
EX LIBRIS
54

42D CONGRESS, 2d Session. | SENATE. | MIS. DOC. No. 61.

UNITED STATES COMMISSION OF FISH AND FISHERIES.

PART I.

REPORT

ON THE

CONDITION OF THE SEA FISHERIES

OF THE

SOUTH COAST OF NEW ENGLAND

IN

1871 AND 1872.

BY

SPENCER F. BAIRD,
COMMISSIONER.

WITH SUPPLEMENTARY PAPERS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1873.

FORTY-SECOND CONGRESS, SECOND SESSION.

IN THE SENATE OF THE UNITED STATES,
February 6, 1872.

Ordered to lie on the table and be printed.

IN THE SENATE OF THE UNITED STATES,
February 19, 1872.

Resolved by the Senate, (the House of Representatives concurring,) That five thousand extra copies of the report of the Commissioner of Fish and Fisheries be printed, one thousand five hundred for the use of the Senate, three thousand for the use of the House of Representatives, and five hundred for the use of the Commissioner.

Attest:

GEO. C. GORHAM,
Secretary.

IN THE HOUSE OF REPRESENTATIVES,
March 5, 1872.

Resolved, That the House concur in the foregoing resolution of the Senate to print extra copies of the "Report of the Commissioner of Fish and Fisheries."

Attest:

EDW. McPHERSON,
Clerk

Mollusks

UNITED STATES COMMISSION, FISH AND FISHERIES,
Washington, January 31, 1872.

SIR: In pursuance of a joint resolution of Congress, I have the honor to present herewith a report of operations and inquiries prosecuted during the year 1871 in reference to the decrease of the food-fishes on the sea-coast and in the lakes of the United States.

Very respectfully, your obedient servant,

SPENCER F. BAIRD,
Commissioner.

HON. SCHUYLER COLFAX,
President of the Senate.

CONTENTS

REPORT OF THE COMMISSIONER.

ACCOMPANYING PAPERS.

For a list of these, see the end of the volume

I.—REPORT OF THE COMMISSIONER.

PRELIMINARIES OF THE INQUIRY.

The importance to the United States of the fisheries on its coasts can scarcely be exaggerated, whether we consider the amount of wholesome food which they yield, the pecuniary value of their products, the number of men and boys for whom they furnish profitable occupation, the stimulus to ship and boat building which they supply, and, not the least of all, their service as a school for seamen, from which the merchant-marine, as well as the Navy of the country, derive their most important recruits.

A few years ago, in view of the enormous abundance of fish originally existing in the sea, the suggestion of a possible failure would have been considered idle; and the fisheries themselves have been managed without reference to the possibility of a future exhaustion. The country has, however, been growing very rapidly; the construction of railroads and the use of ice for packing have furnished facilities for sending fish in good condition all over the country, and the demand for them has increased in proportion. The object of those engaged in the fisheries has been to obtain the largest supply in the shortest possible time, and this has involved more or less of waste, and, in some cases, reckless destruction of the fish.

The discovery, too, that fish can be made to supply a valuable oil by boiling and pressing, and that the residue, as well as the uncooked fish, furnish a valuable manure, to be applied either directly or after special preparation, has constituted an additional source of consumption on a very large scale.

As might have reasonably been inferred, the supply, which formerly greatly exceeded the demand, now, to a certain extent at least and in certain localities, has failed; and the impression has become prevalent that the fish themselves are diminishing, and that in time some kinds, at least, will be almost or quite exterminated. This assertion is made with reference to several species that formerly constituted an important part of the food supply; and the blame has been alternately laid upon one or another of the causes to which this result is ascribed, the fact of the decrease being generally considered as established.

The first official notice taken of this state of affairs, with the view of adopting measures for relief, was on the part of the States of Massachusetts and Rhode Island, both being especially interested in the question, as the greatest depreciation was alleged to have occurred on their southern border. The cause assigned by those who complained most of the result was the multiplication of "traps" and "pounds," which captured fish of all kinds in great numbers, and, as was supposed, in greater quantity than the natural fecundity of the fish could make good year by year, especially in view of the fact that these catches were made during the spawning season, thereby destroying many of the fertile fish and preventing others from depositing their eggs.

Petitions were presented to the legislatures of both these States in the winter of 1869–'70, asking that a law be passed prohibiting the use of fixed apparatus for capturing fish; and the whole subject came before special committees of the legislatures, and was discussed in all its bearings. The Massachusetts committee, of which Captain Nathaniel Atwood, of Provincetown, was chairman, after considering the evidence adduced, decided that there was no reasonable ground for the complaint, and that any action on the part of the State was inexpedient. (See page 117 of the present report.)

On the other hand, the Rhode Island committee, after giving a much greater amount of personal attention to the matter, came to the conclusion that the prayer of the petitioners was well founded, and they reported in favor of a very stringent law, prohibiting the further use of "traps" or "pounds," excepting within a limited district. (Page 104.) So far from agreeing with the Massachusetts committee on this subject, they gave it as one result of their inquiry that the difference in abundance of food-fishes between the present time and that ten years ago involved an increase in expense of at least $100 per annum to one thousand persons, resident on or near the sea-coast; or, in other words, that one thousand families were taxed to the amount of $100 a year for the purchase of food which previously was readily taken by one or other of its members, at odd moments of time throughout the season. So totally different were the conclusions arrived at by the two committees.*

The report against the prayer of the petitioners, made by the committee of the Massachusetts State senate, settled the question for the time, and no further action was taken. The report of the Rhode Island committee, however, was presented to the legislature, but nothing definite was done. In this State it became a political question rather than an economical one, and shared with the regular issues in determining the result of elections. Rhode Island being strongly republican, the republican ticket was usually elected without any question; but the

* This remarkable contradiction in the results of the two commissions showed the necessity of a special scientific investigation on this subject, to be prosecuted in the way of direct experiment upon the fish themselves, their feeding and breeding grounds. It will be observed that the conclusions depended generally upon the evidence of fishermen alone. The same was the case with the British commission, of which Professor Huxley was a member, and which in the course of its researches visited eighty-six places on the coast of England, and had before them large numbers of persons engaged in the fisheries, some of them using nets and trawls, and others lines. These gentlemen reported that there was no proof adduced to show that the supply of fish in the British seas had decreased, and therefore they opposed any restrictions.

nominee of that party for lieutenant-governor, being looked upon as opposed to the abolition of the trapping of fish, was defeated by the popular vote, although subsequently elected by the legislature. The prevailing sentiment throughout the greater part of the State appeared to be in favor of the prohibition of traps, a measure which was confidently anticipated by all parties, although the propriety of such a course was contested by many persons whose judgment was entitled to consideration. Among these was Mr. Samuel Powel, a member of the State senate, who insisted that the question was too little understood to warrant such action, and that it should first be made the subject of inquiry on the part of scientific men before a proper decision could be reached.

In the accompanying foot-note I present a communication from Dr. Hudson, received as this report is going through the press, in regard to the action on the same subject taken by the State of Connecticut.* This has more particular reference to shad and salmon, but has a part in the general inquiry.

---

*STATE OF CONNECTICUT, DEPARTMENT OF FISHERIES,
Hartford, Connecticut, January 2, 1873.

DEAR SIR: You ask for a short history of the efforts made to secure a law prohibiting pounds used for the taking of shad, or prospectively of salmon. In 1866 the Commissioners of fisheries of the New England States met at Boston to discuss measures for restoring salmon and increasing the number of shad in the different rivers of the States. The Connecticut River of our State was the only stream under special discussion, as four of the States, New Hampshire, Vermont, Massachusetts, and Connecticut were all equally interested. An agreement was finally made that the commissioners of Vermont and New Hampshire were to furnish all the salmon-fry necessary to restock the river, Massachusetts was to furnish fishways for all dams on the river in the State, and the Connecticut commissioners were to procure a law abolishing pounds at the mouth of the river. In accordance with this agreement, our commissioners succeeded in having a law passed in 1868, approved July 31, 1868, section 2 of which is as follows: "That from and after the year 1871 it shall be unlawful for any person to erect, construct, or continue in the waters along the northerly shore of Long Island Sound, in this State, any weir or pound for the taking of fish." You will notice that no penalty is provided in case of non-observance of the law. To remedy this defect a law (which I inclose) was passed in 1871, approved July 24, 1871, making a penalty of $400, but giving a majority of the commissioners authority to grant permits. As Massachusetts had built no fishways, and New Hampshire and Vermont did not pretend to live up to their promise in consequence, permits were granted under certain restrictions, and in 1872 the legislature passed a new law by which pounds may be allowed to fish except from sunrise on Saturday until sunrise on Monday, with a few hours' allowance for tides. All restrictions on fykes have been repealed.

Yours, very truly,

WM. M. HUDSON.

Prof. S. F. BAIRD, *Washington, D. C.*

AN ACT in addition to an act for encouraging and regulating fisheries.

Be it enacted by the senate and house of representatives, in general assembly convened:

SECTION. 1. That upon a written request of the fish commissioners, or a majority of them the selectmen of any town in the State shall appoint two or more such persons as shall be approved by such fish commissioners to be fish wardens, whose duty it shall be to assist the fish commissioners in detecting and prosecuting offenses against the fishery laws of the State, and who shall be paid a suitable compensation from the treasurer of

In view of such considerations as were adduced by Mr. Powel, and of the contrariety of opinion on the part of State committees, it was deemed desirable that the whole matter should be investigated by some scientific officer of the general Government presumed to be competent to the inquiry and entirely uninfluenced by local considerations. Indeed, as the alleged diminution of the fisheries was in tidal and navigable waters of the United States, and over which the Federal Government exercises jurisdiction in other matters, it was maintained by many that the State governments had no control, and that any enactments on the subject must be made by Congress; especially as, if left to the States, it would be impossible to secure that harmony and concurrence of action necessary for a successful result.

It will be observed that in all these cases the question turned upon the evidence of men who were interested in one way or another, and whose daily bread might depend largely upon the conclusions arrived at. Many of them had made large investments of money in nets and boats, while others who had no such interests acted upon the natural antipathy that seems to exist between those using the net and those fishing with the line. It was also shown, by some of the testimony, that in many instances persons were biased in their evidence by intimidation, either expressed or understood, on the part of the owners of nets. Ad-

---

the town; and in addition thereto shall have one-half the penalty that may be recovered and paid into the treasury for any offense detected by them.

SEC. 2. Chapter 27 of the session laws of 1869, approved June 21, 1869, is hereby appealed.

SEC. 3. After the year 1871, any person who shall set, use, or continue, or shall assist in setting, or using any pound, weir, set-net, or other fixed or permanent contrivance for catching fish in any of the waters within the jurisdiction of the State without the written permission of the majority of the fish commissioners, shall forfeit and pay the sum of $400 to the treasury of the State.

SEC. 4. All the provisions of the third and fourth sections of the act entitled "An act in addition to an act for encouraging and regulating fisheries," passed May session, 1867, and approved July 26, 1867, are hereby extended and shall fully apply to this act; and all parts of acts heretofore passed which are inconsistent with this act are hereby repealed.

SEC. 5. In addition to the penalties provided in section three, any justice of the peace for the county in which such pound, weir, set-net, or other fixed or permanent contrivance has been so set up, used, or continued, or where any persons shall violate any of the laws of this State by fishing at such times as are prohibited by law, is hereby authorized and directed, upon the written request of any fish commissioner or fish warden, to issue his warrant commanding the sheriff, constable, or any other proper person or persons in such warrant named, to cause the same to be seized forthwith, together with all the parts thereof, and all nets, seines, boats, oars, sails, tackle, ropes, and other articles employed therewith, or used in violation of the laws of this State as aforesaid, and to be removed and sold at public auction to the highest bidder, and, after paying out of the proceeds of such sale all the expenses of such seizure, removal, and sale, to deposit what remains in the treasury of the State. The provisions of this act shall not apply to any pounds set for the purpose of catching white fish between the eastern boundary of the town of Clinton and Pond Point, in the town of Milford.

SEC. 6. All acts or parts of acts inconsistent herewith are hereby repealed.

Approved July 24, 1871.

mitting, however, that the use of nets of certain kinds has done a great part, or even the whole, of the mischief complained of, it was a matter worthy of serious inquiry whether so positive a measure as absolute prohibition was expedient or necessary, and whether by limiting the time during which the use of nets is allowed, the interests of both parties may not be reconciled, by giving to the fish the opportunity of spawning undisturbed, and also by regulating the size of the mesh, so as to catch only the oldest and largest fish. All this, however, was only to be ascertained by a careful study of the habits of the fish, so as to determine the nature of their food, the growth of their spawn, and other circumstances bearing upon the solution of the problem in question.

The following bill for this purpose was therefore introduced into the House of Representatives by the Hon. H. L. Dawes, and became a law on the 9th of February, 1871:

[RESOLUTION OF GENERAL NATURE—No. 8.]

JOINT RESOLUTION for the protection and preservation of the food-fishes of the coast of the United States.

Whereas it is asserted that the most valuable food-fishes of the coast and the lakes of the United States are rapidly diminishing in number, to the public injury, and so as materially to affect the interests of trade and commerce: Therefore,

Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the President be, and he hereby is, authorized and required to appoint, by and with the advice and consent of the Senate, from among the civil officers or employés of the Government, one person of proved scientific and practical acquaintance with the fishes of the coast, to be commissioner of fish and fisheries, to serve without additional salary.

SEC. 2. *And be it further resolved,* That it shall be the duty of said commissioner to prosecute investigations and inquiries on the subject, with the view of ascertaining whether any and what diminution in the number of the food-fishes of the coast and the lakes of the United States has taken place; and, if so, to what causes the same is due; and also whether any and what protective, prohibitory, or precautionary measures should be adopted in the premises; and to report upon the same to Congress.

SEC. 3. *And be it further resolved,* That the heads of the Executive Departments be, and they are hereby, directed to cause to be rendered all necessary and practicable aid to the said commissioner in the prosecution of the investigations and inquiries aforesaid.

SEC. 4. *And be it further resolved,* That it shall be lawful for said commissioner to take, or cause to be taken, at all times, in the waters of the sea-coast of the United States, where the tide ebbs and flows, and also in the waters of the lakes, such fish or specimens thereof as may in his judgment, from time to time, be needful or proper for the conduct of his duties as aforesaid, any law, custom, or usage of any State to the contrary notwithstanding.

Approved February 9, 1871.

As passed, the resolution provided for the extension of the inquiry to the lakes, at the instance of some of the western members, who desired that the subject of the diminution in the supply of white-fish and other species in the western waters should be investigated.

To carry out the provisions of the law, an appropriation was made by Congress to meet the necessary expenses of the investigation, and the position of commissioner (without salary) having been tendered by the President, I accepted it, with the determination of giving to the inquiry as much consideration as the time at my disposal would permit; and, receiving the necessary leave of absence from Professor Henry, the secretary of the Smithsonian Institution, I proceeded to Vineyard Sound early in June, 1871, as it was in that region that the alleged decrease was most clearly manifested, and established my headquarters at Wood's Hole, a village on the coast about eighteen miles from New Bedford, and directly opposite Holmes's Hole, (now Vineyard Haven.) From this center I could readily reach all such points on the adjacent coast, as were most likely to furnish important facts bearing on the question. About the same time Mr. J. W. Milner, of Waukegan, Illinois, a gentleman of scientific training and ability, proceeded to Lake Michigan and spent the entire summer and autumn in prosecuting his labors in reference to the fisheries of the lakes, the results of which will be presented hereafter.

The provision of the law directing the executive officers of the Government to render all the aid in their power to the required investigations was found to be of great value. By the direction of the Secretary of the Treasury, and through the courtesy of Mr. J. A. P. Allen, collector of customs at New Bedford, I was enabled to obtain the use of the small yacht Mazeppa, belonging to the New Bedford custom-house, as well as the services of the captain of the vessel, John B. Smith, esq., then janitor of the custom-house. A substitute in the way of a boat and captain was, however, furnished to the custom-house from the appropriation for the inquiry. The Treasury Department also instructed the collector of customs at Newport to detail the revenue-cutter Moccasin, belonging to that station, and in command of Captain J. G. Baker, for use in my investigation whenever her services were not required in any other direction. The Light-House Board granted the occupation of some vacant buildings and of the wharf connected with their buoy-station at Wood's Hole; and the Secretary of the Navy placed at my command for the summer a small steam-launch, belonging to the navy-yard at Boston, and gave me the use of a large number of condemned powder-tanks, which served an excellent purpose in the preservation of specimens. I am also indebted to Professor Henry for permission to use the extensive collection of apparatus belonging to the Smithsonian Institution in the way of nets, dredges, tanks, &c., and thus saving the considerable outlay which would otherwise have been necessary.

Due use was made, in the course of the summer, of all the facilities in question, and I beg leave here to express my acknowledgments to the Treasury and Navy Departments; as also, among many others, to Captain Macy, of the Newport custom-house; to Captain J. G. Baker and officers of the Moccasin; Mr. J. A. P. Allen, collector of customs, New Bedford; to Captain John B. Smith, of the Mazeppa; to Captain Edwards, of the light-house buoy establishment at Wood's Hole; as also to various other gentlemen whose names appear in the report.

CHARACTER AND PROGRESS OF THE INVESTIGATION.

The plan adopted for the inquiry was determined upon after careful deliberation. The great contrariety of opinion developed in the State investigations as to what should have been the best-known facts in the life-history of the fishes and their associates in the sea, made it necessary to study the natural history of these species as thoroughly as possible, so as to have a more complete knowledge of the facts, and consequently better means of arriving at satisfactory conclusions. Works already published upon American fishes proved to contain comparatively little of value as to the biography of the coast species; and the evidence of fishermen and others, whose judgment ought to be reliable, was found to be entirely contradictory and unserviceable. A systematic plan of inquiry was therefore drawn up, with the assistance of Professor Gill, embracing the points in the history of the fishes information relative to which was desirable, and a series of questions was devised, (see page 1,) answers to which, if satisfactory and complete, would leave little room for future inquiry. These were printed for the purpose of giving them a wide circulation, and include queries in reference to the local names of each kind of fish, its geographical distribution, its abundance at different periods of the year and in different seasons, its size, its migrations and movements, its relationship to its fellows or to other species, its food, and its peculiarities of reproduction; also questions relative to artificial culture, to protection, diseases, parasites, mode of capture, and economical value and application—eighty-eight questions in all, covering the entire ground.

As the history of the fishes themselves would not be complete without a thorough knowledge of their associates in the sea, especially such as prey upon them or in turn constitute their food, it was considered necessary to prosecute searching inquiries on these points, especially as one supposed cause of the diminution of the fishes was the alleged decrease or displacement of the objects upon which they subsist.

Furthermore, it was thought likely that peculiarities in the temperature of the water at different depths, its chemical constitution, the percentage of carbonic-acid gas and of ordinary air, its currents, &c., might all bear an important part in the general sum of influences upon the fisheries; and the inquiry, therefore, ultimately resolved itself into an investigation of the chemical and physical character of the water, and of the natural history of its inhabitants, whether animal or vegetable. It was considered expedient to omit nothing, however trivial or obscure, that might tend to throw light upon the subject of inquiry, especially as without such exhaustive investigation it would be impossible to determine what were the agencies which exercised the predominant influences upon the economy of the fisheries.

As already stated, the preliminary arrangements having been made, and the necessary leave of absence granted by Professor Henry, I left

Washington and established myself at Wood's Hole, where shortly after my arrival I was joined by Mr. S. J. Smith and by Professor A. E. Verrill, of Yale College, who had kindly undertaken to conduct the inquiries into the invertebrate fauna of the waters. With the facilities in the way of steamers and boats already referred to, I repeatedly visited in person the entire coast from Hyannis, Massachusetts, to Newport, Rhode Island, as well as the whole of Buzzard's Bay, Nantucket, Martha's Vineyard, &c., and in addition to making collections and investigations, I secured the testimony of a large number of persons who were interested in the inquiry; among whom were nearly all the leading fishermen, both line-men and trappers, as well as those who had been dealers in fish and engaged in supplying the markets of New York and Boston for many years. Many of these persons eagerly embraced the opportunity to tell their story of alleged wrongs, to urge various methods for their redress, or else to claim the possession of certain inherent rights which it were rank injustice to deprive them of. A verbatim report of this testimony was made by Mr. Henry E. Rockwell, an accomplished phonographer, and has been printed in part, beginning on page 7.

I also made the acquaintance of several gentlemen of literary ability and research, who had previously given much attention to the various questions connected with the fisheries, and who had in a measure become champions of the opposing sides, and obtained from them elaborate arguments on the subject. That of Mr. J. M. K. Southwick, of Newport, in behalf of the traps and pounds, will be found on page 76, and of Mr. George H. Palmer, of New Bedford, and Mr. J. Talbot Pitman, of Providence, as opposed to their continuance and in the interest of the line-fishermen, on pages 88 and 196.

Many important facts were thus elicited by means of the inquiries and testimony referred to, suggesting hints for personal examination to be subsequently prosecuted. Nearly all the fish pounds and traps along the coast, some thirty in number, were visited, and their location and character determined. These have been designated on a map of Massachusetts and Rhode Island, which accompanies the present report.

The large number of pounds in the vicinity of Wood's Hole rendered it an easy matter to obtain material for investigation; and the opportunity was embraced for determining more satisfactorily, from the contents of the stomachs of the different kinds of fish captured, the precise nature of their food. For the facilities in the way of specimens furnished by the proprietors of these pounds, always readily given, I beg to render my acknowledgments; especially to Captain Isaiah Spindel, at Wood's Hole; to Captain Rogers & Brothers, at Quissett; to Captain Peter Davis, at Ram's Head; to Captain Jason Luce & Co., at Menemsha Bight; to Captain Phinney, at Waquoit, and to others.

In addition to the material secured by thus sedulously visiting the pounds and other localities for the objects mentioned, seines and nets of different kinds were set or drawn almost every day, for the purpose of ascertaining facts connected with the spawning of the fish, the rate of growth of the young, the localities preferred by them, &c. Professor Verrill and his parties wese engaged also throughout the summer in making collections along the shores at low tide, as also in the constant use of the dredge and the towing-net.

One important question connected with this investigation, in addition to determining the character of the food available for the fishes, was to ascertain its comparative abundance, a great diminution or failure of such food having been alleged as one cause of the decrease of the fisheries. Care was therefore taken to mark out the position and extent of different beds of mussels, worms, star-fishes, &c., at the sea-bottom, and by straining the water at various depths and at the surface, to ascertain the amount of animal life therein. Temperature observations were also repeatedly taken and recorded, especially from the revenue-cutter Moccasin, under command of Captain Baker.

Having ample facilities at hand for making zoological collections, the opportunity was embraced to secure large series, not only for the national museum at Washington, but also for other establishments; and a sufficient quantity was gathered to supply sets (as soon as they can be fully elaborated) to the various colleges and other public institutions throughout the country. Large numbers of fishes, especially of the more showy kinds, such as sharks, skates, rays, &c., in which the waters abound, were secured for a similar purpose, and a partial distribution to colleges and societies has already been made of the duplicates of this portion of the collections. The occasion was also embraced by several gentlemen to make special collections for establishments with which they were connected. Among them we may mention more particularly Professor Jenks, in behalf of Brown University; Professor Hyatt, for the Boston Society of Natural History; Professors Smith and Verrill, for Yale College; Professor Todd, for Tabor College, Iowa; Doctor Farlow, for the Botanic Garden at Cambridge, &c. Facilities for such enterprises were always gladly furnished.

With a view of exhibiting the character of the fishes of the region explored, and determining their rate of growth, an experienced photographer accompanied the party, who, in the course of the summer, made over two hundred large negatives of the species in their different stages of development, at successive intervals throughout the season. These constitute a series of illustrations of fishes entirely unequaled; forming an admirable basis for a systematic work upon the food-fishes of the United States, should authority be obtained to prepare and publish it.

Among gentlemen interested in science who visited Wood's Hole during the summer for a greater or less period of time, either with special reference to co-operation in the work of the commission, or on account of the interest experienced in such investigations, may be mentioned Professor L. Agassiz, of Cambridge; Professor J. W. P. Jenks, of Brown University; Professors Verrill, Smith, D. C. Eaton, William D. Whitney, William H. Brewer, and Mr. Thatcher, of Yale College; Professor Hyatt and Dr. Thomas M. Brewer, of Boston; Dr. W. G. Farlow, of Cambridge; Professor Theodore Gill and Dr. Edward Palmer, of Washington; Colonel Theodore Lyman, Massachusetts commissioner of fisheries; Mr. Gwyn Jeffries, of England; Mr. J. Hammond Trumbull, of Hartford; Professor Todd, of Mount Tabor, Iowa; Professor O. C. Thompson, of the Technical Institute, Worcester, and several others.

As already mentioned, my own stay on the coast of Wood's Hole extended until the early part of October; and, on my departure, I commissioned Mr. Vinal N. Edwards, of that place, to continue the investigation as far as possible, by collecting facts in regard to the more important species, and especially as to the time of their leaving the shores. This he performed with great fidelity, besides securing valuable specimens of rare fishes and transmitting them to Washington.

An interesting result of the labors at Wood's Hole, during the summer of 1871, consisted in the great variety of fishes obtained through the pounds and otherwise, many of them of kinds previously unknown on the New England coast. The total number actually secured and photographed amounted to one hundred and six species, of which twenty or more are not included in the great work of Dr. Storer on the fishes of Massachusetts. Nine species are mentioned by various others as found in the waters of Vineyard Sound, but which were not secured; making one hundred and fifteen in all now known to belong to that fauna.

Among the more interesting novelties observed in the way of fishes was a species of tunny, a kind of small horse-mackerel, (the *Orcynus thunnina*,) a species weighing about twenty pounds, and which, although well known in the Mediterranean and in the warmer part of the Atlantic, had never been recorded as taken on the American coast. This fish proved to be quite common, not less than five hundred having been taken in the fish-pounds at Menemsha Bight alone. Two species of the sword-fish family, never noted before in the United States, were also captured. A complete list of the fishes taken, appended to this report, will elucidate more clearly the richness of the locality.

The variety of other marine animals secured was also unexpectedly large. Most of these will be referred to in the appendix, in the form of a paper by Professor Verrill. A list of the algæ, furnished by Dr. W. G. Farlow, of Cambridge, will also be found therein.

After completing my field labors for the season of 1871, I had a conference in Boston with Mr. Theodore Lyman, fish commissioner of Massachusetts, and Mr. Alfred Read, commissioner of Rhode Island, together with Mr. Samuel Powel, of Newport, when the results of the season were discussed, and the draught of a fishery bill presented, which was proposed for adoption by the States of Massachusetts and Rhode Island. The deliberations and discussions of this meeting will be found on page 125.

Simultaneously with the inquiries prosecuted during the summer of 1871, by myself and companions, a careful study was made of the food-fishes found off the coast of North Carolina, by Dr. H. C. Yarrow, acting assistant surgeon United States Army, stationed at Fort Macon. The value of the services of this gentleman in the collection of facts and statistics of the fisheries, and in adding to our knowledge of the natural history of the species, as well as in making collections of specimens, can scarcely be overestimated. The conclusions arrived at by this gentleman and his notes upon the specimens will be found embodied in the report.

During the summer and autumn of 1871, Mr. J. W. Milner, deputy commissioner for the great lakes, made the complete circuit of Lake Michigan, visiting every pound and gill-net station, and collecting a most important body of information and material. This will be made the subject of a special report, as soon as the data collected in 1872 can be properly arranged.

GENERAL RESULTS OF THE INVESTIGATION.

Having thus given an account of the circumstances which led to this inquiry, of the method of research adopted, and of the steps taken to carry out the programme, I now proceed to discuss, in a general way, the results obtained by the investigation, premising, however, that this is but the fruit of two seasons, and requires to be revised by a careful comparison of results for several successive years. Enough, however, has been determined to furnish a general indication in regard to habits of the fishes, and of the methods most likely to accomplish the object of their restoration to their original condition.

As already stated, the objects of the investigation, as authorized by Congress, were, first, to determine the facts as to the alleged decrease of the food-fishes; secondly, if such a decrease be capable of substantiation to ascertain the causes of the same; and, thirdly, to suggest methods for the restoration of the supply. A fourth object incidental to the rest was to work out the problems connected with the physical character of the seas adjacent to the fishing localities, and the natural history of the inhabitants of the water, whether vertebrate or invertebrate, and the associated vegetable life; as also to make copious and exhaustive collections of specimens, for the purpose of enriching the national museum at Washington, and of furnishing duplicates for distribution in series to such suitable collegiate and other cabinets as might be recommended for the purpose.

This research into the general natural history of the waters was considered legitimate, as, without a thorough knowledge of the subject, it would be impossible to determine, with precision, the causes affecting the abundance of animal life in the sea and the methods for regulating it; and the record of these facts, accompanied by proper illustrative figures, it was believed would be a very acceptable contribution to the cause of popular education, and supply a want which has long been felt in this country.

As the direct operations of the commission required the use of extensive and complicated apparatus, the additional cost of securing specimens enough for the principal cabinets was found to be trifling, and the opportunity for enriching them with material usually so difficult of acquisition it was thought should by no means be lost.

Nearly all enlightened nations have devoted much time to the investigation of precisely such subjects, the German government, in particular, having now in progress, under the direction of the National Fishery Association, an exhaustive examination of all its shores and the adjacent waters, believing that, by a thorough investigation, *a priori* in this direction, the various problems in reference to the culture and protection of fish, oysters, lobsters, crabs, and the like, could be more readily settled.

I. DECREASE OF THE FISH.—Bearing in mind that the present report has more particular reference to the south side of New England, and especially to that portion of it extending from Point Judith on the west to Monomoy Point on the east, including Narragansett Bay, Vineyard Sound, Buzzard's Bay, Martha's Vineyard, and Nantucket, I have no hesitation in stating that the fact of an alarming decrease of the shore-fisheries has been thoroughly established by my own investigations, as well as by evidence of those whose testimony was taken upon the subject.

Comparatively a few years ago this region was perhaps the scene of the most important summer fishery on our coast, the number of southern or deep-sea species resorting to its shoal bays and inlets to deposit their eggs being almost incredible. The testimony of the earliest writers, as well as that given by witnesses examined, and set forth in the appendix to the present report, as to the abundance of the fish, is believed to be by no means exaggerated; and even within the memory of persons now living, the mass of animal life was exceedingly great. The most important of the fish referred to were the scup, the tautog or black-fish, the striped-bass, and the sea-bass, in addition to which there were species of less importance, although equally edible, such as the sheep's-head, the king-fish, the weak-fish, &c.

The appearance of these fish was very regular, and their arrival upon the shore could be calculated upon with almost the same precision as the return of migratory birds; varying only, year by year, with special conditions of temperature and oceanic currents. Other species, more capricious in their appearance, and belonging essentially to the division of outside fishes, were the mackerel, the blue-fish, the Spanish mackerel, the bonito, &c. The alewife, or gaspereaux, and the shad were also included; as likewise the salmon, at an earlier period, although this fish was exterminated at a comparatively early period. (See page 149 *et seq.*)

In view of the facts adduced in reference to the shore-fishes, there can be no hesitation in accepting the statement that there has been an enormous diminution in their number, although this had already occurred to a considerable degree with some species by the beginning of the present century. The evidence of the fishermen, however, and of others familiar with the subject, as published in the present report, goes to prove that the decrease has continued in an alarmingly rapid ratio during the last fifteen or twenty years, or even less; and I can state of my own personal observation that localities in Vineyard Sound where nine years ago an abundance of scup, tautog, sea-bass, &c., especially the former, could be caught, do not now yield one-tenth part of the weight of fish, in the same time and at the same season. As the decrease is most strongly marked in the case of the scup, I refer for the details to the chapter on that fish, (page 228.)

We may also refer to the testimony of the Rhode Island committee, on page 104, in reference to the increase of the cost of living on the coast of that State, in consequence of the diminution of the fisheries. "One very intelligent man thought it made $100 difference in the cost of living to those persons living on the shore and in the small towns on the bay, and, from his own experience, he had no doubt that there are one thousand persons living near the shore to whom it made this difference, amounting to a loss to them of $100,000 each year, that of the high price of fish in Providence market not being taken into account." (Page 105.)

The condition of things referred to is, perhaps, not felt uniformly over the entire coast, but in certain regions the complaint in regard to it is universal; and it will be our object to make inquiry hereafter as to the real causes of the evil.

Many persons are in the habit of considering that the fish supply of the sea is practically inexhaustible; and, therefore, that a scarcity of any particular location is to be referred rather to the movements of the fish, in changing their feeding-grounds capriciously, or else in following the migration, from place to place, of the food upon which they live. This may be true to a certain extent, as we shall hereafter show, but it is difficult to point out any locality where, near the shores in the New England States, at least, under the most favorable view of the case, the fish are quite as plentiful as they were some years ago; and still more so where, by their overlapping the original colonists of the sea-bottom, they tend to render the abundance appreciably greater than usual. And, furthermore, if the scarcity of the fish be due to their going off into the deep waters of the ocean, it is, of course, of very little moment to the fisherman that they are as abundant in the sea as ever, if they do not come upon such grounds as will permit their being taken by his lines or nets.

It is by no means to be inferred from our remarks as to the scarcity of fish that fewer are actually caught now than formerly at any time;

the contrary, perhaps, being the case, since by means of the improved methods of capture, in the way of pounds and nets, an immense supply is taken out at certain seasons of the year so as frequently to glut the markets. The scarcity referred to is better shown by the great difficulty experienced by line-fishermen in securing a proper supply throughout the year on grounds where they were formerly able to catch all they needed for their own use and for sale.*

The evil effects of the state of things here indicated, are felt in many ways. Primarily on the part of many fishermen, resident on the coast, who have been in the habit of making a living by the proceeds of their occupation, not only supplying themselves with food, fresh and salt, for the year, but also making a comfortable living by sales of their surplus. At the present time this resource is cut off to a great degree from this class of people in many places on the Massachusetts coast, where, as on Nantucket, Martha's Vineyard, and elsewhere, the deprivation from the loss of profits by fishing is being most seriously felt. The result, of course, of the inability to make a living in this manner is to drive the line-fishermen to other occupations, and especially to induce them to leave the State for other fields of industry. In consequence the population is reduced, and the community feels this drain of some of its best material in many ways. Furthermore, property depreciates in value, farms and houses are abandoned, the average of taxation is increased, and many other evils, readily suggesting themselves, are developed.

Again, an important stimulus to the building of ships and boats is lost in the decreasing demand for vessels of various grades; and, what is more important to the country at large, the training of skilled seamen with which to supply our national and our merchant marine generally is stopped, or more or less interfered with. It is well known that the line-fisheries, in their different manifestations, have always been looked upon as of the utmost importance in a politico-economical point of view, for which reason bounties were paid by the General Government; and, although these have been lately withheld, it may yet be necessary to restore them in order to regain our lost ground.

II. Causes of the decrease.—As the testimony and considerations already adduced may justly be considered as establishing the fact of the vast decrease in the extent and value of the summer shore-fisheries on the south side of Massachusetts and Rhode Island, the question recurs

*In the article on scup in the body of the report (p. 228) will be found a detailed account of the occurrence of the young fish, to an enormous extent, in the spring of 1871, and the speculations as to their origin. These reappeared in 1872, though in much less numbers, as two-year-old fish, and by autumn weighed from one-third to half a pound, and will doubtless be met with again in 1873 as marketable fish. There is, however, no evidence to show that a renewed supply of young fish, or at least in anything like the same numbers, was present in 1872; which tends to render the problem of their appearence still more difficult of solution.

as to the causes which have led to this result. These, as commonly given, are principally the following:

1. The decrease or disappearance of the food upon which the fish subsist, necessitating their departure to other localities.

2. A change of location, either entirely capricious or induced by the necessity of looking for food elsewhere, as just referred to.

3. Epidemic diseases, or peculiar atmospheric agencies, such as heat, cold, &c.

4. Destruction by other fishes.

5. The agency of man; this being manifested either in the pollution of the water by the discharge into it of the refuse of manufactories, &c., or by excessive overfishing, or the use of improper apparatus.

These we will now proceed to discuss briefly in their order, beginning with, first, *disappearance of the food.*

To this subject special attention was given in the course of the investigations of 1871 and 1872, as the suggestion was quite plausible, and by many was believed to be of great weight. The dredging operations under Professors Verrill and Smith, were admirably calculated to test this question, as the sea-bottom was raked in every direction by the dredges; and the towing and drifting nets revealed the extent and comparative abundance of animal life in the surface-water or throughout its depths.

Fortunately for the proper solution of this question, an extensive series of dredging operations had been conducted by myself in the waters in the vicinity of Wood's Hole, as long ago as 1863, when the diminution in the abundance of the fishes had not made itself so palpable. As a general result, it may be said that, so far from there being any scarcity of invertebrate life in the waters during the summer of 1871, as compared with earlier years, its actual amount was such as to strike with astonishment every one in our party engaged in the inquiry. The dredge was never brought up from scraping the bottom without being filled with worms, star-fishes, sea-urchins, shells, &c. The location of numerous mussel-beds, of acres in extent, was established; the towing-net would become almost filled, in a short time, with embryos of crabs, worms, ascidians, &c., and, on several occasions, in dredging off the coast, to a distance of twenty or thirty miles, the water was found to be so thick with animal life that a bucket of water drawn up would contain hundreds of specimens, the sea indeed appearing like a thick mush of organisms. If any difference were appreciable between the seasons of 1863 and that of 1871, it was in favor of the latter, possibly, indeed, because of the much less number of fishes calculated to reduce the mass. The validity, therefore, of the assumption of a diminution of food may be denied in the most positive terms.

