'$, more of the young were obtained.

May 12. Young specimens were caught in the dip-net, and in the evening in north latitude $38^{\circ} 40'$, west longitude $73^{\circ} 53'$, the large towing-net took three young examples.

May 20. In north latitude $38^{\circ} 50'$, west longitude $74^{\circ} 06'$, young hake were obtained in the towing-net.

May 22. At 8 p. m., in about north latitude $39^{\circ} 45'$, west longitude $73^{\circ} 49'$, a young specimen was obtained in the towing-net.

May 30. About 9 miles southwest $\frac{1}{2}$ west from No Man's Land five young hake were obtained in the towing-net, the largest of them nearly $2\frac{1}{2}$ inches long. Young specimens were caught in dip-net; others, under floating rock-weed.

PHYCIS CHUSS.

May 22, in about north latitude $39^{\circ} 36'$, west longitude $73^{\circ} 37'$, using fresh clams for bait, the *Grampus* took a small male of this species. In its stomach were large *Amphipods*. Its spermaries were white and well developed.

May 30, in about north latitude $41^{\circ} 12'$, west longitude $71^{\circ} 09'$, an individual of this species was caught on the hand-line. On the same day, about 14 miles southwest $\frac{1}{2}$ west from Gay Head, several small examples were again taken by the same method.

PHYCIS TENUIS.

In the morning of April 27, with pork bait, we caught six hake in north latitude $37^{\circ} 43'$, west longitude $74^{\circ} 15'$, at a depth of 36 fathoms. In weight the fish ranged from about 3 to 12 pounds. In their stomachs were the pen of a squid, a *Citharichthys*, and another fish which was unrecognizable. On the evening of the same day hake were taken in abundance. They were well fed and in fine condition; their stomachs contained *Prionotus*, *Centropristis*, *Clupea astivalis*, *Scomber scombrus*, and the little flounder observed in the morning. The fishing bank is in north latitude $37^{\circ} 43'$ to $37^{\circ} 45'$, west longitude $74^{\circ} 15'$, depth 36 fathoms.

May 7, two individuals were taken in north latitude $39^{\circ} 20'$, west longitude $73^{\circ} 09'$, using menhaden for bait.

May 22, in about north latitude $39^{\circ} 36'$, west longitude $73^{\circ} 37'$, the *Grampus* tried hand-line fishing with fresh clams; two specimens of the common hake were taken. In the stomach of one of them was an unrecognizable eel-shaped or blenniform fish. These examples were females with very small ovaries.

On the same day a young example, 2 inches long, was caught at the surface in latitude $39^{\circ} 45'$, longitude $73^{\circ} 49'$.

ONOS CIMBRIUS.

Young specimens were caught in the dip-net May 12.

Again in the evening of May 12 in north latitude $38^{\circ} 40'$, west longitude $73^{\circ} 53'$, the large towing net captured a young rockling.

On May 20, in north latitude $38^{\circ} 50'$, west longitude $74^{\circ} 06'$, a great many young rockling were caught in the towing net.

CYCLOPTERUS LUMPUS.

Young specimens were caught in dip-net May 30, under floating rockweed, in Narragansett Bay.

PRIONOTUS.

April 23. Captain Rowe took in a purse seine, 30 miles off Hog Island, about 25 or 30 barrels of sea robins in company with alewives, young dog-fish, a few young *Lophius*, and three tinker mackerel. This was a

most unusual and unexpected catch, the sea robins being true bottom fishes.

COTTUS OCTODECIMSPINOSUS.

May 30. About 14 miles southwest $\frac{1}{2}$ west from Gay Head, we caught an 18-spined sculpin on the hand-line.

SCOMBER SCOMBRUS L.

Localities of mackerel, 1887.

April 8. Schooner *Grampus*, off Smith's Island, mouth of Chesapeake Bay, caught two mackerel with alewives. Another vessel was reported to have taken some about that time.

April 10. Captain Keene, of the schooner *Howard Holbrook*, reports having seen small schools and two large schools at night in north latitude $37^{\circ} 50'$, west longitude $73^{\circ} 13'$; these were supposed to be large school fish. The schooner *John S. McQuinn* saw fish on the same night.

About April 20, Capt. Sol. Jacobs and Captain Nauss stated that there was quite a body of fish in north latitude $37^{\circ} 25'$, to $37^{\circ} 40'$, and west longitude $74^{\circ} 25'$ to $74^{\circ} 35'$. It was observed that alewives were more or less mixed with the mackerel usually, and it was remarked by the fishermen up to the end of April that the mackerel schooled mostly at night.

April 23. Capt. Sol. Rowe caught three tinker mackerel in a purse seine, 30 miles off Hog Island, in company with *Prionotus*, *Olupea*, *Squalus* and *Lophius*.

April 27. Capt. Joseph Smith, schooner *Alice M. Center*, saw his first school of mackerel in north latitude $37^{\circ} 36'$, west longitude $74^{\circ} 42'$.

April 27 or 28. Captain McKay is said to have seen large mackerel 60 miles south of No Man's Land.

In the latter part of April, the schooner *Melissa D. Robins* saw a quantity of small mackerel in the night, about north latitude $38^{\circ} 17'$, west longitude $74^{\circ} 15'$.

May 1. Captain McGowan was in a school of mixed fish in about north latitude $36^{\circ} 43'$, west longitude $74^{\circ} 43'$, and says that the body of fish was the largest he has seen in the south in five years.

The schooner *Carrie Parsons*, on the night of May 1, saw a large mass of mackerel in north latitude $36^{\circ} 47'$, west longitude $74^{\circ} 53'$.

May 2. Captain Smith next saw the mackerel in about north latitude 37° , 50 miles east by south from Cape Charles. He followed them about 35 miles north-northeast.

May 2. Captain Fernald, schooner *Lilla B. Fernald*, caught some mackerel off Hog Island, in 17 fathoms. The schooner *Lula Wilbur* also took some.

May 3. Steamer *Vidette* from Mobile, at New York, reports in latitude 36° N. water fairly alive with schools of mackerel; mackerel fleet 50 miles north.

May 4. About this date the schooner *Edith Rowe* reports having taken 200 barrels of small mackerel 18 or 20 miles southeast from Barnegat.

May 5. The schooner *Carrie Parsons* saw a large body of fish at night in north latitude $37^{\circ} 08'$.

May 7. The schooner *Carrie Parsons* saw plenty of fish at night in north latitude $37^{\circ} 30'$, west longitude $74^{\circ} 39'$; 28 fathoms.

May 8. Between 8 and 9 p. m. we saw from the *Grampus* five schools of fish, one of them very large; north latitude $38^{\circ} 03'$, west longitude $74^{\circ} 18'$.

May 8. The schooner *Ralph Hodgdon*, of Gloucester, saw several schools in the morning and at night in north latitude $37^{\circ} 48'$, west longitude $74^{\circ} 15'$.

May 9. Captain Smith caught 104 barrels salt and some fresh in north latitude $37^{\circ} 50'$, west longitude $74^{\circ} 34'$. His was the northwest vessel of the fleet and alone, the fleet of thirty sail being barely visible to the southeast.

May 9. The schooner *Margaret S. Smith* reports a large body of mackerel extending from north latitude $37^{\circ} 46'$, west longitude $74^{\circ} 15'$ to Cape Henry. They were showing up well day and night for a week except May 8.

The catch of eight vessels in a fleet of twenty-one or twenty-two was all made between latitude $37^{\circ} 20'$ and $37^{\circ} 40'$; longitude $74^{\circ} 28'$ and $74^{\circ} 50'$.