The second alleged cause, *that of change of abode on the part of the fishes,* has also received proper consideration; but the most careful inquiry failed to reveal any locality or localities along the coast where these fishes were to be found in an increased abundance, such as would result from the overlapping of the normal supply of any part of the coast by that from a different region. The fish were certainly not displaced in an easterly direction; and to the west of Narragansett Bay their numbers, though perhaps not diminished to the same extent as east of it, were decidedly less than formerly.

Thirdly, disease or atmospheric agencies.—The question of epidemic diseases among fishes is sometimes suggested by finding large numbers coming ashore, at times with and at others without any assignable cause. Occasionally this may be referred to volcanic exhalations, which charge the water with sulphuretted hydrogen gas or other noxious substances, and thus produce death. Where no positive cause can be indicated, the occurrence of some form of disease is frequently assigned as the reason. It is stated, for instance, that in the last century the blue-fish about Nantucket, then in great abundance and of enormous size, so large indeed that thirty of them would fill a flour-barrel, were attacked by a disease which destroyed them in large numbers; and that the Indians of the island were nearly exterminated at the same time, either by sharing in a common attack, or by eating the diseased fish. In the course of time the blue-fish again returned to the Nantucket waters, although of much smaller size than formerly represented; but the Indians never recovered their ground, their number being now extremely limited.

The agency of cold is also given as producing occasionally great mortality, especially among the tautog. A very cold spell, occurring at low tide some years ago, is said to have killed the tautog in such numbers that hundreds of tons were thrown ashore at Block Island and along the southern shores of Rhode Island and Massachusetts. This fact appears to be well attested, and, in all probability, may have had a decided influence, and similar facts, though on a much smaller scale, have been adduced in reference to the young scup in the late autumn, but this cannot have material influence on the number of old scup, as may be the case with the striped bass and tautog, both of which are known to be winter residents of these shores. Similar facts have been observed even as far south as the Gulf of Mexico, where the occurrence of a "norther" not unfrequently produces more or less mortality by chilling the water.

The *fourth* cause of decrease, as alleged, namely, *the ravages of predaceous fishes,* I am quite satisfied is one worthy of serious consideration, the principal offender in this respect being the blue-fish. No one who has spent a season on the coast, where this fish abounds, can fail to have been struck with its enormous voracity, and the amount of destructiveness which it causes among other kinds of fish. Wherever it appears in large numbers it is sure to produce a marked effect upon the supply of other fishes, either by driving them away from their accustomed haunts or by destroying them in large quantities in any given locality. Ample evidence to this effect will be found in the testimony presented in the present report, as well as in the article on the blue-fish, (page 235.) As there stated, it is a pelagic or wandering fish, going in immense schools, and characterized by a voracity and bloodthirstiness which, perhaps, has no parallel in the animal kingdom.

The fish seems to live only to destroy, and is constantly employed in pursuing and chopping up whatever it can master. As some one has said, it is an animated chopping-machine. Sometimes among a school of herring or menhaden thousands of blue-fish will be seen, biting off the tail of one and then another, destroying ten times as many fish as they really need for food, and leaving in their track the surface of the water covered with the blood and fragments of the mangled fish.

The blue-fish range in size, when two years of age and over, from five to twelve pounds. I ascertained by a careful inquiry into the number shipped by the dealers along the shore that about a million and a quarter could be estimated as the number captured along through Vineyard Sound and on the coast from Monomoy Point through Long Island Sound and sent to market in 1871. Any one who has seen these fish will judge that not one in a hundred is taken. If, now, we admit the presence of 100,000,000 blue-fish in these waters referred to, we may form some estimate of the number of fish destroyed by them. To estimate twenty per day as the number destroyed, if not devoured, by each blue-fish, is by no means extravagant, when we bear in mind the result of my own examinations and the testimony of others.

We all know that fish-spawn and fish in different stages of growth constitute the principal source of food to other fishes in the sea, and that the great proportion of fishes devoured are of tender age. The blue-fish, however, will often attack species but little less than itself, and the 100,000,000 referred to probably destroy fishes of two or three ounces and upward; that is to say, those that have passed the ordinary perils of early life, and have a fair chance to reach maturity. Therefore, if 12,000,000,000 are eaten, the number destroyed off the New England coast in a season of one hundred and twenty to one hundred and fifty days can be easily estimated.

No other sea-coast than that of the Atlantic border of the United States can show, as far as our information extends, so destructive a scourge as the blue-fish, occurring in such numbers, of so large a size, and of so massive a frame; able to cope with and mutilate, if not devour, any other fish of less size. Indeed, I am quite inclined to assign to the blue-fish the very first position among the injurious influences that have affected the supply of fishes on the coast. Yet, with all this destruction by the blue-fish, it is probable that there would not have been so great a decrease of fish as at present but for the concurrent action of man, as we shall endeavor to show farther on.

Under the *fifth* head, that of *human agencies*, we may consider first the question of the pollution of the water by poisonous agencies.

These may consist, as already stated, of chemical substances, which exert a directly poisonous influence, or of mechanical objects, such as sawdust, which, it is said, gets into the gills of fishes, and ultimately causes their death, or, falling to the bottom, with edgings, bark, &c., covers up the gravel and destroys the natural spawning-beds, and thus prevents the development of the eggs.

These causes, however, apply essentially to rivers, and their injurious action in such cases has frequently been substantiated, and has invoked, in many instances, legislative interference. They exercise very little influence, however, in regard to the fishes of the sea. The testimony before the Rhode Island legislature would tend to show that, in the immediate vicinity of factories on the Narragansett Bay and its tributaries, many of the smaller varieties of fish were as abundant as ever, and that, even in the vicinity of gas-works, the discharge from which, as containing creosote and other substances, might be expected to produce a very injurious effect, the only result was the imparting of an unpleasant, tar-like taste to oysters and other mollusks that occurred in the neighborhood. It is by no means impossible that some fish might be driven away from the vicinity of the discharge of such an establishment; but that any marked effect could be produced on a large scale is not to be admitted.

Whatever the condition of things may be in Narragansett Bay, we know that none of the agencies alluded to exist, to any considerable extent, along other portions of the New England coast, where the fact of a similar scarcity of fish has been equally established.

We come, therefore, to the question of improper or excessive fishing. The capture of the sea-fishes by man is usually prosecuted either by the hook and line or by means of nets or weirs. Nets for the capture of fish may be divided into those which are movable and those which are fixed. Among the movable we may mention the seine, which incloses the fish in bodies, and either hauls them to the shore or gathers them in the open water, and the gill-net, in which the heads of the swimming fish pass partly through the meshes of the net, by which, in their effort to withdraw, they are held securely. These gill-nets may be either fixed or floating; if the latter, they are called "drifting nets."

The apparatus for capture by fixed nets have various names and modes of operation, as "traps," "pounds," "weirs," "fykes," &c. The trap is an apparatus peculiar to the Narragansett Bay, and consists of an oblong inclosure of netting on three sides and at the bottom, anchored securely by the side of a channel. Into this the fish enter, and the bottom of the net being lifted to the surface at the open end, the fish are penned in and driven into a lateral inclosure, where they are kept until needed. A net of this character requires constant attention, as the fish, after making the circuit of the trap, can readily pass out, unless prevented. On page 10, in Mr. Southwick's testimony, will be found a figure and diagram illustrating the construction of these two forms of apparatus, as also in the special article on modes of capturing fish.

The pounds and weirs are adapted not only for taking, but many of them for retaining, the fish until it is convenient to remove them, needing no watching to prevent their escape. These are of various construction, depending upon the depth of the water, the tide, the nature of the shore, the kind of fish to be taken, &c. The most common form on the south side of New England consists of a fence of netting, extending from the shore, and nearly perpendicular to it, for a distance of 50 or 100 fathoms or more, as the circumstances may require. The outer end of this straight fence or wall is carried into a heart-shaped fence of netting, the apex of which is connected with a circular "bowl" of net-work, the bottom of which lies upon the ground, at a depth of 20 to 30 feet. The fish, in their movement along the coast, first strike against the fence of netting and are directed outward, following the fence or "leader" along until they reach the end, which, of course, brings them within the "heart." Here they wander around for a time, their only easy avenue for escape being through the apex into the "bowl," and in which when entered they continually circle about without ever finding the outlet. It is a peculiarity of fishes in their movements, especially when in schools, that they do not turn a sharp corner, but move around in curves; and the nets in question are so arranged that the curves they are likely to take never bring them toward an avenue of escape, but rather tend to conduct them farther within.

The "weirs" differ from the "pounds" principally in being constructed, in whole or in part, of brush or of narrow boards, with or without netting; and they are sometimes so arranged that at low tide a sand-bar cuts off the escape of the fish, leaving them in a basin inside, allowing them to be taken at any time before a certain stage of rise of the next tide. The variety of these modes of capture is very great, and I have given in the appendix a description of the forms best known, accompanied by the figures necessary for their illustration, and to these would refer for further information.*

---

*On the map accompanying this report I have marked the traps and pounds in operation in 1871, on the south side of New England, east of Point Judith, as far as I was able to ascertain their existence. Information concerning those in Rhode Island was furnished by J. M. K. Southwick. Notices of those farther east were, for the most part, supplied by Captain Edwards, supplemented by my own observations. To Captain Prince Crowell I am indebted for a list of the weirs in Cape Cod Bay, represented on a separate map. I also give a separate sketch of Seaconnet Point, showing the peculiarities of arrangement of the traps in that region.

According to Mr. Southwick, there were in Narragansett Bay, in 1871, twenty pound or heart nets, of which the map represents eight on Conanicut Island, and eight on Rhode Island. There were sixteen traps—seven on Rhode Island and nine at Seaconnet Point. Seven of the latter indeed are double, each counting as two, making twenty-three, or a total of forty-three. But few of these were fished after the middle of June.

In Buzzard's Bay and on the Elizabeth Islands the pounds were as follows: One at

The propriety of authorizing the erection of weirs and pounds occupied the attention of the Canadian authorities a number of years ago, and, in consequence of the results of special inquiries, and the general impression on the part of the fishermen and others interested, the use of weirs and traps was forbidden in certain portions of the Dominion, as in the vicinity of Miramichi, and they were placed under close restriction in other localities. The amount of offal usually thrown into the water in the vicinity of the herring-weirs was supposed to have an injurious effect in driving away schools of herring; and a marked decrease in the shad-fishery of the Bay of Fundy and the Gulf of Saint Lawrence was ascribed to the action of the weirs in entrapping the young fish and causing them to perish in immense numbers. In the appendix to the present report I give the testimony of various English writers in regard to the necessity of protecting the fisheries by restricting the time of capture and the nature of the apparatus. Among these Bertram is very outspoken in his views, taking direct grounds against the report of the British commission, consisting of Professor Huxley and his associates.

As I have already remarked, the ordinary brush-weir arrangements, as used on the coast of Great Britain, are not calculated to produce very serious effects, owing to the fact that it is only species coming into comparatively shallow water that are captured in them; and there is abundant opportunity for the fish to escape from their toils, unless attended to immediately. I am, however, inclined to think that with the introduction of the improved American methods of traps and pounds

---

Clark's Cove; three on Sconticut Neck; one at West Island, near New Bedford; one at Mattapoisett; one at West Falmouth; two at Quissett Harbor; two on Long Neck, near the guano-works of Wood's Hole; one at Hadley Harbor, two at Ram's Head, one at Robinson Hole, Naushon; five in Menemsha Bight; two at Tisbury, five at Lombard's Cove, two in Holmes's Hole, one west of West Chop, Martha's Vineyard; one at Falmouth; one at Waquoit, and one at Coltuit, on Vineyard Sound; or a total of thirty-five recorded, besides others probably omitted. Of these the greater number were kept down only to about the middle of June. Among those known to have been worked till late in the season were at least two near New Bedford; two at Quissett; one at Wood's Hole; two on Naushon; four on Martha's Vineyard, and one at West Falmouth; twelve or more.

I am informed that the number of pounds and traps in Narragansett Bay, in operation in 1872, was about the same as in 1871, but that there was a considerable increase to the eastward. Then there were four more at Menemsha Bight; one at Lombard's Cove; one at Paintville, Martha's Vineyard; two or more at Kettle Cove, Naushon, and one on the north side of Narhawena, an addition of at least nine to the thirty-five previously enumerated. More would doubtless have been erected if suitable locations could have been found.

According to the chart furnished by Captain Crowell there were fifteen weirs in Cape Cod Bay in 1871, extending from Barnstable to Wellfleet.

It is very probable that I have not learned the situation of all the traps and pounds in Massachusetts waters, as Mr. Bassett, of New Bedford, in his testimony in 1872, stated that there were seven between New Bedford and Mishaum Point, of which I have only enumerated four.

into Great Britain, a very different verdict would be given as the result of thirty years' trial.

While the seines ensnare enormous quantities of certain kinds of fish, under especially favorable circumstances, the pounds and traps take them in still larger numbers, because they act without the direct agency of their owners, who can remain on shore during stormy weather, assured that the very disturbance of the sea will conduce to the greater extent of the catch. Thousands of barrels of fishes are frequently taken at a time, and I am myself cognizant of the capture of no less than 20,000 blue-fish, representing a weight of at least 100,000 pounds, in one weir, in the course of a single night. In the appendix will be found an account of captures effected at various weirs and pounds.

With this general explanation of the character of these potent engines, we may perhaps realize their bearing upon the question of the fisheries. As set in the waters of Rhode Island and Massachusetts, they are usually put down in the early spring and kept at work for six weeks, or even longer; not unfrequently throughout the whole summer, but are taken up before the autumnal storms occur, in order to prevent their destruction. The expense of a net-pound is very considerable, amounting to two and even three thousand dollars, while four men at least are required throughout the season to attend to one. They are usually in operation by the 1st of May, sometimes being set a little earlier and sometimes later, and they take generally more or less in the order specified the following more important kinds of fish:

Alewives, (*Pomolobus pseudo-harengus*, Gill.)
Horned dog-fish, (*Squalus americanus*, Gill.)
Tautog, (*Tautoga onitis*, Gthr.)
Mackerel, (*Scomber vernalis*, Mitch.)
Menhaden, (*Brevoortia menhaden*, Gill.)
Scup, (*Stenotomus argyrops*, Gill.)
Sea-bass, (*Centropristes furvus*, Gill.)
Blue-fish, (*Pomatomus saltatrix*, Gill.)
Squeteague, (*Cynoscion regalis*, Gill.)

By the middle of June the supplies of some of these fish decrease to such an extent that the traps and pounds are generally taken up for the season. Some of the pounds, however, are kept down throughout the summer, especially with the object of securing menhaden, blue-fish, Spanish mackerel, and squeteague, other fish being captured occasionally, but in inconsiderable amount.

It is noteworthy in this connection that, with the exception of dog-fish, mackerel, alewives, and menhaden, the edible fish taken in the first part of the season consist of those species which constitute the great body of the summer-catch with the line, and which are known to find their spawning-ground along the south coast of New England. It is these fish to which the inquiries of the Rhode Island and Massachusetts legislatures have been particularly directed, and which, with the exception of blue-fish, make up the most important part of the summer fisheries. They are still taken in great numbers by the pounds and traps, although fewer than formerly, and consist in great proportion of adult males and females, ripe with milt and with spawn. We can, therefore, easily understand how a most injurious influence may be exercised upon the fisheries by the capture of so large numbers under the circumstances referred to.

In all discussions and considerations in regard to the sea-fisheries one important principle should be carefully borne in mind, and that is that every fish that spawns on or near the shores has a definite relationship to a particular area of sea-bottom; or, in other words, that, as far we can judge from experiment and observation, every fish returns as nearly as possible to its own birthplace to exercise the function of reproduction, and continues to do so, year by year, during the whole period of its existence. This principle underlies, as is well known, all effort looking toward restoring to our rivers their supply of salmon, shad, and alewives; since it is well known that it is not sufficient to merely remove restrictions that had for years prevented the upward run of these fish, but a colony of young fish must be established in the head-waters of these streams, which, running down to the sea at the proper time, and returning again when fully matured, shall fill the waters to the desired extent.

It is an established fact that salmon, alewives, and shad, both young and old, have been caught on certain spawning-beds, and after being properly marked and allowed to escape, have been found to re-appear in successive years in the same locality. The principle is rather more difficult to establish in regard to the purely marine fishes; but experiments have been made by competent men on our coast and elsewhere, which prove the existence of the same general principle in relation to them. Thus, I was informed by an intelligent fisherman living at Rockport, Massachusetts, that he had himself, on several occasions, marked young and old halibut, and during several seasons they had been retaken on about the same grounds.

A second law, equally positive, with a great variety of fish, is that they pass from their spawning-grounds to the sea by the shortest route that will take them out into the deeper waters, where they spend the winter; and that coming and going to and from a given locality, they follow a determinate and definite line of migration.

Having in mind these two propositions, we shall then better appreciate what takes place when fish are disturbed or caught up during the breeding-season. Should nets be set along their line of travel before they have spawned, so that when they strike the coast they are immediately arrested, first at one point and then at another, running a continued gauntlet of dangers in their course to their final destination; and should an appreciable proportion of them be caught before the eggs have been laid and fertilized, it is very easy to see why the stock should rapidly diminish. It is not a sufficient argument in reply to this to point to the enormous number of eggs laid by a single fish in each season, amounting in some instances to perhaps from five thousand to hundreds of thousands, or even millions, since this immense fecundity is an absolute necessity to preserve the balance of life under the water. The eggs and the young fish furnish the appointed food to an immense variety of animals, many species of fish as well as crustaceans and other animals depending entirely upon them for their support. Among the particular enemies of the eggs and the young fry may be enumerated the small minnows or cyprinodonts, the atherinas, silver-sides or friars, the cunners or chogset, the young of many larger fish, the different kinds of minute crustaceans, including also the lobsters, &c. These are not interfered with to any material extent by any form of net, as they are too small to furnish profitable employment in their capture, and they pass readily through the meshes of any nets that would be set for other purposes. Although, therefore, the amount of spawn and of young fish may be materially less than a previous average, the predacious animals just referred to will probably still destroy as many as ever, since they have every opportunity for picking up their prey at all times; and whatever the scarcity at first, they are likely to get all they require. For this reason, we cannot count upon the increase of the fish that escape the perils of their journey to furnish a sufficient supply, since if half the young brood is lost by means of the capture of the parents through human agencies, before and during the spawning season, a very large percentage of the remainder is prevented from attaining maturity by other enemies.

As most fish require from three to five years of growth before they are capable of reproduction, and in many cases remain in the open sea until this period is reached, it will follow that for several years after the establishment of an exhausting fishery the supply may appear to be but little interfered with, since there are several successive crops of fish to come on at the annual intervals, and not until the entire round has been completed do these injurious agencies begin to present the evidence of their severity. It is easy, therefore, to understand why, after five or ten years' fishing, the supply of fish in a given bay, or along a certain stretch of the coast, will be reduced to a very considerable degree, and although it may be perfectly true that the sea is practically inexhaustible of its fish, yet if the fish of a particular region are cleaned out, there is no hope that others will come in from surrounding localities to take their places, since those already related to a given undisturbed area continue in that relationship, and have no inducement to change their ground. It should therefore be understood that the exhaustion of a local fishery is not like dipping water out of a bucket, where the vacancy is immediately filled from the surrounding body; but it is more like taking lard out of a keg, where there is a space left that does not become occupied by anything else.

These considerations also furnish a sufficient answer to the objection against the necessity for any protection of the fisheries from disturbance during the spawning-season; namely, for instance, that should Massachusetts pass laws for their protection, it would be of no avail so long as Rhode Island and Connecticut failed to do the same. The practical result of protection on the one hand and of license on the other, probably would be, that after a few years' interval fish would be as abundant as ever on the Massachusetts coast, and would be almost exhausted on those of the adjacent States, and an important market would be furnished to the Massachusetts fishermen outside of the limits of their own State.

Another fallacy, which vitiates much otherwise sound argument on the question of protection, is in confounding regular shore-fish, that come in from the deep seas to the coast to spawn, with the outside fish that come and go with more or less irregularity, and usually feed and swim near the surface. In the one category we may enumerate the porgies or scup, tautog or black-fish, and the sea-bass; while the other includes such fish as the sea herring, blue-fish, mackerel, Spanish mackerel, and some others. The occurrence of the latter group is, to a large extent, determined by the presence of the former. Should the first mentioned be decreased materially in number, it becomes necessary for their pursuers to seek other waters for their proper supply of food. The case of the cod, that feeds largely upon ground-fish, as well as upon the more surface-loving herring, is another instance in which the scarcity or abundance of one fish is influenced by that of others.

It was formerly supposed that certain fish, as the herring, the shad, and the alewives, with others of like habits, prosecuted an extensive migration along the shores of the ocean, covering, sometimes, thousands of miles in the sweep of their travels; and much eloquent writing has been expended by such authors as Pennant and others in defining the starting-point and terminus, as well as the intermediate stages of the voyage. The shad, too, which, as is well known, occupies all the rivers of the Atlantic coast from Florida to the Gulf of Saint Lawrence, was thought to begin its course in the West Indies, and in an immense body, which, going northward, sent a detachment to occupy each fresh-water stream as it was reached, the last remnant of the band finally passing up the Saint Lawrence, and there closing the course. We now, however, have much reason to think that in the case of the herring, the shad, the alewife, and the salmon, the journey is simply from the mouths of the rivers by the nearest deep gully or trough to the outer sea, and that the appearance of the fish in the mouths of the rivers along the coast, at successive intervals, from early spring in the South to near midsummer in the North, is simply due to their taking up their line of march, at successive epochs, from the open sea to the river they had left during a previous season, induced by the stimulus of a definite temperature, which, of course, would be successively attained at later and later dates, as the distance northward increased.

The principle may safely be considered as established that line-fishing, no matter how extensively prosecuted, will never materially affect the supply of the fish in the sea. As a general rule, fish, when engaged in the function of reproduction, will not take the hook, whatever be their abundance; but, as soon as the critical season has passed, they feed very voraciously, and then can be readily caught by skilled fishermen. It therefore would be no evil should every fully grown fish of three to five years old and upward be lifted from the sea after the close of the spawning season, in the course of a season, since the following year we may look for a new generation coming into exercise the function of reproduction; and ample provision will thus exist for a renewed supply from year to year. As already explained, the case is entirely different when these fish are caught before they spawn, all the evils that we have depicted following in the train of such thoughtless destruction, precisely equivalent to killing of all the mature hens in a farm-yard before they have laid their eggs, and then expecting to have the stock continued indefinitely. As well might the farmer expect to keep up his supply of wheat, year by year, while he consumed all his grain, reserving none for seed, and without the possibility of obtaining it from any other source.

Objections have been made to the use of what is called the trawl-line, trot-line, bultow, &c., in capturing fish of the cod family. This consists of a strong cord of 18 or 24 thread, sometimes of several hundred fathoms in length, to which are attached at intervals of about six feet short lines of nearly three feet in length, having hooks at the end. These, to the number of four or five hundred or more upon a single line, are baited and sunk to the bottom by anchors, and at regular distance, the ends of the main line being buoyed so as to show their locality. At intervals throughout the day these lines are examined, being taken up and carried across a boat, the fish captured removed and the empty hooks rebaited, and the whole again replaced. Immense numbers of fish are taken by this method, especially on the coast of England and on the banks of Newfoundland, as likewise along various parts of the New England coast.

Although this practice has excited the animadversions of some on account of its supposed destructive nature, it seems hardly possible that it can be really injurious, since it does not take the spawning fish, and merely represents the result of an increased number of hand-lines.

Our remarks have been hitherto directed toward the practice of the destruction of the parent fish before the function of spawning has been properly accomplished. It is equally reprehensible to interfere in any way with or destroy the spawn after they have been laid, or the young fry after they are hatched. This result is said to follow the use of the trawl-net, which, dragged carefully and sedulously, day by day, over that portion of the sea-bottom which constitutes the great nursery of fish, bruises the eggs and harrows up the sea-weed or grass to which the eggs have been attached, or among which the young fish are playing, and gathers it inside of the net, involving the destruction of all life that may be inclosed. This evil has not manifested itself in America, owing to the almost entire absence of trawl-net fishing, as it has in Europe, where it is considered as doing much more mischief than all other modes of fishing put together. Should this engine of destruction come into general use on our coast and add its agency to those already referred to in connection with the pounds and weirs, the diminution of the supply may continue to go on in a vastly greater ratio than ever.

We have now considered at considerable length the influences separately exerted by the blue-fish and by human agencies upon the number of food-fishes on our coast; and we next proceed, as a *sixth* division of the subject, to discuss the result of their combined action, especially in view of the great destruction of the spawning fish.

While, perhaps, in view of the wonderful fecundity of fishes, the blue-fish alone, or the traps alone, might not produce any serious consequences upon the general supply, their combination in any locality cannot fail to have a very decided effect; as what the one spares the other destroys in large part; and in the enormous consumption in addition of the eggs and young fish by the minor inhabitants of the water, we can easily imagine how speedily an approximation toward extermination may be effected.

My explorations, as already referred to, have shown the existence in the waters, in addition to the larger kinds and their young, of immense numbers of small species of fish, such as the friar or atherina, the various species of cyprinodonts, &c., occurring in great numbers, and feeding almost exclusively upon the spawn and young of fish. These, it has been shown, are not affected by any modes of fishing, and in fact, if anything, are more abundant than ever, in consequence of the diminution of larger fish by which they are devoured in turn. Some are resident in particular places along the shore, while others move along the coast in large bodies. Being always on the grounds and congregating upon the spawning-beds, they are engaged in a continual work of destruction, and when the ordinary ratios have not been disturbed they simply tend to prevent an overproduction of the different species of fish; but if other causes of diminution co-operate when they have devoured their share, and the different crustaceans, star-fishes, &c., have been kept supplied, the percentage of eggs left for development and of young fish for attaining maturity becomes less year by year until practical extermination may follow.

As far as the blue-fish is concerned, however, if it were even possible to drive it off by any human agency, the fishermen of the south coast of New England would strenuously object, since, after its appearance on the coast, in May or June, it is the most important food-fish to be taken; and, as will be observed by the testimony presented, it was as much the diminution of the blue-fish as of any other species that excited the apprehension and alarm of the fishermen. It is, however, in all probability, the increasing scarcity of the shore-fishes that has involved the reduction in addition of the blue-fish, since these require food in large amount and of easy access, and they would naturally leave for more favorable localities.

During the season of 1871, while blue-fish and Spanish mackerel were comparatively rare in Vineyard Sound and the adjacent waters, they abounded to an enormous extent in localities farther to the west, the coast of Long Island Sound and the coast of New Jersey being supplied with them to an unprecedented degree. It is not a little suggestive that while traps are scarcely known in the waters referred to, there has been no complaint in regard to the scarcity of the shore-fishes, nor but little of that of such species as the menhaden, blue-fish, &c.

MEASURES SUGGESTED FOR RELIEF.

In view of all these circumstances, therefore, the conclusion appears warranted that if measures can be taken to prevent the present great destruction of spawning-fish, the supply will again increase before long, and with the increasing abundance of the shore-fishes, the blue-fish will also increase in number. At the same time, I am not prepared to advocate the abolition of traps and pounds, as without them it would probably be extremely difficult to furnish fish in sufficient quantity to meet the present and increasing demand of the country. Nor is it probably desirable to suppress them during the whole of the spawning-season, as it is in consequence of the profits made during that time that the fishermen are enabled to meet their expenses, and very few would put down and maintain their traps for the summer-fishing alone. The traps and pounds also perform an important service in the capture of bait, especially of herring, alewives, and menhaden, for the spring mackerel-fisheries, without which it is alleged that this latter industry could not be successfully prosecuted. In this connection, however, it should be stated that the practice of carrying seines or gill-nets, and of catching herring and menhaden for themselves on the mackerel grounds, is rapidly increasing with the mackerel fishermen, who, consequently, do not depend to the same degree as formerly upon the pounds.

There is, however, no reason why there should not be occasional intermission during the six weeks when most of these fish deposit their eggs, of sufficient length of time to allow a certain percentage to pass through to their breeding-ground; and, after consultation with various persons interested, I have come to the conclusion that if the capture of fish in traps and pounds be absolutely prohibited, under suitable penalties, from 6 o'clock on Friday night until 6 o'clock on Monday morning, even during a season of six weeks only, (thus requiring a close time of three nights and two days, to enable the fish pass and perform their natural function of reproduction,) the interest of all parties would be subserved. Indeed, it would seem to be decidedly to the advantage of the owners of the pounds to enter heartily into such an arrangement, as it is well known that in the height of the season the supply of fish thrown into the market is so great as very materially to reduce the price paid the fishermen. This, however, does not affect the consumer in the least, as the fish are all sold to middle-men, who keep up the retail price. Large numbers of fish, however, at this season become spoiled, and are either thrown overboard or converted into manure.

By intermitting the catch as suggested, there is a greater certainty that the entire supply will be put to its legitimate use as food; and it is probable that, while less money may be made by the middle-men referred to, the owners of the pounds and traps would receive quite as large an amount of money for less labor and for three-fourths the same weight of fish. This arrangement would also furnish an opportunity for persons connected with the fisheries to repair their apparatus, or attend to other duties. I have, indeed, been assured by many persons engaged in this business that they are fully aware that it would be for their interest, in every way, to have the close time specified, and that they will gladly welcome a law to that effect, if it be made universal in its application.

In view of all these considerations, I have draughted a bill, which has been presented to the consideration of the commissioners of several States, and to several eminent lawyers, well versed in the local laws of their respective States, and corrected to their satisfaction. A copy of this bill, as finally modified, is given on page 132. I sincerely trust that this, or a somewhat similar bill, may become a law in the States of Rhode Island, Massachusetts, Connecticut, and New York, as I am satisfied it would be for their benefit. Although there may be no serious question as to the right of the General Government to make enactments in regard to the common waters of the United States, it is possible that any attempt on its part, at the present time, to pass this law would meet with considerable opposition; and it would be extremely difficult for the United States to enforce any special requirement or penalty connected with a close season.

The plan of licensing the pounds, so as to give the State more efficient control, is considered one of great importance, and will, I believe, be acceptable to the owners of these establishments, as it would give them a security against interference from other parties that they do not at present possess.

The penalty attached to fishing without a license, and the ability of a State the more readily to punish an offender by depriving him of his permission to fish, will render parties careful how they offend; and by giving to the informer, in consequence of whose complaint the license is withdrawn, the first choice of taking the station forfeited, an intense vigilance will be induced on the part of those who may desire to secure a favorite location, and thus supersede the necessity of an expensive surveillance on the part of the State.

In the event, however, of the refusal of the States mentioned to establish the very limited close time suggested, I would recommend the passage by the United States of a law absolutely prohibiting, until further notice, the erection of fixed apparatus for taking fish, after a period of one or two years, on the south side of New England and on the shores of Long Island, which constitute the spawning-grounds of the shore-fishes referred to. Although this would be a serious blow to the pound and trap interest, yet the grace allowed would permit the owners to use up their material in the way of nets, and render the enforcement of the law less onerous. The restoration of the fish to their original abundance would be thus accomplished in a much less time than by any merely palliative measures; and there is no reason to anticipate that there would be, in the mean time, any material decrease in the supply, or any rise in the price of fish to the consumer. There would still be open to the fishermen the use of seines, gill-nets, &c., which would capture fish in large quantity without overstocking the market; and the inducement to the use of the hook and line would furnish employment to large numbers of persons now needing it, while the markets would be more regularly and equally supplied. The wholesale cost of fish would probably be somewhat increased, but the competition being distributed among a large number of persons would prevent an excessive charge by the retail dealers; and the only difference would be that a few men would not make large fortunes in a short time, as they are now in the way of doing.

The erection of fixed apparatus requires a considerable amount of time, generally several days, and, once set, its presence along the coast could readily be determined by an occasional patrol by vessels of the Revenue Department, any violation of the law to be met by confiscation of all apparatus, including nets, piles, boats, &c. It would therefore be comparatively easy to prevent, at little or no expense to the Government, the infringement of the law of absolute prohibition, while it would be impossible to exercise a sufficient oversight as to the violation of the regulation in regard to close time, this requiring a multiplication of officers to be had only from among the regular authorities of the States themselves.

As already explained, the suggestions and reasonings here are restricted exclusively to the capture of fish by means of fixed apparatus in the waters on the south side of New England. Whether it is expedient to enact regulations in reference to taking menhaden and other fish in the waters of Long Island Sound, and elsewhere, by means of nets, or of herring, &c., on the eastern coast of New England, I hope to make the subject of a subsequent inquiry and report.

A potent objection to the abolition of pounds is the service they render during the spring in procuring bait (alewives, herring, mahaden, &c.) for mackerel-fishing. I am assured, however, that this can be done to a sufficient extent by seines or gill-nets, especially since the discovery that the true herring can be taken in the coast of Maine and in the Bay of Fund y in the spring, apparently to an unlimited extent. If, however, the States will pass the regulation requiring a close time of two days and three nights, and for six weeks only, from the 20th of April to the 15th of June, as proposed in the bill, severer measures will, I trust, be unnecessary, and we shall probably find a gradually increasing supply of valuable food.

RESULT OF INQUIRIES IN 1872.

In consequence of an unavoidable delay in the publication of the present report, I have been enabled to include in it the results of inquiries respecting the fisheries on the south coast of New England during the season of 1872, having revisited many of the localities of the investigations of 1871, and sending an assistant to others.

I found what I had expected, that with the exception of the scup, fishes of all kinds in Vineyard Sound and Buzzard's Bay were as much scarcer in 1872, compared with 1871, as they had been in that year compared with the preceding one. (See pages 183–194 *et seq.*) The testimony everywhere, with scarcely an exception, both from line-men and trappers, was that the whole business of fishing was pretty nearly at an end, and that it would scarcely pay parties to attempt to continue the work on a large scale in 1873.

The pounds of Messrs. Jason Luce & Co., at Menemsha, took a larger number of fish, as shown by their statement of catch kindly furnished to me, (p. 173,) but only by increased exertion, and this during a very short period. The other pounds, according to testimony taken by Mr. Edwards, scarcely met their expenses in any single case.

At Nantucket most of the fishermen estimated the decrease at from one-half to three fourths, compared with last year.

Very few blue-fish were taken on the north side of the island with the line, the supply being furnished by means of gill-nets alone. According to some the supply was rather greater on the south side; but the difference between the two seasons was the greater, as the period for fishing was longer this year than the last, and was less obstructed by stormy weather.

Several of the fishermen at Nantucket (all, however, personally interested in gill-nets) contested the statements of others as to the decrease of fish, while many, both pound and line fishermen, stoutly maintained the fact.

At Edgartown and Hyannis the testimony was absolutely unanimous as to the fact of a woful diminution and the doubtful future of the entire fishery interest. At various places on Martha's Vineyard, as already remarked, the evidence was in the same direction from both net and line men.

Captain Hinckley, of Wood's Hole, testified that fish were never so scarce at his pound as this season, with the exception of menhaden, alewives, and dog-fish. These he found it difficult to dispose of on account of their numbers, and was obliged to turn many out of his nets unsold.

He considered the number of blue-fish scarcely one-fourth as great as usual, and these were of small size. Squeteague, also, were much scarcer.

At Newport the testimony was conflicting. Some persons, principally, however, fish dealers and trappers, maintained that fish were as plenty as last season, or even more so; this being based, however, upon the number of small scup and an unusual run of Spanish mackerel. Such assertions were, on the other hand, strongly denied by numerous line-men; and some of these testified that fish were never so scarce; and others admitted that they were no more plenty than last year, with the exception of the catch in the traps, which was quite equal to the usual average.

There was, however, no exception to the impression that blue-fish were much scarcer this year than last; this substantiating the opinion that they have been gradually diminishing for many years past. (See the article on blue-fish.)

Tautog and sea-bass were also scarcer. The scup were perhaps less numerous than last season, but made more show, as the small fish so plentiful in 1871 had attained a larger size, and were in a certain degree marketable. These, according to the testimony of some, were as plenty as ever they had been before; but this was certainly not the case in Vineyard Sound and Buzzard's Bay.

It is also noteworthy that whatever may have been the causes which produced so large a crop of young fish in 1871, they were not persistent, since comparatively few were taken in 1872 of the same dimensions as last year.

Upon the whole, the decrease in the fish appeared to be more marked in Vineyard Sound and Buzzard's Bay than about Newport; and this fact may be of much significance, when we remember that the pounds have multiplied much more rapidly in this locality than about Newport, where, indeed, as I am informed, the number was about the same in 1872 as in 1871. In 1871 the number was thirty-five. There were four new ones at Menemsha Bight, one at Lombard's Cove, and one at Paintville, on the north side of Martha's Vineyard; two or more in Kettle Cove, and one on the north side of Nashawena; making at least nine in all, in addition to the number there in previous seasons. The general result, as already stated, was that scarcely one made sufficient profit to pay for the outlay and labor.

The New York markets, as might be expected, were fully supplied with fish during the season of 1872, no appreciable difference being realized by the wholesale dealers. If anything, however, striped bass and blue-fish were scarcer, while the small scup, from the waters south of Massachusetts and Rhode Island, were shipped in large numbers, although scarcely of a size to render them marketable, their average weight being little more than from a quarter to half a pound.

In view, therefore, of all these facts I have no hesitation in saying that all the arguments presented in the earlier part of this report, in favor of regulating the fisheries on the south side of New England by law, are enforced by the experience of the season of 1872, and that it is too evident that, unless some protective measures be adopted, the fisheries in these waters will be practically destroyed in a very short time.

This result will, of course, bring its own relief in time, since the cessation of trapping will permit the fish to recover their ground; but several years will be required for this, and doubtless as soon as there is any show of increase the traps will be again brought into use.

For several days during the present season Spanish mackerel were extremely abundant, so much so, in fact, that for a time they were sold in Newport at fifteen cents per pound. At Wood's hole pound five hundred and ninety-three were taken in one day, (August 23,) being a larger number than the entire catch of 1871. The total catch at this pound amounted to nine hundred and sixty-four.

Tautog, as already stated, were scarcer, and fewer striped bass were captured. A few salmon were taken at Seaconnet and at Menemsha. A marked increase in the abundance of shad and alewives was noticed, the shad especially being so plentiful about Newport that, according to Governor Stevens, they could not be sold in New York. When captured they appeared to be moving eastward. Alewives, too, were in unusually large numbers, this being the natural result of the operations of the fish-commissioners of New York, Connecticut, Rhode Island, and Massachusetts in protecting the alewives and opening the rivers for their entrance, while the abundance of shad was doubtless due to the enormous number hatched out under the direction of the Connecticut and New York commissioners and allowed to escape into the water. This certainly is a speedy realization of all the anticipations for the increase of shad, since fish, usually selling at a dollar a pair, became so abundant as not to be worth taking to market. This abundance, while rather unsatisfactory to the fishermen and dealers, is of great moment to the consumer.

Of mackerel none were taken off the south coast of New England, as in 1871. Messrs. Jason Luce & Co. secured a larger number of squeteague than in any previous year, and the testimony in regard to them elsewhere varied considerably, some maintaining that they were more abundant, others that they were scarcer.

GENERAL SUMMARY OF RESULTS.

The general conclusions at which I have arrived as the result of my investigations of the waters on the south side of New England during 1871 and 1872 may be briefly summed up as follows:

I. The alleged decrease in the number of food-fishes in these waters within the past few years has been fully substantiated.

II. The shore-fishes have been decreasing during the past twenty years, gradually at first, but much more abruptly from about the year 1865, the reduction by the year 1871 being so great as entirely to prevent any successful summer-fishing with the hook and line, and leaving to the traps and pounds the burden of supplying the markets. This statement applies also, but perhaps to a certain extent, to the blue-fish. The decrease in their numbers first manifested itself about ten years ago, and is going on quite rapidly until now.

III. This period of decrease represents the time during which the traps and pounds have been well established, their operations increasing year by year, and their catch, especially in the early spring, being always very great.

IV. In 1871 and 1872 the decrease in the number of fish has been so great as to reduce very largely the profit formerly derived by the traps.

V. The appearance, in 1871, of an unusually large number of young fish spawned in 1870 is a phenomenon only to be explained by the probable escape of a larger number of breeding-fish than usual during the previous season, an abrupt decrease in the ravages of blue-fish and other species, or else by a spontaneous movement northward of newly-hatched fish that ordinarily would have remained on a more southern coast. While these fish will probably, for several years, constitute a marked feature in the fisheries, there is no evidence of the existence of a second crop of young fish corresponding to the one in question.

VI. The decrease of the fish may be considered as due to the combined action of the fish-pounds or weirs and the blue-fish, the former destroying a very large percentage of the spawning fish before they have deposited their eggs, and the latter devouring immense numbers of young fish after they have passed the ordinary perils of immaturity.

VII. There are no measures at our command for destroying the blue-fish, nor would it be desirable to do this, in view of their value as an article of food. The alternative is to regulate the action of the pounds so as to prevent the destruction of fish during the spawning-season.

VIII. The quickest remedy would be the absolute abolition of the traps and pounds. This, however, would be a harsh measure, and their proper regulation will probably answer the purpose of restoring the supply, although a greater number of years will be required. Such regulation may consist either in prohibiting the use of traps or pounds during the entire season of the spawning of the fish, or for a certain number of days in each week during that season.

IX. As the principal profit of the pounds is derived from the catch of fish during the spawning season, it will probably be sufficient to try the experiment of prohibition of the use of nets from Friday night until Monday morning of each week of the spawning-season, and after that no restriction need be imposed.

X. It is desirable that the regulation for a close time during each week be passed by the several States; and if this cannot be effected, then the General Government should enact absolute prohibition, or at least during the spawning-season, as it possesses no officers who could exercise the supervision required to enforce the partial closure, or before whom complaints could be entered and the penalty exacted.

XI. Any marked increase in the number of the shore-fishes, resulting from their protection during the spawning-season, will probably tend to restore the blue-fish to their original numbers.

XII. As there is reason to believe that scup, and to a less degree other shore-fishes, as well as blue-fish, have several times disappeared at intervals to a greater or less extent, within the historic period of New England, we cannot be certain that the use of traps and pounds within the last ten years has actually produced the scarcity complained of. The fact, however, that these engines do destroy the spawning fish in so great numbers renders it very probable that they exercise a decided influence. No vested interest or right will suffer by the experiment of regulating the period of their use, as we have attempted to show that a better price will be obtained from a smaller number of fish, by preventing the glutting of the market, and the consequent waste of so perishable an article as fresh fish.

XIII. A feeling of bitterness entertained by the line-fishermen and the general public against traps and pounds, and those who own and profit by them, will in a measure be allayed if the experiment of regulation and restriction be tried, at least for a few years.

CONCLUSION.

In preparing the present report, my object has been to consider the subject of the New England shore-fisheries in a strictly dispassionate manner, not taking side with any of the different parties on the question as a special advocate, and attempting to draw such general conclusions only as the facts seemed to warrant. With the view, however, of enabling any one interested to review the ground for himself, I have given in detail the testimony (principally phonographic) collected during the inquiry in which I have been engaged, and added the special arguments of representative men on the opposing sides, prepared and furnished at my request, or else reprinted from official sources. To these I refer for the more local details and considerations of the subject, and especially in regard to the movements of scup in the Rhode Island waters.

As the entire questions at issue are most nearly related to the scup and the blue-fish, I have given on pages 228 and 235 respectively as complete an account of their habits and peculiarities as the material at my command will allow.

For a detailed account of the principal methods in use for capturing fish in the United States by lines, nets, or otherwise, I refer to the article in the appendix. The subject is by no means exhausted, and I hope to refer to it again, and to include some important forms of such apparatus used in other countries and especially applicable to our own, together with some account of improved methods of curing fish for the market as yet unknown in the United States.

In addition to a list of the fishes found at Wood's Hole, amounting to the large number of 116 species, I give a complete list of all the fishes known to occur on the eastern coast of North America, as prepared and furnished by Professor Theodore Gill. I am collecting materials for full descriptions and biographies of these species, to be published hereafter, with appropriate figures, should such a work be called for.

The account of the natural history of the south shore of New England is rendered much more complete by the memoir of Professors Verrill and Smith on the marine invertebrates, with its excellent illustrations, all executed in relief by the method of Jewett & Co., of Buffalo. The list of the algæ, by Dr. Farlow, will also furnish an important indication in reference to the distribution of this group of plants.

An accompanying map of the south shore of Massachusetts and Rhode Island is intended to show more particularly the distribution of animal life—the fish-food—along the coast by indication of the results of soundings, dredgings, and temperature observations, made by Professor Verrill and myself during the season of 1871. On this same map is recorded likewise the position of all the traps and pounds in use in 1871, as far as I could ascertain their situation. There is also a separate diagram of the traps at Seaconnet, where are taken, as is said, nearly nine-tenths of all the fish caught by fixed apparatus in Rhode Island. I have also given a diagram of the weirs on Cape Cod Bay, as furnished by Captain Crowell.

SPENCER F. BAIRD,
Commissioner.

SMITHSONIAN INSTITUTION, *December* 2, 1872.

CONTENTS.

* For detailed table of contents of the report of the commissioner see p. v.

II.—GENERAL PLAN OF INQUIRIES PROSECUTED.

For the purpose of securing greater precision in the inquiries prosecuted in reference to the natural history of the fishes and the influences exerted upon their multiplication, a general plan was drawn up, with the assistance of Professor Gill, which was followed, as far as practicable, in the investigations. For greater facility the same features were thrown into the form of questions, answers to which were entered by their corresponding numbers, as shown in the testimony. This systematic arrangement of the subject and the corresponding questions are as follows, it being understood that some particular kind of fish is usually under discussion:

MEMORANDA OF INQUIRY RELATIVE TO THE FOOD-FISHES OF THE UNITED STATES.

A. Name of the fish in question in different localities.
B. Geographical distribution.
  At present time.
    Change of location with season of year.
  In former times.
    Supposed cause of any permanent change.
C. Abundance.
  At present time; in different seasons and localities.
  In former times; in different seasons and localities.
  Supposed cause of variation in abundance.
  Probable change in the future.
D. Size.
  Maximum length, girth, and weight.
  Average length, girth, and weight.
  Rate of growth.
  Length and weight at age of one, two, three, &c., years.
  Difference of sexes in this respect.
E. Migrations and movements.
  Arrival and departure.
  Period of stay.
  Certainty of arrival.
  Route of movement coming and going.
  Number and times of runs or schools in one season, and differences, if any, in the runs.
  Difference in time of arrival of the sexes and ages.
  Feeding of fish after arrival.
  Summer abode.
  Winter abode.
  If anadromous; when they enter the fresh water and when they leave it.
  If anadromous; what the movements up and down fresh waters of adults or of young.
  Rate of progression of schools in fresh or salt water.

- Relation of movements to tides.
- Depth of water preferred by schools or single fish.
- Temperature and general condition of water preferred.
- Favorite localities in any region; whether bottom be sandy, rocky, muddy, grassy, &c.

F. Relationships.

- To its own species; whether gregarious, solitary, grouped by age or sex at any season, predaceous, &c.
- To other animals; whether preyed upon by them, feeding upon them, &c.
- Special enemies, friends, or companions.

G. Food.

- Nature.
- Mode of taking it.
- Time of taking it.
- Quantity consumed.

H. Reproduction.

- Interference with spawning by lines, nets, &c.
- Age of male and of female, respectively, when capable of reproduction.
- Change in physical condition, (color, shape, fatness, &c.)
- Date of spawning and its duration, as relating to the individual as well as to the species.
- Preferred localities for spawning, as to place, temperature, &c.
- Special habits during spawning season.
- Special habits before or after spawning.
- Ratio of mortality in old fish from spawning.
- Number of successive years of capacity for spawning.
- Nesting-places.
    - Are nesting-places prepared? If so, whether of grass, stones, sand, &c., or cleared areas, and whether made by one sex only, or both.
    - If ridges or furrows are formed, how made?
- The eggs.
    - Mode of fecundation.
    - Where laid.
    - Where and how attached, if at all.
    - Whether covered up, and how, or whether exposed in water.
    - Number laid by one fish at one time, and the number during lifetime.
    - Size and color.
    - Special enemies.
    - Guarding of eggs by either sex.
- The embryo and young fish.
    - Time necessary for development.
    - Ratio of fish hatched to number of eggs laid.
    - Proportion of young fish attaining maturity.
    - Movement after birth; whether remaining on spawning-ground, and how long, or whether changing from fresh to salt, or salt to fresh water, &c., and when.
    - General appearance and successive changes.
    - Rate of growth.
    - Special food.
    - Enemies and diseases of eggs and young.
    - Relation of parent fish of either sex to young; whether protective, predatory, &c.

I. Diseases.
K. Parasites.
L. Artificial fish-culture.
M. Protection by law.
N. Capture.
- Methods.
  - By lines.
  - By nets.
    - Floating or movable, (seines, gill-nets, &c.)
    - Fixed, (traps, pounds, weirs, dams, &c.)
  - Other methods of capture.
  - Bait.
  - Influence of modes of capture on abundance.
- Season of capture.
  - By lines.
  - By nets.
  - Otherwise.
- Time of tide when taken.
- Statistics of capture.
  - By lines.
  - By nets.
  - Otherwise.
- Value of fish taken.
- Disposition of fish taken.

O. Economical value and uses.
- For food, (fresh, salted, smoked, dried, &c.)
- For oil.
- For manure.
- For other purposes.
- Price, in its variations with place, season, and year.
- Export and trade, in their variations with place, season, and year.

P. Remarks relative to foreign or domestic allies.

QUESTIONS RELATIVE TO THE FOOD-FISHES OF THE UNITED STATES.

A. Name.

1. What is the name by which this fish is known in your neighborhood? If possible, make an outline sketch for better identification.

B. Distribution.

2. Is it found throughout the year, or only during a certain time; and for what time?
3. If resident, is it more abundant at certain times of the year; and at what times?

C. Abundance.

4. How abundant is it, compared with other fish?
5. Has the abundance of the fish diminished or increased within the last ten years, or is it about the same?

6. If diminished or increased, what is the supposed cause?
7. What is the amount or extent of the change in abundance?

D. SIZE.

8. What is the greatest size to which it attains, (both length and weight,) and what the average?
9. State the rate of growth per annum, if known; and the size at one, two, three, or more years.
10. Do the sexes differ in respect to shape, size, rate of growth, &c.?

E. MIGRATIONS AND MOVEMENTS.

11. By what route do these fish come into the shore; and what the subsequent movements?
12. By what route do they leave the coast?
13. Where do they spend the winter season?
14. When are the fish first seen or known to come near the shore, and when does the main body arrive; are the first the largest; are there more schools or runs than one coming in, and at what intervals?
15. When do the fish leave shore, and is this done by degrees or in a body?
16. Is the appearance of the fish on the coast regular and certain, or do they ever fail for one or more seasons at a time, and then return in greater or less abundance; if so, to what cause is this assigned?
17. How do the runs differ from each other in number and size?
18. Which sex comes in first; and how far advanced is the spawn in the female on first arriving?
19. Will either sex, or both, take the hook on first arriving; and if so, is there any period of the stay of the fish when they refuse it?
20. If they refuse the hook at first, how soon do they begin to take it after arriving?
21. Do the schools of fish swim high or low; and is their arrival known otherwise than by their capture; that is, do they make a ripple on the water; do they attract birds, &c.?
22. What is the relation of their movements to the ebb and flow of the tide?
23. Does spawn ever run out of these fish taken with a hook?
24. Answer same question in regard to fish taken in nets or pounds; is the spawn ever seen in any quantity floating about inside of nets?
25. Are these fish anadromous; that is, do they run up from the sea into fresh water for any, and for what, purpose?
26. If anadromous, when are they first seen off the coast; when do they enter the mouths of the rivers, and what is the rate of progression up stream?
27. If anadromous, what the length of their stay in fresh water, and when do they return to the sea, or do they become exhausted by breeding and die?
28. Do the different sexes or ages vary in this respect?
29. Do these fish come on to the breeding-grounds before they are mature; or do you find the one or two year old fish with the oldest?
30. What are the favorite localities of these fish; say whether in still water or currents, shallow or deep water, on the sand, in grass, about rocks, &c.?
31. What depth of water is preferred by these fish?
32. What the favorite temperature and general character of water?

F. Relationships.

33. Do these fish go in schools after they have done spawning, or throughout the year, or are they scattered and solitary?
34. Have they any special friends or enemies?
35. To what extent do they prey on other fish; and on what species?
36. To what extent do they suffer from the attacks of other fish, or other animals?

G. Food.

37. What is the nature of their food?
38. Are there any special peculiarities in the manner of feeding of these fish?
39. What amount of food do they consume?

H. Reproduction.

40. Is there any marked change in the shape or color of either sex during the breeding-season, or any peculiar development of, or on, any portion of the body, as the mouth, fins, scales, &c.?
41. Are there any special or unusual habits during the spawning-season?
42. Is spawning interfered with by lines or nets, or otherwise?
43. At what age does the male begin to breed, and at what age the female?
44. For how many years can these fish spawn?
45. Does the act of spawning exert an injurious effect?
46. Where do these fish spawn, and when?
47. Can you give any account of the process, whether males and females go in pairs, or one female and two males; whether the sexes are mixed indiscriminately, &c.?
48. Is the water ever whitened or colored by the milt of the male?
49. What temperature of water is most favorable for hatching?
50. At what depth of water are the eggs laid, if on or near the bottom?
51. What is the size and color of the spawn?
52. What is the estimated number for each fish; and how ascertained?
53. Answer the question for one season, and for the lifetime.
54. Do the eggs, when spawned, sink to the bottom, and become attached to stones, grass, &c.; or do they float in the water until hatched?
55. Do the fish heap up or construct any kind of nest, whether of sand, gravel, grass, or otherwise; and if so, is the mouth, the snout, or the tail used for the purpose, or what; and if so, how is the material transported; or do they make any excavation in the sand or gravel?
56. Do they watch over their nest, if made either singly or in pairs?
57. When are the eggs hatched, and in what period of time after being laid?
58. What percentage of eggs laid is usually hatched?
59. What percentage of young attains to maturity?
60. What is the rate of growth?
61. Do the parents, either or both, watch over the young after they are hatched?
62. Do they carry them in the mouth or otherwise?
63. What enemies interfere with or destroy the spawn or the young fish; do the parent fish devour them?

64. Are the young of this fish found in abundance, and in what localities?

65. On what do they appear to feed?

I. Artificial Culture.

66. Have any steps been taken to increase the abundance of this fish by artificial breeding?

K. Protection.

67. Are these fish protected by law or otherwise?

L. Diseases.

68. Has any epidemic or other disease ever been noticed among them, such as to cause their sickness or death in greater or less number?

69. When have these epidemics taken place, and to what causes have they been assigned?

M. Parasites.

70. Are crabs, worms, lampreys, or other living animals found attached to the outside or on the gills of these fish?

N. Capture.

71. How is this fish caught; if with a hook, what are the different kinds of bait used, and which are preferred?

72. If in nets, in what kind?

73. At what season and for what period is it taken in nets, and when with the line?

74. What would be the average daily catch of one person with the hook, and what the total for the season?

75. Answer the same question for one seine or pound of specified length.

76. Is the time of catching with nets or pounds different from that with lines?

77. Is it caught more on one time of tide than on another?

O. Economical value and application.

78. What disposition is made of the fish caught, whether used on the spot or sent elsewhere; and if the latter, where?

79. What is its excellence as food, fresh or salted?

80. How long does it retain its excellence as a fresh fish?

81. To what extent is it eaten?

82. Is it salted down, and to what extent?

83. Is it used, and to what extent, as manure, for oil, or for other purposes, and what?

84. What were the highest and lowest prices of the fish, per pound, during the past season, wholesale and retail, and what the average; and how do these compare with former prices?

85. Are these fish exported; and, if so, to what extent?

86. Where is the principal market for these fish?

87. Name and address of observer.

88. Date of statement.

III.—TESTIMONY IN REGARD TO THE PRESENT CONDITION OF THE FISHERIES, TAKEN IN 1871.

NEWPORT, RHODE ISLAND,
August 1, 1871.

The following reports were all made by a phonographic reporter, Mr. H. E. Rockwell, of Washington, and are intended to present the words of the witnesses, without alteration:

HENRY O. TIFFT:

There are very few fish indeed now, to what there used to be. They are growing scarcer every year; they are much scarcer this year than last, I think. I hear people who fish say that they cannot do anything to what they could once. One of them told me he had been out and fished a week, and did not catch a black-fish. The traps catch them up in the spring of the year. The tautog are a species that go up the Providence River to spawn; it is salt water all the way up. We used to catch scup and tautog, as many as we wanted, away up Providence River; but they don't catch scup now. I don't think they could go anywhere in Narragansett Bay and catch scup with a hook and line. I don't think they catch them much in the pounds.

Mr. MACY. If you were to take a vote of the people, I think it would be ten to one against the use of pounds. All the people say to me that the pounds are the cause of the diminution of the fish.

Mr. TIFFT. Most of the traps are in the river; none outside. They are in the East and West Bays, and all the way up on both shores nearly half-way up to Providence. There is a trap-seine at Point Judith now; there is a pound everywhere that they can drive stakes. There are three times as many pounds this year as last; it is a money-making business, and all want to go into it. They say the legislature has no power to stop them, and will keep on fishing if they are prosecuted. The fish strike at Point Judith before they do in West Bay. It seems as if they were coming from the south. Traps were put down first at Saughkonet. In the spring of the year you will see little spring-bass in the market, about six inches long, taken in these nets. The majority of them are small when they first come.

Mr. MACY. Sixteen or eighteen years ago there were five vessels went out from here, fishing for mackerel, but they sunk money in it and dropped the business.

Mr. TIFFT. There are some pounds on the south end of Providence Island, on both sides of the Canonicut, and through the east and west passages, up as far as Tiverton. Scup are out of the question. All kinds of fish are killed out, and the breeding broken up. I think, what the pound men call small scup, that they say they catch so plenty this year, are skip-jacks.* They look almost precisely alike when small. The skip-jack is a small species; never grows large; the only difference from the scup is, that the skip-jack has finer scales than the scup. The skip-jack grow about four or five inches long. They are caught about the wharves here; but no scup has a chance to spawn in our waters.

* This is a mistake; the fish in question are small scup.—S. F. B.

Mr. MACY. The squeteague are four times as plenty now as I have ever seen them before, and keep increasing. In 1830 we caught the first blue-fish in Nantucket; but in 1831 my uncle caught a barrel which he salted. They became plenty afterward, and continued so up to the year of the plague that killed off all the Indians but two children. They all disappeared that year.

Mr. J. J. CURRY, dealer in fish:

The Spanish mackerel are caught in this vicinity. They are more scarce this year than usual. The blue-fish run about as last year, but larger. I have kept a fish-market here six years. I do not think the blue-fish scarcer than they were six years ago. There was a time, six years ago, when in August, for three days, we could not get any. I do not know that there are any more traps used now than there were six years ago. We get all our fish for market here in this neighborhood, except halibut, round mackerel, and salmon; these come from Boston. Six years ago the price of Spanish mackerel was forty cents a pound; now they are worth a dollar a pound. Salmon are selling for fifty cents a pound. I buy my fish from the pound-men, paying about fifty-five cents a pound for Spanish mackerel. Last year we had four times as many Spanish mackerel as formerly. They were first caught here four years ago. We get eight cents a pound for blue-fish; never sell them for less than that. Flat-fish we can hardly give away in this market. We get eight cents a pound for weak-fish, (squeteague.) We do not sell many round mackerel; we cannot get more than ten or twelve cents a pound for them fresh, and, when salted, they sell for eighteen cents Scup bring five cents apiece on an average; not more than six or eight cents a pound. We get no scup scarcely.

SAMUEL ALBRO, dealer in fish:

We get forty cents a pound for sheep's-head; they are taken in the West Bay. We get five cents a pound for flat-fish, (flounders;) take anything we can get for them; they are not much used here. We get half a dollar a pound for salmon. There is one kind of flat-fish, that we call pucker-mouth, that is better than the other kind. For lobsters we get five cents a pound. I think blue-fish are more plenty than last year. Tautog are scarce. George Crabb* makes five dollars a day catching tautog with a hook and line the year round. He will average a hundred pounds a day. In the spring our market would not be as well supplied with fish if it were not for the pounds, because they can catch them in pounds before they will bite the hook. Down at Gooseberry Island they took in one pound as many as 10,000 barrels of small scup, so small that they did not want them; the net was so full that they could not haul it, and had to catch hold of the bottom of it and tip them out. They were spawned south. They never saw such a lot of young scup here before. It was from the 14th to the 18th of May that they caught so many young scup. The big ones came along about from the 1st to the 10th of May.

FRANCIS BRINLEY, esq., chairman of the Commission on fisheries of Rhode Island:

We had many meetings of the Commission in different parts of the State to make inquiries, and found the people generally ready to answer them, though some hesitated. As a general thing, the pound or trap men here would not attend the meetings, although invited through the notices in the newspapers. Mr. Stevens did not appear before the Com-

* See George Crabb's testimony, p. 30, to the contrary.

mission, nor did he respond to the interrogatories sent him. There has been a new development of this question since our last report was made. It is likely that the subject will come up next winter; it is largely a political question here. There was a bill prepared last spring in the senate, about which there is a good deal of feeling, as it varies from the bill which I prepared, in applying to the whole State of Rhode Island. Originally I took the ground that we would try the experiment of running the line in a particular manner. That was opposed because it was unequal, and it was said, "This is a partial line." Now they say to the pound-men, "You have had time to get out of this business and pull up your traps; and having been forewarned, we will now run the line the whole length of the waters of the State." It is possible there may be some resistance on account of want of jurisdiction, as gentlemen ot the profession are generally willing to embark in such matters. In Connecticut they have passed a law prohibiting the catching of shad in pounds after this year.

Mr. LYMAN. In Connecticut they set their pounds to the west of Connecticut River; they do not catch enough east of it to make the business pay.

Mr. MACY. I know that a few years ago you could go out back of the fort and catch as many scup as you wanted; but I would like to see any one catch a scup there now. They said the people in Connecticut and Massachusetts are catching in nets, and why should we be cut off here? We catch shad very rarely here. Excepting very early in the season we get them from the East. About fifty-five or fifty-six years ago they caught shad plenty around Nantucket.

Mr. LYMAN. That was a sporadic run, about which there was something very curious.

Mr. BRINLEY. In the Providence Press, within two or three days, there has been a very strong article, in which the writer speaks of the great number of young scup which have been caught, even within the waters near the city, except where the water was charged with impurities, these young fish having got the advantage of the net fishermen by coming in two weeks earlier this year than usual.

Professor BAIRD. Does he mean to imply that these same young scup come in year by year?

Mr. BRINLEY. No; that they escaped the nets this year, in consequence of coming in two weeks earlier than usual. Young scup have been killed in Providence Bay by the impurity of the water.

General C. C. VAN ZANDT. I was chairman of a committee of the legislature on the subject of the shell-fish, and I found that the impurities had a great influence. We found oysters with a perceptible odor of coal-tar, that were taken five or six miles down the bay. This was some years since.

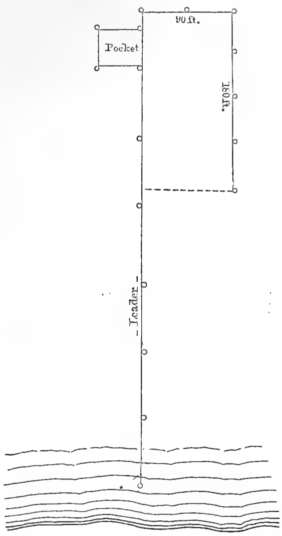
Mr. SAMUEL POWEL. The people who are interested in this question do not understand it at all as a whole. I think many facts are needed before we can act correctly in regard to it. To attempt to stop the trapping would not be useful in the end, as the traps gather great quantities of fish in a short time—more than the lines could do in a long time. The matter here is now fought off till next January. I am wedded to no theory; but there is a curious fact that the fish come this year, bringing their little ones with them.

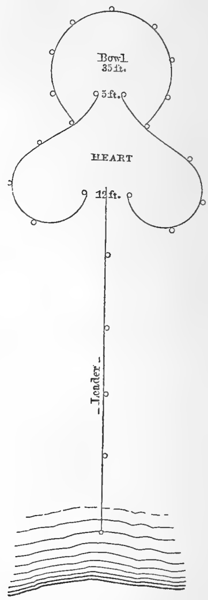
NEWPORT, RHODE ISLAND, *August* 2, 1871.

J. M. K. SOUTHWICK:

I am not now a practical fisherman, although I have fished many years with traps and nets of different kinds. The question is one which excites considerable feeling. We have two styles of nets; what is called the trap, and the heart-seine or pound.

[These were illustrated by drawings in this manner:]





There is no bottom to the trap-net, and it must be watched all the time. Fish, when not excited, will remain in it some time, especially scup; but menhaden are apt to get out unless they are closely watched.

The first trap is set at Franklin Hollow, to catch the fish as they run south, on the eastern shore of the West Passage. It has a leader of something like a hundred fathoms. Traps have been tried on the west shore, but no fish are caught there in the spring.

There is a heart-seine in Mackerel Cove, which has a leader of about seventy-five fathoms. There are two set near Fort Adams. I set one five years at Pine-Tree Beach, having a leader of forty-five fathoms. The leader is generally set perpendicular to the shore. There is a heart-seine at Coddington's Cove. The rest are usually traps. I catch fish usually by the 10th of May. This year the fish came earlier, and probably could have been caught by the 1st of May. The fish were ten days later at Coddington's Cove than at Pine-Tree Cove. When the fish first come in the spring, we catch a few at first, and then a hundred or two, and then pretty soon several hundred barrels. The first run is generally larger than the later. The first run of scup that comes in, is generally of large scup, all large, weighing from two to three pounds. Then, perhaps a week afterward, the smaller scup, two-thirds the size of the others come in; and two weeks later they come that weigh from half to three-quarters of a pound. The last run are smaller, and many not worth saving, and many pass through the meshes of the net.

There is a phenomenon that has happened this year not commonly observed by fishermen before. The Saughkonet and all the other fishermen—I come in contact with all—report to me that they saw the small scup in vast quantities about the time they were taking up their nets; they described them as being from half an inch long up to three inches. That was about the 1st of June. Still later they were reported to be further up the bays; and in July Mr. Arnold, of West Greenwich, told me that the river up there seemed to be full of them.

From the middle to the last of May the heart-seines are put down at different points along higher up the bays; some of them may have been put in about the 1st of May, but they do not begin fishing much until a little later. I have a heart-seine now at Dutch Island Harbor, in the West Bay.

Flat-fish are caught about here in the winter.

Captain Calhoun stated to me that he saw the first scup caught here, which was placed on exhibition at the United States Hotel. There is a tradition that they first occurred here about 1793, and the sheep's-head disappeared here about that time. There have been more sheep's-head caught here this season than I have ever known. I have seen a dozen in the market at once.

Scup have been much more abundant this year than at any time during the last five or six years; still, not so plenty as at some former periods.

The blue-fish have not shown themselves very plenty yet this year; they have been rather scarce. There have not been so many as last year, up to the present time.

I think the squeteague have been as plenty as ever before; they have been very plenty indeed.

About the time that the blue-fish come, the scup disappear.

There is no doubt but that the great majority of the fish are destroyed while in their spawn or small fry.

In May the spawn of the scup is found in different degrees of development; while some are quite ready to spawn, others have it developed but little. Some have no spawn in them. I saw six cleaned in the month of May, of which only one had spawn; there might have been the same number taken, and every one had spawn in it.

We catch in our traps and pounds the scup in largest quantity; next come the sea-bass; then, squeteague; then, blue-fish; and then the flat-fish, called the brail, the pucker-mouth, and the flounder; then, tautog.

The great bulk of the fish caught in the pounds goes to New York.

I have known scup sold as low as fifty cents a barrel, five or six years ago. They sometimes sell fish for just what they can get, because they cannot be kept long enough to get them to market. Sea-bass bring about the same price as scup generally—about five cents a pound. Squeteague bring four cents; blue-fish, five cents; flat-fish, from two to three cents—many have been sold for two cents each. Very few fish are salted here, except the herring.

Menhaden are second to scup in number of pounds caught; they are used for oil and bait. One gang caught 1,500 barrels of menhaden last week. There are three or four oil-works on this island. This season is reported to be the best for many years for menhaden. For bait they are sold for a dollar a barrel, and sometimes a dollar and a half. When sold for manure, they bring about thirty cents a barrel. The purse-nets supply the oil-works generally with menhaden.

JOHN D. SWAN:

I have been fishing about forty-eight years, with hook and line; have never used traps or seines of any kind—nothing more than a gill-net for herring for bait. I have fished about Brenton's Reef, mostly for black-fish, (tautog.) I think tautog is about as plenty this year as last; but not so plenty as five years ago. Eighteen or twenty years ago, in two hours I could get as many as I wanted. Then we got four or five cents a pound at retail; now we get eight cents. If we get fifty pounds a day now, and work hard, we do a pretty good business. I sell to families; dealers give only about five cents a pound.

I have not seen a scup this season in the water. We used to catch them when fishing for tautog. I have not seen the run of young scup that there is so much said about; I have not seen young scup this year in greater quantity than usual.

We did not formerly catch scup with the hook until ten days after they were seen. They used to run so thick that they would crowd one another up out of water. There was one place where they run over a point where the water was nine feet deep, and they were so thick as to be crowded out of water. I went there this spring in the month of May, and did not see a scup there.

Mr. SOUTHWICK. It was reported that scup have been seen there.

Mr. SWAN. Scup have been dwindling off ever since the traps appeared, and I attribute the diminution to the traps.

Mr. SOUTHWICK. I think it is due to some increase of enemies. I think all fish, if left alone, would multiply at certain periods and become very numerous, until their particular enemies increased and destroyed their spawn. We know that all spawn has enemies. I do not think there has been so much decrease as is asserted; I think it has been principally in the bays and not in the waters generally. They are scarce in the bay from over-fishing by the great number of fishermen around the shores. In fishing for bass, they will play with the bass they hook until he drives all the other fish away. I think that has an effect on the bass. The scup, I think, are affected by the impurities of the water in coming up the bay. The appearance of the blue-fish and the impurities of the waters from the manufactories keep out the scup.

Mr. SWAN. I have not caught a blue-fish this year except when fishing for bass; they are not plenty enough to be worth fishing for.

Mr. SOUTHWICK. My observation shows that the blue-fish have been less than last year. They struck in very scattering.

Question. When were scup first seen this season?

Mr. SOUTHWICK. Somewhere about the third of May, at Pine-Tree Cove. Frequently we do not see them, though they are in the water. They swim slowly and almost always with the tide. I think they drift backward and forward with the tide; unless frightened, they never go against the tide.

Mr. OBED KING. There is not three days difference between Watch Hill and Gay Head. This season they caught scup at Gay Head first.

Mr. SOUTHWICK. I used to think it was safe not to put in my net at Pine-Tree Cove till I heard of the fish being caught down near the light-boat, off the mouth of the harbor. That was so well established as being safe to act upon, that I should not hesitate now to act upon it. For three years, I think, the 10th, 11th, and 12th of May were first days on which scup were caught. This year they seined them about the 3d of May. Sea-bass were more plenty at Saughkonet this year than last.

Mr. SWAN. I have not found them so plenty.

Mr. SOUTHWICK. I fished at Pine-Tree Cove five years, and for the first four years I did not exceed four or five hundred pounds a month. This year I got at some single hauls more than during the whole former season. Last year I got as many as twelve or fifteen hundred-weight. I do not know the cause of the diminution of the scup, but I think they may have diminished from the same cause that many other fish have that were never caught in our traps, such as the bull's-eye; the old fishermen say they used to catch them in large quantities.

Mr. SWAN. They used to be here every season. They disappeared twenty-five years ago. There is not one to ten striped bass that there used to be. They catch the small ones by hundreds, in the traps, early in the season.

Mr. SOUTHWICK. We take up the traps after May, and do not put them down again at all. The heart-seines are kept down through the season, because the heart-seines do not need watching, and you can go and get the fish out at any time, the fish remaining in them. The traps are best when the fish come in large bodies. We catch menhaden in the traps sometimes, but we have to work very quick. The heart-seines are supposed to catch all the time.

Mr. KING. Nine out of ten of the fish have spawn in them in the spring; they are slow and lie around, and will not run out of a square trap. Gill-nets are used around here too; they catch blue-fish in them outside, but they are much more scarce than formerly. They say scup are blind when they first come, but it is not so; they move slow because they are full of spawn. Large bass are caught here in the winter, in deep water, with clam-bait, but they are slow in biting. In one winter they were thrown up in great numbers on Block Island, frozen to death. The pucker-mouth is caught in winter in shallow water; the other flat fish go into deeper water.

Mr. SWAN. I caught a Spanish mackerel about twenty years ago. We should not get many now were it not for the traps.

Mr. SOUTHWICK. They are caught only in the heart-seines, because the square traps are taken up before they come in.

Mr. SWAN. I can remember when the blue-fish first came in; they did not catch them when I was a boy. It must have been forty years ago when, at one time that I had been fishing for tautog, I trolled for blue-fish, and got several that day. Twenty years ago we could catch scup in any quantity, but since the traps came in they dwindled off.

Mr. SOUTHWICK. Nobody disputes the fact that scup have of late years been less plenty than formerly. They showed themselves quite plenty last year. Near Bristol Ferry they caught them in plenty.

Mr. KING. There were not so many barrels shipped to New York this year as last.

Mr. SOUTHWICK. That is no criterion. The great bulk of the fish are sent directly to New York from the traps in vessels.

Mr. KING. There have not been half so many vessels on the river as last season. I have not caught three scup in three years.

Mr. SOUTHWICK. The pounds about Point Judith have taken more than in any year for three years; that is the general information. There is one trap, near the Spouting Rock at Watch Hill, which has been more successful in getting scup this year than for a number of years.

WILLIAM DENNIS, Esq.:

Question. Have you paid any attention to the political economy of this fishing question?

Answer. I am a Newporter, and am here every year for about two months, and I fish all the while with a line. I have fished regularly since 1828, and know something about it. Compared with the fishing twenty years ago, under the same conditions, the number of tautog caught now would not be more than one-eighth as many. There are no scup now; I have not caught one this year. I have been fishing two weeks, and fishing where scup ought to be very abundant; I have not caught one or seen one. I consider them nearer gone than the Indians. Twenty years ago I used to go outside for my fishing mostly, and my car would hold from one hundred to one hundred and fifty pounds. In the ordinary condition of weather I would fill it and be home by nine o'clock in the morning; and when I left off fishing, having caught as many as I wanted, I could have caught as many more if I wished. I think that now, fishing the same time, under the same circumstances, on the same ground, if I saved all that I could, and exhausted my ability, and got twenty-five pounds of all kinds of fish, I should do well. I fished for nothing except tautog. I first began to appreciate a difference within ten or twelve years—a very sensible difference. I never saw any difference until traps were set. I know that, after the traps had been in successful operation a short time, there was a clear diminution of the fish, the same that there always is in countries where birds are trapped. You cannot shoot up the game—neither woodcock nor pinnated grouse; and you cannot exterminate the fish with the hook and line. Consequently there was no diminution until the traps were set here. Of course the fish are diminishing all the while. I don't believe that to-morrow morning you can take a box of crabs, and go out and catch a hundred pounds a day for a week. We don't know what they take in traps. They say they never get any, although other people have seen them carried off by the cartload. They take everything from a shark down to a large chogset. The very moment you sink your trap to the bottom, you are sure to take shark as any other fish. Those who fish for striped bass tell me they are very scarce. I have been here two weeks, and have caught a few fine tautog, but I have caught them all in the river; and of course that is no way to determine whether there are any fish, because if there were one or two hundred fish here at this time, they would be sea-fish that came into the river. I remember very well when the blue-fish came here.