May 9. The schooner *Clara S. Cameron* reported the capture of 50 barrels of large fish, not mixed with small ones. At night Captain Carroll took about 12 barrels of mixed fish, two-thirds of them between 11 and 12 inches long, the rest tinkers. Capt. Sol Jacobs also made a small haul of the same kind. At this time the water was full of "slicks." The fish were very wild, and most of the sets failed.

May 10. Captain Thomas, schooner *Maud S*, took 47 wash-barrels in north latitude $37^{\circ} 07'$, west longitude $74^{\circ} 40'$; 35 fathoms.

May 10. The gill-nets of the *Grampus*, in north latitude $38^{\circ} 07'$, west longitude $74^{\circ} 21'$, caught twenty-one mackerel and one mackerel shark. The mackerel ranged in length from 11 to $12\frac{3}{4}$ inches. Most of them were alive, and one put in the well recovered fully. All were meshed in the south side of the nets, seven in the lower part of the mackerel-net, and fourteen well up in the surface herring-net. The depth of the school may therefore have been 5 fathoms or more. None of the fish were nearer than 3 feet from the top of the net.

On this night Capt. Sol Jacobs took a small school of 13 to 15 inch fish. He saw a number of small schools, but no large ones.

May 11. Captain Williams reported having seen several schools at night about 35 miles north-northeast of latitude $38^{\circ} 34'$, longitude $74^{\circ} 15'$.

May 11. Captain Carroll, schooner *Warren J. Crosby*, caught 75 bar-

rels of large mackerel in the night. He says four or five other vessels caught fish in our vicinity.

May 12. The mackerel from May 3 to this date seem to be located between 37° and $38^{\circ} 10'$ north latitude, and $74^{\circ} 28'$ to $75^{\circ} 25'$ west longitude. Some were caught as far north as $38^{\circ} 40'$, west longitude $73^{\circ} 52'$. These were principally small and mixed, except one trip of large fish. The species was said to occupy a width of 15 miles east and west and to extend 25 or 30 miles north and south.

May 12. Schooner *M. S. Ayer*, 60 miles south-southeast from Cape Henlopen, seined 200 barrels round fish.

May 12. Schooner *Grampus* took one mackerel in gill-net at 4.35 a. m. latitude $38^{\circ} 30'$, longitude $73^{\circ} 55'$.

May 12. Captain McGowan left New York. He saw small schools off Scotland Light-Ship, which he thought were large fish. Schooner *Col. J. H. French*, coming from northward, reports a small school or two.

Captain Spurling, schooner *Lizzie Maud*, reports twenty-five sail arriving at New York since May 3. The fish were taken from 15 miles off Smith's Island, Maryland, to 50 miles off-shore, latitude of Cape Henry. Captain Chase, schooner *Clara S. Cameron*, reports the southern body of fish enormous and very wild.

May 13. In north latitude $37^{\circ} 48'$, west longitude $74^{\circ} 13'$, 37 fathoms, a fleet of eleven vessels was working on the mackerel. About sundown four vessels set for fish, but one made a water haul, while the *Henry Morganthau*, of Portland, Captain McGowan, the *Caroline Vought*, of Boothbay, and one other vessel were successful. Captain Collins and I went to the *Morganthau* to see them bail in. They had about 200 barrels of mixed fish, ranging from 11 inches to $13\frac{1}{2}$ inches. She had just arrived here from New York.

May 13. Capt. Sol. Jacobs, schooner *Mollie Adams*, is reported to have caught mackerel in 12 fathoms off Winter Quarter Shoal.

Captain Chase, schooner *Clara S. Cameron*, took 127 barrels of mixed mackerel at night off Winter Quarter Shoal. He saw milt but no eggs, and thought there were no females.

May 13. Eight schools, mostly large ones, were seen from the *Grampus* at 7 p. m. A vessel near us caught a small school. The watch saw several more schools in the night. The location was latitude $37^{\circ} 48'$ N. and longitude $74^{\circ} 13'$ W.; 37 fathoms.

May 13. Captain Smith left New York and saw no fishermen except Captain Joyce, who seemed to be going to market. He saw no fish on the way south.

May 13. The schooner *William M. Gaffney* has just come from the northward. She cruised all the way from 15 miles off Fire Island and saw no fish. Our position was about north latitude $37^{\circ} 48'$, west longitude $74^{\circ} 13'$.

May 14. The schooner *John G. Whittier* came out of New York and sailed to the southward, keeping close in shore. She saw no fish.

May 15. Between 8.30 and 9.30 p. m. ($38^{\circ} 41'$ to $38^{\circ} 51'$ north latitude, $74^{\circ} 16'$ to $74^{\circ} 09'$ west longitude, 21 to 22 fathoms), *Grampus* saw eight or nine schools, some very large. At 9.45 a school about twice as long as the vessel was along-side. Between 11 and 12 p. m., twenty-four schools were seen. Between 12 and 2, five more were seen. All appeared to be working to northeast, some of them fast. The fish were only about 12 miles southeast of the southern light ship (Five Fathom Bank), and we sailed through them for 10 miles.

May 15. Six vessels joined the *M. S. Ayer* in Philadelphia, each of them having 200 barrels or more.

Schooner *Grampus* saw multitudes of mackerel, alewives, etc., mixed, in north latitude $38^{\circ} 41'$ to $38^{\circ} 51'$, west longitude $74^{\circ} 16'$ to $74^{\circ} 09'$, 21 or 22 fathoms. The schooners *Edward E. Webster* and *Warren J. Crosby* were seen taking mackerel.

May 17. Schooner *John G. Whittier* took 10 or 12 barrels of mackerel, mixed with alewives in excess, off Five Fathom Shoal. Schooner *Hattie L. Newman* caught some mackerel, with abundant alewives, in the same locality.

May 18. Captain Wilcox, steamer *Alaska*, seined 2 barrels of large mackerel off Shinnecock in 12 fathoms.

Captain Cromwell, schooner *Hattie Evelyn*, saw a large body of fish about in north latitude $39^{\circ} 21'$, west longitude $73^{\circ} 39'$, showing day and night and traveling north-northeast.

May 19. Schooner *Grampus* saw numerous schools of fish from 6 to 8 miles west-southwest from southern light-ship on Five Fathom Bank, and many more at night not far from this locality. These were supposed to be menhaden.

May 19. Captain Cromwell reports the fish working fast east-northeast to east-southeast.

May 19 or 20. Schooner *Margaret S. Smith* took good mackerel north by east from the southern light-ship on Five Fathom Bank.

May 20. Schooner *Carrie E. Parsons* reports plenty of mackerel 30 miles southeast from Barnegat.

Captain Cromwell was in about $39^{\circ} 56'$ north latitude, $72^{\circ} 46'$ west longitude, 40 fathoms. The fish worked southeast; eleven or twelve vessels were among them. After that they lost them.

Captain Harty, schooner *Israel J. Merritt*, caught 189 barrels off Barnegat.

May 21. Numerous schools of fish were seen during the night from the *Grampus*. These were said to be mackerel and alewives. This was about in north latitude $39^{\circ} 40'$, west longitude $73^{\circ} 38'$.

May 21. Captain Harty took 125 barrels 25 miles southeast of Sandy Hook light-ship. They were from 11 to 13 inches long, and a large body of fish was in that vicinity.

May 21. Plenty of fish are reported by pilot-boat No. 6 southeast of Barnegat, the light just awash.

Captain Wilcox, steamer *Alaska*, took 73 mackerel south of Neapeague, Long Island, near shore.

May 22. Captain Greenleaf was told by a coaster that there were plenty of fish south-southeast from Fire Island during the night. He could not tell what they were, but it was supposed that some of them were mackerel.