Mr. SWAN. The blue-fish were small when they first came here, not weighing over a pound and a half. The biggest I ever caught weighed fourteen pounds. I think I have seen one weighing eighteen pounds.

Mr. DENNIS. I have my own theory about squeteague. I was fishing, six or seven years ago, off Point Judith, when I hooked the first squeteague I ever caught here. I then took twelve large fish, weighing seven or eight pounds. I take it they require a peculiar kind of bait, which is becoming more abundant than it has been. There is only one fish here that maintains its numerical integrity; that is the chogset.

Mr. SOUTHWICK. Nothing but menhaden are used for manure. In the five years that I fished I never sold any to be put on land, except about two barrels of waste fish. I have sold, perhaps, in that time, seventy-five barrels of menhaden.

Mr. SWAN. We find the tautog two or three miles from land in winter, and the chogset stow away in deep water. Lobsters are pretty scarce now. Last year I averaged forty a day in my pots; this year not more than twenty-five or thirty. They sometimes burrow themselves up in the sand.

Captain SHERMAN fully indorsed the statement of Mr. Dennis. He had been fishing with him a great deal. There has been a general depreciation of the fish since the traps have been set. The bays are so blocked up with nets that the fish cannot come in. It will not admit of an argument. I can think of nothing else than the traps as the cause of the diminution.

Mr. SOUTHWICK. If traps are the sole cause of the diminution of the scup, what could have been the cause of the diminution of the bull's-eye, sea-bass, blue-fish, and squeteague, all of which have disappeared almost wholly in this century, and again returned, with the exception of the bull's eye? I am told the sea-bass disappeared about thirty years ago, and then came on again.

Mr. SWAN. I never knew them to disappear. About fifteen years ago, one 4th of July, I trolled for blue-fish while going out to my lobster-pots, and I got a striped bass that weighed thirty pounds. After I had hauled my pots, I caught two more, one weighing nineteen and the other twenty-one pounds. On the 8th of July I went again, and, after hauling my pots, I cut up a little lobster and fixed my bait, and when I threw my line it got snarled, and in trying to twitch out the snarl, I caught a fish; and that day I got eight that weighed in the aggregate two hundred and seventy-six pounds after they were cleaned. I do not think the steamboats have any influence in diminishing the fish. A steamer coming within fifty yards of a fishing-place would not drive away the fish. In former times, a common impression among the fishermen was that if the heads and gills of the fish used for bait were thrown into the water, it would scare away the fish, but I always throw them overboard.

I have no idea how old scup are when they spawn. I think scup as large as a man's hand will have spawn in them. We generally save the spawn of the large scup to eat. Scup move with the tide; other fish we do not see so much, as they keep near the bottom; the scup are seen when they go over shallow places.

I don't think I ever saw scup in blue-fish; I have found little mackerel and shiners something like a herring, and menhaden. Blue-fish throw out all that is in their stomach when caught.

Before traps were put in we could see the tautog in the water about the rock, and under the edges of the stones in a warm day. Some say you cannot catch tautog in a thunder-storm. That is "all in your eye." I caught more fish in one thunder-squall than I had caught all day in another place. When tautog are plenty, the best bait for them is the crab; but I always fish with lobsters. They eat the muscles off the rocks. I have seen some of the rocks covered with muscles at one time, and then the star-fish would come and eat them all off.

I think there are more hand-line fishermen than there were fifty years ago. The business has rather increased during the last twenty years.

Bonito were never plenty about here. I never caught more than one in a day and not a great many in all.

I have never seen any fish that appeared sickly except the cod-fish; that is sometimes what we call loagy. I think those have the consumption. Menhaden are very bad bait for lobsters. If there is any in their paunch when boiled, the oil comes right through the meat. Any strong fish affect lobsters in the same way. The bull's-eye fish was poisonous if kept long. It was a kind of chub-mackerel.

Twenty-five years ago, I think, I caught 165 blue-fish in one day and three bass, trolling. That is the most I ever caught in one day.

NEWPORT, RHODE ISLAND,
August 2, 1871—*Afternoon.*

LIEUTENANT GOVERNOR PARDON W. STEVENS:

I have only one pound; I do not trap at all. We thought we could do better in buying fish. The trap is a Rhode Island institution entirely; they are set only about three weeks. Previous to last year they commenced trapping about the 20th of April, but this year not till the 1st of May. The trap is like an oblong box, with one end knocked out. But in a heart-seine we can hold the fish we catch. A brother of my partner got a bass in his pound that weighed fifty-two pounds. The leader of the trap must be long enough to get to a sufficient depth of water. Over on the Saughkonet side the leaders are two hundred fathoms. The leaders run from east to west, with the mouth of the trap to the north; and where they set several traps, the leader of one runs a little by that of another. The fishers there measure off the water and draw for it. There is a sort of agreement among the trappers that the leaders shall be two hundred fathoms. There is one place where they allow them longer. On the southeast corner of the State they allow them to go out five hundred fathoms, so as to get square with the one at Saughkonet Point.

We set the mouth of the trap up stream because, as the tide runs north, the trap must be right across the tide; the open part to the northwest, and the leader on the south side. The mouth is in some instances leaded and goes to the bottom. I never worked a trap at Saughkonet; what I know about the fishing there I learn when I go there to buy fish. I never worked a trap except down in this bay.

I think the fish are bound eastward. I always took the ground that if the fish were bound to the river the traps would not hinder them. I think the heart-seine is much more injurious than the trap, if either. There are many days when a man cannot attend to his trap. It requires almost as much attention to fish with a trap as in the hauling of a seine. Half a gang attend half a day and the other half the rest. It usually requires six men to haul up the gate to a trap. I attend one with one man.

I had a heart-seine at Sachuest Point, thinking that if the fish went up the river there I would try and get some. The leader runs from the shore sixty-five or seventy fathoms. We attended that diligently, and all the scup we got was two. We got perhaps half a dozen tautog, a few dozen codfish, and a few barrels of herring. We set to catch Spanish mackerel or anything that would run in in the summer. I was satisfied that no fish went above, but they went across. I know the fishermen do not go more than two and a half miles north of Saughkonet Point; but we were two miles above them.

As a general rule, we have to set our traps on the east side of the channel for the first run of scup. I do not know so much about the second run, because small scup stay here all summer. When you take up a school of these, they are almost a calico-color; the first run are almost white. I never saw any with regular bars on them. Some that are called the third run of scup are caught up at the head of the bay. I cannot tell whether the large scup have ever been caught up at the head of the bay, because I never fished there. My idea is that the fish come in east of Block Island and strike first at Watch Hill and Point Judith. I don't know how far into the Sound they go; but they catch them first at Watch Hill. I think the big scup do not go up the West River. I have seen them running across Brenton's Reef on their way eastward. Some say they are blind at first, but I never saw any that were so; I never saw any that did not move pretty fair. They move faster in warm weather than when it is cooler. Recently they have got the first scup at Watch Hill; but there used to be a trap west of Beaver Tail light, which picked them up first. Now they have rigged it as a pound.

There would not be more than a day's difference between the times of catching at Fort Adams and Saughkonet. They caught scup in Vineyard Sound this year two days before we did. On the 20th of April we caught thirteen barrels. We caught some on the 18th of April; that was sixteen days earlier than last year. Some of the run got by and went down to the Vineyard Sound.

Scup are more scarce than they used to be.

There were two cold seasons a few years ago, and a great many tautog were frozen, and it was a number of seasons before we could get many to supply the market here. I have heard that they are more plenty this year. When they froze, they were thrown up on the Nantucket shore, and they were cut out of the ice and sent to New York. That was in 1856–'57.

That could not have affected the scup, because they do not stay around here. The chogset were affected in our harbor.

Question. What do you suppose has affected the abundance of the bass?

Answer. They are much scarcer than they were formerly. I do not know what has cleaned them out. I suppose that catching some in the spring of the year may affect them somewhat.

No fish are used for manure except menhaden. I was ready to give two dollars a barrel for scup, and they were not worth that for manure. That was the lowest price this year. The highest price was five dollars at the traps. We get in New York just what the commission merchants are a mind to pay us. Sometimes we do pretty well, and sometimes not. The scup are packed in bulk in ice, and sent to New York or Philadelphia. A common sloop-smack from New London carries about 100 barrels.

Question. Supposing that it is decided to try any experiments with traps, in the way of legislation, is there any compromise that can be made between no traps at all or all that people choose to put down; would it be expedient to attempt any limitation of the length of the leader, the size of mesh, and time of keeping them down?

Answer. I judge that a limitation of time would be best.

Question. What would be best, so many weeks or so many days in a month?

Answer. I should say, so many days. They run about a month, and then the fishing in traps is all over—from the 20th of April to the 20th of May.

Question. Suppose it should be said that no fish should be taken from noon on Saturday to noon on Monday; would that be acceptable?

Answer. It ought to be; and it ought to be made acceptable. Now, although half the men go home Saturday noon, the rest will make up a gang and fish Sunday, and find a fellow with a smack, to whom they will sell their catch, and then divide what they get, and thus make the share of each greater than that of the rest of the gang.

Question. How could you treat a trap or pound so that they could not catch any fish?

Answer. Have it hauled up. We haul our pound up with a long line, leaving the bottom up about two fathoms.

Question. What would you suggest as the proper way of securing general obedience to such a law?

Answer. Hold the captains of the gangs responsible; either confiscate their property or make a heavy penalty.

I have had a long controversy with Tallman about menhaden spawning twice a year. Every fisherman says menhaden come along full of spawn in the spring, and go back in fall full of spawn.

Question. Do you find small scup to any extent in the blue-fish that are taken in any way excepting in traps?

Answer. It is very seldom we catch them in any other way except with the gill-net. I have found blue-fish with young scup in them; when taken in gill-nets, we almost always find scup in them. Blue-fish caught with a drail often vomit up the food in them. Sometimes three-fourths of the food would be young scup. I have shaken them out of them within a week. Squeteague and blue-fish do that; they will eat anything that runs free. To-day I picked up one, and just took and pressed on the belly of the fish, and he was full of them. The pound is full of these small fish, and they get the little fish in the pound. I have seen the little striped smelt in them, packed in them, and looking like a row of pencils. Sometimes they will come ashore with a lot of scup in them; and then again they will have nothing but hake and sea-robins. They will bite these off close up to the fin; and then they will come ashore with mackerel. I have seen them with small flat-fish in them. I don't know as I ever found a crab in a blue-fish. I have always taken particular pains to know what the blue-fish feed on. Until this became so extensive a watering-place, I have shipped four thousand pounds of black-fish to New York in a year. I have shipped a thousand to fifteen hundred sugar-boxes—bought them and sold them. But then the competition became so great that I could not afford to buy them. What were wanted here were sold readily, and the balance were sent off. The retail dealers here buy fish wherever they can get them. Two buy to send to New York, in connection with what they sell here.

We caught from one thousand to fifteen hundred pounds last week. We found them accidentally out in Saughkonet River. They come up from the bottom every night. We catch blue-fish in gill-nets more than in the pounds. They destroy the nets very badly.

I do not know as blue-fish are more plenty than last year; there have been days when they cannot catch any. We are catching now full as many as we did last year. We get the fish at night; we catch the fish below the middle of the net then; but when the fish are playing on the top, we get them near the top of the net. We have our nets with a mesh two and one-half inches to four and one-half; they are from fifty to ninety fathoms long. They are made by Mr. Stowe, of Boston.

My partner's brother went down the other day and caught twenty-eight bass. If there comes a heavy sea, on the fall of the sea they can get large bass, plenty of them. My partner's brother went down and caught eight or nine hundred-weight, and Mr. Perry Cole and Mr. Durkee get a great many.

Question. Are eels scarcer than they used to be?

Answer. I think so. Whether the gas-works have affected them or not I do not know. Six or seven years ago I was a member of the legislature, and I went out one morning and found a man on the steps opening a basket of oysters, and I could smell the coal-tar in them very plainly. Fourteen or fifteen years ago I kept a fish-market on Long Wharf, and you could see the tarry substance rise on the water and spread out while going through the bridge. We have had a thousand pounds of fish killed by it in one night. Scup will not go up Providence River; it is nothing but a mud-hole. It is only in the pounds that we get the little scup. When fish were running here, we caught a great many young scup from two to five inches long. I never knew anything like it before; none of us ever saw it before. If it had occurred it would have been observed. Menhaden have been more plenty this year than for many years before. I heard a regular fisherman say he never knew such July fishing as there has been this year in the West River. Menhaden are caught in the pounds in the spring of the year. Forty to fifty barrels of menhaden would be a large yield. But the purse-nets take as many as they can hold, and sometimes they lose their nets; they cannot gather up the fish soon enough, and they would die and sink; and they would have to cut open the seine.

We get mackerel here in this harbor; they are poor in the spring, and have spawn in them. In August they have no spawn in them. We do not catch any fish much when they are full of spawn, neither black-fish nor scup, nor the first run of mackerel. Here are ninety to one hundred sail of mackerel-catchers lying off here, and they take the fattest mackerel I have ever seen. Last year was the first time they have ever done it. Mackerel promise to be plenty this year. There is no sale for the spring-catch; they are poor mackerel.

Question. If we had three times as many scup as we now have, could we buy them for any less money?

Answer. If the fish were not exported from Rhode Island, they would not be worth a cent a pound.

Question. Why has the wholesale price been less this year than before?

Answer. It is because of the increase of pounds in Vineyard Sound, and they all send fish to New York. Squeteague run from three to ten pounds. Large ones began to come here five or six years ago. They are much larger now than they used to be. They were here once before, and went off more than forty years ago, and they have not been plenty since until within a few years.

When the blue-fish first came back, the people would not eat them; there was no sale for them; people said they would make a sore on those that eat them. The prejudice against them was so great that you could not sell one in market.

In 1854 I used to catch the bull's-eye. They were here for a considerable time after that, and had been off and on before that. They were not a regular fish.

There is only one pound at Saughkonet River. I have the only one there. There was one set up in Coddington's Cove by a man by the name of Clarke. He got a great many Spanish mackerel, and that set us after them. The right to fish is as perfect as any right we have here in Rhode Island. The right to the fisheries and the right to the shore are all the same. All the people have a right to go on the shore, being only liable for any damage. There is a path clear round from the bathing-houses to the boat-house here. The right is universally recognized in Rhode Island.

NEWPORT, RHODE ISLAND,
August 3, 1871.

NATHANIEL SMITH:

I am seventy-three years old. I have fished forty-six years. There were scarcely any fish when I left the business, three years ago, on account of my health. Fish used to be very plenty, so that any one could get as many as he wanted; they were plenty until the trapping was commenced. That was about 1828 or 1830. But I fished before they had any trapping or purse-seines. One man could catch scup enough forty years ago to load a boat in a short time. I have seen the water all full of them under my boat. Every one could catch as many sea-bass or tautog as he wanted. The blue-fish came around in 1834, I think. I caught the first blue-fish, which was about a foot long. Every year they became more and more plenty; but still they did not make any difference with the other fish. It never made any odds with the tautog nor bass-fishing, because I have caught the bass right among them. I had a bass once with a scup in his throat, choked with it. I don't think blue-fish trouble scup at all. I never saw scup spawning; but think they spawn up the river, close in shore. I never fished for scup much, but they were plenty, and there was no difficulty in catching them until they began trapping them up. It was just so with tautog. I got up the first petition against trapping tautog, and got seventy to one hundred signers, and Sam Brown got one hundred. It was handed to our legislature, and laid on the table, and I suppose thrown under the table or turned out doors. The tautog began to grow scarce twenty years ago. They set traps up over Saughkonet shore at the time I got up the petition. I think, if traps could be stopped, we should have fish plenty in the course of three or four years. The spawn is taken up with the fish going in to spawn in the spring of the year; there is no seed left in the water for fish to grow from. Thousands and thousands of hundred-weight of tautog have been sent to New York, besides hundreds of boxes of scup. I have seen them take thousands of pounds of tautog off Gooseberry Island in a morning and send them to New York. But now they cannot get them around the shores.

The blue-fish were in these waters before, and very large. My father used to catch them about the year 1800, not far from that. I think, from what was said when I caught the first one, they must have been out of the water sixteen or eighteen years. About 1800 they were very plenty. They first made a net of rattan to trap them, and then they all went away in a body, and till the little ones came back they did not return again. I used to catch the little ones and bring them to market; but nobody would buy them, and so I threw them away. The first man who brought blue-fish to our market was Mr. John Springer, and he first brought them when they came back the last time.

Scup were always here; were here when my father was a boy.

When I first began to catch blue-fish, they did not weigh more than a pound or two apiece; but when they were here before, my father said they weighed sixteen and eighteen pounds.

They first began to set traps on the eastern shore about 1827; they used to set them just the same as now; they would drive the fish into the pockets at the ends.

There are no school-bass here in the fall of the year. In old times, thirty or forty years ago, the bass were around in schools in September, and would run until cold weather. I have caught them as late as the 10th of December. I would get from one to two hundred a day. I used mackerel or menhaden for bait. I used dead bait, but of late years I fished with lobster bait. That would not answer only when there was a heavy sea and the water was thick; I used to catch a boat-load in a day in that way. I got sixteen one morning, four of which weighed 206 pounds, and the rest would weigh from thirty to forty pounds apiece. Four or five years ago I could not catch any. The sea-bass are very scarce now.

Mackerel used to be caught here all the year round, but they are scarce now.

The skip-jack is something like the bonito: the bonito has a darker and broader stripe than the skip-jack. The bonito is striped like an albicore.

I don't know but one kind of sword-fish here. I know the bill-fish; they are a long fish, with a bill something like that of a sword-fish. I have seen a bill-fish three feet long. They are not at all like the sword-fish. They have little fins like the mackerel. They followed some ship in here; they were here in the fall of the year and latter part of the summer, only one year. That was forty years ago; I have seen none since. The docks were all full of them then, about eight or ten inches long and very black. They would bite anything you might put down, even a bit of pork.

The bull's-eye fish were here from 1812 to 1830, perhaps; they were very plenty. The women would haul them in with seines—barrels of them; once in a while two or three are caught in the fall of the year; they were nearly a foot long, very thick and fat. One year they poisoned every one who eat them; people thought they had been feeding on some copper-bank; they were much fatter than common mackerel. I salted a barrel, and carried them out to Havana. They were never sent from here to a market abroad. They were so fat they would rust too quick, like the Boston Bay mackerel. Split them and they would fall apart, they were so fat.

Menhaden are decreasing too. In 1819 I saw a school of menhaden out at sea, when I was going to Portland, that was two miles wide and forty miles long. I sailed through them. We were out of sight of land. They appeared to be all heading southwest. There were no fish near them. I have seen a school on this coast three miles long. I think they spawn in April or May.

They catch a few shad in the traps here now; they never used to do that. They get plenty of herring in the spring. Herring are bigger than alewives; they come along together and spawn together; they spawn in April and May; they are used only for bait. People never pretend to smoke them. There are many different kinds of herring.

NEWPORT, *August* 3, 1871.

W. E. WHALLEY, of Narragansett Pier:

I am using a trap-seine. We work on the tide, and we don't care on which side of the seine it is. We catch all kinds of fish that wear scales, and some that don't—big fish and eels. We catch sturgeon, from seven pounds up to three or four hundred. I do not know how many heart-seines are being worked this season. The heart-seines take the fish both ways; the trap, only one way. They are of various sizes, according to the locality, the leaders being from seventy-five to two hundred fathoms. The trap-seine is calculated to take fish working down an eddy; the heart-seine, where the tide works both ways. They are at Horse Neck, and all along where the tide sets both ways. Taking fish in traps depends on the eddies; the better the eddy the better the chance for fishing. When the tide sets up into the bayous, there is an eddy when it runs back, and the fish run in. We fish every half-hour, and get from a few barrels to five hundred, and when the tide is over we wait; we fish only when the tide is running in; we do not expect to get as many on the ebb-tide as on the flood, except in some places. At Gooseberry Island we fish on the ebb-tide. At Sachuest Point we have fished two seasons, and I have fished at Point Judith on the flood-tide. There is a westward tendency there at the ebb-tide. On the strong ebb, these fish coming across the Sound strike through there. At Gooseberry Island I wanted a flood-tide, and that brings an eddy inside, making a bay for a mile or a mile and a half.

On Saughkonet River there is not much tide, only when it blows fresh to the north or south. There are two bridges there, and we always thought we did best at them on flood-tide. We never set any nets on the west side. When I went there in 1857, there were eleven traps; next year, fifteen; and the next, seventeen. The traps were first started in 1846, by Ben. Tallman. He invented the trap.

Question. What do you think about the general question of traps; do they affect the quantity of fish or not?

Answer. Yes, sir; I think, if they were stopped, the fish would be much more plenty.

I will give my reasons why I have answered "yes." I do not mean to say that traps should not be used on our coast. I do not mean to say they should be abolished, but I do mean to say that, in the way they are handled, and used, and allowed to be set anywhere, without regard to water, place, &c., they are an injury to the fisheries, and are what is killing off and curtailing the luxuries that the Creator has furnished, and intended should be enjoyed. My ideas are derived from nine years' experience in trapping and seining, and I have heard the other fishermen say the same thing. I am a fisherman, and expect to fish as long as I do anything.

In the first place, our bays are large in proportion to the size of our State, and the school-fish have not a place where they can go and stop wagging their tails long enough to lay their spawn, while the oysters are protected. Here is a trap and there is a purse-net, so that from the time they come in until they go out somebody is after them.

And, what is worse than all, our own State's people cannot get them at all. They will bring them in and sell them to carry away for a quarter of a cent a pound, in the month of May; and now to-day you cannot buy them for ten cents a pound. Why? Because they have been taken here for twenty years, before the spawning-time, and sent out of existence for nothing. If you kill a bird before it lays its eggs, where is your increase? And so, if you kill your sheep, where is your stock? Can we raise anything if we don't try to keep our breeding-stock good? Is it expected that we can have fish if we will put them on the land for manure at a quarter of a cent a pound? And now you cannot buy them for ten cents a pound. Confute it if you can.

When I could go out here and catch from three to five hundred-weight of black-fish in a day, I have been told not to deliver them, and when I brought them in, to cover them up with scup, and then carry them away and throw them in the river after dark, and not sell them in Newport. Why? So that the inhabitants would not know where they came from. I have done it. They are selling fish from off Point Judith, and sending them to New York.

But they have thrown striped bass into the dung-heap, because they could not get ten cents a pound; deacons of churches did that. Now you cannot get them at all. I used to get enough Saturday afternoon to last my family a week; go now, and you don't get a nibble. Give us some protection, and, by-and-by, we may have a place that the fish can go to and lay their spawn, and where the young fish can grow.

Black-fish (tautog) we cannot get. Yesterday we had five men fishing, and 27 pounds, 22 pounds, and 19 pounds each was the best they could do. If it was not for lobsters, our fishermen could not get enough for their breakfasts.

We take striped bass in nets, at the mouth of Saughkonet River, and at the back beaches. The fish run eastward in the spring, the same as the geese go north. But black-fish and bass can be caught here all the year. I fish inside of the point in winter, and outside in summer. We get bass through the ice, in winter; sometimes a barrel of them. They go into the mud in eighty feet of water. The bass and tautog are a native fish; the blue-fish is a traveler, here to-day and gone to morrow. I don't care anything about them.

Shad are a fish that will run up the rivers annually if not hindered. I have caught shad at Gooseberry Island, seven hundred a day, with a trap-seine. That is no rig for catching shad; but if you go to work and prepare for it, you can catch shad plenty.

In regard to tautog, bass, and scup, we cannot make a living fishing for them, as we used to do. Many a man has been driven out of the business. I could show you a dozen good boats rotting down, all gone to destruction; and the fishermen have taken to something else, which they had no love for. It drives people away from the State. We had about three hundred fishermen here twelve years ago, who got their living directly from fishing. That was their legitimate business, with the drag-seine and hook; not with the purse-seine or trap. They did not know anything about a trap till I set it. Two have been set there since.

The men have left here and gone down off the Banks; gone to New London to go on board fishing-smacks; gone to the eastward and to the southward. It is depopulating our shores of the men of that class. There are now only about fifty men fishing where we had three hundred; and some of the old men remain, but all the young men have gone, the fishing has been so killed out within the last five years. Instead of fishing, those who remain have, many of them, gone to taking boarders. Unfortunately I got broke down, and did not earn my salt; but I have followed the fishing business and have kept boarders. People come here from abroad in the summer, for what? Because Rhode Island has been noted for hook-fishing. Dr. Babcock comes with his rod and reel for striped bass. This year he has caught one; that is all. Last year he caught two. Many others have tried it, with no better luck. They come here for fish; they don't care anything about our stale meats, for which I pay thirty cents a pound, that are brought from Cattaraugus County, New York. That is the change we have made; we send fish out at a cent and a quarter a pound, and they send us beef at thirty cents a pound. Five hundred thousand dollars have been paid out to build up Narragansett Pier, for the purpose of a fishing-place. It is a good, quiet neck, where they can go fishing, having a beach equal to any; and you may see a man with his whole family, each of them having a rod trying to catch some fish. They catch anything they can, and carry it home to have it cooked; and because they cannot get what they used to, they give us the name of having depreciated the fish.

The tautog and striped bass have diminished most; that is, we feel their loss most.

Question. Supposing you were in the legislature, and wished to draw up such a bill as would be fair and just to all parties, what would you do so as to control the traps as to number, size, place, and time?

Answer. My proposition to the legislature was, to allow only a certain number of nets from Point Judith to Saughkonet River, so as to allow the fish to come in.

Question. Suppose the pounds were down from the 1st of June through the summer, and only then, what would be the effect?

Answer. I should say they should not be set before the 15th of June. From the 15th of May up to the middle of June I have caught tautog and scup that were full of spawn, and were ready to shoot spawn at the touch, and when they were taken into the boat they would throw their spawn; you could almost see the fish in the egg. The fish are later in a cold, backward season.

Question. What would be the effect of this plan: To require the fishermen to take up the pounds two days in seven, say from 12 o'clock Saturday till Monday, and have a proper penalty for violation of the law?

Answer. It would have the effect of making a great catch Tuesday morning. As a general thing, they would get almost all the fish. I used to do the same thing. The fish would lie back of the leader, not having a free passage.

Question. Suppose you pull up the leader?

Answer. Then the course would be clear.

Question. Suppose you were to require that the nets be so arranged that there could be no impediment for two or three days, would not enough fish get by the nets so as to secure an abundant stock of the fish, year by year?

Answer. That would help; of course it would. Why do the fish come in to the shores? So that every man can get them. How was it with our fathers? I remember when my father used to say he was going off to the beaches for scup. Every family in the spring of the year used to go and pick up scup enough for their use. They smoked them. Do you see them now? Why not? Because our stock-fish are taken away at the season of the year before they have spawned. And now the human child has got to suffer for it. Traps are down here all summer, and they catch eels, flounders, and Spanish mackerel, and everything that swims, more or less.

Question. Squeteague?

Answer. We have always caught squeteague here with the hook. They are not a new fish to me. I have always known them from childhood. I know you cannot go off Point Judith and catch a scup to-day. I will give a dollar a pound for every scup. Ten years ago you could catch any quantity, and there was fifteen miles of coast you might fish on. The scup used to come from Point Judith to Brenton's Reef in about two tides. I used to have my boat ready to run back and forward, and in about two tides or twenty-four hours after catching them at Point Judith I got them at the Reef. It is about twelve miles. If the wind was northeast, they would come slower. They come in on the tide and go back on the ebb, and sway with the tide, going a little farther forward every time. When they first come in, they are kind of numb; some call them blind. I think there is a kind of slime on the eye in winter, and they want a sandy bottom to get off the slime. From Point Judith to Saughkonet is about four tides—two days.

Question. Did they come much earlier than usual at Point Judith this year?

Answer. About the same. They expected them in February, and got the seines ready. They had them in the water in March. I always judge by the dandelions; when I see the first dandelion, scup come in;

I watch the buds, and when the buds are swelled full, then our traps go in. When the dandelion goes out of bloom and goes to seed, the scup are gone; that is true one year with another, though they vary with the season. I am guided by the blossoms of other kinds of plants for other fish. When high blackberries are in bloom, we catch striped bass that weigh from twelve to twenty pounds; when the blue violets are in blossom—they come early—you can catch the small scoot-bass. That has always been my rule, that has been handed down by my forefathers.

Question. When scup were plenty, and they first had traps, did they keep them down all summer?

Answer. One season I kept them down till the 12th of June; that was the latest I ever kept a trap down. In the latter part of the time I got from fifteen to twenty barrels a day; but in the early part of the season I got a thousand or fifteen hundred barrels a day. That was ten years ago.

Question. You think if a trap were kept down all summer, some scup and other fish would be taken all the time?

Answer. Yes. The fish are changing ground for food; to-day I may go to such a place and catch scup, and to-morrow I do not get them there; they have worked up the food there. It is just the same as in the case of herds in a pasture. We find out by one another where the fish are; we are all along, and we signal each other when we find good fishing. That is the way we used to fish; but now they are so scarce, we don't tell when we find a good place. It makes the people selfish as the pigs. That is the tendency.

Question. How long have you known Spanish mackerel?

Answer. About eleven years. I don't know that I ever saw one but once before I was fishing at Gooseberry Island. I think they might have been here before, and they would have been taken if they had been fished for in the same way, in the summer season. The hotter the weather, the more Spanish mackerel we get. Last year we had the hottest season for some time and the most Spanish mackerel. They are a southern fish. I have caught them with a drail on a hook. They are not a native of our waters. I never knew any caught thirty or forty years ago. They are not as plenty yet this year as they were last. I caught fifty last year in my gill-net. We get all our fish over at the pier in gill-nets—tautog, shad, menhaden, sea-bass, squeteague, and Spanish mackerel. We use the menhaden as bait for sea-bass. We get cod-fish, pollock, and hake in the traps. I never knew any torpedo-fish here.

We cannot get any scup now. I have not seen one since the trapping season was over. I have five men now fishing for me, but none of them get any scup. I think the blue-fish are about as abundant as last year. They come in schools at different times. Scup first come in from the 15th to the 25th of April, and will not bite when they first come in; they are not caught with the hook until the last of May or first of June. Fish do not generally bite when spawning, so that any amount of line-fishing will not destroy the fish. I have seen many a handsome fish that I wanted, but could not tempt to bite; they would turn aside and leave the most tempting bait. At other times the most inferior bait will be taken greedily. The hook and line will not make any inroads on the fish so that there will not always be a supply.

I never knew a blue-fish to feed on scup. In all my catch of blue-fish for three years I have not been able to find one. I find squid, lances, herring, menhaden, and the tail of the robin, bitten off just back of the fin. I have found eels in them, but never, within three years, have I found a scup in a blue-fish. I have examined every one. I caught three blue-fish yesterday, and they threw out a great many squid. I think the feed for the young fish is as plenty as ever—as it was twenty years ago, with the exception of the menhaden and herring. Crabs never were more plenty, and the lobsters are more plenty than I ever knew them. I think squid are as plenty as I ever knew them. People complain that menhaden have left the bay. Along about the first of September they will come back, perhaps; I know that is about the way they generally do.

The lance is found all along the coast; I never found it buried in the sand.

I only know one kind of sword-fish and one kind of bill-fish. I have seen the saw-fish when I was a boy—about thirty-six years ago. They followed some sulphur-bottom whale in.

EDWARD E. TAYLOR:

I have caught but a few fish; I want something done to try to save the fish for my children.

Question. How are we to help your children to get fish?

Answer. You will have to abolish traps. I used a trap-seine this spring, but I am now running gill-nets. We have only three, one hundred and sixty or one hundred and seventy fathoms in all. We have caught about a dozen Spanish mackerel this year. We sell our blue-fish at five cents a pound to the dealers here; to families we sell some at eight cents a pound. I do not find scup in blue-fish.

I have seen scup, and blue-fish, and sea-bass all come to my bait in the deep, clear water, at the same time, down back-side of Gay Head. I would drop my line down, and I could see them when they came to the bait in about twenty feet of water. I used menhaden, cut up, for bait.

We got a great many small scup in the traps in the latter part of May, about two to two and a half inches long, right at the south side of the island. I caught an albicore last year that weighed 550 pounds. It was sent to Providence for steaks. It was sold for ten dollars. Last year we caught a fish called cero that weighed 7½ pounds; it was sold for five cents a pound, not knowing the worth of it.

I owned a trap before the war, and sold out very cheap, to go to the war; and when I came back, after three years, I found the fish had decreased very much. I was the first witness on the stand before the committee of the legislature against the traps. As long as the law allows any one to fish with seines, I shall do it; and as soon as they make a law to stop it, I shall stop.

I do not know what protection is best; I think there should be a law to prevent fishing at certain seasons, or with nets of a certain size of mesh. A great many small scup are caught in the traps and destroyed, because the people are too lazy to let them go.

I can recollect when you could catch bass all day long; now I have to turn out every day, at from one to two o'clock in the morning, and to get my lines in as quick as it is light, for after the sun is two or three hours high they will not bite, unless it is thick water and a heavy sea. I have fished with another gentleman three years, and I do not think we have caught a bass in the afternoon. He is an amateur sportsman, and he likes to go now better than when the fish were plenty, because it is more of a science to catch one when there are but a few. I have had a bass run out sixty-four fathoms of line; one run out the length of three lines. He weighed 48 pounds.

Mr. GARDNER BREWER:

I have been a resident at the end of the avenue eleven years, and I think the tautog and blue-fish are falling off very much. I do not think fifty have been caught off my grounds this year. My friend and neighbor, Mr. Mixter, who came here about eighteen years ago, sold his place in disgust, because he could not get fish. That was his great pleasure, and he went off almost in a rage. He used to scold a great deal about the destruction of fish in the spring. It is really a great misfortune to Newport. I used to see a dozen boats fishing off my place at a time, but now they have abandoned it. I have not seen a boat there this year.

Testimony of E. E. TAYLOR resumed:

When I was a boy, I could catch four or five hundred scup here early in the morning, and, after coming ashore and peddling them out, two for a cent—and sometimes not get my pay at that price—would then go off in the afternoon and catch as many more. I recollect that when the factories stopped, in 1857, I think, the people were thrown out of work, but they could go and get fish in any quantity to live on, scup and blue-fish. The poor people could go off and get as many as they wanted without any trouble. Soon after the twine went into the water. The first piece of twine I set was a mesh-net, with a two and a half inch bar—too big. It would fill chuck full of scup. Then I and my brother-in-law, George Crabb, went to fishing together, and got a net twelve feet deep and thirteen fathoms long, and we could get as many scup as we could haul; but I suppose now you could not get half a dozen there. Then I bought a $40 net; and then, with others, we bought a large trap.

We have done very little in catching blue-fish. We caught more last year in two weeks than all I have caught this year. It looks to me like a miracle how any fish get by the traps. The coast is strung all along full of twine; and how the fish can go eastward and get back again I do not know. About the only thing that can account for it is the occasional heavy seas. When the water is thick it keeps so off the shore two miles, and the fish follow along the edge of the thick water; that is the only way that they escape.

Question. Do you think that if all sorts of nets were abolished, fish would be more plenty in three years?

Answer. Yes, sir. I think that where there is one now there would be a hundred in three years.

Question. Suppose we say, "You may fish with as many gill-nets and draw-seines as you please, but not with traps," how would that be?

Answer. It would not make a great deal of difference.

Question. Suppose we say "You shall not fix your nets except in the tide-way?"

Answer. That would not effect any thing. We moored our gill-nets at each end with anchors; they do not swing with the tide. We set them in as still water as we can. The mackerel run with the wind, and we set so that they shall strike square.

I do not see that the blue-fish run any lower this year than last. We catch them about the middle of the net. We have seventy-six meshes deep, and catch them about midway. We have a $4\frac{1}{2}$-inch mesh; we catch some all the way down. As a general thing, we catch them that weigh from 2½ pounds up to 7 and 8 pounds. An eight-pound blue-fish is rare. We caught this morning eighteen fish; yesterday morning we caught fifty. That is big. For three mornings we took nothing but two little dog-fish and some butter-fish.

We send our fish to New York sometimes. We open our blue-fish. I do not find scup in any of them. The dog-fish that we have around here feed on crabs; sharks feed on menhaden. The heaviest shark we have around here is the thresher; they feed on menhaden. I saw a thresher-shark kill with his tail, which was nearly eight feet long, half a bushel of menhaden at one blow, and then he picked them up off from the water. They come up tail first, and give about two slams, and it is "good-by, John," to about half a bushel of menhaden. The body of the thresher-shark is about a foot longer than the tail.

When the blue-fish first came here and were caught, people used to think they were poison. My father, who was eighty-two years old when he died, said they used to catch blue-fish that weighed sixty pounds. That was a long time ago. I can recollect when they first began to catch them here; it was about thirty-two years ago; I was about ten years old. My father said sheep's-head used to be caught here in great abundance some forty-five or fifty years ago. I used to have to fish all day to get as much money as I now do for the few fish I catch. The scarcer the fish the higher the price. I have peddled striped bass about the streets at four cents a pound; now they sell at the market at from seventeen to twenty cents a pound.

NEWPORT, *August* 3, 1871—*Evening.*

At the office of Captain Macy, custom-house, this evening, there were present several fishermen, some interested in traps, and others who fish only with lines.

Mr. SMITH, an old fisherman, said scup and tautog were growing more and more scarce. This, he thought, was owing to the use of seines. He had not caught a scup in four years with a hook. Ten years ago he could make good wages catching scup. The first of June was the time he first started for fishing. When they first come in, scup will not bite for about three weeks. They are full of spawn then, and are going up the river. He never saw a scup spawn. Had not caught a blue-fish this year; it would not pay a man to fish for them with a hook. I used to catch three hundred pounds in a day. Blue-fish came in here first about forty years ago. They began to grow scarce about fifteen years ago.

Mr. WILLIAM RECORD. I set gill-nets myself; I set the first seven years ago. It was not unusual to catch from five to eight hundred pounds in a day. I am now setting from two hundred and fifty to three hundred and fifty fathoms, instead of fifty fathoms, that I had at first. Once I caught twelve or thirteen hundred weight, but generally I don't think we caught over five hundred weight. I have five nets now; but I don't catch as many fish as I did when I had one net, seven years ago. We fish on the beach inside of the point, near what we call the Beach House. We set the nets so as to break the tide, and therefore we calculate to set inside of the points of the small bays. I don't think there is one fish in a hundred that there was twenty years ago. Then it took half a dozen men to keep the net clear; now we generally haul them once a day, and they are not overloaded.

I catch once in a while a Spanish mackerel. They came along some, a fortnight ago, so that there would be four, three, or two in the net at a time; then, for several days I did not catch any. Hot, calm weather is the time to catch them. I have never seen them schooling around like blue-fish.

[One person present said one hundred and sixty Spanish mackerel were caught at one haul up at Coddington's Cove.]

The gill-net does not catch one-fourth as many as a heart-seine. In the gill-net it is very seldom that we catch a blue-fish weighing less than three pounds. A small Spanish mackerel goes through our net. The greater part of the fish are caught about a fathom below the surface, in a gill-net. We catch most when we have southerly winds; not many with northeast and north winds.

The first run of scup was more plenty this year than last; but nothing compared with nine or ten years ago. Governor Stevens and Mr. Whalley took up their net, and they turned out seven hundred barrels of scup, because they could not sell them. Afterward they sold them at Point Judith, for eighteen cents a barrel. They sold some for twelve cents a barrel, and I have no doubt they got more that year in that one trap than have been caught in all the traps in Rhode Island this year.

They made some good hauls in 1863, but they have been growing more and more scarce ever since. Governor Stevens took all of 10,000 barrels of scup that season. A thousand barrels were lost. They were saving them to get $1 25 a barrel, and they had to sell them for 60 cents a barrel. When they were taken out, 250 barrels were put on board a Fall River schooner. I used to see large schools of scup off outside, when I was fishing, but I have not seen any lately. They are growing scarce, from some cause; we are either working them up, or else we are growing so wicked that they will not come to see us.

Twenty years ago it was no trouble to go down and catch from half a dozen to twenty small-sized bass in an afternoon; but now, when anybody catches three or four bass, it is told of as something strange.

Fish are plenty in New York, because where there was one seine years ago, there are twenty now.

In the spring of the year, the average size of scup is a pound and a half.

[One person said he was present one morning this year when Mr. Holt's heart-seine was drawn, and there were as many as twenty barrels of little scup turned out.]

The small scup follow after the big ones, and there is a class that is called mixed scup, coming along about a week after the first run of large scup. Small scup are caught all summer, with heart-seines—last year's scup.

They used to set the seines about the middle of April, but now they do not until the last of April or the first of May; this year they came along rather earlier than usual. The nets are generally kept down about a month. All the nets were put down this year about the same time, and they all began to catch scup as soon as they were down. They got five dollars a barrel for the first scup; then down to three. They are not used for manure now. They have been going down in number steadily since 1862; they were put on the land in 1862.

Menhaden come along after the first run of scup; they do not purse menhaden till after they get through with the scup. They used to put down the traps about the 20th of April, and took them up about the

20th of May, when they went into the menhaden fishing; but now they keep the traps down through May.

When I was a boy I used to see men who followed tautog fishing go off in the early morning, and come back with as many as they could sell by 7 or 8 o'clock in the forenoon; now you cannot get any to sell by going all day.

The striped bass that winter on our coast have dwindled off to nothing.

GEORGE DWINNELL:

In 1835 they put their seines together near Point Judith, and they caught fish by thousands; they have never been so plenty here since.

In one trap there were 20,000 small bass caught in one season; they were sold at 25 cents a dozen. We used to catch them weighing from two to four pounds; now we don't get any of that size. At one time I caught bass for a week that weighed from twenty to sixty pounds; then there was a seine put in, and they started off.

MR. MACY:

I have seen 2,000 pounds caught here in a day. George Mason sold what he caught in one day for $22.

MR. SMITH:

Seven years ago the 28th day of June, I sold fifty-six dollars' worth, that I caught before 6 o'clock in the morning; I got eight cents a pound for them.

GEORGE CRABB:

I do not average more than two dollars a day, fishing. The greatest catch in one day this year was 206 pounds; I have not caught over 200 pounds a day but twice this year—once 201 and once 206. They were extraordinary days, and I fished from 3 to 4 o'clock in the morning till 6 o'clock in the afternoon. If I had fished as long a few years ago, I should have got more than my boat would carry. I have loaded my boat with sea-bass, but I cannot get any now; I think my average catch has been about sixty pounds a day, during this season. The season is best about four months. I used to catch blue-fish; this year I have not caught any.

MR. SMITH:

I have caught twenty-four blue-fish with a hook and line; they are not worth fishing for.

MR. C. H. BURDICK:

Four years ago last May I went off fishing, and caught 63 blue-fish in one school; that night my brother-in-law, who had a seine in Coddington's Cove, caught over five thousand pounds. The school went right up the river, and they caught them.

MR. MACY:

When I first came here, there would be thirty or forty sail of smacks here for fish. There has been a great falling off until this year, when there are scarcely any. About all the fish caught here have been shipped from the steamboat wharf.

Mr. RECORD:

Mr. Swan's father told me that at the beginning of the present century scup were a new fish.

Extract from correspondence with parties near Newport.

"NEWPORT, R. I., *August* 4, 1871.

"About the 10th of October, in the year 1869, Captain Joseph Sherman and William B. Gough in three hours' fishing caught 250 pounds of tautog and 40 pounds of cod and sea-bass. Another boat occupied the same ground the same day, and caught 250 pounds tautog—two men fishing.

"WM. B. GOUGH."

"NEWPORT, *August*, 1871.

"DEAR SIR: Thinking you might wish to verify, or inquire more into the matter while here, I send you the statement of Captain Garritt, of Westerly, Rhode Island. He has known bass caught in June that weighed from half to one pound, that were first put into a pond, and, when taken out in October following, weighed six pounds. A boy living with him caught, at the mouth of a small brook, two miles above the fishing-ground on Pawcatuck River, a female tautog weighing about 5 pounds. It was very full of far-developed spawn. He thinks the spawn would weigh a pound. The water where taken was not over one foot deep. He also states that the light-house keeper, (not the present,) Mr. Pendleton, lost a bob fishing for bass at Watch Hill, that was taken next day with the fish in Long Island Sound. It was identified and returned to him.

"Yours, with respect,

"J. M. K. SOUTHWICK.

"Professor BAIRD."

"TIVERTON, *August* 11, 1871.

"DEAR SIR: I have been informed that you are collecting information about fish for the purpose of guiding Congress, if they see fit, to take up the question. If so, I should like to submit some facts to you about their increase, decrease, &c., that have come under my observation.

"This question is important, for it affects a large number of people, and there are large sums of money invested, and hasty legislation upon one-sided facts might ruin men, and all trouble might be averted provided the proper facts were presented.

"My opinion is that man is not an enemy of a salt-water fish. I mean by that statement that all machinery yet devised by man for taking fish does not perceptibly affect the supply, although there are many facts about fish, looked at superficially, that would tend to lead a man to a different conclusion. For instance, scup have disappeared from Narragansett Bay. Some say seines have been the cause, or traps. But squeteague have taken their place, and where, ten years ago, there were millions of scup, now there are almost none, but millions of squeteague. How does that square? If the traps destroy one, why not the other, for they both come the same course and both are caught in traps. But the most significant fact in relation to the squeteague question is, they don't come few at a time and gradually increase from year to year, but suddenly appear. Hundreds of acres could be seen any clear day between

Point Judith and Providence; and the same unexplained cause can be shown by facts of every fish that inhabit our waters. For ten years there have not been blue crabs about here. This year the water was alive with them about as large as a three cent piece, and probably in a year or two they will be as thick as they used to be when you could catch easy three bushels at a tide. Ten years ago there were twenty square miles of blue muscles off Hyannis. In a few years they disappeared.

"Tell me where I can see you, and I will come and talk with you. I should like for you to come to Round Pond, Maine, and I would see that you were shown this fish question as you ought to see it, by going among the fishermen and observing its practical workings. I would furnish you every facility, and I think you would like it. I shall be in New Bedford within a fortnight, and if you are to be in that vicinity, let me know, and I will find you if my business will let me.

"Write me, and send your letter to Round Pond, Maine.

"Yours,

"DAVID T. CHURCH.

"Professor BAIRD."

NAUSHON ISLAND, VINEYARD SOUND,
August 23, 1871.

Testimony of PETER DAVIS, of Noank, who has two pounds in Buzzard's Bay, on the northwest side of Naushon:

I have been here all the spring; got in about the first of May or last of April. A few scup were here then. They caught them westward of us before we put down. I think most of the scup had gone by on the 1st of May; they were the first fish we caught.

My idea about fish striking the shore is, that they strike in square from deep water when they find the water of a certain temperature. They run close to the shore, and, if the shore rises gradually, they will come in very close to it, into very shoal water. We have caught plenty of small scup, and they are plenty now. They are five or six inches long. We first caught these small ones about the last of June; none of them earlier than that. We get very few big scup now. I have made up my mind this year that scup grow pretty fast. I think a year-old scup weighs about three-quarters of a pound. We get some that don't weigh over half a pound that I think were spawned this spring.

I have fished at Montauk five or six years. We have caught a few stingarees here, but do not catch many now; it is late in the season for them, I think. We used to get them up at Montauk until the last of July and into August. I do not recollect but three kinds of stingarees caught here. We are not paying expenses now. We got some mackerel early, and we get a few squeteague. Blue-fish have been more plenty this year than last. They are a very uncertain fish, anyway. They are somewhere, of course, but they don't show themselves all the time. I don't think there is any greater variety of sharks and rays at Montauk than here. We used to get a silver-fish there that weighed forty pounds. The scales were two and one-half inches, and looked as if they had been plated. The fish was shaped a good deal like the salmon. They had a curious-shaped mouth, that seemed to have a joint in it, where the lower jaw slid into the upper one.* Squeteague eat scup either in or out of the pounds; they are as voracious as blue-fish. We get for

* Probably *Megalops thrissoides*.

blue-fish about five cents a pound; but we make the most on squeteague. We have taken 10,000 pounds of squeteague this year; we took 6,000 pounds at one haul in the middle of June. That was nearly the first run. The biggest squeteague we have caught, I think, would weigh ten pounds. A north wind or northeasterly wind is the best for fish here.

REUBEN DYER, at Mr. Forbes's farm, west end of Naushon:

We caught two or three scup a day; not so many this year as last. There are more little scup around the wharves near New Bedford than there are here. Squeteague are not more than half as plenty about here this year as last. We catch them up at Quick's Hole. When fishing for tautog, once in a while we would catch one. We use menhaden as bait for squeteague. Most are caught after dark. We used to catch a good many blue-fish at the bottom. All fish are scarcer this year than last. There have not been any blue-fish around this year, except very small ones. I have seen, formerly, this hole (Robinson's Hole) all alive with blue-fish.

Scup began to get scarce about here seven or eight years ago. The decrease was not sudden, but gradual. I cannot say it was the traps, exactly. I think the blue-fish destroy a great many fish; they eat up the little fish.

The men who have pounds here caught a few mackerel the first part of the season. They do not catch many Spanish mackerel; but a few bonito. I do not think shore-seines destroy the fish much; but some kinds of fish are destroyed by traps.

SYLVANUS WESTGATE, at Robinson's Hole:

I am out on a seining-cruise. I have a net of about sixty fathoms. I am not doing much now; catch some blue-fish and bass. I generally haul at night. I think I should not catch anything in the day-time. I have not caught a hundred scup in five years with the seine. I have not caught any bass this year that weighed over twenty pounds. I don't think they are half as plenty as last year; there is no kind of fish as plenty, unless it is menhaden.

Mr. DYER. I have caught three sea-bass this year. A few years ago I could go out and catch fifty or sixty.

Mr. WESTGATE. I think the traps destroy the fish; I don't think the seines do much hurt. We have seined ever since we were born; but a trap is a stationary thing, and if a fish is going by he must go in.

Mr. DYER. They catch more than they can sell in the traps. The pockets are sometimes crowded, and a great many die. This spring they could not get smacks to take the fish to New York fast enough.

Mr. WESTGATE. They need not try to stop trapping; they will run themselves out pretty soon.

Mr. DYER. The fish taken at the pound here are not worth $25 a day. Last year a man hired the privilege of the pound at Menemsha Bight, and he sold $1,200 worth in a week. Squeteague are not half as plenty this year as last. The scup, sea-bass, and tautog, when they come in in the spring, are full of spawn, ready to shoot. They have ripe spawn in them when they come into the pounds. I had some and dressed them, and found spawn in them so ripe you could not take out the spawn whole.

Mr. WESTGATE. I think blue-fish and squeteague kill about as many fish as pounds. A blue-fish will kill twice his weight in a day. A blue-fish will go wherever scup can go, and they feed at the top more. They feed at the bottom at night.

Mr. DYER. I can tell you just my opinion about traps. If they did not catch the mother fish in the spring, when they come along the shores to spawn, I don't think they would destroy the fish a great deal. They should not be allowed to put them down so early. I think they should not be allowed to put them down before the 1st of June. By that time the bottom fish have got through spawning.

Squeteague come about the 10th of June; they come from the westward; they catch them at Long Island before we do here.

Question. What would you say of the plan of allowing them to fish at any season, but requiring them to draw up the net two or three days in a week?

Answer. That would be a good idea.

Mr. WESTGATE. I do not think Spanish mackerel have been around here many years; they were something new to me, and I had been fishing twenty years.

Mr. DYER. I never saw a Spanish mackerel till this year.

Mr. WESTGATE. I never saw a bonito till two or three years ago; I have not caught many this year. I think new fish are coming on to the shores, and if it were not for the pounds we would have them plenty.

PASQUE ISLAND, VINEYARD SOUND,
Club-House, Pasque, August 23, 1871.

PHILIP C. HARMON, treasurer of the club, thought it a gross outrage to have fish-pounds on the shore near. This pound was kept, he said, by New London men. There was a much larger capital employed in pound-fishing than he had supposed—between five and six millions of dollars. Fifty bass destroyed in the spring prevents a vast amount of increase.

PETER BALEN, a member of the club, said he understood that the trappers threw away, at one time, a large number of dead black-fish, (tautog.) There are not as many tautog as there used to be by nearly one in twenty. There is a great diminution of the ground-fish. The bass are more scarce. I think the traps interfere with them very much. We had a law passed to prohibit drawing a seine on this island; but they draw a net every night, and if I were to go and try to stop them, they would insult me. I am persuaded the trappers do not make any money for themselves, and they perfectly clear the whole coast of fish. I think the great evil of the traps is, that they catch the fish in spring before they have spawned. I do not think the blue-fish diminish the other kinds of fish that I spoke of. They generally follow the menhaden.

Mr. HARMON. The blue-fish have very materially diminished along here within three years, to such an extent that when fishing off our stands we do not take more than two or three in a day. Out here I have caught as many as sixty in a day by drailing for them. Now we cannot catch any. The blue-fish and bass accompany each other, I think. The blue-fish chop up the menhaden, and the bass pick up the pieces. I don't think there is one blue-fish where there were fifty a few years ago.

Mr. BALEN. Two of us caught twenty-eight bass once, weighing from five to twenty pounds apiece.

THOMAS E. TRIPLER, a member of the club, said he had been here eight days, and had caught twenty-four bass, weighing from four to twenty-nine pounds. I think they are more plenty than they were last year.

MENEMSHA BIGHT, MARTHA'S VINEYARD,
EAST OF GAY HEAD, VINEYARD SOUND,
September 22, 1871.

JASON LUCE & CO., (the company consists of Jason Luce and Brother, Mr. Tilton, and two other men :)

Blue-fish are quite plenty near Noman's Land as late as November. We find little fish in the stomachs of blue-fish ; we have taken out small scup. I took forty-two scup about two inches long out of the stomach of one blue-fish, a year ago this summer, out at the eastward of Edgartown. The blue-fish weighed about three and a half pounds. Besides the forty-two that I counted, there were some so far gone that they could not be counted.

Menhaden average from 225 to 240 in a barrel. We caught this year 2,000 barrels, or about 470,000 menhaden. We caught over 100,000 mackerel ; not so many as last year. We began fishing about the 12th of April, and caught alewives first. We caught about 100,000 dog-fish this year. All fish were earlier than usual this year. Mackerel generally come from the 5th to the 10th of May, though we get some scattering ones earlier. Menhaden come next. Tautog come early, with the herring. We catch shad the last days of April. When we see blue-fish, we conclude the spring fishing is at an end. We generally catch them about the middle of June, going west. We see acres of them schooling off here. They are over in the Bay ten days earlier than here. Some come into the Sound through Quick's Hole. Menhaden are taken in the Bay before we see any here. We catch scup here just about the time they do at Saughkonet. I think a part of them come in by way of Saughkonet, and a part by Gay Head. Scup are around Noman's Land, and are caught there with the hook. We have noticed a good many young scup this year ; *never* saw them so before. This is the third season we have fished in the summer and fall, but this is a new thing to see so many young scup. I was up in Connecticut last week, and they told me the young scup were numerous there. The scup we take in the pound are spawning fish. We take them weighing from one and a half to two pounds. Many will not weigh over half a pound. We catch more of that size than of the large size. I have dressed scup that were not very large which had the red-roe in them, which we call ripe. I think we find spawn about as often in the medium-sized fish as any.

We have every opportunity of knowing what fish eat, and about their spawn, because we handle a great many. We can squeeze young ones out of a dog-fish any month in the year. Last year we caught a drum. We caught two salmon this year. We catch what they call sea-trout—not more than three or four in a season. We catch the salmon in May. We catch a few blue-fish, squeteague, and skip-jack, or bonito. We have caught 150 albicore at a time.* We have caught as many as 500 this year. They bring six cents a pound. We catch lump-fish in the season of all sizes, up to twenty inches long. They are as apt to get the first scup at Lombard's Cove as we are here.

---

* *Orcynus thynnus.*

I suppose we catch more fish in our two pounds than are caught in all the other pounds in the Sound put together. We think this is because we are so near the ocean. When both pounds are in operation, we catch more fish in the eastern one. Later in the season we see schools of fish coming from the west.

We can judge something of the way fish are going by those that are gilled in the leaders. We have caught the conger-eel in the spring. They are a spotted fish, and have considerably large holes in the side of the mouth. We catch many of them every year. We catch the true cat-fish also every year.

Question. What would you rent your pound for by the month and man it—five hundred dollars?

Answer. If you would say five thousand dollars a month, we might talk about it.

Before we came here with our traps, the herring had begun to diminish up in Squib-Nocket Pond. But last year they could catch as many as they wanted—from five to ten thousand at a time.

Last year and the year before they caught more than they had in any year for thirty years. Scup began to diminish long before we put down pounds here. Summer trapping would not pay without the spring trapping. I have dressed tautog in the month of August chock-full of spawn.

Question. Would it suit you to propose to close the pounds for a certain time in each week; say from Saturday noon until Monday noon; and make the law imperative on all the pounds, so that no fish should be taken during that time by anybody; and with such penalties that it will be absolutely certain that the law will be enforced?

Answer. That would suit us better than to be stopped entirely. We would like that, of course, if we could not do any better.

Question. What would be the best way to prevent fish from going in the pounds?

Answer. Close the door; and if they went into the heart, they would pass right under.

We make a good deal of money on mackerel; and it is no worse for us to catch mackerel than for the mackerel-catchers. The money that we make on tautog and scup is a mere trifle. We make money on the fish that nobody pretends to catch with the hook. We have been in the pound business about ten years, and I do not see any diminution of fish of any kind. Mackerel last year were plenty with us.

There should be a pretty heavy penalty, in order to carry the thing through; and it ought to be so.

Question. What should be the nature of the penalty?

Answer. I should say put it pretty heavy, for we should obey the law.

Question. How much?

Answer. [All present agreed that $1,000 was not too much.]

Question. Would you advise a fine and confiscation of the equipment?

Answer. Yes, sir; that is a good idea.

Question. What would you think of requiring a license, in order to put down a pound?

Answer. I should like that very well.

Question. How far apart should the pounds be of two different parties?

Answer. About a mile.

Question. Would you say that, when a license to place a pound in any given locality was granted, that there should be no change of location without a new license?

Answer. There should be no change to any great extent. It is not a common thing to change a pound from one point to another.

I think we should fare better to have the United States control the business than to have the State do it. We want all to be served alike in the fishing business, as well as other things. If we cannot fish, we don't want our neighbors to fish. If we could have our rights secured to us by a license, it would be better for us.

[All agreed that if it was a uniform thing to have the time of fishing restricted, it might be quite as well.]

Boston is the market for mackerel. We catch a great deal of bait to supply the cod and mackerel fishermen. We don't catch the kind of fish that the people are contending for after the 1st of June.

We never hauled our trap on Sunday, and are not disposed to do it; if the fish come in then, well and good. We have caught but few striped bass; perhaps sixty or seventy.

One of our leaders is 216 fathoms and the other 225.

About one hundred and fifty barrels of scup in a day is as many as we have caught this year.

Last year, on the 28th of September, mackerel were more plenty in this bight than we ever saw them. Our traps were not down then; we have never fished so late as that. But we propose to keep our traps down this year till the end of the season.* The fall mackerel are small. In the spring they are larger, and we get all the way from two to eighteen cents apiece for them.

The bill-fish, as distinct from the sword-fish, is found near here. The sword is smaller; the fin does not hook over like that of the sword-fish, but goes straight up; but not so high as the fin of the sword-fish. The sword is not so flat. There is a good deal of difference in the eating. You can see any quantity of them sometimes; but they are shy.

EDGARTOWN, MARTHA'S VINEYARD,
September 27, 1871.

This evening there were present at an examination of the subject of fisheries the following-named persons, who are employed in fishing, but who have formerly been commanders of ships, and several of them captains of whale-ships: Captain Francis Pease, Captain Charles Marchant, Captain Alexander P. Fisher, Captain Gustavus A. Baylies, Captain Joshua H. Snow, Captain Theodore Wimpenny, Captain Rufus F. Pease, Captain Thomas C. Worth, Captain Thomas Dexter, Captain John P. Fisher, Captain George Coffin, Captain Josiah C. Pease, Captain Leonard Courtney, Captain George A. Smith, Captain Richard Holley, Captain Grafton N. Collins, Charles F. Dunham, esq., Dennis Courtney, Henry B. Huxford, William Simpson, Holmes W. Smith, John Vinson, Thomas Dunham.

The persons who principally spoke for the others were Captain Francis Pease, Captain Rufus F. Pease, Captain Josiah C. Pease, and Captain George Coffin.

---

* They were kept down into October, but no mackerel were taken.—S. F. B.

Captain FRANCIS PEASE. Fish are getting a great deal scarcer than they used to be. A few years ago you could sit on the end of the wharf and catch fish enough before breakfast for a family. Any boy or old gentleman could do it. Now they are gone. The scarcity commenced when they began to put down the pounds. There used to be scup and tautog all through the harbor here very plenty, but now we can scarcely get any that are eatable; we have to go out of the Sound. Every year we have to go farther out.

I do most of my fishing outside. I have not noticed the harbor as much as the other fishermen, and do not know about there being young scup here, though there always are some. I was on the wharf fishing for cunners and I got two or three little scup.

There are no traps on the island this side of Holmes's Hole. Up at Menemsha they caught up so many fish that they could not dispose of them. We do not get blue-fish as plenty as we used to. There are a good many caught with seines. The boatmen think they have not done as well this year as before. Most of the fish caught here are shipped to New Bedford and New York. There are some thirty-five boats that are sending off fish. Vessels come in and take them—four or five of them. The majority of the boatmen sell to the vessels. The latest that I have known blue-fish to be caught was the last of October; but those are what we call the fat ones, weighing from ten to fifteen pounds apiece. We don't catch many of them, and those we want ourselves. Most of them are caught over at the island of Muskeget. I think the blue-fish spawn at the south. They are a warm-weather fish; the least cold will send them off into deep water.

Captain JOSIAH C. PEASE. We calculate that the blue-fish spawn here about the last of July and first of August. I have seen them when I think they were spawning on the sands. I have caught them a short time before full of spawn, and then for a time afterward they would be thin and weak. They do not get much fat about them till the last of August or first of September. They spawn on white, sandy bottom, right out to the eastward of this island, toward Muskeget. I have seen them there in considerable numbers formerly. All kinds of fish are scarcer now than they used to be. A few years ago we could get any quantity of them.

Question. What has made them scarce; has there been any disease among them?

Answer. Yes, sir. The disease is twine, I think. Fishing never killed out the fish.

When I was a boy we could catch as many scup right off the wharves as we wanted. I do not think there are as many fish caught with the hook and line as there used to be. We would catch them if we could get a chance.

It is only about twelve years since fish have been shipped in large quantities. Before that the market was nearer home, and no fish caught with the hook and line were shipped. Bass were so plenty in those days that we could not get more than three or four cents a pound for them; now they are worth ten or twelve cents. I recollect seeing one man, when I was a boy, haul up three thousand, that he allowed to lie and rot. Our boats could then get one hundred in a day quite frequently; large bass, too.

Question. But bass are not caught in the pounds, are they?

Answer. They are a cunning fish, and know enough not to go into the pounds after they have been in one once.

I do not know where the striped bass spawn. I have never seen any very young; none two or three inches long.

I never saw a young squeteague.

I have seen plenty of young rock-bass not more than two inches long.

The striped bass go up into the ponds and among the eel-grass, I suppose.

Question. Don't you think the blue-fish have something to do with making other fish scarce?

Answer. No. There have always been blue-fish. For thirty years they have been plenty.

Captain RUFUS F. PEASE. Blue-fish came in here before 1830. I recollect of hearing the old folks talk about blue fish. I caught them before I went to sea, in 1824.

Captain GEO. COFFIN. I caught enough to load a boat in 1825. They were so plenty, I caught them just as fast as I could haul them in.

Captain FRANCIS PEASE. I have heard my father speak of the large blue-fish, weighing forty pounds. I think that must have been before the beginning of this century. They were all gone long before my day. The first that I recollect were small fish. The large blue-fish are not as active as the smaller ones. I think the blue-fish that are around in the summer, weighing five or six pounds, are the same as we catch now, which are large and fat.

Captain RUFUS F. PEASE. Blue-fish are growing plenty now away down toward Nova Scotia, and are growing less year by year here. The mischief of the pounds is, they keep the price down, and they cannot sell their own fish. I think they injure every man; I can see in the last ten years a great change.

Question. Why are fish so dear at retail?

Answer. That is all owing to the market-men, who have a compact among themselves that they will not sell below a certain price.

Captain FRANCIS PEASE. It makes no difference with us whether fish are high or low; they will not give us but about a cent a pound, while at the same time they keep their agreement not to sell for less than eight cents.

There were as many as twenty-five boats from the bluffs around here this year, driving off the fish from the shoals. They are not fishing-boats; but they come with a crowd of sail on, and they frighten the fish.

If fish were not caught any faster than they are taken with a hook and line, they would be plenty.

Captain JOSIAH C. PEASE. The pounds take all the breeding-fish that come into the shores. I saw in New Bedford, the first of May, large scup, full of spawn, and rock-bass. They were taken in the pounds, and could not have been caught with lines; it was too early.

Captain R. F. PEASE. They had so many tautog taken at Wood's Hole at one time that the net sunk and the fish died, and they had to turn them on the shore. They were chuck-full of spawn; large breeders in there, looking for a place to deposit their spawn.

Captain JOSIAH C. PEASE. Some of the farmers will have a pound, and go to it in the morning, and take out the fish and ship them, and then go to work or their farms. They do not follow fishing for a living.

Captain R. F. PEASE. The law ought to be uniform. One reason why the pounds were not stopped by the legislature of Massachusetts was, that the Provincetown people made a statement that they could not fit out their vessels with bait, unless they had pounds to catch it for them.

Question. Could they?

Answer. How did they do it before? They had the same facilities then as now. They used to send to Nova Scotia for bait; now they use only herring and menhaden for bait. Menhaden are getting scarce. This harbor used to be full when I was a boy; but it is a rare thing to find any here now, because they are caught up. They don't catch them at Saughkonet Rocks, as they used to. If they keep on catching them up as they have done, we shall have to send to California to get a mess of fish. We have had bonito here this year, and there have been more squeteague about this year than before.

Captain FRANCIS PEASE. When I was a boy, we used to catch squeteague very plenty. You cannot go off here now and get fresh fish enough for dinner and get back in time to cook it. You will soon have to go to New Bedford to get fresh fish. I used to go out at this time of the year and catch half a barrel, in a short time, of big pond-scup eight inches long.

Captain R. F. PEASE. Round Muskeget we used to do well catching the large blue-fish and bass, but now we cannot get any fish there. I am down dead against any fishing except with hook and line. A man who is rich can sweep the shore with nets, but a poor man, with his boat, cannot get any fish. The big fish eat up the little ones!

Captain J. C. PEASE. I think five hundred pounds is the highest amount I have ever caught this year in a day. Four years ago I caught 1,472 pounds in a day. I used to go three or four years ago and get 250, 275, and 280 fish in a day, but now it is hard work to get a hundred. They have been decreasing gradually every year for four or five years. Last year there was a great fall from the year before. I know there is nobody who goes over more ground for blue-fish than I do. I caught the first blue-fish this year the 29th day of May. Sometimes I get them as early as the 25th of May. We generally catch a few of the first when we are fishing for codfish at the bottom. We catch codfish till the last of May. We do not see them at all on the top of the water when they first come. We begin to see their whirls on the water about the middle of June. If the weather is warm, they will be here till the middle of October. I have caught them as late as the first of November. I have caught blue-fish that weighed thirteen or fourteen pounds. Blue-fish now are our main stay. If I could have my choice of the fish to be plenty, I would choose sea-bass. Scup are too small, unless they are very plenty; indeed, you could not make any wages catching them. I would like to have a law prohibiting the use of pounds and seines for ten years. Is not that fair? They have had a chance for ten years, and a few are monopolizing the whole fishing.

Question. What fish would be materially affected by seining besides bass?

Answer. As quick as frost comes, the bass go out into the rips, and we can catch them with hook and line. They follow the small fish out of the shallow water. The cold weather drives the little fish out, and the bass follow them. We never catch in the summer, in July and August. Last year, one day, I saw an immense number of blue-fish down beyond Cape Pogue. It was quite calm, and I could not catch one. There was a seine set there that afternoon, and hauled ashore about three hundred. That night a gill-net was set, and next day you could not see a fish. They were all frightened away. That was some time in June, I think.

Question. Would not they have gone off any way?

Answer. No, sir; you would see them month in and month out, if not disturbed.

Question. What do blue-fish eat?

Answer. They will eat everything that is living. We have a great many launces that they eat. They take young scup and squid. They eat a good many eels, too, and anything they can get hold of. [The general opinion was that blue-fish do not often eat eels.] The blue-fish eats off the tail of the eel.

Captain R. F. PEASE. You may go to work and dress 1,500 blue-fish, and I'll bet you won't find an eel in any of them. There is a time when, I think, they are spawning, when they will not bite at all, and they have not anything in them; but we generally find them pretty full. Eight or nine years ago, any laboring man could go down to the wharf and get as many scup as he wanted for breakfast, and then go to his day's work. They were good-sized scup; but now, if we get any, they are not fit to eat. Fourteen years ago, I could make more money catching blue-fish at a cent and a quarter a pound than I can now for three cents. I could sell them at three-fourths of a cent or a cent a pound, and make good wages at that. The vessels that come here now in the first part of the season offer two cents a pound.

NANTUCKET, *July* 18, 1871.

Testimony taken at Nantucket, July 18, 1871, being made up of statements by several persons engaged in fishing either with lines or nets of different kinds, Captain C. B. Gardner, Sylvanus Andrews, John G. Orpin, and Captain Winslow being the principal fishers with lines, and Mr. Snow, Gershom Phinney, William C. Marden, and Mr. Chapin using nets, the last two using hooks and lines also:

The testimony of those using hooks and lines only was substantially as follows:

Boat-fishing is nothing now. Blue-fish are not more than half as plenty as five years ago. They were not as plenty five years ago as they were ten years ago. They grew less after the use of seines and gill-nets began. That broke up the schools of fish that used to go around the island two or three times a day. Forty years ago the blue-fish were very small, about ten inches long. They were not here before that. Year by year they became larger, and in about three years obtained their full size. Up to this time blue-fish are scarcer on both sides of the island than they were last year, though early in the season they were more plenty.

The average catch up to this time has been less this year than last; but more have been taken, because there have been more nets. Fifty nets, probably, have been added this year, generally on the north side. These are visited every morning. They are from thirty to forty fathoms long. They will gill a blue-fish that weighs two pounds. Up to within a few years you could go with a boat anywhere in this harbor and get as many blue-fish as you wanted. Now they are driven out by the nets. They used to have spawn in them, but they don't now.

Mr. SNOW, who uses seines or gill-nets, said:

The 29th of May we caught the first blue-fish. We don't catch them as early with the hook as in seines. They came here late this season. About a hundred a day is a good catch this season. They weigh about six or seven pounds. In September we catch them weighing twelve to fifteen pounds, getting twelve out of a hundred of that size. That is when they are passing back. We have caught some in the nets this spring that weighed ten pounds. We can catch blue-fish steadily throughout the summer; generally get some every day while they are here. When we get two tides a day we get more fish. They come in on the flood, and we take them when they are going out. We invariably catch them on the ebb. [It was here explained that the nets are set parallel to the shore.] The bait comes in-shore nights, and, I presume, they follow it in. They feed on herring and such like. They will eat all the scup they can get.

[The line-fishermen denied this statement, generally agreeing that they never find any pieces of scup in the blue-fish.]

Mr. SNOW. I have seen hundreds and thousands of little scup in them. They will pick up a crab, and when they cannot get anything else they will eat sand-squibs. I have found shell-fish in them, that they pick up from the bottom. On the line-fishing grounds the blue-fish do not eat scup, because they have spurs on them.

[It was generally agreed that they will eat small scup, and that they would drive away the scup, that run for protection into the eel-grass.]

Mr. ANDREWS. I think a large one would not run away.

Mr. SNOW. I have seen the largest scup in them, and even blue-fish in blue-fish. I don't think they waste any fish they catch.

Mr. WINSLOW. Nine-tenths of the blue-fish have no scup in them; but most of them have menhaden in them. There are no blue-fish here in the winter. They come about the 1st of June. I think there are fewer in the harbor this year than heretofore.

Mr. SNOW. We have probably two this year to one last year.

Mr. WINSLOW. We do not catch so many with the hook.

Mr. SNOW. We get some every day, but not so plenty as for a time back.

Question. How do you explain that there are three times as many in the seines and less caught with hooks?

Mr. WINSLOW. Those caught in the seines are small.

Mr. SNOW. We get as great a proportion of large ones as we did last year. I think blue-fish are more plenty in nets than last year.

Mr. ANDREWS. That is my explanation, too—because the nets have destroyed the hook-fishing.

Mr. WINSLOW. We used to get from two to three hundred blue-fish in a day through the season.

Question. Have the select-men given permission to put down traps?

Mr. MACY. They have not refused any.

Mr. SNOW. The pounds did not do well last year, because they were not rigged right. I never fished with a pound, and don't know anything about them. Fishing with pounds is much more expensive than with set or gill nets. It would cost $6,000 to put down a pound at Great Point. I do not think there are more than twice as many gill or drift nets this year as last. There are about fifty gill-nets out belonging to the people of Nantucket, and some fifteen or twenty to others, all on the north side of the island. They are twenty-five to fifty fathoms long, and from thirty to fifty meshes wide. The size of the mesh is from four and one-fourth to four and one-half inches, No. 15 or No. 16 thread. We get the largest blue-fish in the fall. The biggest one I ever heard of weighed twenty-five pounds. I have seen two fish that weighed forty pounds, one weighing eighteen and the other twenty-two.

GERSHOM FINNEY. I think blue-fish are more plenty this year than they were last; they are very numerous this year. I think the large fish are more plenty, as well as the small.

Mr. ANDREWS. We don't catch any on the north side with hooks.

Mr. MACY. I went out with a party and got forty, a week ago. I know that the fishermen generally say they get fewer on the north side.

Mr. SNOW. I think more fish would have been caught with the hook and line if the price had been such as to suit the people.

Mr. WINSLOW. I have been up six or seven times, and have averaged, I think, two each time. I think we should have averaged more than that two years ago; perhaps not last year.

Mr. PHINNEY. I don't know where the blue-fish spawn; we see their young ones here. I have seen them alongside the wharf, about four inches long, a little later than the middle of July. They would catch the little launces and drive them about. The first school that comes is generally the largest.

Mr. SNOW. I caught the first blue-fish about the 22d of May.

Mr. PHINNEY said the 1st of June.

Mr. WILLIAM C. MARDEN and Mr. CHAPIN fish at Great Point. They fish some with nets and some with hooks. Blue-fish are more plenty than last year, at Great Point, by one-third. We were there last year, from April till about the middle of October, and we never got so many on the lines during the whole season as we have up to this time this year, fishing with the same apparatus.