May 22. The schooner *Carrie E. Parsons* reports having seen plenty of fish during the night about north latitude $40^{\circ} 09'$, west longitude $73^{\circ} 23'$.

May 23. Captain Greenleaf cruised recently as far south as Cape Henry and saw no fish.

Schooner *Joe Hooker* saw mackerel in the morning in north latitude $40^{\circ} 17'$, west longitude $73^{\circ} 10'$. The fish were going northeast.

Captain Chase, schooner *Clara S. Cameron*, saw a few small schools at night 13 miles south-southeast from Montauk. Fishing was prevented by starlight.

Schooners *William H. Foye* and *Grover Cleveland* saw three schools 12 miles south-southwest from False Montauk.

May 23. Captain Chase reports having seen during the night large bodies of fish deep in the water 45 miles southwest $\frac{1}{2}$ south from Shipneck.

May 24. Schooner *William H. Foye* has cruised recently about Block Island and saw no mackerel.

May 26. Schooner *Mary H. Thomas* caught in the day-time 35 barrels of mackerel with alewives, 18 miles southeast from Block Island; also 25 barrels of mackerel with 100 barrels of alewives. In length the fish were from 11 to 14 inches; those of 14 inches were few, but many were 13 inches. The fish were going south-southeast slowly.

May 27. Captain Decker, schooner *Robert J. Edwards*, took 50 barrels 15 miles southeast from Block Island in the afternoon. He observed particularly that no eggs were present, but some large sexually developed males were captured.

Schooner *Elsie Smith* seined 50 barrels 15 miles south-southeast from Block Island; 18 vessels were present; 12 took fish.

May 27. Capt. John Whitmore, schooner *Fannie Spurling*, at 2 p. m. saw a large body of fish "just shadowing" 15 miles southeast by south from Block Island; they "came up good" at 5 p. m. From 2 to 5 p. m. they went about 5 miles northeast. He reports 12 sail getting fish. The fleet was scattered over 3 or 4 miles in extent.

Captain Harty, 40 miles southeast $\frac{1}{2}$ east from Block Island, saw about 12 small schools at night. Weather prevented setting.

May 30. Schooner *Grampus* was in north latitude $41^{\circ} 12'$, west longitude $71^{\circ} 09'$. Plenty of mackerel mixed with alewives were showing well in the afternoon. Some vessels are getting them a few miles southwest of us. Two men from a dory threw bait directly into the schools, feeding with their heads out; the fish turned, but refused to jig. We

saw 12 or 15 schools of large Block Island mackerel which were not mixed with alewives.

West-southwest and southwest from No Man's Land, 6 to 8 miles, we saw many "pods" and some moderately large schools. One school, about 5.15 p. m., was "cart-wheeling."

At 7.30 p. m. twenty-odd sail are working on mackerel about 10 or 12 miles west-southwest from No Man's Land. Many boats are out.

Size of mackerel.

As a rule the mackerel taken during April were principally tinkers. Most of the fish that we saw ranged from about 11 to 13 inches. Mixed mackerel were the rule.

Miscellaneous notes.

In the early days of seining it is stated that the mackerel never dived under the seine; now they do it only too often. I was informed that Captain Jacobs once made thirty-two consecutive water-hauls and was successful with the thirty-third set. In setting the seine they aim to get the heads of the fish; that is, the advance part of the school, and not the tails.

It is stated that poor fish hang down in the seine much harder than fat ones.

Captain Warren, schooner *Alice C. Jordan*, told Capt. D. E. Collins that on February 10, 1887, he saw about a half barrel of mackerel 10 or 12 inches long, and very poor, taken in a seine with herring in English Harbor, Fortune Bay, Newfoundland.

It has been generally remarked by the fishermen that mackerel have been hard to seine this year. They have been noted for their deep diving and sudden disappearances.

In the latter part of May it was sometimes difficult to dispose of the fresh mackerel even in New York. One captain said that he had difficulty of that kind. It is stated also that the schooner *Warren J. Crosby* carried fish to Philadelphia and had to split them.

James Rogerson, cook of the *Alice S. Hawkes*, states that large quantities of small mackerel were taken in weirs at West Quoddy, Me., in July, 1886, and carried to Eastport.

Captain Fernald was told by a lobsterman at Seal Cove, Mount Desert, Me., that he saw a great mass of mackerel standing on their heads on the bottom, the bodies canted a little.

Captain Fry saw a large spawn in a big Block Island mackerel about the end of November, 1886. He examined it carefully.

Captain Fernald saw lots of large fish about September 1, 1886, about Seal Island and Duck Island, Maine, and only one vessel near. They seemed very tame, but he could not catch any.

Food of mackerel.

May 13, in north latitude $37^{\circ} 48'$, west longitude $74^{\circ} 13'$, 37 fathoms, stomachs of mackerel obtained from the schooner *Henry Morganthau*, of Portland, were gorged with minute phosphorescent entomostraca, resembling those taken by us with towing-nets in the same locality.

A separate account of the invertebrates taken by the *Grampus* has been prepared by Mr. Richard Rathbun and others, to whom the collections were referred.

Reproduction.

Among the fish taken by the schooner *Henry Morganthau*, May 13, in north latitude $37^{\circ} 48'$, west longitude $74^{\circ} 13'$, 37 fathoms, I noticed at least one well-developed male, and some ovaries of females containing eggs, which were apparently almost mature. These fish have been schooling daily in the day-time.

Failure of toll-bait.

Toll-bait was tried in all waters traversed by the *Grampus*, but always without capturing a single mackerel.

SCOMBER PNEUMATOPHORUS.

Capt. Thomas Steelman, of the steamer *Nellie C. Rawson*, and Captain Valliant, reported the occurrence of mackerel 7 to 8 inches long in abundance about the middle of August, 1886, from Hereford Inlet to Barnegat. Capt. Sol. Jacobs informed us of the report by coasters that some schools of mackerel were off Fenwick's Island in August, 1886, and they say they caught a few of the fish.

The schooner *M. S. Ayer* was informed that mackerel, some of which weighed $1\frac{1}{2}$ pounds, were caught during the summer of 1886 off Atlantic City, N. J., and sold by boat fishermen to the hotels. Inquiry made from a dealer in Atlantic City furnished a corroboration of this statement.

Capt. Henry C. Fish informed us that he saw, about September 1, 1886, four or five very large schools (a thousand barrels) of "Bull-eyed" mackerel 7 or 8 inches long. One of the steamers caught some, but he did not. The locality must have been off the south shore of Long Island.

June 28.—Brig *H. B. Hussey* reports, June 28, Five Fathom Bank light-ship bearing west by north 50 miles, saw small school of mackerel. These were probably *S. pneumatophorus*.

Willard Nye, jr., was informed by a fisherman at Yarmouth, Nova Scotia, that the first chub mackerel caught there he caught in September, 1886. During that year about a dozen were reported in that vicinity. In 1887, up to August 15, they were plentiful. Two men, fishing from a boat for the ordinary mackerel, caught a dozen a day.

At Halifax, Nova Scotia, in 1887, the fishermen had not seen any of the chub mackerel.

PORONOTUS TRIACANTHUS.

April 13. One large specimen was caught in a gill-net in latitude $37^{\circ} 29'$, longitude $75^{\circ} 12'$.

April 25. A young example was taken in the towing-net.

April 26. One young individual was secured in latitude $37^{\circ} 36'$, longitude $74^{\circ} 28'$.

Young specimens were caught in the dip-net May 12.

Young examples were obtained in the towing-net May 6, in north latitude $38^{\circ} 43'$, west longitude $73^{\circ} 48'$.

In the evening of May 12 four small individuals were taken in the towing-net in north latitude $38^{\circ} 40'$, west longitude $73^{\circ} 53'$.

POMATOMUS SALTATRIX.

On the evening of May 12, in north latitude $38^{\circ} 40'$, west longitude $73^{\circ} 53'$, a bluefish $1\frac{1}{2}$ inches long was captured in the towing-net. This is one of the very few young bluefish so far obtained in our waters.

TYLOSURUS MARINUS.

April 30. Capt. Scott Rackliff, of the schooner *Volunteer*, sent to the *Grampus* a billfish, which he had caught in his seine off Chesapeake Bay.

BREVOORTIA TYRANNUS.

April 21. In the harbor of Fortress Monroe we heard the "flip" of the menhaden frequently.

May 10 or 11. Captain Williams reported enormous quantities in New York Bay, inside the Hook and in the vicinity of Sandy Hook.

May 12. Capt. Henry C. Fish, steamer *Vesta*, reports first capture, this date, off Barnegat.

May 16. Capt. Henry C. Fish says menhaden were caught off Shinnecock, same date as in 1886.

May 16. Several menhaden steamers are lying at Delaware Breakwater. Dead menhaden were floating out with the tide from the breakwater as the *Grampus* entered.

May 17. Capt. Thomas Steelman, steamer *Nellie E. Rawson*, reported the capture May 16, of 10,000 menhaden, the first of the season. They are fifteen days later than usual; last year at this date the fishing was good. A body of menhaden went past Cape Henlopen May 2 and 3.

May 19. Schooner *M. S. Ayer* reports seeing plenty of menhaden at night, not far from north latitude $38^{\circ} 42'$, west longitude $74^{\circ} 21'$.

May 20. Schooner *Grampus* at night saw schools which were supposed, from their movements, to be menhaden. The position was not far from latitude $38^{\circ} 46'$, longitude $74^{\circ} 12'$.

Captain Jones, schooner *Alice S. Hawkes*, saw large bodies off Absecon, from 5 to 20 miles off-shore.

May 25. Capt. Henry C. Fish says there seems to be a large but scattered body of menhaden off Montauk. He thinks there is a larger body yet to come.

May 25. Mackerel fishermen report large bodies of menhaden 40 miles southeast from Montauk. They show in Long Island Sound about the middle of June, and range eastward to Nantucket and Buzzard's Bay.

May 29. Menhaden steamers belonging in the vicinity of the eastern end of Long Island are engaged in fishing in its waters.

CLUPEA VERNALIS AND ÆSTIVALIS.

As early as April 23 Capt. Sol. Rowe seined some alewives about 30 miles off Hog Island. In company with them, at the surface, he caught 25 or 30 barrels of sea robins (*Prionotus* sp.), young dogfish (*Squalus acanthias*), a few young goose-fish (*Lophius piscatorius*), and three tinker mackerel.

May 22 the schooner *Grampus* took in gill-nets four specimens of *Clupea vernalis*, one female and three males. The female was about 10 inches long and larger than any of the males. The ovaries and spermaries were very small, showing that these are probably young fish and not yet ready to leave the sea, although full grown, or nearly so. The locality is about north latitude $39^{\circ} 40'$, west longitude $73^{\circ} 38'$.

On the night of May 22 the schooner *Porter Roberts* set in about north latitude 40° , west longitude $73^{\circ} 28'$, and got alewives.

May 26. Captain Decker, schooner *Robert J. Edwards*, went out from Sandy Hook in company with 20 fishermen. He sailed east $\frac{1}{2}$ south from Sandy Hook. At a distance of 50 miles he saw large bodies of alewives. He caught about a bushel of them. In dressing them no eggs or milt were noticed, from which it is probable that these were young fish. They were going northward about 7 miles per hour.

May 28. The schooner *Mary H. Thomas* caught alewives with mackerel, 18 miles southeast from Block Island; she took 25 barrels at one set and 100 barrels at another time.

May 30. The schooner *Grampus* saw numerous schools of alewives mixed with mackerel 17 miles southeast $\frac{1}{2}$ south from Brenton's Reef light-ship, or north latitude $41^{\circ} 12'$, west longitude $71^{\circ} 09'$. The fish were showing well in the afternoon.

RAIA LÆVIS.

April 27. Specimens were caught on hand-lines in north latitude $37^{\circ} 43'$, west longitude $74^{\circ} 15'$, 36 fathoms.

May 7. Two females were caught on hand-lines from the *Grampus*, menhaden for bait, in about north latitude $39^{\circ} 20'$, west longitude 73°

09'. They were feeding on hermit crabs and a gastropod resembling *Natica*.

May 8. In the afternoon the *Grampus* took a female of this skate on a hand-line. In its stomach were numerous hermit crabs of good size. The shells of the crabs were not present, except a single small one.

May 9. Males of this species were taken from the *Grampus* on hand-lines in about $37^{\circ} 46'$ north latitude, $74^{\circ} 15'$ west longitude.

In the afternoon of May 9, in about north latitude $38^{\circ} 03'$, west longitude $74^{\circ} 10'$, we took barn-door skates of both sexes and found crabs in their stomachs.

SQUALUS ACANTHIAS.

April 23. Young examples were taken in a purse seine by Capt. Sol Rowe 30 miles off Hog Island in company with *Prionotus*, *Clupea*, *Lophius*, and *Scomber*.

April 24. Five dogfish were caught on hand-lines; their stomachs were empty. One female contained young 6 inches long. When the young were dropped into a pail of water they tried to swim. Opening the abdomen of a dogfish does not prevent it from swimming off into and under the water at a rapid rate.

April 26. In the evening dogfish were taken on hand-lines.

April 27. Many examples, principally females, were brought up on lines in north latitude $37^{\circ} 43'$, west longitude $74^{\circ} 15'$. One male had on his livery of numerous large milk-white spots. The females had no large spots, but a few small ones. The green eye of this species is remarkable.

May 7. The *Grampus* caught several dogfish, all of which were females but one, in about north latitude $39^{\circ} 20'$, west longitude $73^{\circ} 09'$, and on May 8 two females were taken in north latitude $38^{\circ} 25'$, west longitude $74^{\circ} 06'$, 28 fathoms.

May 9. In about north latitude $37^{\circ} 46'$, west longitude $74^{\circ} 15'$, dogfish were taken from the *Grampus* on hand lines.

May 11. In about north latitude $38^{\circ} 11'$, west longitude $74^{\circ} 23'$, from 23 fathoms the *Grampus* took several dogfish with fresh mackerel for bait. Several fish at a time would follow the hook up to the surface.

Very early in the morning of May 12 about a dozen dogfish measuring 15 inches or so in length were taken from the gill-nets of the *Grampus*. Later in the same day in about north latitude $38^{\circ} 30'$, west longitude $74^{\circ} 02'$, additional specimens were taken on hand-lines.

During the afternoon of the same day in about north latitude $38^{\circ} 03'$, west longitude $74^{\circ} 10'$, we took dogfish, mostly females, and found in their stomachs *Prionotus*.

May 12. During the evening, which was remarkably fine with a smooth sea, swarms of dogfish were seen at the surface, their dorsal fins showing out of water. They were generally in pairs. Capt. D. E. Collins told me that he has seen myriads of them on the fishing banks

in summer. We tried hand-lines, but even the dogfish were off the bottom and we caught nothing. The dogfish near the surface amused themselves and us by trying to steal the bait from our hooks without taking the hook in their mouths. One of the men held a line alongside among the dogfish. A very shrewd youngster came up and bit at the shank of the hook as if to try its quality; then he carefully took between his teeth one edge of the bait as far as possible from the point of the hook, and shook his head like a dog to free the morsel, and he escaped with it.