Mr. ANDREWS. On the south side we have not caught so many, up to the present time, as last year.

Mr. PHINNEY. I think they came rather earlier this year than last.

Mr. MARDEN. We got them at Great Point about the 11th of June, first.

Mr. SNOW. We are southwest of Great Point. They always come earlier to the west, on the front side of the island, than eastward. As a rule there are larger fish outside. Sometimes they come in schools, sorted by sizes, and sometimes all mixed up.

[All the gentlemen agreed that they could not tell anything definite about the spawning of blue-fish. Some would spawn when they first came. Mr. Snow had caught them with spawn in them, the last of July. Mr. Andrews had seen them with spawn in them as late as the last of August.]

Mr. SNOW thought scup more plenty this year than last, at Long Hill.

Mr. ANDREWS said the whole place where they were caught was not larger than the room in which they were then sitting; and that was the only place where they can be caught, about a few rocks.

Mr. MACY. They are very particular about their ranges. When one gets the range of them exactly they can be caught in plenty there. We caught 150 there, the other day, one of which would weigh probably two pounds. But most of them would weigh not more than half or three-quarters of a pound. Last year it was almost impossible to get scup. We paid five and six cents right along to get even small scup.

Mr. SNOW. Last year, in September, we had a heavy gale, and after that, for three days, we had scup. I don't know where they came from. Generally they were on the in-shore side of the net. I think they are more plenty this year than last. Crow-fish, (black-bass,) generally so called about here, are more plenty, as well as tautog.

Mr. SNOW had seen no young scup three or four inches long. He had seen, that day and the day before, some about an inch long.

Captain BURGESS, an old fisherman, in response to a question about the use of nets, said: If it was expected that he should say gill-nets made fish more plenty, such an answer could not be drawn from him very easily. Of the summer fish, the blue-fish and scup are the principal to be relied upon. Very few tautog are caught here. Blue-fish are scarcer, as a uniform thing, on the north side of the island than they have been. I fish on the north side of the island, from Great Point to Muskeget.

Mr. PHINNEY. I have seen more fish this year than in any two years before.

Mr. CHAPIN. There have been more than twice as many fish in the bay this year as there were last.

Mr. PHINNEY. I think they swim very low this year.

Mr. SNOW. I catch them lower than usual. I think they are after the bottom bait.

Mr. PHINNEY. We find them with eels in them, and every thing that lives at the bottom.

Mr. ANDREWS. I fish both ways. Twenty years ago we could catch enough at the top.

Mr. SNOW. Twenty years ago there were no nets belonging to Nantucket people, but they came here from Cape Cod and fished.

Question. Might we say that, upon the whole, the blue-fish are more plenty this year than last; but that, in consequence of their swimming lower than usual, they cannot be caught with hooks?

Mr. PHINNEY responded affirmatively, others not answering.

Mr. BURGESS. I should like to see some one go from Tuckernuck to the Point and get ten fish a day; whereas ten years ago you might get a hundred. I don't know the cause of the decrease; I think it is the nets. I have seen acres and acres along Great Point, but they would not bite.

Mr. ANDREWS. I think that is about the time they are spawning. I have seen them when they would not take the hook anyhow, perhaps for an hour, and then they would bite.

Mr. PHINNEY. We find plenty of spawn in the blue-fish this year; but not so many as we did at first; about the 10th of June we found it most plenty. We find now more males, generally, than females.

Mr. BURGESS. The roe of the female is yellow; that of the male is white. I do not know where blue-fish spawn; I never saw any of the eggs floating on the water. I think the females deposit their spawn, and then the male deposits his on top of it. I am very much opposed to nets of all kinds; I think they are a general loss and disadvantage.

Mr. SNOW. I don't know what the fish are going to bring this year. Last year they sold for about $8 and $10 a barrel. I do not send any fresh fish, but salt them. We send the salted blue-fish to New York and Baltimore. A barrel holds 200 pounds, which would make them worth about four to five cents a pound.

Mr. BURGESS. I think the scup, on the whole, are more plenty this year than last, but they are small; we do not get large ones, as we used to. The small ones are just as full of spawn. We find scup, not more than two or three inches long, with spawn in them. It appears to be perfect. Blue-fish a foot long will spawn. I got some to-day that I think were a foot long, and they had spawn in them. I think it is wrong to this whole community to have pounds.

Mr. SNOW. I think the blue-fish have used up the bait, and are going away to seek it. There used to be herring and menhaden plenty, but they are gone now. We do not find as many menhaden and herring in the blue-fish as we did in June.

Mr. ANDREWS. There has been more bait passing this island this year than for a long time.

Mr. BURGESS. The menhaden come in the spring, and then again in June, and pass by and go into deeper water, where it is cooler, and come back in the fall.

Mr. PHINNEY. There have been more mackerel here this year than last. There has been only one net for them. This was a special net, smaller than the blue-fish net. There have been more schools in the bay this year than last—large mackerel, that would be called large "threes." They were spawning when they went through. We never catch any small mackerel in nets. Cod-fish are around here in the spring and fall. They are gone now. They spawn here in the fall. We find spawn in them in October and November—very full; never, or very seldom, in the spring.

Mr. HOLMES had fished for cod on the Banks, and had found spawn in them in July there; sometimes got a bucketful, in latitude 45°. They do not appear to have any spawn in June, and we catch only a few female fish that have spawn in them. The Bank cod are a different kind from the shore cod. No shore cod are found with spawn in them except in the fall. I have seen a cod that weighed one hundred pounds—more than five feet long.

Mr. BURGESS. We once caught, on the Georges, 1,100 fish in one day, and they made 110 quintals of dried fish.

Mr. ANDREW thought cod as plenty as they had been. The shore fish bring about twice as much as those from the Banks. Take them right through, and they will not weigh four pounds each. We have a very large school here in the winter that will not average more than a pound and a half apiece.

Pollock are very plenty here, but they do not bring much. They come from the last of April to the first of June. They have no spawn in them then. I do not know when they spawn.

Haddock spawn from the last of October to December.

Halibut are not caught much about here.

Squids are plenty; they are not used.

Dog-fish are caught; many use them. They are not around here much at this time of the year.

Mr. BURGESS. The blue-fish were later than usual this year; I think two weeks later.

Mr. SNOW. We caught the first blue-fish the 30th day of May.

JULY 19.

SAMUEL H. WINSLOW, in 1870, June 17, went up about Tuckernuck and caught 130 blue-fish; on the 18th of June eight nets were set there; on the 22d he went there fishing again, and got only one fish. The nets, in his opinion, had driven them away, (to the devil, he said.) He thought the nets were driving the fish from the island.

GEORGE WINSLOW. Ten or fifteen years ago we could catch as many scup as we wanted anywhere around in our harbor. They were around the wharves; they are a salt-water fish altogether. Now we can catch scarcely any; it would not pay to go after them. It was so with bass. Ten or fifteen years ago we could go out here and load a boat with bass in a short time, weighing fifteen or twenty pounds. They commenced seining; and now it is very rare to catch bass. Bass and scup are pretty much used up; and the blue-fish are going out at about the same rate; they are driving them away as fast as they can. I have caught 140 barrels in a season of blue-fish at Great Point. Then they commenced netting in the bay with seine and weir and every way in which they capture fish with nets. The second year after they commenced they had a net at Great Point, and I could not get anything to pay at all. Mr. Snow was with me then, and he has had to leave it and sell his fish-house. I presume a man could not get ten barrels of blue-fish in a season now. The nets alter the course of the fish. I think the nets use them up in a measure, and they drive them away. The blue-fish are not as plenty on the rips anywhere outside; they don't begin to be. I think about fourteen years ago they were the most plenty; then they commenced netting, and they have fallen off. I have stood on the south shore and loaded a cart in a short time, catching them over the surf; but now you could not catch half a dozen in the same time.

The scup and striped-bass are used up almost entirely. They went at the scup on a larger scale. Four or five years ago they commenced seining scup, to take them to the New York market. Our fish come from the south; and the scup and other fish, as the temperature of the water becomes right, come in and go eastward. They seine them in almost any depth up to eight or ten fathoms. They seined scup in the early spring, as they were passing. I have known as many as six hundred barrels seined at one haul, by a man named Lamphear, up near Tuckernuck Island, and he took them to New York. They were taken on the muscle-beds, at any time in the season for them. I think the scup spawn with us, because in July you begin to see small scup—we did years ago, but don't now. Years ago old gentlemen used to go and sit on the wharf, and in a short time catch a basketful; but one may sit there now from morning till night and not get one. The blue-fish are not only scarce but small. This same Mr. Snow has fished with me with a hook for years, and he was drawn away because he could not catch enough.

Most of our blue-fish are passing fish, and in a month they will be down east of Cape Ann. Year by year they go away eastward further and further. There are no pounds on Nantucket; they do better with gill-nets, and depend entirely on them.

Blue-fish are very destructive to drag-nets. The reason fish are so cheap is partly because they run in a great many from the provinces, and blue-fish generally follow the mackerel in price, and there are still many last year's mackerel on hand. Where we used to catch five or six hundred barrels of blue-fish in a season, off Great Point, we cannot now catch a barrel. As soon as the harbor is strung with nets the blue-fish leave. All fish have their homes, and a class of fish will make Great Point Rip their home if not driven away. The fish strike our shores to the westward, the herring coming first, then the mackerel, the blue-fish, and scup, and all coast along down eastward.

Question. What remedy ought to be applied to make the fish more plenty?

Mr. WINSLOW. Take the seines out directly; I do not want a net in the waters in any shape or form. If you want to save the fish, you must take the nets out. Any man who has observed, will say that the fish have depreciated very much in the last fifteen years.

The principal food of blue-fish generally is menhaden and squid. They can get menhaden or mackerel all the season through. Sometimes they will leave our shores for a few days and go off south of the island, and when they come back they will be full of mackerel. I never saw any cod-fish in them. They will eat flat-fish from the bottom. The menhaden are very scarce now, and I think we shall lose them, too, very soon, because they are using them up for oil. In this month, and from the 20th of June, the ocean used to appear to be literally covered with menhaden. Now there are not a quarter as many as there used to be. People think they are plenty because, by using a purse-net one or two hundred fathoms long, they can purse several hundred barrels at a haul. Menhaden spawn in all the little bays as they pass along the coast. They go into some rivers sometimes. I think they spawn early in the season. I have seen schools of young menhaden in the fall, but I do not recollect seeing any lately.

I think the scup spawn in some still places in our harbor. When we first catch them the spawn is very fine, and about the latter part of June they begin to lose the spawn. Scup feed on clams and muscles.

Mr. GEORGE F. DUNHAM. I have stopped at anchor over night in two fathoms water, and in the morning have found scup-spawn sticking to my rope. Herring spawn in the grass. I never found a scup in a blue-fish nor an eel. Menhaden and squid are their principal food.

Mr. WINSLOW. Sea-clams were not here until about three years ago. I first observed them by seeing the ducks over them. Four years ago, perhaps, there was a bed three miles long of little ones, about a quarter of an inch long, and the ducks found them and fed on them. The second year, also, the ducks came, but the clams were pretty large for them to swallow, and the third year they did not come.

Mr. DUNHAM. It is not the scup they catch that makes them so scarce; it is the spawn they kill. I have caught spawning scup and have sold the spawn—quarts and quarts. Scup bite here when they first come; blue-fish will not.

Captain GARDNER. Have been on the south shore of the island eight years; have never caught any scup there. I catch codfish, haddock, pollock, halibut, and plaice, which looks like a halibut a good deal. The plaice-fish weigh sometimes twenty pounds. They are as good a fish as the halibut. Flat-fish are much more scarce than they used to be a few years ago.

I catch a good many dog-fish. They are on our shoals. I went off the 6th of June and caught them on the 10th. In six weeks I have caught about thirteen hundred. They grow there four feet long; will average three feet. I have caught but few blue-fish, and those when fishing for cod-fish on the bottom. I do not think the blue-fish stop there at all. In the fall of the year I have no doubt there are many mackerel about there, for you see fowl and fin-backs, porpoises and gannets, and I think they are after mackerel.

Mr. DUNHAM. In the deep holes out here in the pond, I used to go with my boat and throw a stone overboard to give the scup a start, and then I would throw my dog over, and so I would follow, and drive them up to the shore and clear out of the water. They would spring out on the bank, and I have caught five hundred at a time in that way.

Mr. MACY. Within ten years I have seen boys go to the wharf and get scup, as many as they wanted, but for the last five years we get them only at Long Hill.

HYANNIS, MASSACHUSETTS, *June* 29, 1871.

Captain ALMORAN HALLET:

I have been fishing off the coast here for twenty years. The number of fish has decreased very much, and I think the decrease is due to the pounds. It is not for the want of proper food, for there are a great many shell-fish and muscles here, and the fish that we catch are full of them. There is as much food for the fishes here now as there was twenty years ago. We never used to catch the sea-clams as much as we do now; they are taken with rakes for the market; they are taken in water from six to twelve feet deep.

Blue-fish are much more scarce here than they have been. I do not know where they spawn.

Scup are not a fourth as plenty as last year. I think they spawn somewhere in the Vineyard Sound; they used to spawn in this bay; twenty years ago you could see schools of the young in the fall, all about in the bay; they have not been seen so for four or five years. We begin to catch scup usually about the 10th of May. They could not be caught with traps any earlier than they are caught with hooks. When we catch them they are full of spawn. I caught two this spring that weighed 7½ pounds; I never caught any larger.

The matter of fishing is one of great importance to the people here; many get their living by it. In these places, Barnstable and Osterville, there are one hundred boats employed in the business of fishing, which would represent more than a hundred families. If the fishing is broken up, the people will have to go to sea or to work on the land. Most of them are old men, and, like myself, have no trade. I do not know what else I could do. The biggest part of the men who have been in the fishing business have no trade, and must fish or go to sea. It would affect the sail and boat making business, too, if the fishing were to fail; they cannot get half price for their boats.

The business is falling off, year after year, worse and worse, for six or eight years. I have been off here and in the course of a single forenoon caught 800 scup that would weigh five or six hundred pounds; but now I have not caught fifty pounds in this whole spring, and I have been out every day since the 1st of May. I have not averaged a pound of scup a day, fishing right on the same ground where I used to take so many. Smacks that used to come in and get five or six hundred pounds in a day, do not come at all now. I lay it to the pounds.

The diminution began about ten years ago, and there has been a falling off every year; so that I have not got more than a quarter as many this year as last; and it is the same with others.

There are no pounds right about here. The fish come here a fortnight earlier than at Nantucket. Scup and bass follow the shore. They used to catch scup near Saughkonet so plenty that they sold them for ninepence a barrel. They are never caught east of Sandy Point.

We always regarded this as the great breeding-ground for scup; they always had spawn in them when they came, but in October they had no spawn in them.

They used to come from New London, and eighteen boats would load a smack in a day.

We got two cents a pound for scup this year, and two now for blue-fish. Last year we got two to the 1st of July, and then three. Ice was generally scarce last year, and, as we had ice, we got better prices than some others.

When they were as plenty as at one time we could not give them away.

If the pounds stop the fish from coming along we shall not have any to catch.

There is no need of pounds to get bait for mackerel and cod-fishermen, because we can get all the bait that is wanted with purse-nets, the same as has been done before.

Menhaden are scarce here now. They spawn here in these waters.

I have seen plenty of little ones here in September and October. We do not get any mackerel here with the hook.

We used to get a great many striped bass in the bay here in the month of May. They do not stay here in the winter, and are only caught in May and June, and then again in September.

It is not true that the more pounds there are the more fish; the more pounds the less fish. There is not a boat fisherman in Hyannis but knows that pounds are the cause of the fish being so scarce here. I think they catch our scup about Saughkonet, in Rhode Island. They get them sooner at Saughkonet than at Vineyard Sound, and about a week earlier at Waquoit than here.

This year the scup came here first, on the 22d day of April, which was about two weeks earlier than usual.

We send most of the fish caught here away to market. The blue-fish are sent to New York. Many people around here have not had a scup this year.

A few Spanish mackerel are caught here in the fall in nets; they are never caught with the hook. None were caught until within five or six years.

There are no skip-jacks here. I have not seen any stingarees here

---

HYANNIS, MASSACHUSETTS, *June* 29, 1871.

ALEXANDER CROWELL:

The fishing business has gone down so that it is not more than one-fourth of what it was four years ago. The pounds take the whole schools. They are killing all the spawn and will thus kill the breed. I am quite sure it is the pounds; it is plain enough. The fish all come here from the west through Vineyard Sound. Six or seven years ago, the New London smacks would come here and eighteen men would load a vessel every day, carrying about five thousand pounds—about one thousand five hundred fish. They have now given up the business, they get so few.

The scup used to stay till the last of July and then go away, and come again in September; but the big ones did not come again till the next spring.

The blue-fish came here about thirty-five years ago. We catch sea-bass here, but very few compared with what we used to do. The pogies have gone also. We get very few Spanish mackerel. The menhaden are also more scarce. The blue-fish feed on menhaden.

The scup spawned in the Sound here.

HYANNIS, MASSACHUSETTS, *June* 29, 1871.

JOSEPH G. LORING:

The number of fish has decreased here very much within the last ten years, since I first began to deal in them. The fish taken here are principally caught with the hook; never taken in pounds. We think that the pounds keep the fish from the shores; we do not get fish in-shore as we used to. Pretty soon after the pounds were first put down we began to notice a decrease in the fish, and whether the pounds break up the schools or what the trouble is, we do not know; but we know the fish are much more scarce than they used to be.

Scup we used to get in the Bay, generally full of spawn in the spring, and in old times we could get them till October; but now it would be about impossible for a man to get half a dozen, where ten years ago he could get two or three hundred. They have become less and less every year. This year, as compared with last, I do not think there is more than half a crop. For the last six years they have grown less and less.

We think the pounds cause the trouble. We think these grounds are the place for the fish to spawn. This seems to be the home of the scup, on this sound here. They are never caught in Barnstable Harbor; but the pounds off that harbor get bass and blue-fish. The general impression about here is that the pounds injure the fishing; and if the question of having pounds or not was put to vote in this county, seven-eighths of the people would vote against them.

Shad used to be taken in the pounds, but for some years I have not seen a box of shad on the shore.

There are not more than one-third as many persons employed in connection with the fisheries on the shore as there were five years ago. Those who have lost their business of fishing have gone away. There are three places in the village of Hyannis where the fishermen bring in their fish to be sent to New York to market; and they now bring in at each place about a ton a day. At each place about sixteen boats are employed. We give two cents a pound this year, but vary some according to the market. We used to give three and four cents a pound.

HYANNIS, *September* 18, 1871.

CHARLES H. WALLEY:

I have always lived here, and have followed fishing the last three years, with a boat. Blue-fish have not been caught more than half as plenty this year as last.

The highest price paid by dealers here for blue-fish was two cents a pound, unless for a few days they may have paid three cents.

Very few blue-fish are caught now; only one or two in a day.

Of bottom-fish (scup, tautog, and bass) they get from twenty-five to seventy-five pounds a day, in good weather.

Very few rock-bass are caught here.

Scup have not been near as plenty this year as last. June is the best time for scup, but this season there were very few.

TIMOTHY CROCKER, (a dealer in fish:)

Blue-fish have not fallen off in number as much as other fish. I think the pounds have had a tendency to make fish scarce; also traps and seines. I do not think blue-fish will trouble scup or rock-bass very much. We used to find menhaden and squid in the blue-fish in the spring.

Scup and sea-bass have fallen off very much within the last five years. I have not seen any more show of little scup this year than last.

Four years ago Mr. Loring and I loaded a vessel with sea-bass in one day, and had fifty barrels apiece to head-up and send to New York, besides. They were all taken with the hook.

I have had about twelve regular boats fishing for me this summer. I think they averaged about one hundred pounds a day during the season. One day I had 9,600 pounds brought in. I had more fish in 1869 on account of being in company with another man who was doing something in the business. My average this year was about fifteen boats. One or two of them had two men in them.

Account of Mr. Timothy Crocker's business for the following years:

	Boxes.	Barrels.
For 1867	180	410
For 1868	174	382
For 1869	260	394
For 1870	170	215
For 1871	190	172
Total	974	1,573

Each box contained 300 pounds, and each barrel 150 pounds.

974 boxes	292,200 pounds.
1,573 barrels	235,950 pounds.
Total	538,150 pounds.
Supposing each fish weighs 5 pounds	5)538,150 pounds.
	107,630 fish.

J. G. LORING, (a dealer in fish:)

I had as many as sixteen or eighteen men employed this year; on an average about fourteen men; and the same for the last four or five years.

Scup and bass have been falling off every year for many years. Scup were never known on the east side of Cape Cod. With twenty-five boats we loaded a vessel one Saturday with big sea-bass. We got one and three-quarter cents a pound for them. The next year we got dispatches not to ship sea-bass and scup; they would not pay the freight.

Scup are not caught on the south side of the Vineyard. This is their natural cruising-ground. I do not think the scup go back in schools in the fall, but go just as it happens.

Spanish mackerel are rather falling off here this year. Three years ago they were most plenty. The first I ever saw was five years ago; but they were much more plenty the next year.

Squeteague are increasing here. They are caught where blue-fish are caught, drailing, and while fishing for blue-fish.

Account of J. G. Loring's shipments of fish for the following years:

	Barrels.
For 1866	552
For 1867	612
For 1869	694
For 1870	799
For 1871	567
Total	3,224

In 1866 twelve men were employed in fishing, and in subsequent years an average of fifteen men. The barrels contained 150 pounds of fish each.

[Reducing the above to pounds, there are found to be 483,600; and on the supposition that each fish weighs 5 pounds, there are 96,720 fish.]

Captain HETSEL HANDY:

You may call on anybody on Cape Cod, and you will find he was brought up to go to sea. There was nothing else for us. Steam has now taken the lead; and we must either take our families and go away, or else something must be done to enable us to live here. With a weir two or three men can catch more fish than all the other fishers on the coast. They ship off a hundred tons a day to New York, and they must be used up or spoil; whereas if they were caught with a hook and taken care of they would be good, healthy food for men to eat.

I don't know of any other way than to stop the pounds wholly. The pound-men will not be satisfied with taking up their nets two days in a week. The decrease of fish this year is 50 per cent. Fishermen who have been in my employ two years say they used to fetch in five hundred pounds of fish in a day and get a cent a pound for them. Now they go out and try from 2 o'clock in the morning, and come in at night with one or two fish; and some come with no fish at all. Twenty boats will not bring in more than two barrels. It seems to me the men have not made seventy-five cents a day; and they get up at 1 or 2 o'clock in the morning and are off at the "Bishop's," or some other fishing-ground outside, when day breaks.

We have paid two cents a pound for blue-fish, and have lost a quarter of a cent a pound.

I ship to Baker & Co., J. W. Miller & Co., and Crocker & Haley. I sell some, too. They don't lose anything. I sent two boxes of blue-fish at the same time; for one I got $12, and for the other a dollar, or less.

I have heard men solemnly swear they would destroy the pounds and everything connected with them that they could lay their hands on before they would submit to have the maintenance of their families thus taken away.

I think Government does not do what it should to protect the fishermen in their trials to get a living.

I have handed a man a quarter of a dollar, and even less, for his day's work in fishing; and they would say their arms felt as though they would drop off. It is a hard case anyway. What are they going to do next winter? If they are well they may keep out of the poor-house.

There are a good many mackerel-fishermen who go from here.

There are two weirs in Harwick; four this side of Monomoy.

Blue-fish like squid very much; they drive eels clear up the creeks. The first blue-fish caught are caught at the bottom, while fishing for scup. I never saw any scup in blue-fish. I have found a whole menhaden in the stomach of a blue-fish.

Gill-nets never ought to be set in these waters. The fish die in them and drop around, and that frightens away all that kind of fish. Two or three men about here have had weirs for thirty years; and they say that if they cut up a shark and strew the pieces around they are not troubled with sharks any more.

If the work is given up to the pound-men, I do not know what will become of the fishermen. It seems as if they cannot exist together—the rich or the poor man must have it.

I think 100,000 blue-fish have been taken about Hyannis this year.

I have not seen a large scup in two years. I shipped some of the handsomest blue-fish I ever saw to New York. I gave a man $20 for a thousand pounds, and I sent them in boxes, for which I got $6 33 a box, containing three hundred pounds!

The blue-fish are not so plenty as they were last year.

I have had a single man catch 618 pounds in a day, for which I paid $12 36.

I have been told by men that saw it that this year there were twenty carts loaded with fish at Saughkonet to be carried off for manure. The fish had gone there to spawn, and after spawning, if not caught, they would go eastward. All the fish caught there are those that go there to spawn. They cannot be caught there after they have spawned.

I paid to Eleazer Baker for six days' fishing last year $59. He caught scup, tautog, and a few bass. I don't think he has made half the money this year that he did last.

Seines scare blue-fish all away.

HENRY LUMBERT, (Centreville, near Hyannis:)

I was once interested in a trap, but use a net altogether now. We used to catch menhaden mostly. I have shipped this year about 110 boxes and 120 barrels from four boats. They were pretty much all blue-fish.

I have not sent ten barrels of scup. We got about fifty Spanish mackerel in all. We caught one the 23d of July this year, and last year the 15th of July. We took the last we caught about the last of August. Most of the Spanish mackerel were sent to the Parker House, Boston. We got from twenty cents to a dollar a pound.

No fish are as plenty as they were a few years ago. I suppose the traps and pounds, and their being caught up, makes them scarce. Eleven years ago we could catch any quantity; but we were not much better off than now, for we could not sell them. We got from $15 to $20 a box of 300 pounds; this year they will not average over $6 a box. Blue-fish are so destructive I have told the fishermen that Government ought to pay a bounty of a cent a head for every blue-fish. We drive blue-fish pretty hard here.

Spanish mackerel were first caught here five years ago. I caught the first, and sold what I caught in two nets for fifty cents a pound.

I think the schools of fish are broken up at Saughkonet. We have caught less fish this year than ever.

We used to sell to smacks eleven years ago, and got a cent a pound; we never shipped any then. But we salted fish then. I salted fish for several years. Blue-fish are not salted much now here.

The prices were better this year than they were two years ago, but not so good as last year; that was because ice was scarce last year. There are too many fish caught and sent to New York.

WOOD'S HOLE, MASSACHUSETTS, *July* 6, 1871.

Captain EDWARDS:

SCUP.*

I have lived in this place thirty-five years, and have followed fishing more or less since I was a boy.

* The numbers are those corresponding to the queries on page 3 of the present report.

2. Not found here except from May till October, varying a little as to the time of coming and going, according to the season.

3. They used to be more plenty in June than any other time, and that is about the time when scup first take the hook.

4. No more abundant.

5. Diminished, so that there is scarcely one scup where there were a hundred ten years ago.

6. Have been caught beyond the increase, in nets.

8. Three pounds; the average, including spring and summer fish, about three-fourths of a pound. The large scup come first, and the little ones follow them.

10. The female is the largest; but probably there is no difference except on account of the spawn.

11. They come from the southwest, following the shore from Watch Hill or Point Judith, into Buzzard's Bay, generally swimming two or three fathoms under water.

14. A few scattering fish are caught about the 10th of May; this year a few were caught in April, the season being earlier than usual.

15. They leave in October, and by degrees; once in a while one is caught as late as the first of November

16. They come regularly, with a decrease in numbers from year to year.

17. The larger fish come first generally.

18. Both together; they spawn within five to eight weeks after they first appear.

19. Neither will take the hook; they appear blind at first.

21. Swim low; never seen by the ripple on the water.

22. They come in-shore on the flood-tide, and off with the ebb. In former times I have waded in and driven hundreds ashore and killed them with nothing but a stick.

23. I have never known it to happen.

25. No.

29. The different sizes come together.

30. Gravelly bottom; rather in currents.

31. Found at all depths, to ten fathoms.

33. No; not after spawning.

34. No.

35. They feed on shell-fish.

36. Not at all, except that the spawn may be eaten.

37. Crabs, and other small shell-fish.

38. No.

39. Not a great amount; not voracious.

40. Not in breeding-time; but usually in the latter part of the season there is a difference in color in both sexes, according to the color of the feeding-ground. On light, sandy bottom they are invariably light-colored; and on rocky bottom, dark.

41. None.

42. By catching the fish while going to their spawning-ground.

46. They always spawn in grass, and prefer some current caused by the natural ebb and flow of the tide.

50. Near the bottom.

51. Yellowish.

63. The parent fish does not devour them; but eels and other fish eat the spawn.

64. Very few now seen anywhere.

68. No.

70. No.
71. With the hook; mostly by nets and pounds. Clam and squid are the best bait for the hook.
73. Taken in nets most in the month of June; with the hook through the summer.
74. A man may now catch four, or he may catch a dozen in a day; but at any rate, so few that no estimate can be made.
76. They are caught two or three weeks earlier in nets than with the hook.
77. The flood-tide is best for fishing.
78. Sent to New York and Philadelphia.
79. Good; best when newly caught.
81. Very extensively.
82. Probably none are now salted, since so scarce.
83. Not used for manure now. It was formerly; but is now too scarce.

BLUE-FISH.

They come about the 1st of June and remain till the middle of October; most abundant in June.
4. There are more pounds of blue-fish caught now than of any other kind.
5. Diminished.
6. I think they have extended their cruising-ground to the east, as they do not find the bait that they used to.
7. Diminished more than half; probably three-fourths, so that there is not more than one-fourth as many.
8. Sixteen pounds; the average of the first run, which is the largest, seven pounds; the later runs will not average over two and a half pounds.
10. I think not.
11. They seem to come more directly from the sea, and from the eastward. They are caught at Watch Hill before they are found here. Thousands of them go outside of Nantucket, following the mackerel and menhaden.
12. No particular route.
14. They follow along one after another, the largest coming first, generally following near the shore, and come in from all directions. Most plenty about the middle of June.
15. At different times, never breaking up the schools.
16. Rather regular; but constantly decreasing in numbers.
17. The largest come first and leave last.
18. They have no spawn when here.
19. They always will take the hook if they have the right kind of bait—any kind of fish—a good piece of fresh herring or menhaden is good enough for them.
21. Swim both high and low; they show themselves at the surface, and attack birds.
23. No.
24. No.
30. In currents; generally on sandy bottom where the water is not deep, on what are called "rips."
31. From two to five fathoms.
32. Not very warm.
33. They keep together in this vicinity.

34. The horse-mackerel* and the porpoise; nothing else troubles them.
35. Voraciously on most kinds of small fish, squid, herring, menhaden, smelt, &c.
36. Very slightly.
68. No.
70. No.
71. In nets, pounds, and with hooks; the best bait being menhaden, herring, or squid.
72. Pounds and gill-nets.
73. Taken in nets from the 1st of June till the middle of October, and during the same time with the hook.
74. Not a regular business here.
76. No.
77. Most on the flood-tide.
78. Sent to New Haven, New York, and Boston, and used here more or less.
79. Good when fresh; and when salted equal to No. 1 mackerel.
80. Only a short time.
82. Salted to a considerable extent.
83. No.

TAUTOG.

2. From first of May to the middle of November. Most abundant in May and October. In the summer season they are in the grass, and do not bite well.
4. Rather more abundant than other fish.
5. Decreased some; not so much as other fish. They are not exposed so much to nets, as they do not make any long journeys.
7. Nearly one-fourth.
8. One remarkably large, twenty-two pounds; generally the largest, twelve pounds; and the average, not over two pounds.
9. I once tried an experiment with one that weighed half a pound, putting him into a lobster-car, where he had plenty of room and plenty of food, there being three hundred pounds of living lobsters with him. He was kept in the car from the 1st of May to the end of October, six months, when he had destroyed all the lobsters, and weighed three-quarters of a pound! Thirty-two years ago I put some thousands of small tautog in the pond, some of which staid there five years, but none were caught weighing over two and a half pounds, and they had one year's growth, at least, when put in the pond.
10. They do; the female is shorter and thicker than the male, and generally the largest.
11. They come directly in from the sea.
13. They go out to the mouth of the sound, far enough to prevent being chilled and frozen to death, in water from fourteen to twenty fathoms in depth.
14. They do not come or go in schools, and are first seen among the rocks. The first fish are the largest.
16. They appear regularly, never failing unless killed by the frost.
18. They spawn in June.
19. They will not bite when they first come in.
20. Within ten days they will take the hook.
21. They swim low, on the bottom nearly.

---

* This is the Tunny, (*Orcynus secundidorsalis.*)

22. They work in-shore on the flood, coming among rocks after crabs.
23. Yes.
29. They are found all together.
30. They prefer a current, from one to four fathoms in depth, among rocks; found sometimes much deeper.
33. They do not travel in schools.
37. Shell-fish entirely, muscles, crabs, lobsters, &c.
41. They usually go among the grass for spawning.
42. No.
46. In June, in bays and harbors, among grass.
50. Near the bottom.
63. Eels probably destroy the spawn as much as anything.
64. Usually in the grass, near where they are spawned.
68. Very cold winters kill them sometimes, so that they are found on the shore outside frozen, on Noman's Land and Gay Head. This has happened twice in ten years. Thousands have been destroyed in this way. They will freeze under water, the inside being a bunch of ice.
71. Caught with nets in the spring, and then with the hook. The hermit crab is preferred by them; crabs and lobsters are next best.
76. They are taken in nets from the 1st of May through the summer; with hooks from the middle of May. They are most plentiful in May.
74. Fifty pounds a day, with the hook.
77. Caught more on the flood-tide.
78. New York is the principal market.
79. Good, fresh; not usually salted. Retains its excellence as a fresh fish as long as any fish, after being caught.
81. All that can be caught.
84. Highest price by the quantity in New York, this year, twelve cents a pound. That is as much as they ever brought, and was for a lot taken early.

SQUETEAGUE.

Come about the middle of June, and remain till about October. Generally caught in July.

5. There have been more for the last four years than before, but not so many this year as last. They are not very abundant. Have increased within the last ten years.
7. There were none ten years ago.
8. Six pounds; average three pounds.
11. They come from the sea, and straggle along the coast looking after food. They are not considered a running fish. I am confident they do not spawn here.
14. They make their first appearance in June. There is no difference in the size of those that come first from that of those that come last.
15. They leave by degrees, in small bodies.
16. Not regular.
17. The same.
18. No spawn seen in them.
19. They are an uncertain fish about biting, anyway. They are caught in nets and traps before any are caught with the hook.
20. Have not known any to be caught with hook within three weeks of their arriving.
21. Swim anywhere, at bottom or top, just where the bait is. They attract birds, the same as the blue-fish when they come under a school of small fish.
22. They will venture into shallow water on the flood-tide.

23. No.
30. On the sand and about rocks, both; generally where there is some current, and where the small fish gather.
31. From one fathom to six. Often found in the grass where the water is low.
34. None that I know of.
36. None.
37. Small squid and all kinds of small fish.
71. With hooks, drag-nets, and pounds. For bait white shiners are used; sometimes a piece of menhaden.
76. Taken in nets first.
79. Moderately good.
81. Quite extensively.
83. No.
84. Average price is low; one and one-half cents a pound here a week ago.
86. New York.

MENHADEN.

Come in May, and remain till the middle of October; generally most early in the season.
5. Decreased very much; very few now, comparatively.
6. They are caught in nets.
7. Scarcely one now to ten thousand formerly.
8. Less than a pound.
11. Come from the west; pass by now. They formerly remained in the harbor all summer.
12. They go off to sea by way of the mouth of the sound and bay.
15. They leave in small bodies; they run together all the time.
16. Regular decrease for ten years; no increase at any portion of that time.
17. No difference.
18. Not one in twenty has any spawn. I do not think they spawn at any particular season; the first caught is as likely to have spawn as any. Those that stay in the summer run up where the water is brackish and remain; and in New Bedford River there are thousands of young ones in the fall; the same is true at Mattapoisett, Wareham, and Monument River.
21. Generally swim high; make a ripple, but do not attract birds.
29. Half-grown ones are found with the old ones. I do not think they come here when only one year old.
31. Four fathoms.
33. They keep together in schools.
34. Almost all fish prey upon them.
35. None; they eat bait or any small substance floating in the water. They get very fat; but I never found any small fish in their stomachs.
36. Very greatly.
37. Cannot give it a name.
39. I think not much.
42. The breeding-fish are caught in nets.
46. Nobody has found out; it is supposed they spawn at all seasons.
63. All kinds of fish eat the young; have even more enemies than when full-grown.
64. No, not now.
67. No.
68. No.

71. In sweep and purse nets and in pounds; not with lines.

78. Used for manure, oil, and mackerel-bait.

84. Highest price, \$1 50 a barrel for mackerel-bait; fifty cents at the guano works. About the same as former prices.

86. Here, for fish-bait, and to the guano-works. About two thousand barrels were sold to fishermen, for \$1 50 a barrel, for bait. Scarcely a quarter of those caught about Buzzard's Bay go to the fishermen, but go for oil and guano.

HERRING.

There have been as many herring the past year as for many years; more abundant just about here than for two or three years before. They come about the first of March and stay till June. The young ones strike in about the 15th to the 20th of May, and in a pleasant afternoon there will be from one to three acres very lively with half-grown herring, and those not much larger than the finger; among these a few old ones that seemed to be their guides. The little ones never go up the rivers. They are caught with nets when running up creeks. Good, fresh; most of them are salted. They were formerly sold early in the spring to the George's fishermen for bait. This year they brought about forty cents a hundred; generally average seventy-five cents a hundred. Most are carried to New Bedford to market. I seined up the herring for bait, at the pond near my house, for three years in succession, and in that time used them all up, so that none come there now.

WOOD'S HOLE, *June* 19, 1871.

Captain THOMAS HINCKLEY, JR:

On the 19th of April of the present year we laid our net and got 25 tautog. The pounds were put down about the middle of April. The herring or alewives did come into Buzzard's Bay as soon as into the Vineyard Sound. I think they come direct from the sea, and do not run along the coast. They are caught in February off the coast outside of the Vineyard. The Georges fishermen get their bait of English herring down east, before the alewives come here. The English herring come here about the 1st of May, but are not plenty then. Last year we caught considerable many in the bay, but this year not any. There are many in the bay, and on the 1st of December there are many of the English herring there.

The pounds are down and in operation in Buzzard's Bay, about the 20th of April. Alewives are the first fish we catch. The menhaden this year were out of season—earlier than common. They struck in Buzzard's Bay, and we caught a few the 20th day of April. It was something remarkable, never known before. I think some had spawn in them then; about the 1st of May they had. They should not strike good until about the 10th of May.

SCUP.

2. No; only during the summer months. They make their appearance about the 15th of May, and remain until about the middle of October. In about a week after they come in they are most abundant. They leave gradually, much more slowly than they come in.

4. They are the most abundant of any fish caught with the hook.

5. It is decidedly scarcer than it used to be, and it is becoming more and more scarce. You catch fewer in the pounds and fewer with the hook. I do not mean to say you catch less scup this year than last year. The diminution cannot be noticed so much from one year to another, but during a period of five years. This year is remarkable for the nets having taken an immense number of small scup, about half grown, except the little ones, of which we make no account. It is unusual to have so many half-grown ones come in. There are little ones, that is, very much smaller ones than we have got here for many years. These run with the big fish, and are taken with them. The big fish seem to pilot them in.

8. The largest scup I ever saw was about a foot long—would weigh four pounds, I think; though I never measured or weighed them exactly. The big scup come first every year. We find nothing but large ones, the first that we get; the next school, four or five days later, would be smaller, half grown, weighing from half to three-quarters of a pound.

9. I think it takes scup three years to grow. I think the small ones we get this year were spawned last year, and that the little ones were two years old. I think I can distinguish about three sizes every year. I never saw any spawn in the middle-sized ones. The last year's scup will, most of them, go through a two-inch mesh; the middle size will not. Scup will only grow to about such a size, when they stop growing.

11. They tell me that they catch scup at Montauk Point before they get them in Gardner's Bay. They get them at Watch Hill before they do at Saughkonnet; first at Montauk, then at Watch Hill. I cannot tell how long a time between Montauk and Saughkonnet. They used to run up into Narragansett Bay before they reached Saughkonnet, around by Rhode Island Bay; and even sea-bass went the same way.

After striking the main land they follow closely around the shore, in about eighteen feet of water, so deep that you cannot see them in a school. If the pounds are set in less than eighteen feet of water we do not catch the scup. They are caught about one day sooner at North Falmouth than at Wood's Hole. They are generally found in Vineyard Sound sooner than in Buzzard's Bay. This year they caught them at Menemsha Bight three or four days before we did in the bay, and two or three days earlier than at Saughkonnet. I do not think there is any difference in the time of getting them on the two sides of Vineyard Sound. I think those that come into Buzzard's Bay come out again into Vineyard Sound; otherwise the bay would be full. I do not know that there was any more protection in Buzzard's Bay this year than the year before.

5. I do not think the little scup are as plenty as they were ten years ago; but there were more this year than last year.

46. I think that the scup that come into the sound go to Hyannis to breed.

7. In Waquoit Harbor they used to get any quantity of scup; they were large and fat, because they lived on clams. Since the pound was set there they have not caught any scup with the hook in the harbor. The pound is on the west side of the harbor.

12. I think they return the same way that they came, most of them; others go right out to sea.

15. I do not think there is the same regularity in leaving that there is in coming in; they do not school as much in going out. In the fall of the year, when scup leave the ponds, they will school up and go together. All sizes go out together.

13. I do not know where they spend the winter; they are never seen here then.

14. In the spring there are several schools. Take the biggest part of the time the large scup come first and have three or four days' running, then the middle-sized ones, and then the smallest ones. Between the periods there is a time when we catch only a few. The large ones are caught only four or five days, and little ones about the same length of time.

2. The scup generally strike about the 25th of May, and we get them up to the 20th of June. There is no use in fishing after that. About the 15th of June we get the most scup; this year it was about the 1st of June, the season being two weeks earlier.

I think not more than one-third of the scup that come into the bay in the spring would stay there if there were no pounds. I think we do not catch but a few of the scup that would keep in Buzzard's Bay. I think we catch somebody else's scup, and but a few of our own. It is only when fish are running that we can catch them in pounds. Where they belong, they will not run into pounds. In Clark's Cove there are two or three pounds, and there is any quantity of menhaden there; but they cannot catch any at all in the pounds. Those menhaden belong there; they come there to spawn.

18. The sexes generally come in together. The female dog-fish comes in first. When the scup first come in the spawn is not grown; about the 15th of June it is pretty full.

20. When they first come in they will not bite the hook. Neither will any kind of fish; none of those caught in the pounds will bite the hook. Even if as plenty as they used to be, scup would not bite the hook until about the 20th of June; and I think they would bite about the same time all along the coast.

21. The gulls do not follow them at all. I think they swim within from two and a half to four feet of the bottom; not nearer the bottom than a foot, nor higher than about four feet from it.

22. I do not think the tide makes much difference about their coming in.

19. I do not think you can catch many scup with the hook when spawning. Sea-bass and cod-fish sometimes bite when spawning.

23. Many fish are caught in the pounds when spawning, the mackerel most plentiful; tautog and scup also. The spawn is often seen on the nets.

25. They do not run into fresh water, only into shoal water.

29. We find small and large scup coming in together.

30. On a sandy bottom, not necessarily rocks, excepting in the fall of the year, when they will come on the rocks somewhat. It does not make much difference as to the water being still or running.

31. They are caught in water about fifteen feet and over.

32. You get them in the sound just as well as in the bay.

33. I think they school a little in going out, but not so much as when coming in.

34. I do not think the blue-fish trouble scup any to speak of; nor sharks either, as they are so spiny they will not take them when they can get other fish.

37. They feed mostly on sea-clams. I have seen them root down into the sand in summer for clams. Sometimes they feed on other shell-fish and small muscles.

38. Along the shore where it is sandy you can see where they have made a little hole digging for clams.

40. I do not think there is any difference in color when breeding. On a rocky bottom they are darker and more barred than elsewhere.

37. They usually go to a place with rocky bottom to get some kind of crabs or something of the sort.

47. I do not think the small scup are the males accompanying the big females, because in the large scup you find spawn, but in the middle-sized ones you do not have any show of that sort. The breeding females are a little larger than the breeding males—simply swelled out more.

45. I do not know what becomes of the spawn when laid, but I think it sticks to the bottom; because if it floated at the top I should have seen it when scup were plenty. All the spawn that we find in the pounds is in the bottom of the bowl—none on the sides.

47. I think they spawn in the school.

63. I do not know of any; I do not know what the small fish feed on.

68. I never knew any sort of disease in scup.

71. Salt menhaden is said to be about the best bait, and salt clams. We generally use soft clams for scup.

72. In a seine, mostly in the fall. Sometimes in a floating net.

74. When most plenty, the average catch with a hook and line would be eight or nine hundred a day. They would bite about as fast as you could put the bait in, and you pulled them in two at a time.

77. Scup, and all fish in the sound, bite best on the slack of the tide, and not when it is running in full strength. In the bay it does not make so much difference.

86. New York and Philadelphia.

79. It is good salted; people used to salt them for winter.

80. They are best when first caught; but they eat them in New York when they have been caught a fortnight.

83. Never sold in any quantity to the guano-works; when used for manure they are put directly on the land. Never used for oil.

84. Highest price at wholesale this year was six cents a pound; the lowest, two cents. The price was less this year than last; not because more were sent to market, but because there were so many pounds down.

I think the fish-pounds are a curse to the country, but I don't believe in Rhode Island catching our fish. In 1860 there was but one fish-pound, that at Waquoit, and before that we used to catch scup at Saughkonnet, but after they had it down three or four years we did not begin to catch one-half the fish we did before. They used to come from Naushon to buy scup to put on the land, and then we tried to get a living by catching them, but as soon as they got pounds at Saughkonnet our fish were gone. There are not now one-hundredth part as many sea-bass as there used to be.

MENHADEN.

1. Known as pogee, here.

2. Some are found all summer; it probably breeds here.

3. They first appear at the westward. They strike Montauk Point, and follow along the coast exactly like the scup, but go rather more into the bays. They go in more shallow water; I have seen them in 12 feet. A school looks reddish. I have seen a school a mile wide and a mile and a half long. They frequently swim near the surface, and make a little disturbance that can be seen. The first school swims rather deep, but as they become more plenty they can be seen. They generally come in about the 10th of May; this year we got the first the 21st of April—about three weeks earlier than the average. We got about a

hundred barrels at once. But they strike off again for about a fortnight before they come regularly.

4. It is the most common fish on the coast, but is nowhere near so plenty as formerly.

5. They have diminished.

6. To pounds and purse-netting; and I think they run in deeper water this year.

7. There were not one-tenth as many caught this year as were caught last year, although there were a good many more pounds.

8. They run two different sizes; the largest, I think, are scarcely a foot long.

9. It takes them three years to grow.

10. You cannot tell the sexes apart, except by the spawn. They both spawn.

11. They come in like the scup, but hug the shore closer.

12. They go more to the westward than scup, and very nearly the same way they came.

13. I do not think that any stop here in the winter; they breed in salt-water.

16. They keep coming in thicker and faster till they get to the height, and then they go off again.

15. I think they go off in schools.

18. Both sexes come in together; they spawn about the 20th of May.

23. It does, when they are full.

19. They never bite the hook.

37. I think they live mostly on sand-fleas.

46. They spawn in shoal-water, in the latter part of May. We find young menhaden here in the fall.

21. Nearer the surface than any kind of fish I know.

34. All fish eat them. They make the best bait, because they are so oily.

36. I do not think the blue-fish could affect their abundance when they were so plenty as they were many years ago; but where we catch thousands and thousands of barrels it must make a difference.

37. When caught in the pounds they are traveling, and then we seldom find much food in fish. The fish we catch in pounds are not feeding, but are bound for their breeding-grounds.

40. No difference.

41. I think they spawn like alewives; the eggs not so large as those of herring.

71. Never with the hook; only with nets. They are taken with purse-nets throughout the season.

15. They disappear from the middle to the last of October.

75. The largest haul we ever made was 1,200 barrels; but I have known others to catch from 1,600 to 2,000 barrels.

86. Most of ours was sold to the mackerel and George's fishermen. If pounds were abolished, I do not know what the cod and mackerel fishermen would do for bait. It would not pay for all the pounds to be kept down for the purpose of catching cod and mackerel bait; if a few only were down it would pay. If the pounds were taken up by the 10th of May, the scup would not be affected here. The scup are not any appreciable profit of a pound every year, but on the whole they are. The demand for fish for bait lasts till about the 10th of June; after that they are sold to the oil-works, and the scrap goes into the guano.

84. We get about a cent apiece for them when they first come. Of the George's men we get half a cent apiece, and about seventy-five cents

a barrel of the mackerel fishermen. When sold for oil they bring about thirty cents a barrel. That is less than the former prices. Last year the price was fifty cents a barrel, and other prices in proportion. All kinds of fish brought a low price this year, because there were so many pounds running against each other. Last year we got $2 50 a barrel alongside the fish-pound; now we get only $2. We sell menhaden for oil to the guano-works here. They grind up about six hundred barrels a day.

MACKEREL.

2. We got some stragglers earlier; but about the 9th of May we calculated that the main body struck; that is, that they came in for good. They appeared about the same time in the sound and in the bay.

11. We caught them in the bay before they were caught at Wood's Hole. They always strike on the east side. All the fish we caught this spring had been up the bay and were coming out.

2. The mackerel run about ten days.

4. They were unusually plenty this year; I think from a half to a third more this year than before.

6. I do not know why they were more abundant this year.

11. In the fall they appear to go more out in the sea channel. They go east in the spring and westward in the fall. Last fall they were very plenty in the mouth of Vineyard Sound; were caught by the mackerel fishermen about the middle of October—large mackerel.

8. Those caught this spring were so large that a flour-barrel would hold only 140, without any ice, and laid on the head would go half round. They were not fat, but very poor. Sometimes we get smaller ones.

17. There was only one general run.

13. I do not know.

18. Both come in together. There is a scale over the eye, so that it looks very dim in the spring, and they will not bite.

73. It is only caught in nets in the spring; they will not then bite the hook.

23. Certainly, any quantity.

21. Near the surface.

37. Nothing but small fish.

34. The blue-fish eat them; all kinds of fish will eat them.

46. When we first catch them there is spawn in them, so ripe that it will run out, about the 10th of May. They could not have got far from these waters before spawning.

64. I have seen young mackerel here in the fall; they are found in the ponds, about five inches long. These, I think, were spawned in the spring.

52. I have no idea how many.

72. At sea they are caught in purse-nets.

71. They are caught with the hook outside by the 1st of May.

78. Highest price, ten cents a pound, and the lowest, three, by the quantity. It was less than last year.

86. New York and Boston.

TAUTOG.

2. When the winter is moderate I have seen them around all winter. In a hard winter many come ashore dead. They are more plenty in the summer.

71. A tautog will not bite when it is closed up.
4. Rather more plenty than scup.
5. Much less plenty than formerly.
8. Nine or ten pounds. The largest are caught in the spring, in the fish-pounds.
9. About three years in growing.
10. The female is more plump, and a shorter fish than the male.
11. We catch them at the head of the bay (west) before they are caught here; the best place is along the coast in Buzzard's Bay.
46. Among scattering rocks, or an eel-grass bottom. I have seen them come in where there was not more than four feet of water, and seen them spawn there. Sometimes two or three big fish are seen together. They come to spawn about the beginning of June, and stay about a fortnight.
52. The eggs are plenty, as large as those of the herring.
14. They come in in schools, the first mostly large fish.
2. They came this year on the 19th of April, and continued to come more plentifully till the 25th of April. This was about two weeks earlier than usual.
19. They will not bite when they first come in.
20. Sometimes they will bite just before they spawn; and then, again, right after. They almost always have one biting spell, just before spawning, from the middle to the last of May.
46. I do not think they drop their spawn until the 1st of June.
23. Sometimes the spawn runs out about the 1st of May, in the pound. That depends upon the number, whether they are crowded or not.
42. All the fish we take in pounds we take before they spawn; none of them afterwards.
21. Close to the bottom.
30. About rocks and eel-grass, whether spawning or harboring.
34. None that I know of.
37. Crabs, muscles, and barnacles; and I have caught them with little lobsters in them. The hermit-crab is the best bait for them, and sand-crabs.
86. New York, particularly.
82. No; it is not good.
83. Not used for manure.
84. The first caught brought $75 for four barrels, in New York. A barrel averages 180 pounds, without ice. The lowest price was one and a half cents a pound here.

SQUETEAGUE.

2. They are most plenty in August.
5. They are more plenty every year, while the blue-fish is getting scarce.
2. We found them first this year about the 1st of June.
6. They increase because the blue-fish diminish.
8. The largest about nine pounds.
9. They attain their growth in three years.
11. They come from the West.
17. There are different sizes, but not so great as in scup.
20. They are not caught here with the hook. In the bay they are caught, and will bite menhaden for bait.
37. I think they feed on the same as the striped-bass; that is, small fish.

BLUE-FISH.

2. Come in spring and leave in the fall. Come about the 20th of May.

21. Not so near the top as the menhaden. We only know they are here by first catching them in the pounds.

76. Caught in pounds before they bite the hook.

8. The larger ones caught first; weigh from five to eight pounds.

11. They go eastward. Come in from the sea, like mackerel. Most of the migrating fish come in like scup, some running nearer the shore than others.

23. Never saw one with a spawn in it.

64. There are many young ones about here.

5. They are decreasing; the decrease began within four or five years.

6. I think those taken in the pounds make much difference.

75. The largest haul I ever knew in a pound was about seven hundred.

20. They begin to take the hook about the 10th of June.

11. They scatter in summer, and school again when they run out.

37. Any fish that are swimming; they want something to chase. Never knew them to eat crabs or shell-fish. Never saw worms in their stomachs.

42. Know nothing about their spawning.

68. Never knew of any disease among them.

82. Yes; many are salted in the fall, as it is then fat.

83. Never used for manure.

84. Highest, eight cents a pound; and lowest, four. That is as much as the price last year. They were scarce this year.

SPANISH MACKEREL.

2. We began to catch them two years ago, about the 25th of July. Caught till the middle of September.

4. More plenty last year than the year before.

37. About the same as that of striped-bass.

8. Average about three pounds; never saw any of the very large ones, so called.

SEA-BASS.

2. First taken about the 1st of May. It is found here in the summer and in the winter.

5. Much scarcer than formerly.

8. Have caught them that weighed twelve pounds.

11. Much like scup; but do not school as much as scup.

75. Have caught three or four hundred in a pound at a time.

83. They used to put them on the land about Seconnet.

46. I think on the eel-grass bottom.

37. They catch some fish and eat crabs. Mackerels' intestines are the best bait; and the stomach of the menhaden is largely used as bait.

82. Never.

84. Highest price, six cents a pound, and the lowest, four. Have known the price as high as fifteen and eighteen cents.

STRIPED-BASS.

11. They go eastward, like scup and sea-bass.

2. First caught about the first of May.

46. Think they spawn out south, in the fall.
5. They are much diminished—almost exterminated.
71. We catch them with hooks in the spring; but they will not weigh half a pound apiece, and are all of the same size.
30. These little ones go into the ponds every year.
8. The largest weigh from three to seven pounds, and then the old sea-bass, as they are called, weigh from ten to eighty or ninety pounds.
17. There are three runs of striped-bass; the smallest coming the 1st of May, the second size about the 20th to the 25th, and the biggest about the 1st of July.
72. They will not go into pounds; or if they do they get out; except the small ones.
5. They are less plenty than formerly.
71. They begin to bite about the 10th of June.
30. The little ones go into fresh water; the larger ones never do.
2. I have known them here all winter. The little bass stay in the ponds until it is very hot, and then come out, and go in again when it is cooler. The large ones are caught in deep water.
37. Mostly they feed on brit—little fish. They will eat crabs, and a large one will eat herring or menhaden.
11. They go eastward in spring and westward in the fall.
84. The highest price this year was not over half a cent a pound. We caught none of the large ones.

COD-FISH.

72. With the hook; none in pounds, to speak of.
2. Last of March and first of April off Noman's Land. Come into the sound about the 10th of April; they stay till about the first of May.
11. I think those that come into the sound go west.

HERRING.

2. Caught in pounds about the 1st of April.
11. Bound eastward. When they run low they are traveling.
75. The largest haul last year was 13,000.
5. More plenty this year and last than for some years before.
6. I do not think it is from the planting on the coast. Perhaps it is because the blue-fish are gone. They were appreciably more abundant this year than last; and also last year than the year before.

WOOD'S HOLE, *September* 5, 1871.

Captain ISAIAH SPINDEL:

Captain Spindel is the manager of a fish-pound at the eastern extremity of Buzzard's Bay. They took scup first this year on the 27th of April. The pound was put down on the 12th, and the first fish were taken on the 14th. Herring and alewives were the first fish taken. Some English herring were caught with the rest, but not very plenty. They are easily distinguished from the alewives. I call them "blue-backs." They are the same as they catch down east in nets, and also in Cape Cod Bay. We got the English herring all the time we did alewives. I should say both were caught as late as the middle of May. We caught them most plenty about the last of April. Never caught over three thousand at a time. We sold them for bait; all the alewives caught in spring go for bait. We could sell ten times as many, if we could get them, for bait. We sold a few at New Bedford. A few are salted by people here. They do not eat many fresh.

Menhaden come next. The first one we caught last year was on the 23d of April; and the first mackerel at the same time.

The mackerel and menhaden caught then were stragglers. Likely enough the next day we got two or three, and so on. About the 10th to the 15th of May was the best time for catching menhaden last year; this year they came on the 21st of April, when we caught a thousand. We caught a few stragglers before. I think we caught one or two about the middle of April. We brought them ashore and tried them for their fatness. The first that come are nearly as fat as they are in the fall of the year.

The English herring have spawn in them when we first catch them. The alewives and menhaden have some. I never saw much spawn in menhaden any time; not so much as in alewives.

I have seen blue-fish and squeteague throw the food out of their stomachs when caught. I think the blue-fish fill their stomachs and then empty them just for the fun of the thing, so as to catch more fish I have seen them go into a school of menhaden and catch some and throw them up again, and then go in again. I could not swear they threw the stuff up, but I am quite positive it is so. I have seen the fish all chewed up thrown out in the water. They often bite fish, and swallow a part and leave the rest.

We do not catch tautog with the first run; not till about the 5th to the 15th of May. We catch only now and then one in April.

Sea-bass (black-bass) come a little after the tautog, along about the 20th of May to the 10th of June. We do not catch any stragglers in April.

We got the first lot of scup on the 27th of April, when we got four barrels, I think. We got them most plenty about the 8th of May. We did not catch a great many this year. At one haul I think we got two boat-loads, say thirty-five barrels in all. These were very large—three-pounders, some of them. They had spawn in them, not very ripe. I have seen spawn in middling-sized scup—the two-year old scup. When most plenty, we got $2 50 and $3 a barrel for scup. We sold to Powel, of Philadelphia. Those we sold at New Bedford we got three cents a pound for.

The lowest price we have ever sold blue-fish for was two and a half cents a pound—about the first of July. I sent some to New York, and got $4 98 for two barrels. They would weigh 180 pounds to the barrel. That was about the 25th of July.

We have caught less fish this year than last, and got poorer prices for them. We have cleared expenses, though. If I had known the result this year I should have undertaken the business, even if I had other business. We did three times as well last year, though. I do not know why we did not do better this year; whether it was in consequence of the greater number of pounds in this vicinity, or because the fish were caught more at the westward.

Question. What were some of the peculiarities in respect to fish this year?

Answer. Scup came earlier; menhaden and herring about the same time as usual. We have not caught any more squeteague this year than we did last. Mr. Luce, at the Vineyard, said he caught as many as last year, but did not get so much for them. We caught as many common mackerel as last year; but they were more scarce than any other fish.

Squeteague we took first about the 20th of July, excepting now and then a scattering one; not more than half a dozen in all before that time. They had spawn in them—good, nice spawn. I took particular notice of the difference between the spawn of herring and squeteague. The herring-spawn was larger; that of the squeteague a dark red, and smaller than that of herring. But all I noticed had spawn in them. We never catch any small squeteague, though the first we caught, I think, was not over a foot long.

Cod-fish we catch once in a while; the large, overgrown, logy ones. We caught one pretty good-looking cod-fish.

We never catch haddock.

Pollock we have caught a few.

Cod-fish are caught off on the Middle Ground in the spring; once in a great while they catch a haddock, but not often.

Hake they catch occasionally.

We never catch any salmon or salmon-trout.

Striped-bass we caught last year, sixty or seventy, weighing from eight to twelve pounds. It is pretty difficult to catch them in a pound. They go in, but seem to go out again very quick at the mouth.

Question. Do any of these go back in the fall as they come in in spring?

Answer. Yes; menhaden and mackerel. I do not know how late scup stay; we have caught them in October, in a moderate fall. Tautog stay in the bay all winter, in the deep water.

Captain SMITH, who was in company with Captain Spindel, said he had lived here and on the island twenty years. Blue-fish were most abundant in this vicinity from twelve to fifteen years ago; much more plenty than now.

Captain SPINDEL: When the guano-works were started, seven years ago, I went purse-seining for the company, and there were plenty of blue-fish up in the bay then. The next year I was looking for schools of mendaden and went aloft, and saw nothing but blue-fish as far as I could see—for miles around—breaking water in schools. There were no menhaden there. There was a blue-fish for every square yard; they were all over the water, and it was as calm as could be. I stood on the deck and looked at them and then went aloft, and they were as far as I could see. I have never seen anything like it since. I have known blue-fish in Massachusetts Bay as far back as fifteen or sixteen years ago. I went to California about twenty years ago, and I think they were there before I went away. The blue-fish drive out other fish when they come into a bay—all kinds of fish that are not larger than themselves.

Mackerel have come in more plenty, and blue-fish not so plenty. I think the blue-fish do more harm to the fishing than the pounds do, ten times. I don't think pounds make fish any more scarce. Where a pound catches one fish, other fish eat up thousands.

Question. Suppose the blue-fish eat up nine-tenths of all the scup, and the traps caught the other tenth when going to the spawning-ground, would not that make a difference?

Answer. It might make a difference; but it would make a difference if they were caught with a hook. Take it this year; there have been a great many pounds—lots of them—to the westward; and they say they never had so many fish as this year. I wish fish would diminish so that we could get a decent price for them. There are five times as many fish eaten as there used to be. Any one would think that 5,000 vessels, catching mackerel with spawn in them, would diminish the number;

some years they are scarce, and then again you can get any quantity of them.

I have seen very small mackerel in Provincetown Harbor, not more than two inches long, in July.

Question. What is the number of mackerel taken in pounds, compared with those taken with the hook?

Answer. Not one-tenth. This year and last there have been more purse-seines for mackerel than ever before. When fish are moving, bound somewhere, we catch them in the pounds, when they come near the shore. They follow along in here, and away they go again.

Question. Do you suppose bound for the eastern end of the sound, to come into the bay?

Answer. Yes, sir.

When mackerel have spawned and are in schools they will refuse the hook, sometimes for a week at a time. I think they have no spawn in them in July. When they are out here they are full of ripe spawn. They will take the hook in the spring, even when they have spawn in them. They run out as far as fifty miles from the shore.

I never caught a scup out at sea.

I do not think pound-fishing is a quarter as bad as blue-fish for destroying fish. A blue-fish will destroy a thousand fish in a day. When they get into a school of menhaden you can see a stream of blood as far as you can see. They go into them, and they will destroy the whole school before they let them go. I think menhaden are more scarce than they used to be. They put up the guano-factory here on account of menhaden being so plenty then. Twenty-five or thirty years ago there were no blue-fish, and menhaden were plenty. Only once in a while were there any blue-fish then. Finally the blue-fish got so plenty they drove all the menhaden out of the bay. There are plenty of menhaden up in the head of the harbors; some blue-fish will go up and drive them up as far as they can; but blue-fish don't like to go up into fresh water.

Squeteague will swallow menhaden whole.

We did not catch any little scup last year in the pounds. Once in a while we caught one of large size; but now we get a good many small ones every morning. We let them go, all we can.

Sharks and rays are more plenty in the early spring; they seem to go with the early fish.

Stingarees don't come until July.

HEAD OF BUZZARD'S BAY,
September 25, 1871.

POTTER BRIGHTMAN, (lives at Westport, but was fishing near the head of the bay:)

I can tell you it is slim fishing; the fishing is growing worse every day. There is nothing doing at Westport. Here I can fish every day about, but there you cannot. I am catching tautog altogether; I have not caught a scup since I have been here. There are some boats that go off and catch a few little ones, very few. I have been off here fishing for tautog, and, while catching that car full of them, could catch two bushels of scup. I do not see any difference in the little scup this year. They are caught up; that is what makes them so scarce. The traps and pounds here catch them; they catch more in one night than all the smack-men can catch in a season. Before they commenced trapping I could come up here and catch enough to get ready to go home again in ten days. The fish grow scarcer every year.

Question. How are you going to remedy it?

Answer. I would stop the trapping; that would remedy it. I would vote to stop trapping pretty quick.

Six or seven smacks used to come up here, and every one get a load; now nobody has got a load for a long time. There would be as many again fishing with hook and line if it were not for the traps.

There are no traps about Westport; they had one, but the head man was accidentally shot, and it was stopped; and since then there have not been any traps set there.

Soon after they began to trap at Wood's Hole fish began to grow scarce. In one night they caught 200 barrels of tautog; and not only that, but they take them as spawning fish.

Fish will not bite when full of spawn. I have seen two bushels in a heap all throwing out their spawn. Then you cannot get a fish to touch your hook. I have seen as many as twenty-five large fish doing that. They look as though they were all in a snarl, coming right up under your boat. Sometimes you will see a pair together. I have seen them shoot their spawn. They will not bite then, and you cannot do anything with them.

They spawn anywhere, where they happen to be. I have never seen scup spawning.

Tautog spawn the last of May or first of June.

Blue-fish have been pretty plenty the latter part of the season; the first part they were scarce; most of the time less than last year, and very small.

I never saw them spawning; and I don't know as I have taken them with spawn in them; I don't know a great deal about that kind of fish; I follow tautoging.

I have caught 2,400 tautog in a day, with the help of one man. But I have not made a living by fishing this summer. I have done the slimmest that I have ever done since I have run a smack. I went out with another man, and fished all the forenoon, and both of us got about twenty-five pounds.

The largest tautog I ever caught weighed fourteen pounds. Rock-bass are very scarce; I have not caught but one since I have been here. I used to catch a great many here. In fishing for tautog, while I got a hundred weight of them I would catch fifty to seventy-five pounds of bass. I believe I did not catch one this spring.

I do not know where squeteague spawn. They are more plenty than they used to be for a good many years. Forty years ago they were more plenty.

I remember when there were no blue-fish around.

If the traps were stopped the fish would come back again in half a dozen years.

There are very few hook-fishermen now. Most of them have given it up because they cannot make a living.

Question. When they caught fish in old times where did they market them?

Answer. In New York. I think it is twenty years since they have sent fish to New York.

They first begun to set traps at Watch Hill, and then at Saughkonet.

I came up with a man about a week ago, and we have caught about seven hundred pounds. We have fished ever day—two of us.

COHASSET NARROWS, *September* 25, 1871.

A. J. HATHAWAY:

I have been here twenty years, and I never saw the young scup so plenty as they have been this year. Striped-bass are five times as plenty this year as they were last.

There are more tautog here, and about the same number of squeteague as last year.

There are a good many young blue-fish up this harbor; but no large ones.

I think blue-fish and bass spawn up in this river.

Small mackerel come up here, arriving about the first of October, and staying three or four weeks. Last fall we caught a good many.

PATRICK BUTLER. There have been plenty of small-sized scup about here this year. For two or three years back there have been very few here. Twelve or fifteen years ago they were very plenty; but for two or three years back a man could not get enough to have a mess to eat, with a hook and line.

ROBERT P. HOLMES. There have been a good many young scup about here this year. There was a great quantity of young menhaden. I have not seen so many young scup for a long time. The breeding scup in the spring here were not more than 8 inches long. We have not caught any big scup at all.

I never saw a young squeteague.

I think blue-fish spawn up in this bay, because we see a great many little fish. I found a young blue-fish Sunday morning, not over an inch long. For the last two years we are not catching many blue-fish.

S. S. RIDER, (head of Buttermilk Bay.) There seem to be a great many scup here this year; some three and some six inches long. We don't see any scup that will weigh a pound here now, and we don't get but a few any way. My father, twenty years ago, used to catch three boat-loads at a tide. Now you might as well look for a salmon as for a large scup.

IV.—SPECIAL ARGUMENTS IN REGARD TO REGULATING THE SEA-FISHERIES BY LAW.

ARGUMENT OF SAMUEL POWEL, ESQ., DELIVERED IN THE RHODE ISLAND LEGISLATURE.

This question of the protection of the fisheries of Rhode Island is one demanding the most careful examination.

The most important aspect is the supply and cost of valuable food supplied by fisheries.

How shall the amount be rendered most ample and how shall the cost be reduced to the lowest price?

An able committee, with great labor, patience, and care, have devoted much time to the subject. They have taken a vast deal of testimony, and, at pages 22 and 23 of their formal report, they give us this deliberate opinion upon the subject, in these words: "The opinions—depend." And again, on page 23, they say: "As was anticipated—irreconcilable."

At pages 29 and 30 the committee admit the testimony of Mr. Tallman, to the effect that forty-five years ago the menhaden-men pulled up their nets to allow scup to pass, *lest they should cut their nets;* that ten years afterward (*i. e.*, 1835) "We sold them at ten cents a barrel, for manure."

Now, bearing in mind that the present constitution dates in 1842, this authoritatively fixes and establishes the custom of netting scup as existing seven years, say, prior to the constitution. This is a *very important point in one aspect of the case.* It is the testimony adduced by the committee, and not by me. At page 30 they further state: "Ten years after [*i. e.*, 1845] we begun—knowledge." Now, our committee met many witnesses face to face; they had witnesses representing both interests, and their secretary himself had the previous winter represented, as a sort of counsel, the appellant interest. And with all this, the best means of reaching an opinion, they have told us, (pages 21 and 22:) "The subject," &c.

Now, besides taking personal and written testimony, our committee have earnestly examined the most important documents and reports, both upon our own and upon the fisheries of foreign countries; and with perfect frankness and sincerity they show us what I must display to you in regard to the wandering fishes of the mighty ocean, to which families the scup belong. The United Kingdom (English) report (cited at our report, page 15) asserts that, notwithstanding the most careful inquiries, there was no instance where it was statisfactorily proven that various nets and weirs, "used in bays or estuaries," have "been permanently injurious to the supply of fish," while, on the other hand, it is proved that, in certain bays and estuaries, such fishing has gone on for years without permanent injury to their fisheries.

A Frenchman disputes this in some degree; still it is the deliberate opinion of the British official report. Then our committee cite a counter-report of the commissioners of inland fisheries of Massachusetts, who criticise the above report of the British commissioners, chiefly because, to arrive at their conclusions, they (the Englishmen) adopted the very same and about the only course acted upon by our own committee. It is true the Englishmen asked 62,000 questions, while our committee did not do so extensive a wrong, for they asked, I believe, only about 5,000. The only way in which our committee departed from the English procedure was that three of them spent a day in a steamer visiting our traps. However, they have not thought this visit even worthy of mention. So we may suppose it yielded no important results in their eyes.

I understand our commissioners to quote, at page 21, from these inland Massachusetts commissioners, the following words: "On our—— of menhaden." "At times—— but absence."

Here allow me to remark that while our committee claim the evidence that horse-mackerel (blue-fish) do not devour large scup, it was fully proved they do devour all the young scup.—(See minority report of winter of 1870.)

Now, I might read the last two paragraphs on page 21, still quoting the last-cited authority, the inland commissioners of Massachusetts, who merely admit that it is claimed—not proved—that no amount or kind of fishing can diminish the "schooling or wandering fish of the high-sea," citing the kinds, and that it is likewise claimed—not proved—that the local bottom fishes, which are peculiar to certain limited areas near the shore, may be greatly reduced, or even practically annihilated, in certain places by improper fishing. Among these they cite the tautog, some others, and also the bass and the scup.

Now, the scup are known to be schooling, wandering fish of the high seas, and come from the Gulf Stream and from the Florida Cape. This is their undenied history, except here, *where the whole question as to scup is begged and distorted* by the Massachusetts report. This point thus makes against them.

All the evidence of our commissioners shows when and how the various runs of scup strike our coast, and that they are not local, but come in from the high seas. I ought to read our report at pp. 12, 13, and 14, to show the judgment of another Massachusetts committee. They sum up by saying, (p. 13,) "In view—legislation." And upon the next page they cite the report of the most able scientific English commission thus: "Yet that commission—be repealed."

I may dismiss the Massachusetts report by citing from p. 14, that they, among other causes accounting for the diminution of the scup, tautog, &c., in Buzzard's Bay, ascribe it, in part, to a scarcity of food, owing to the deleterious substances thrown into the water from manufactories, which affect the clams and other species of mollusca, and also to the advent of blue-fish, who drive away nearly all other species of fish.

Captain Atwood, and I believe others, give the date of the first appearance of the scup in the waters of Buzzard's Bay at 1793, which, let me remark, was just seven years *after* the terribly severe winter of 1780, and that our scup diminished after 1856–'57.

Now as to the variableness of many species of sea fishes, Dr. Storer, in his History of the Fishes of Massachusetts, which includes the waters of our bay, gives the following facts, written in 1853: "In August, 1846—quite small." Page 45, Storer says: "Dr. Yale—blue-fish came," and more to the same effect, on same page. On 23d of June, 1847, a squeteague, &c.; page 53, Storer says: "Captain Atwood has seen," &c. Page 73 speaks of the great abundance of sword-fish at Martha's Vineyard, which eat shoals of mackerel and menhaden, &c.

[Quotations are made from Storer at pp. 277, 422, 334, 339, 365, 226, 231, 82, 83, 265, and 269.]

So much for Storer. Star-fish and oysters are notoriously bad friends. An old fisherman of Newport, and I believe he is far from being alone in his views, often said the steamboats seriously injured the fishing. Now, without claiming undue weight for all these restraining or repressive causes, they should have due and that a very great weight when we form our opinions. Every one of these facts has a direct bearing upon the intricate question before us.

There is a sound principle of philosophy to be applied to questions of science, and most especially in the department of natural history. It is, not to mistake a succession of phenomena or a coincidence for cause and effect.

Now, in the reptilian family, low down in the scale of creation, where we find the fishes, the variety of circumstances which attend their existence is very great, and very curious; so that the most learned men have been unable to indulge with any safety in dealing with analogies. The circumstances which mark the habits of each species vary with one another in a most extraordinary way. Thus the United States commission, in running the Texas boundary line, found fresh-water fishes which produced their young alive. Other fishes are curious, and especially, I believe, the salmon family, which appears in both fresh and salt water; and this is the family which most especially has been proved to return to its native waters. It has no relation whatever to the migratory fishes of the sea, which range the coast from the Mexican Gulf to the waters of Massachusetts Bay—few of them pass that cold point, Cape Cod.