This habit of swimming with the dorsal out of water is called "finning." Captain Collins has seen it in June on Brown's Bank, the fish extending as far as the eye could reach on moderate evenings; some of the men of the *Grampus* have seen the "finning" all through the moderate summer evenings on the New England fishing banks.

LAMNA CORNUBICA.

May 10. The gill-nets of the *Grampus* were hauled and contained twenty-one mackerel, while rolled up in the eastern end of the herring net we found a mackerel shark 67 inches long. In its stomach were the remains of six *Prionotus* and four small *Squalus*. I found a few parasites, most of them on the edges of the caudal lobes. The location of this haul was in about north latitude $38^{\circ} 07'$, west longitude $74^{\circ} 21'$.

FISH EGGS.

May 19. In the evening, not far from the southern light-ship on Five-fathom Bank, the *Grampus* took many floating eggs in the towing net.

May 20. In latitude $38^{\circ} 42'$, longitude $74^{\circ} 21'$ a few floating eggs were taken in the towing net.

May 26. Floating eggs similar to those found near Five-fathom Bank Southern Light-ship, May 19, were caught with the towing net in the eastern end of Long Island Sound early in the morning. The oil globule was very noticeable in these eggs.

May 30. Two species of floating eggs were found abundant in Naragansett Bay, differing in size and development. Two ribbons of *Lophius* eggs were seen. The envelope of the egg mass was so tough and tenacious that we were obliged to cut it with a knife. The eggs are in honeycomb-like cells.

FISH TRAPS.

May 26. Some of the fishes caught in the fish traps about the eastern end of Long Island about this date are: *Tetodon turgidus*, *Prionotus palmipes*, *Stenotomus chrysops*, *Centropristis furvus*, and *Brevoortia tyrannus*.

FISHERMEN'S VERNACULAR.

Characteristics of fishes: "Slap" of menhaden, "raining or pattering" of herring; "Chug" of mackerel. Alewives, and menhaden settle when alarmed; mackerel dart away; "mulling" of herring and menhaden means gradual settling.

A small bunch of fish is a "small pod"; a "dory pod" contains about enough fish to fill a dory. A "red school" is one which lies under a mass of red entomostraca, etc., forming its food. "Butts," the heads of a school, or of fish. "Red birds" or "sea geese" are red phalaropes. Tails schooling and heads settled means that the advance fish have been alarmed and sunk while the rear end of the school is still schooling. "Swinging" of a school is cart-wheeling. "Soaking to windward" is moving slowly against the wind.

Speaking of an unsuccessful set of the seine for a school of fish a captain said, "I set at it but didn't stop nothin'."

Another expression of a captain who saw a chronometer on the *Grampus* for the first time was, "I never was shipmates with a chronometer before."

Another captain, who thrust a board with all his strength to a drowning man, said, "I pooned a board at him."

CETACEANS.

The cruise was remarkable for the scarcity of cetaceans. Puffing-pigs were seen at Fortress Monroe, Delaware Bay, and near Montauk. A few blackfish were seen on May 1. I observed among them what appeared to be an *Orca*, but they were too far off to be identified.

On the 11th of May a moderately large-sized school of porpoises was seen coming from the southward in about north latitude $38^{\circ} 11'$, west longitude $74^{\circ} 23'$.

On the evening of May 14 a school of about thirty *Delphinus* was alongside, and near night a few more were seen. This was in north latitude $38^{\circ} 03'$, west longitude $74^{\circ} 12'$.

On May 15 Captain Fernald caught a *Delphinus* containing a fetus 22 or 23 inches long, which was removed alive and seemed almost viable.

Early in the morning of May 24 a school of porpoises was seen off the south side of Long Island.

On May 24 also a small whale was reported by one of the men of the *Grampus* near Montauk.

May 27, 40 miles southeast $\frac{1}{2}$ east from Block Island, Captain Harty reported whales plentiful.

BIRDS.

We were struck by the remarkable scarcity of birds during our entire cruise from Fortress Monroe to Cape Cod. The species which are usually recognized as the associates of the mackerel were generally

scarce; gannets were never plentiful, and "sea-geese" (red phalaropes) usually were only in small bunches and widely scattered. It was remarked by the fishermen that the mackerel and the birds remained unusually long in the southern waters south of Cape Henry.

On the 12th of May Captain Chase told us that birds were so abundant with the southern body of fish as to interfere with seining. On the 21st of April, in the harbor of Fortress Monroe, we found the usual abundance of ducks; gulls, terns, and kittiwakes were also present; cormorants, loons, and grebes were occasionally seen. Coots had not yet left those waters.

On the 5th of May coots were flying to the southward in Delaware Bay. On the 16th of May, when we returned to the breakwater, no coots were seen. On the 16th, two small flocks of coots were seen flying southward in the eastern end of Long Island Sound. A large flock was observed near Brenton's Reef light-ship, also flying southward.

In the evening of May 13, in about north latitude $37^{\circ} 48'$, west longitude $74^{\circ} 13'$, we saw a flock of phalaropes.

In the evening of May 20, in about north latitude $38^{\circ} 42'$, west longitude $74^{\circ} 21'$, a small flock of phalaropes was observed, and on the 26th of May we saw a flock of the same birds near Montauk.

In the evening of May 9 three jagers were tolled up with liver, but not close enough to be shot. Two of these birds were near us on May 29, but the sea was too rough to attempt their capture.

Petrels, Cary chickens, called "sailors' ghosts" by the fishermen, were seen everywhere, and could frequently be brought up alongside by the use of fish-chum close enough to be caught with dip-nets.

Land birds were occasionally noticed at sea. A chestnut-crowned sparrow came aboard on the morning of April 29 when we were probably 50 miles offshore, and a small hawk was alongside on the same evening. On the 9th of May, when we were 49 miles offshore, a red-headed woodpecker flew on board the *Grampus*.

May 27, 40 miles southeast $\frac{1}{2}$ east from Block Island, Captain Harty reported birds plentiful.

Bird feathers.

At 8.30 p. m. May 23, in north latitude $40^{\circ} 19'$ west longitude $73^{\circ} 06'$, some floating feathers were obtained in the towing-net. These are considered by fishermen to indicate the presence of fish in the direction from which the feathers come.

NOTICE OF THE SMALL SURFACE ORGANISMS TAKEN IN THE TOW-NETS, AND OF THE CONTENTS OF MACKEREL STOMACHS, BY RICHARD RATHBUN.

The number of lots of towings handed to me for examination was 36. Some of these were obtained by means of a large conical net, of rather coarse mesh, intended principally for the capture of fish, and in which never more than a trifling quantity of the smaller animals was retained; the larger number were taken in the ordinary pattern of tow-net, made of silk bolting-cloth, and measuring 12 inches across at the mouth and about 22 inches deep; a few were secured with a dip-net. They were all taken at the surface between April 25 and May 30, 1887. The positions have been described elsewhere by Dr. Bean, and are also given below, in connection with the list of species obtained at each locality.

The best results, as regards the smaller animals, were obtained with the 12-inch tow-net, and although the distance actually traversed by the net each time that it was used was not determined, yet we have been able to form some idea of the relative abundance of life in a given area at the surface during the beginning of the mackerel season. The usual length of a towing was from one-half hour to one hour, the vessel sailing at the rate of 2 or 3 knots an hour. The quantity of material from each towing was calculated by liquid measure, the specimens first being allowed to settle thoroughly in the bottle containing them. While this method did not afford absolute results, by measuring the contents of the mackerel stomachs in the same manner a comparison of the two was rendered possible.

The quantity of specimens in each lot of towings was from 1 to 20 drams. One towing, affording 18 drams, was made in 15 minutes May 9, beginning at 8.15 p. m. The 25 towings with the 12-inch net resulted in a total catch of 115 drams of specimens, or an average of $4\frac{3}{5}$ drams to a towing.

The contents of the stomachs of mackerel were preserved on two days only, May 10 and May 13. The size of the fish was from 11 to $13\frac{1}{2}$ inches in length. On the first day mentioned the quantity of food taken from the stomachs averaged 4 drams to a stomach; on the second day it averaged $5\frac{1}{2}$ drams, except in the case of one specimen, which afforded 8 drams. The average quantity of food to a stomach, therefore, agreed very closely with the average results of a towing with the 12-inch net.

These deductions, however, are based upon too few observations to have any special significance. It is well known that the surface organisms serving as food for mackerel and other pelagic fishes are very unequally distributed, and are constantly changing their position, appearing and reappearing under the varying conditions of the water and atmosphere. While sometimes they are apparently absent over wide areas, at others they form dense clouds, plainly distinguishable by their

color. Such swarms would readily attract the schools of rapidly swimming fishes, while they might easily escape the notice of a fishing-vessel moving slowly from place to place. It is also probable, from previous observations of the Fish Commission; that the mackerel feeds to some extent below the surface.

As to the character of its food the mackerel probably exercises little discrimination, but swallows all the smaller objects occurring in its path. Certain species or groups of species are, however, much more abundant than others, and these are recognized as its common or appropriate food. Such are the copepods, the pelagic amphipods, some of the pteropods, and perhaps *Sagitta*. On the present cruise several species of copepods, *Themisto bispinosa* of amphipods, *Spirialis*, sp. of pteropods, and *Sagitta elegans* were the most common and wide-spread, and they were all abundant in the stomachs examined.

A list of the forms identified from the towings and an account of the contents of each towing are given below. In the hasty examination made, many species have undoubtedly escaped notice, and the lists should be regarded as containing only the more common or more conspicuous forms. But few jelly-fishes, representing only two genera and species of small size, were preserved, though other forms were taken by the schooner. *Sagitta* was often very abundant, but annelids were exceedingly rare, and not more than three or four species were observed. Of copepods *Temora longicaudata* was identified from most of the towings; *Calanus*, sp., was nearly as wide-spread, and often more abundant; *Centropages typicus* was very common; *Pleuromma*, sp., composed the bulk of one of the towings, and two of the smaller lots consisted almost exclusively of *Anomalocera Patersonii*. *Themisto bispinosa*, of amphipods, was nearly always present, and sometimes in great abundance, though often young and small; *Calliopius leviusculus* occurred only in Fort Pond Bay, Long Island, and Narragansett Bay. Isopods were rare and represented by only one genus, *Idotea*, of which three species were taken, one, however, only in Narragansett Bay. The Schizopoda and Decapoda were represented by young stages only. Of pteropods, *Olione limacina* was moderately abundant at times, while *Spirialis* was often very common, in some cases composing a large proportion of the bulk of the towing. *Salpa Caboti* occurred only in one instance. The eggs and embryos of fishes were sometimes abundant, but there was seldom any trace of vegetable life, except in the rare occurrence of small decayed fragments, apparently of eel grass, *Zostera*. An interesting feature was the finding of so many species of insects blown or drifted from the shore. Seventeen species belonging to four orders were taken, but each species was represented by only one to four specimens.

Prof. S. I. Smith kindly examined the amphipods, schizopods, cumacea and decapods, and has furnished such identifications as are given. Mr. J. Walter Fewkes has determined the Medusæ, Mr. William H. Dall the Mollusca, and Mr. John B. Smith the insects.

LIST OF THE FORMS IDENTIFIED FROM THE TOWINGS.

CŒLEENTERATA.

HYDROMEDUSÆ.

Trachynema digitale A. Agassiz.

CTENOPHORA.

Pleurobrachia rhododactyla Agassiz.

WORMS.

CHÆTOGNATHA.

Sagitta, sp., probably *Sagitta elegans* Verrill.

CHÆTOPODA.

Tomopteris, sp., and two or three other undetermined forms.

CRUSTACEA.

OSTRACODA.

One undetermined species.

COPEPODA.

Calanus. (Two or more species which have not been identified.)

Pleuromma, sp.

Temora longicaudata Lubbock.

Centropages typicus Kröyer.

Centropages hamatus Lilljeborg.

Anomalocera Patersonii Templeton.

Candace pectinata Brady.

AMPHIPODA.

Themisto bispinosa Bœck.

Calliopius læviusculus Bœck. (From Fort Pond Bay, Long Island, and Narragansett Bay.)

ISOPODA.

Idotea irrorata Edwards.

Idotea robusta Kröyer.

Idotea phosphorea Harger. (From Narragansett Bay.)

CUMACEA.

The young of one undetermined species, represented by a single specimen.

SCHIZOPODA.

Nyctiphanes norvegica G. O. Sars (?), young; also the very young of one or more undetermined species.

DECAPODA.

Larval Macrurans, Anomurans, and Brachyurans.

MOLLUSCA.

HETEROPODA.

Firola, sp.

PTEROPODA.

Clione limacina Phipps.

Spirialis. (Represented by at least two species, one with a tall, the other with a short spire; the latter is the more common.)

TUNICATA.

Salpa Cabotii Desor.

INSECTA.

COLEOPTERA.

Bradycellus rupestris Say. 2 specimens.

Psyllobora 20-maculata Say. 1 specimen.

DIPTERA.

Limnophila? 2 species; each 1 specimen.

Goniomyia? 2 species; each 1 specimen.

Erioptera? 1 species; 1 specimen.

Geranomyia. 1 species; 1 specimen.

Eristalis transversus Wied. 1 specimen.

Nemotelus, sp. 1 specimen.

Anthomyia, sp. 4 specimens.

Drosophila, sp. 1 specimen.

Muscid. 1 sp. Loc. uncertain. 1 specimen.

HEMIPTERA. (HETEROPTERA.)

Euschistus variolaris Beauv. 1 specimen.

HEMIPTERA. (HOMOPTERA.)

Siphonophora, sp. 3 specimens.

ARANEA.

Misumena americana Keys. 2 specimens.

Epeira labyrinthica Hentz (young). 1 specimen.

DESCRIPTIONS OF THE CONTENTS OF THE TOWINGS, ARRANGED CHRONOLOGICALLY.

April 25, 6 a. m. (lat. $37^{\circ} 36' N.$, long. $74^{\circ} 28' W.$); large net. Contained about 25 specimens of *Themisto bispinosa*, 2 specimens of *Olione limacina*, and about 15 specimens of *Spirialis*, sp.

April 27, 6 to 7 a. m. (lat. $37^{\circ} 43' N.$, long. $74^{\circ} 15' W.$); large net. Contained about 20 specimens of *Themisto bispinosa*, and 1 each of *Nyctiphanes norvegica* (?), young, and *Pleurobrachia rhododactyla*.

April 27, 8 a. m. (lat. $37^{\circ} 43' N.$, long. $74^{\circ} 15' W.$); small net; quantity 5 drams. Consisted almost entirely of *Calanus*, sp., with *Centropages hamatus*, abundant, and the following very rare: *Themisto bispinosa*, *Sagitta*, *Olione limacina*.

April 27, 2.35 to 3 p. m. (lat. $37^{\circ} 43' N.$, long. $74^{\circ} 15' W.$); small net; quantity 5 drams. The bulk consisted of *Calanus*, sp., and *Centropages typicus*, with a few other species of copepods in small numbers. *Sagitta* and *Olione limacina* were abundant, and the following rare: *Themisto bispinosa*, *Trachynema digitale*, and fish eggs.

April 27, about 6 p. m. (lat. $37^{\circ} 45' N.$, long. $74^{\circ} 15' W.$); large net. The following were represented by from 1 to a few specimens each: fish eggs, *Nyctiphanes norvegica* (?), young, *Themisto bispinosa*, *Candace pectinata*, *Sagitta*, *Olione limacina*, *Salpa Cabotii*.

April 28 (lat. $37^{\circ} 40' N.$, long. $74^{\circ} 13' W.$); small net; quantity 2½ drams. Consisted almost entirely of the following copepods: *Calanus*, sp., *Centropages hamatus*, and *Temora longicaudata*. There were also a few fish eggs, an abundance of a filamentous diatom, and a single specimen of *Trachynema digitale*.

April 29 (lat. $37^{\circ} 42' N.$, long. $73^{\circ} 53' W.$); small net; quantity 2 drams. Consisted mostly of the following copepods: *Calanus*, sp., *Temora longicaudata*, and *Centropages hamatus*. *Themisto bispinosa*, young, and *Sagitta* also occurred sparingly.

April 30, 7 p. m. (lat. $38^{\circ} 12' N.$, long. $74^{\circ} 26' W.$); large net. Contained a quantity of *Themisto bispinosa* and *Firola*, sp., with *Trachynema digitale*.

May 1, 6.15 to 7 p. m. (lat. $37^{\circ} 36' N.$, long. $74^{\circ} 31' W.$); large net. Contained about a dozen specimens each of *Themisto bispinosa* and *Olione limacina*.

May 2 (lat. $38^{\circ} 25' N.$, long. $74^{\circ} 50' W.$); small net; quantity 1 dram. Consisted mostly of *Temora longicaudata*, with *Calanus*, sp., and *Centropages typicus*. Fish eggs were also abundant.

May 6 (lat. $38^{\circ} 43' N.$, long. $73^{\circ} 48' W.$); large net. Contained from one to a few specimens each of the following forms: *Temora longicaudata*, zoæ of crabs, *Themisto bispinosa*, and *Pleurobrachia rhododactyla*.

May 6 (lat. $38^{\circ} 43' N.$, long. $73^{\circ} 48' W.$); small net; quantity 6 drams. Consisted mostly of *Calanus*, sp., with *Temora longicaudata* very abundant, and *Centropages typicus* and *Spirialis*, sp., common.

May 6 (lat. $38^{\circ} 19' N.$, long. $74^{\circ} 21' W.$); small net; quantity 6 drams.

Consisted almost exclusively of the following species of copepods: *Calanus*, sp., *Temora longicaudata* and *Centropages hamatus*, with a few *Sagittas*.

May 9, 8.15 p. m. (lat. 38° 10' N., long. 74° 16' W.); small net; quantity 18 drams. The net was out only fifteen minutes, and the bulk of the catch consisted apparently of one species of copepod, *Temora longicaudata*. *Themisto bispinosa*, young, and *Sagitta* were also abundant.

May 10 (lat. 38° 06' N., long. 74° 13' W.); small net; quantity 5½ drams. The bulk consisted of copepods, principally *Temora longicaudata*, with *Calanus*, sp., and *Centropages typicus*, both common, and *Anomalocera Patersonii* rare. A few specimens of *Sagitta*, *Spirialis*, sp., and fish eggs, and one specimen of *Pleurobrachia rhododactyla* also occurred.

May 10 (lat. about 38° 11' N., long. about 74° 12' W.); small net; quantity 2 drams. Composed almost entirely of *Temora longicaudata*, with some specimens of *Centropages typicus*, *Calanus*, sp., and *Anomalocera Patersonii*.

May 10 (lat. about 38° 11' N., long. about 74° 12'); large net. Contained 1 to 3 specimens each of *Themisto bispinosa*, *Idotea irrorata*, and *Pleurobrachia rhododactyla*.

May 11 (lat. 38° 11' N., long. 74° 23' W.); small net; quantity 1 dram. Contained the following species: *Temora longicaudata*, *Centropages typicus*, *Calanus*, sp., *Sagitta*, *Spirialis*, sp.

May 12 (lat. 38° 30' N., long. 74° 02' W.); small net; quantity 3 drams. The bulk consisted of *Spirialis*, sp., and the following species of copepods: *Calanus*, sp., *Centropages typicus*, *Temora longicaudata*, and *Anomalocera Patersonii*. *Sagitta* was common; *Nyctiphanes norvegica* (?), young, moderately abundant, and *Olione limacina*, *Pleurobrachia rhododactyla*, and fish eggs, few. The following insects were also taken: *Bradycellus rupestris*, 2 specimens; *Goniomyia* (?), sp., one specimen, and a specimen of an undetermined Muscid.

May 12, 7 p. m. (lat. 38° 40' N., long. 73° 53' W.); small net; quantity 6 drams. Consisted mostly of small crustaceans and *Spirialis*, sp. *Calanus*, sp., very abundant; larval crustaceans and *Sagitta* very common; *Anomalocera Patersonii*, *Candace pectinata*, and *Temora longicaudata* common; *Themisto bispinosa*, young, few; *Idotea robusta*, four. The contents of this towing was labeled as the "Cayenne," of the fishermen, probably referring to the red color of the species of *Calanus*.

May 12 (lat. 38° 40' N., long. 73° 53' W.); dip-net; quantity 2 drams. The bulk consisted of *Nyctiphanes norvegica* (?), young, with very little else, the following, however, being represented: *Anomalocera Patersonii*, *Centropages typicus*, *Calanus*, sp., *Themisto bispinosa*, young, *Olione limacina*, and two specimens representing two species of insects, *Euschistus variolaris* and *Limnophila*, (?) sp.

May 13 (lat. 37° 48' N., long. 74° 13' W.); small net; quantity 4 drams. Consisted mainly of copepods and *Spirialis*, sp.: *Centropages typicus* appears to be the most abundant of the copepods, with *Calanus*, sp.,

and *Pleuromma*, sp., common. *Oliane limacina* and decapod larvæ were also common.

May 14, evening (lat. 38° 03' N., long. 74° 12' W.); small net, quantity 4 drams. The bulk consisted of *Themisto bispinosa*, and of copepods, of which *Calanus*, sp., seemed to be the most abundant, with *Centropages typicus* nearly as common, and *Candace pectinata*, rare. *Sagitta* and *Spirialis*, sp., were also very abundant, and larval decapods, *Oliane limacina* and *Pleurobrachia rhododactyla*, all common.

May 15, 7.30 p. m. (lat. 38° 39' N., long. 74° 03' W.); small net, quantity 2 drams. Consisted mainly of the following copepods: *Calanus*, sp., *Centropages typicus*, *Temora longicaudata* and *Pleuromma*, sp., with *Anomalocera Patersonii*, rare. *Spirialis*, sp., and fish eggs were common; and *Themisto bispinosa*, young, the zoeæ of crabs, and annelids were rare.

May 20, morning (lat. 38° 42' N., long. 74° 21' W.); small net, quantity 4 drams. Consisted mostly of *Temora longicaudata*, *Calanus*, sp., *Centropages typicus*, and the zoeæ of crabs. The following were also abundant: Fish eggs, *Sagitta*, *Spirialis*, sp.

May 20, 7.30 p. m. (lat. 38° 50' N., long. 74° 06' W.); small net, quantity 6 drams. The bulk consisted mainly of one species of copepod, *Anomalocera Patersonii*, with *Calanus*, sp., and *Centropages typicus*, abundant, and *Candace pectinata*, rare. The following also occurred: Embryo fishes, very abundant; fish eggs, few; decapod larvæ, common; *Themisto bispinosa*, young, few; *Ostracoda*, common; *Sagitta*, few; *Oliane limacina*, few; *Spirialis*, sp., abundant; *Pleurobrachia rhododactyla*, abundant. The following insects were taken, from one to three specimens of each: *Geranomyia*, sp., *Eristalis transversus*, *Siphonophora*, sp., *Misumena americana*, *Epeira labyrinthica*, young.

May 20, 7.45 p. m. (lat. 38° 50' N., long. 74° 06' W.); large net. Contained a few *Sagittas* and a few crustacean larvæ.

May 21, morning (lat. about 38° 56' N., long. 73° 47' W.); small net, quantity 1 dram. Consisted almost exclusively of *Anomalocera Patersonii*, which were noticed as the green crustaceans.

May 21, evening (lat. about 39° 26' N., long. 73° 40' W.); very small amount, consisting almost entirely of *Anomalocera Patersonii*, as in the previous towing.

May 22, 8 a. m. (lat. about 39° 43' N., long. about 73° 39' W.); small net, quantity 1½ drams. *Temora longicaudata*, *Centropages typicus*, *Calanus*, sp., and fish eggs very abundant; larval decapods, *Spirialis*, sp., and *Sagitta*, few; 1 specimen of annelid.

May 22, 8 p. m. (lat. 39° 45' N., long. 73° 49' W.); small net, quantity 20 drams. Composed mainly of copepods and larval decapods, the former consisting mostly of *Temora longicaudata*, with *Calanus*, sp., common, and *Candace pectinata* rare; and the latter including representatives of *Brachyura*, *Anomura*, and *Macrura*. Other forms were observed as follows: The young and eggs of several species of fishes;

Themisto bispinosa, moderately abundant; 1 young Cumacean; *Sagitta*, abundant; 3 species of annelids, including *Tomopteris*, few; *Spirialis*, sp., abundant. The following insects were also taken: *Psyllobora 20-maculata*, 1 specimen; *Erioptera* (?), sp., 1 specimen; *Limnophila* (?), sp., 1 specimen; *Anthomyia*, sp., 4 specimens; *Drosophila*, sp., 1 specimen.

May 23, 6 a. m. (lat. 39° 44' N., long. 73° 46' W.); small net, quantity 4 drams. Consisted mainly of copepods and larval crustaceans of several kinds. *Temora longicaudata* was the most abundant of the copepods, with *Centropages typicus*, common, and *Candace pectinata*, rare. The following were also represented: Fish eggs, common; *Themisto bispinosa* (?), very young, rare; *Tomopteris*, sp., 1 specimen; *Sagitta*, few; *Olione limacina*, few; *Spirialis*, sp., few.

May 23, 8.20 p. m. (lat. 40° 19' N., long. 73° 06' W.); small net, quantity 2 drams. Composed mostly of copepods (*Centropages typicus*, *Calanus*, sp., and *Temora longicaudata*), with an abundance of fish eggs and decayed sea-weed. *Sagitta* was common, and *Themisto bispinosa*, young, and larval crustaceans were rare. One specimen each of the following insects were also observed: *Goniomyia* (?), sp., and *Nemotelus*, sp.

May 26; Fort Pond Bay, Long Island, N. Y.; small net, quantity 1½ drams. Composed mostly of amphipods (*Calliopius laeviusculus* Bæck) and copepods, the latter apparently consisting exclusively of *Temora longicaudata*. Fish eggs were abundant, and there were also two specimens of *Pleurobrachia rhododactyla*.

May 30, 9.30 a. m.; Narragansett Bay, R. I. The following species were taken in the dip-net: *Calliopius laeviusculus*, 1 specimen; *Idotea irrorata*, 10 specimens; and *Idotea phosphorea*, 1 specimen.

CONTENTS OF THE STOMACHS OF MACKEREL.

May 10 (lat. 38° 07' N., long. 74° 21' W.), the stomachs were taken from a number of mackerel, and they or their contents were preserved in four jars of alcohol. The stomachs being preserved, with their contents, in three of the jars, give us the means of measuring their capacity, which averaged 4 drams each, the stomachs being much distended and tightly packed with food. The contents of one stomach consisted almost exclusively of adult *Themisto bispinosa*, which gave to the mass a dark purplish or purplish brown color. *Temora longicaudata* and Nematode parasites were also present in small numbers. In eight of the stomachs the bulk of the contents consisted of copepods, mostly *Temora longicaudata*, with *Pleuromma*, sp., very abundant. *Spirialis*, sp., was abundant, and *Themisto bispinosa*, common, the latter being conspicuous from its darker color and larger size, but forming a comparatively small proportion of the mass. Nematode parasites were also common, and fish eggs rare.

May 13 (lat. 37° 48' N., long. 74° 13' W.), a number of mackerel were obtained from the fishing-schooner *Henry Morganthau*, caught with a purse-seine in a depth of 37 fathoms. Thirteen stomachs, with their

contents, were preserved in alcohol. Twelve of these stomachs were of about the same size, and contained on an average $5\frac{1}{2}$ drams of food; one was considerably larger, and contained 8 drams of food. The species composing the food varied in their relative abundance in the different stomachs, but in all cases the bulk of the contents consisted of copepods, and in some this group of crustaceans formed nearly the entire mass. *Pleuromma*, sp., was apparently the most common of the copepods, with *Oalanus*, sp., very abundant; *Candace pectinata* rare to common, and *Centropages typicus* rare. *Themisto bispinosa* was rare to common, and always conspicuous from its color; Macruran larvæ and young Schizopods occurred sparingly; *Sagitta* and *Spirialis*, sp., were abundant. Nematode parasites were common in nearly all the stomachs.

56.—NOTES ON CERTAIN FISHERY INDUSTRIES OF EASTPORT, MAINE, IN 1886.

By R. EDWARD EARLL.

I.—THE WINTER HERRING FISHERY AND THE FROZEN-HERRING TRADE.

The frozen-herring trade of the United States originated with Gloucester fishermen, who brought the first cargoes from Newfoundland in the winter of 1854-'55, and found a ready sale for them at Gloucester and Boston. Others soon engaged in the business, and within a few years quite a number of vessels were employed regularly in bringing frozen fish from Newfoundland to the New England markets.

The hardships encountered in the long and dangerous passage to and from the island during the winter months deterred many who would gladly have engaged in the business from visiting Newfoundland, and these began to look for localities nearer home from which they could purchase their fish. The abundance of herring at Eastport soon attracted the attention of this class, and about 1866 vessels in this trade began to come to this locality, which from its position warranted the using of smaller craft, and from its nearness to the market enabled them to make a much larger number of trips during the season. The greater competition, however, soon advanced the cost of fish so that the profits of the winter's work were usually no greater, if indeed as great, as if the vessels went to Newfoundland. The trade at Eastport has, however, gradually increased, and for the last ten years has had a very decided influence upon the prosperity of the fishermen on either side of the line separating Canada and the United States. The trade has varied considerably from year to year, owing to the mildness or severity of the winter, which has a decided influence upon the industry, a cold winter rendering it prosperous, while frequent thaws often result in serious loss to all concerned, and, owing to the risks incurred, cause buyers to re-