The food of fishes has a vast deal to do with their presence. We know very little about their food. Can any one tell me what is the food of the rich and valuable shad, and that of most of its relatives in the herring family? The food of nearly all fishes, as far as we know, is of an animal nature, and in its turn requires food; and any failure of this secondary supply of the *food of the food* will entail the absence of the fishes which consume the first kind of provender.

Fishes are liable to disease, to parasites. All the perch in the ponds about South Kingston have little black specks in their scales. [Other parasites were referred to.] [Certain enemies named.] I do not wander further into this intricate field. It is enough *to show how many grounds there are for the conflict of testimony so decidedly announced. It has convinced me that there is no sufficient ground, and especially taken in the whole broad spirit of our report, to pass a measure so fraught with the direst ruin to many of our citizens.* * * * *

STATISTICS.

J. M. K. Southwick, from Albro's market, November 2, 1870. (All hook and line.) George Crabb, (alone,) 439 pounds tautog, one day. Mr. Brown, (with man and boy, 3,) 718 pounds tautog, one day. Benjamin Nason and father, (2,) 600 pounds tautog and cod, one day. Samuel Young and Lawrence, (2,) 800 pounds tautog, two days, (not from the books.)

Cary's market, same date, November 2, 1870. Hook and line only. John Heable, (1,) 193 pounds tautog, one day. Mr. Osman and man, (2,) 126 pounds tautog, 97 of cod, one day. Champlin & Huddy, (2,) 260 pounds tautog, 330 of cod, one day. Wm. Champlin and Young, (2,) 388 fish of various sorts, one day.

ARGUMENT OF J. M. K. SOUTHWICK.

NEWPORT, RHODE ISLAND, *October*, 1871.

DEAR SIR: It is with diffidence that I, in compliance with your request, attempt to prepare for you this paper on the fish question; for, as my resources of information have been limited, I cannot claim thoroughness, either in reading or personal observation. Therefore I fear I shall, like too many others who have written upon this subject, give too much of theory without practice; and to escape the study of cause and effect, *jump* at the first plausible theory for the solution of an important question.

That my conclusions are mainly right I can only hope; but I feel assured that your very thorough investigation will establish what is right, and expose and reject what is wrong. If it aids you in settling any point of fact, or helps you to arrive at a philosophical truth, I shall feel repaid.

As much of it was written during a local controversy in this State, it will contain much that may not be of general interest; but, as you said "Don't stop," I give you all as I have written it, hoping that you may be enabled to glean something from it.

THE DIMINUTION OF FISH APPARENT, NOT REAL.

In former times, before the facilities of transportation in ice became the means of supplying the great markets and the interior country with the products of the waters, fish was an article of food only to the few living along the coast, and a small amount sufficed for the demand. Any extra catch, at this time, overstocked the market and caused a glut that gave the appearance of the great abundance that has been attributed to those times.

LOW PRICES.

In consequence of the limited market the prices were very low, and the fisherman never realized pay adequate for his toil, notwithstanding he saved to himself (or to the consumer) the large profits that now go to the marketmen, by daily taking his catch in a barrow to some prominent corner or to the houses of consumers for disposal.

HARD TIMES.

In that day, by dint of lobstering, piloting, and acting as city watchman winter nights, the fisherman who was very industrious and very prudent, managed to make both ends meet; but where one *was* so very fortunate it was only by working early and late, and using the utmost economy.

AVERAGE CATCH.

The fish most caught were cod, haddock, tautog, bass, and mackerel. They would usually get from one hundred to one hundred and fifty pounds, but sometimes failed to catch so much, and then they would complain that "fish were not so plenty as they used to be."

We are told that, sixty years ago, the above complaint was chronic among fishermen, but not of so virulent a type as at the present day, as there were *then* no trappers to charge with being the cause; but *now* there is a competition with them in the waters and markets, where those who will not use improved methods are outdone.

Yet we believe that, where the fisherman really applies himself to his business, he does as well as at any former time, though we would by no means convey the impression that hook and line ever *was* or ever *will be* a profitable way to catch fish.

WHY LESS ARE CAUGHT IN SOME LOCALITIES.

1. Because they are made wild by steamboats, vessels, and an infinite number of small craft, and by being fished for by everybody, and in every way.
2. The fish whose numbers have most diminished in those localities are of the less belligerent kind, while their enemies among fish have increased and driven from their favorite grounds.
3. The failure, or partial failure, of crops of sea-vegetation and small animal life that, according to natural laws, will vary from one year to another, and the great amount of filth that must accumulate on some at least of the feeding and spawning-grounds, may cause a permanent failure in such localities.
4. The impurity of the water that so affects the oyster as to destroy its value for food, as in Taunton River and at other points.
5. The destruction of muscles by the occasional storms that drive the shells up on our shores in windrows two or three feet thick.

OTHER CAUSES OF DIMINUTION.

1. Their destruction at sea from natural enemies there.
2. Convulsions of nature.
3. Distempers.
4. Being chilled by the excessive cold of some of our winters, as in 1856–'57, when tautog were driven ashore in large quantities.
5. The enormous destruction of the spawn and young by natural enemies, that may increase or diminish unobserved and unknown. These enemies may be of their own kind when food is scarce.

From all these causes, may we not find the answer to the question, "What has become of our food-fishes?"

It may be objected that most of these causes are natural ones, that may have operated at other times as well as at present. We answer, they *have* so operated; and perhaps the fluctuations of fish were more remarkable for the half century previous than for the one just passed, and to what, we ask, can it be attributed? Certainly not to fishing.

WHAT FISH HAVE DIMINISHED, WHAT INCREASED, AND WHAT NEITHER WITHIN FIFTY YEARS.

We have stated that there was an apparent, when there was not a real or general diminution. We believe this to be true of bass, and also of tautog. While the indications are that scup have really diminished, the bull's eye have entirely disappeared.

The horse-mackerel, squeteague, butter-fish, and Spanish-mackerel have increased very much, and are fish that were scarcely caught at one time, but are now numerous, in spite of the means used to catch them.

But before we proceed to examine in detail the different fish peculiar to our waters, we will say that their numbers fluctuate in such irregular manner—a season of scarcity often followed by a season of unusual plenty—and their entire disappearance from certain localities for a series of years, to re-appear again, are phenomena that upset our best theories, and make past figures of little account for the future estimate of numbers, as, for instance, in the course of five, ten, or thirty years, there may be an apparent gradual diminution from one year to another, preceeded by a year of abundance. We here submit some facts that lead to the conclusion that bass and tautog are about as plenty as ever.

1. Fifty years ago a shore-seine was used in bassing two weeks; but the men engaged did not get enough to pay for their food while so engaged. A failure to catch, in that time, was not rare.

2. At this writing, July 28, 1871, a boat is in the harbor with 9,000 pounds of bass, the result of one haul with a shore-seine, for which they will probably realize $900. One day this month, one man, Mr. H. G., caught with hook and line 1,000 pounds of bass in two hours!

3. Ten years ago, fishermen caught from 100 to 150 pounds of tautog in a day's fishing.

4. There were sold on the 3d day of November, 1870, at two of our markets, as the day's catch of fifteen men, 2,800 pounds of tautog, besides cod-fish caught by the same, amounting to 600 pounds, being an average of over 226 pounds to each man.

The fishes of our waters may be classified—1. As local and bottom fish, being those that remain in the bay the year round. Of such are the cod-fish, haddock, tautog, flat-fish, and eel. 2. The migratory fish, that visit our waters and remain with us but a part of the year, such as the bass, horse-mackerel, squeteague, sea-bass, scup, herring, Spanish-mackerel, butter-fish, and mackerel.

THE COD-FISH.

The cod-fish are very generally distributed, during the cold weather, in the lower waters of the bay, and, on the approach of warm weather, work off into deeper water outside the bay, and are then less generally caught, but may be taken at all seasons the year round. They are taken by hook and line, troll-line, not otherwise to any extent. They live on shell and other small fish.

I hear of tautog being taken from them that would weigh a pound. I am told by many fishermen that they are as plenty—some think more so—as ever; while some of our local fishermen think they are not so plenty as thirty years ago.

The haddock, the colleague of the cod, are caught with them.

BASS.

This fish has been generally abundant in our waters, but during the last, as in the present century, there have been seasons of scarcity. They first appear in our waters early in May, going eastward. They are caught in traps in May, to some extent, but are of small size, say from one to four pounds in weight. They are caught in July with hook and line and shore-seines, but are of larger growth, say from ten to forty pounds weight. They frequent the bay much less than formerly, but are caught quite plenty at more remote, or less disturbed places, as at the Vineyard Islands, where they appear as abundant as ever they were.

We are told that now, August 21, they are schooling up, and will very soon be, if they are not already, going west, taking the same route by which they came, but, perhaps, a little farther from shore. They are very shy when alarmed, and are made wild by fishing, steamboats, and small craft that swarm in our waters; and from that cause, are kept from the bay. They go very fast when migrating. A very great increase in their numbers might cause an increase in these waters, on old fishing-grounds, but from causes above named I cannot think that their increase can again cause them to come into the bay as formerly.

The most successful fishing for them that I know of is done at the Vineyard Islands, by small craft, fitted with ice, shore-seines, and experienced men. These rarely fail to make a good catch.

We know of the following catches this season by two boats, most of them the result of one haul with the shore-seine; 500 pounds; 3,500 pounds; 3,000 pounds; 9,000 pounds; 3,000 pounds; 2,000 pounds; also with hook and line in our waters, 1,000 pounds in two hours' fishing.

I know of a locality near Tappahannock on the Rappahannock River, where there is very good fishing for them; have caught them there in *January* with troll-lines, but they are most abundant in February. In February, 1867, I saw 6,000 pounds that had been caught there at one haul. There was one fish among them that weighed 80 pounds, the largest I ever saw. The smallest of this lot would probably weigh 10 pounds.

THE TAUTOG.

This fish winters near the mouth of the bay, comes into the bay in the spring—in March or April—remains until November or December, and then returns to deeper waters.

They are caught in May in traps, still later in heart-seines, but more generally by hook and line. They feed on rocky bottoms where seining is impracticable; are caught, sometimes as late as Christmas, in the bay in some deep holes where *some* may winter, but most of them go outside and feed on the ledges until very late, and remain there nearly all the winter.

In February, 1857, after a very cold spell, there were large numbers of tautog driven ashore at Black Island and many other places, chilled, doubtless, by the excessive cold, and from this event many fishermen date a *diminution*.

HORSE-MACKEREL (SNAPPERS, BLUE-FISH) AND SQUETEAGUE, OR WEAK-FISH.

These fish have similar habits, come and go about the same time, and are very destructive to smaller fish. They disappeared from our waters about the first of this century, and returned again thirty-five or forty years ago, and are now generally very plenty; but the present season they have been less so in the bay, though as plenty as usual outside, and I hear they are abundant on the coast of New Jersey.

Although *scup* came some twenty days earlier this season than for a number of years, *these* fish were about as much *later* than usual. They are not much caught now, but what are caught, are generally full of the *small* scup that are so numerous in our waters this year.

The horse-mackerel and squeteague are, perhaps, the bulk of the fish that are caught in heart-seines and gill-nets. When numerous they are very destructive to most kinds of smaller fish, driving them off when they do not destroy them, and following up schools of them to prey upon them.

SCUP OR PORGY.

That these fish first appeared in these waters the latter part of the last century, seems confirmed by all our traditions of them. The first caught being exhibited as a new and unrecognized wonder of the deep, leads us to infer that if ever before they had been here it was too long before that to be remembered by the men of that day. At least they have left us no tradition of their presence here before that time.

It appears that they came here in small numbers, but, favored by certain conditions, they multiplied until they became the most numerous of all our edible fish. If we study the conditions under which they then increased, we may arrive at a correct solution of the question of the cause of the present increase. Here we fail to obtain information that is wholly satisfactory; but it is certain that about the time scup first appeared, horse-mackerel (blue-fish) and squeteague disappeared; and during their absence scup increased to their greatest number; but at the increase of the former they again decreased. Therefore we conclude that the increase of the one is in proportion to the decrease of the other, and also contingent upon the same.

The present season gives us a new phenomenon, corroborative of this inference, the appearance of small-fry of scup in myriads directly after the great run of scup; first, outside, three or four weeks later at the lower waters in the bay; and the late appearance and small number of horse-mackerel. These latter seem to have chosen another field for their operations, and allowed these small scup to escape the destruction that has so commonly been their fate.

In former years scup migrated to our coast about the middle of April, and then appeared to be plentiful all over the bay. For ten years to the present time they have not favored us with their presence until nearly a month later, and then they came in less numbers, and were scattering in the bay. What connection there is in their late coming and apparent consequent small numbers does not appear; but fishermen have a theory that the time and number depend much on the weather, warm southerly winds being most favorable. How far the adverse weather may have operated to keep them back in their migrations to our coast, until the horse-mackerel and squeteague have marshaled their hosts and cut them off, we know not.

TRAPS VS. SCUP.

It is said that traps destroy this fish while seeking an entrance to the bay to deposit their spawn; and this is insisted upon, notwithstanding the traps catch only one way, *i. e.*, when the fish are going out. But if this is true, and the trappers by some legerdemain turn their heads down stream and capture them, what can be said about the spawn, when, as at the present season, precocious little fellows, two or three months old, come paddling their own canoe directly after their fathers and mothers, and fill our waters with their young life? It certainly seems to settle the question conclusively that we do not depend upon the product of our own waters for supplies. And is it not a little singular that objections should be made to the capture of fish while in spawn, when the legislative authorities, in one of the most enlightened States of the Union, passed a law to prevent their being sold at any other time than when in spawn, as being then, and only then, fit for food?

Scup, as an article of food, were little prized until, by the aid of traps, ice, and steamboats, fish were utilized as such over a large area of country; and the immense demand thus created required a vast amount to satisfy it, and has operated to build up this branch of industry to its present magnitude.

OVER-FISHING.

That every fish caught makes one less in the water is true, but if that one, if left, would destroy ten others, then the catching of that one saves the other ten. This may not apply to scup as to more destructive kinds, as horse-mackerel, squeteague, sharks, dog-fish, porpoises, &c.; but in some measure it may apply to scup, for aught we know.

It is known that herring destroy their own spawn, and we believe that all others would in a case of scarcity of food.

The small horse-mackerel are often the little bait upon which many fish feed, and we very much doubt whether their own fathers and mothers would stop to discriminate between their own and the young of another.

That it is possible to so diminish their numbers by fishing that those remaining cannot repair the loss, independent of the vicissitudes of ordinary fish-life, we cannot believe. They are scattered over so much ground that all the devices of man can never reduce their number, without some great auxiliary aid from nature more destructive than anything man can devise, although it may be, when natural conditions are such that they must diminish, from year to year, as some species have, to the point of extermination—then it may be that fishing may hasten; but, as has been said by others, "Under favorable conditions, no amount or kind of fishing can ever make any material diminution of the fish of the sea: 1, because of the small proportion of the whole number that can be caught by any means possible, scattered as they are over so great an area; 2, because of their vast reproductive powers, requiring but a small number to keep the stock good; 3, because the same means that are used to catch food-fishes are equally destructive to other fish, their enemies, the destruction of one of which saves numbers that would otherwise be destroyed.

IMPURITIES.

That the great amount of impurities that are emptied into the waters of this bay from the sewerage of cities, the *débris* of manufactories, and the accumulation of filth from various sources; the ashes of steamers and other substances thrown into the water, while it may not be unfavorable to some kinds, it seems impossible that it should not affect others that inhabit the pure waters of the ocean for a large part of the year.

We know it is said that the impurity either rises on the top or settles to the bottom, and that between these two extremes the water is pure. In some degree we think this true, and to the measure of its truth we ascribe the presence of what we have of the sea-fish in the upper waters of the bay.

Fish, coming to our coasts in schools, swim near the surface. May they not be diverted another way where they come in contact with impurities; or would they find a clear streak of pure water, and follow it to the source of impurity to investigate causes?

Instances are not wanting where the total disappearance of certain fish has been traced to this cause, as the desertion of the river Thames by the salmon; yet the white-bait continue to thrive there in spite of all the filth. So may the cat-fish and the eels thrive in the mud of our rivers, but the bass and tautog never can.

But the impure water is not the only nor the greatest evil of filth emptied into the bay. The great deposits that settle from it and cover the bottom, where the tide is insufficient to carry it off, by its accumulation must destroy much of the small animal and vegetable life that would otherwise furnish food and shelter to the fish. The effect of the impurity in the water is very observable in the oysters of Taunton River, which have become so impregnated with copper, since the introduction of the works near the river, as to destroy their value for food. Similar results have been noticed from gas refuse.

FREEDOM OF FISHING.

At the Creation, "God said, Let the waters bring forth abundantly the moving creatures that have life, and every living creature that moveth, which the waters brought forth abundantly; and God saw that it was good."

After the creation of mankind, male and female, the first great boon conferred upon them by their Maker was dominion over the fish of the sea. So it appears that man's dominion over the fish of the sea does not date with the charter of Charles II and his Rhode Island Colony, but is contemporaneous with the creation of the world; since which time man has continued to exercise it without limit or restriction, as inclination or interest dictated.

That he first exercised it by the use of that most suggestive and simple appliance, the hook and line, of which we have a very early account, is evident; but the increased population causing an increased demand, soon suggested to the progressive spirit of man a better way, and 2,500 years ago the Sacred Historian says: "As fishes of the sea that have no ruler over them, they take up all of them with the angle, they catch in their net and gather them in their drag, because by them their portion is fat and meat plenteous." Thus defining God's first boon as an unrestricted use of the fisheries, that were without a ruler, and showing an appreciation of the means used and the great good resulting from their use; and then exclaimed the good prophet, "Shall they therefore empty their net that brings fatness and plenty?" Not only was an advance made in fishing, but they also made sluiceways and ponds for fish.

In Christ's time nets were much used, and a sort of net that was cast from the ship's side, and thence taken back into the ship like the purse-nets of our day. The shore-seines then used must have been large ones, for it was not considered that 200 cubits (300 feet) was far from land. "They were not far from land, but, as it were, 200 cubits, dragging their net with fishes." "Simon Peter went up and drew the net to land full of great fishes, an hundred and fifty and three." It was thus that they exercised dominion over the fish of the sea, and *sometimes* made great catches, but often "toiled all night and caught nothing." A fluctuating fortune, common to fishermen of all ages.

Those fishermen of Gallilee were countenanced and encouraged by Christ, and were of the first from whom he chose his Apostles. We hear nothing of hook and line at this time, but can hardly hope to make our hook-and-line friends believe it was because that method had become obsolete; but certainly we do not find them mentioned by the Sacred Historian after other methods were mentioned.

It then appears that in other ages improvements were made in fishing as in other industries, and that they then had the means of catching them in quantity, and that hook and line were not the prime means for catching fish.

Coming down to the early days of our colonial existence, we find that the Indians used weirs and nets in fishing, and fish was to them an important staple food; and it became so to the early settlers also, they using weirs, shore-seines, and gill-nets to catch them.

So important was this interest at the time the charter was granted by Charles II, that a special provision was made in it, securing this right, (*e. g.*:) "That it should not in any manner hinder any of our loving subjects whatsoever from using and exercising the trade of fishing upon the coasts of New England, in America. But that they and every or any of them shall have full power and liberty to continue and use the trade of fishing upon the said coasts in any of the seas thereunto belonging, or in arms of the seas, or salt-waters, rivers, and creeks, where they have been accustomed to fish, and to build and set upon the waste lands belonging to said colony and plantations, such wharfs, stages, and work-houses as shall be necessary for the salting, drying, and keeping their fish to be taken upon the coast."

Living under this charter our grandfathers and fathers continued to exercise this inherent natural right with as much freedom as they used the air to breathe and move in, choosing their implements and using them without limit or restriction. And under a constitution that continues to us the same guarantees, we have so increased this productive industry as to make it second to none in a large section of the State.

("The people shall continue to enjoy and freely exercise all the rights of fishery, and the privilege of the shore, to which they have been heretofore entitled under the charter and usages of this State."—Article 1, section 17.)

We do not doubt that our heart-seine is an improvement on the weirs of former times, and that our purse-nets are in advance of those used by the Apostles is likely; perhaps, too, the fish-hook of to-day has a different bend, a sharpness of point, or a larger barb than those in use when man first exercised "dominion over the fish of the sea, that had no ruler over them," but were free to all. And *freedom* did not mean restriction, as it has been defined by the committee on fisheries, where they, alluding to the clause in our constitution containing the charter-rights, say that, "constitutional scruples may make it necessary to restrict fishermen in Rhode Island."

This, then, the most ancient of man's rights, conferred upon him at his creation by his Maker, continued to be exercised and enjoyed by him without interruption for nearly 6,000 years, confirmed to him by the laws of the State, approved and justified by the best informed of this and other countries, who have most thoroughly investigated its merits, is in these latter days brought to trial for its continued existence, and the liberty-loving little State of Rhode Island is asked to lead the van in the crusade against it.

OPPOSITION.

About fifteen years ago many of the most enterprising of the fishermen, better to facilitate and render more successful their business, adopted the method of catching fish known as "trapping," which, as a natural consequence of their better success, provoked the opposition of such of the fishermen as lacked the necessary enterprise or energy to adopt the measures, without which they could not compete in the markets and waters. Re-enforced by occasional and sporting fishermen, they succeeded in creating a prejudice against this method of fishing, such as has been arraigned against every labor-saving machine adopted by other industries with the same result, until parties of wealthy young men, seeking relief from *ennui* or the cares of business, and thoroughly furnished with the most approved tackle, turn fishermenfor a time; but, disappointed in consequence of not catching fish, are easily persuaded that it is because traps have destroyed them; then, without taking the trouble to investigate the matter, an effort is made to unite every element of aggrieved (or imagined to be aggrieved) interest against the net-fishermen, with a determination to exterminate their, the only admitted profitable method of fishing.

By dint of great efforts and one-sided statements by canvassers, they enrolled the names of a long list of petitioners.

That very many well-meaning persons signed the petition, we doubt not; and that some advocated it from a sense of public good, we believe; for the fish question, when first brought to issue before the people of this State, so long as the facts remained obscure, did have some show of fairness to those content to know simply that traps had increased and the price of fish increased, while the catch of fish with hook and line, in some localities, had decreased. While this constituted the whole bulk of the information made available to the mass of the people, and was enforced and made to appear plausible by the eloquent rhetoric of scholastic lore—that the first was the cause, the latter the effect—it is not surprising that many were influenced by it.

But while they are discussing the means of restoring the fish to our waters, the fish themselves re-appear and upset all prognostications of their extinction by human means, and establish the fact that they, like insects, in the lapse of years, fluctuate in numbers, though left to themselves. First, one species, favored by certain conditions, multiply and increase to a number limited only by the amount of food produced, and the ordinary vicissitudes of fish life, until some deadly distemper, a convulsion of nature, the destruction of their normal food, an increase of natural enemies, or the invasion of their grounds by new enemies which take their place and multiply until some of the above-named, or other causes, produce the same effect upon their numbers, and they in turn give place to the former or other species.

Such changes are constantly going on under the inexorable laws of nature, that produce a like effect upon vegetation, sometimes by visible, sometimes by invisible causes; and man can no more change the result by legislation than he can limit the drops of rain that shall fall upon the earth.

To account for all the causes that produce the effect is much beyond the grasps of finite minds; its roots are deeper than they can penetrate. It is comprehended, in all the relations of cause and effect, only by the Allwise Ruler of the universe.

We can only theorize and speculate about the hidden, unsolved mysteries of nature, that show man's weakness, and point the limit of his attainments.

The following communications may serve to illustrate what I have said:

Captain Timothy Gavitt, of Westerly:

Has known bass caught in June that weighed from one-half to one pound, that were put in a pond, and, when taken out in October, weighed six pounds.

A boy living with him caught, by wading in, a tautog weighing five pounds, at the mouth of a little brook two miles above the fishing-ground at Pawcatuck River. It was a female fish, very full and very far developed spawn; he thinks the spawn would weigh one pound. He also states that the light-house keeper at Watch Hill, Mr. Pendleton, (not the present keeper,) lost a bob fishing for bass that was taken next day with the fish on Long Island. It was identified and returned to him. Bass return west in August and September, by the same route they came, but wider off shore.

Statement of Job Tew, aged seventy-six:

Ten years ago saw the heads of scup in the water and along shore, and considered it as an indication of the presence of horse-mackerel, as there were no other fish in water at the time that would do it, it being too early in the season for sharks.

In 1810 bass were scarce.

Fishermen used to complain sixty years ago that fish were not as plenty as they used to be. Have known bass to be very plenty in a particular location, and never appear there again in numbers, without apparent cause for the change.

Think fish generally as plenty as ever. Always did vary one year with another.

Benjamin Dunwell's statement:

Has fished thirty years with hook and line. Two hundred and fifty pounds tautog used to be considered extremely good fishing. Often did not catch enough to eat during the month of August. My day's catch is about the same now as it used to be, both in tautog and codfish.

The seasons vary, but average about the same; do not observe any reduction of fish; go further when fishing for tautog; think that owing to the destruction of them, by being chilled in 1857, since which they have not been so plenty in the bay.

Scup used to be plenty in the bay, but horse-mackerel have driven them off. There are a great many more half-way fishermen now than formerly, and they do not follow it up so well.

Edwin Brown's statement:

Early in May, 1866, saw at Gardner's Bay very small fry of scup and sea-bass, just large enough to distinguish their species.

Fished at Seconnet in 1857; sea-bass were very plenty then. Since that time they have very much decreased, but have again become very numerous, and the last season were as plenty as at any time since I first fished at Seconnet. Caught more tautog the present than any previous year.

PELEG HUDDY'S statement:

Has been a hook-and-line fisherman thirty-five years. Sea-bass were very scattering, when first fished; were told that they were very plenty before that time. About ten years ago they became very plenty, since which they are not so abundant.

Mackerel were more plenty in August, 1870, than ever knew them to be before. Fish generally are quite as plenty as ever, except at certain localities in the bay. While some kinds have decreased, others have increased. Don't believe nets or traps materially affect their number.

Statement of NATHAN KING:

Is now, and always has been, a hook-and-line fisherman; thinks fish, generally, as plenty as ever, but are driven off shore by the steamers; thinks they are the chief cause of scarcity in the bay; has watched them darting from a boat, and thinks that steamers must have great effect in driving or scaring them from the waters.

About twelve years ago, knew of a boat that went to Point Judith for tautog; fished some, without success, at the usual fishing-grounds, then hauled up killick, and worked along slowly—watching all the time for fish; came to a clear spot on the bottom and saw them; carefully dropped anchor, and in a very short time had a good fare of very nice, large tautog. Repeated the same several days, with good success.

When the sun is very hot, tautog leave the clear spots for shelter in the weeds and rocks. Mr. King thinks the fish are very much harassed all along the shore by fishermen; but when they are found in a quiet spot, can be caught quite as well as ever they could. He remembers hearing the complaint, "that fish were not so plenty as they used to be," when he first went fishing; but fishermen forget the poor fares, and remember well the good ones. The nearest places are so much more fished, is a reason for catching less at those places, if there were nothing else to disturb the fish.

Lobsters are quite as plenty as ever; that is to say, that the same number of pots catch as many pounds as thirty years ago.

NEWPORT, *September*, 1871.

HENRY MERRITT'S statement:

Have been engaged in hook-and-line fishing twenty years—principally for tautog; used to catch from thirty to three hundred pounds. The latter was an extra good catch. We considered one hundred and fifty pounds a good day's fishing. The seasons varied somewhat, but cannot tell just which seasons they were most plenty; but think they were more scarce the season after so many were chilled in the winter and driven ashore. They were very scarce two years ago, but very plenty last year; never saw them more so than then.

Caught three hundred pounds tautog several days running, and sometimes two hundred pounds cod-fish on the same day. Fished from Beaver Tail to Point Judith. Thinks the average catch equals former years at same places. Have caught tautog as late as Christmas on the ledges. Have seen scup very plenty on the ledges almost every year, but more last year. Should say there were three times the number fishing now that there were twenty years ago.

Scup are very plenty in the bay at present; have been since June.

P. SOUTHWICK'S statement:

Is seventy-six years of age. When about twenty years old, went several times to the Vineyard Islands, with a seine, to fish for bass; sometimes staid two weeks, but never with success; did not realize enough to pay expenses, and often not enough to pay for food consumed while so engaged.

The fishermen used to say fish were less plenty than formerly, as long ago as I can recollect.

Mr. T. STEVENS, one of our oldest hook-and-line fishermen, says that he, with two others, went to Martha's Vineyard to fish for tautog about thirty-five years ago; would get from one thousand to three thousand pounds in a week's fishing. Went east because they could do better than at home.

NEWPORT, *August* 12, 1871.

WILLIAM SISSON, of Westerly, commenced fishing fourteen years ago; fished all the time since, except from 1861 to 1865, from June to October. Used shore-seine; fished from Long Island to Cape Cod with it. Find bass first appear on western part of fishing-grounds; later, further east. The first that come are smaller. Have not failed to catch good fares any year that I have been fishing, but never caught more than at the present season. The spawn is well developed in most of the bass now; saw last week small bass, smallest four inches long, at Waquoit.

Horse-mackerel are not so plenty the present season, but have been very much more plenty the last few years than when I first fished; think three to one.

Bass feed on the bottom, on small fish, worms, and roots; swim near the surface, sometimes very fast, so that it would take a smart sail-boat to keep up; catch them best on the flood-tide.

Both bass and horse-mackerel attack birds. Have seen small quantity of spawn of bass in seine. They go together to spawning-grounds in the rivers. Have seen scup cut by horse-mackerel, and have taken from them the tail-end of scup that I think would weigh half a pound. I think them very destructive to all kinds of smaller fish, more so than anything I know of.

Fish are just as plenty as ever, but more wild, and keep more off shore, owing to traps and other fishing for them. Bass will take hook any time.

STATEMENT TAKEN FROM MY BOOKS OF THE FISHERY AT PINE TREE.

In 1866, up to May 11, caught $2 25 worth of fish. On the 11th caught 168 barrels of scup, at $2 per barrel.

In 1867, up to May 14, caught $10 worth of scup. On the 14th caught 76 barrels, at $2 a barrel.

In 1868 fished from May 1 to 23. Total sales of all kinds of fish, $86 72.

In 1869, May 6, catch, 2 scup; 10th, catch, 1 barrel; 13th, caught 32 barrels, at $3 a barrel.

In 1870, May 2, catch, 11 scup; 8th, 6 barrels; on the 15th, 60 barrels, at $2 per barrel.

This fishery had been fished about seven years before I fished it in 1866; and I am told that large bodies of scup were taken as early as

April 20; that 200 barrels have been taken at Seconnet as early as the 15th of April.

J. M. K. SOUTHWICK.

The fish question might be summed up thus:

Fish have diminished in certain localities. It is charged that the diminution is in consequence of trapping. Is the charge sustained? If so, then we may stop here. But if only met by the query, what else can be the cause? we might ask by what maxim of law are trappers adjudged guilty without proof, and compelled to seek relief by fixing the guilt? But answer: If no other cause could be given, then it may not be traps; for who can explain the working of the mysterious laws of change written all over the universe? Yet numerous and sufficient causes have been assigned to account for all the real or apparent diminution, besides the fact shown the present season, that an increase of fish is possible without a reduction of traps; that scup, like the herring of England, may increase in spite of the enormous and increasing fishing.

It is proposed to stop trapping three years as an experiment—a sort of sedative to popular clamor. And then what? The business would be destroyed for all time, for none would venture capital in material once rendered valueless, and liable to be again, at the caprice of experimenting legislatures.

As well charge the ice-merchants with short crops of ice, because of large ones gathered in former years, and suspending their business on their failure to demonstrate that it was from other causes.

To stop trapping two days and three nights in the week. Although the scup-traps are down about twenty-five days, the great bulk of the fish are taken within ten days. Now, if allowed to fish but five days of the ten, as may then happen, there would be no chance left the fishermen at this, the most important trap-fishing in Rhode Island.

The effect would not be so detrimental to the heart-seines, although discouraging to those not now very successful. I believe any restriction of the scup-traps, beyond that from Saturday night to Monday morning, would amount to prohibition.

THE FOOD-FISHES OF THE NEW ENGLAND COAST.

BY GEORGE H. PALMER, OF NEW BEDFORD, MASSACHUSETTS.

Within a period of about twenty years, four of the best food-fishes of the New England coast, of different *genera*, different habits, and feeding to a certain extent on different food, have been observed to become, year after year, less in numbers and smaller in size.

These four fishes are—

The striped bass, *Labrax lineatus*, (*Roccus lineatus*, Gill;) sea-bass, *Centropristis nigricans*, (*C. atrarius*, Gill;) tautog or black-fish, *Tautoga Americana*, (*T. onitis*, Gill;) scup, *Pagrus argyrops*, (*Stenotomus argyrops*, Gill.)

For several years this fact attracted but little attention, and called for no special investigation.

At length, however, the subject began to excite the alarm of the fishermen who depended upon fishing for their entire or partial support, and grew to be a subject of very general complaint.

Of these fishes there is no evidence that they have not always been abundant, until within the time mentioned, except the scup, about which there is a tradition that it first became known in Buzzard's Bay, in 1793, since which time it has always frequented the waters south of Cape Cod.

Up to about 1851, no means of taking these fishes were commonly in use, except the hand-line, with a baited hook.

All but one were caught at the bottom, upon their feeding-grounds, with a still bait.

The exception, the striped bass, was fished for, for the most part, among the rocks near the shore, by throwing and hauling an eel or other bait, or sometimes in the tide-ways, and at the bottom, with shrimp or dead or living fish, and in the surf with a bait floating upon or under the surface of the water.

They were all caught in large numbers throughout the entire season, except the tautog, which appeared in the spring and again in the autumn.

The catching of these fishes gave employment to thousands of fishermen, and furnished a cheap and wholesome article of food to all the inhabitants upon the sea-shore.

The supply was always fully equal to the demand. When, however, railroads began to provide easier and quicker means of transportation, when ice came to be used to prevent or retard decomposition, and when the fishes came into more general use as one of the ingredients of fertilizing compounds, wholesale methods of catching them, more or less ingenious, were devised to supply the demand thus artificially created. Then traps, pounds, and weirs were brought into use, and have increased in numbers and efficiency from year to year, and, as they did, the hook-and-line fishermen caught fewer and fewer of fish, during a shorter portion of the season, and these smaller and smaller in size, until within two or three years hardly any of the fishes of the varieties named could be caught by the common practice of hook-and-line fishing.

As a consequence, men who had followed it heretofore for a livelihood gave it up and became trappers themselves, and those who had occasionally pursued it to supply themselves and their families with food, or for recreation and amusement, have been obliged to abandon it altogether, or be content to spend weary and toilsome hours to capture the few stragglers that have escaped the toils of the more crafty and ingenious fishermen.

So well convinced did the people become that the multiplication of traps and pounds and the growing scarcity of fish stood to each other in the relation of cause and effect, that in 1870, simultaneously in Massachusetts and Rhode Island, legislative investigation was demanded, and, to a certain extent, obtained, with a view to such action as should check the evil and prevent the much-feared destruction of these valuable and important fishes.

In what I shall have further to say on the subject, I shall confine my remarks as to those investigations to the "Report of the committee on fisheries, to the legislature of Massachusetts," the "Majority and minority reports of the committee on fisheries in Rhode Island, January session, 1870," to the "Report of the joint special committee of the general assembly of Rhode Island, appointed to examine into the fisheries of Narragansett Bay," to the speech of Mr. Atwood, of the Cape district, chairman of the Massachusetts committee, in support of his report, and to a general review of the facts elicited by those investigations, and to the reasoning upon them.

I shall refer to those several matters, to the evidence brought before both these committees, to opinions stated and conclusions drawn, in such order and connection as shall best serve my purpose, and without more particular reference thereto.

From very similar testimony, the committees in Massachusetts and Rhode Island came to directly opposite conclusions.

The Massachusetts committee reported "leave to withdraw." The Rhode Island committee recommended the passage of "An act to prohibit trap and heart-seining of fish in the waters of Narragansett Bay."

In the Fifth Annual Report of the Commissioners on Inland Fisheries, (Boston, 1871,) those gentlemen, in concluding their remarks "on the possible exhaustion of sea-fisheries," say, "The petition for abolishing weirs, &c., ought to have brought out much valuable testimony, but it proved quite otherwise." This was true, and the criticism that followed it just.

Early in that investigation, and in order to bring out all the valuable testimony possible, the managers for the petitioners represented to the committee the difficulty of procuring the attendance of witnesses; that most of those who were interested to protect the fisheries were poor or of limited means, and that those who were rich, not being pecuniarily interested, had contributed but little to carry on the investigation; that the question was one of great public concern, and asked the committee to obtain from the legislature authority to send for persons and papers, which they, although expressing a determination to give the subject a full and impartial hearing, refused to do. The managers therefore were limited to such witnesses as would willingly attend and the means in their hands enabled them to produce.

On the side of the remonstrants it was not so. These two investigations became so general and looked for such stringent legislation, that the opposition was aroused, and all those who were engaged in the profitable business of trapping and seining fish contributed liberally to defeat, and did defeat, any action on the subject.

One witness in Rhode Island, William Spooner, testified that they went so far as to threaten all those fishermen who should go before the committee to testify anything against trapping.

It is more than probable, however, that limited and unsatisfactory as those examinations proved, they together furnished more evidence than had hitherto been procured, and brought out as many facts as are likely to be obtained by anything short of congressional action on the subject.

It is a matter of surprise, therefore, that so much information was gained, and not that so little that was valuable was in evidence, and although the "very interesting contemporaneous investigation in Rhode Island" went more carefully, thoroughly, and understandingly into the matter, yet we find, on comparing the testimony, that what was proved in the one case was, for the most part, confirmed in the other.

The English commission, the Massachusetts commissioners, and Mr. Atwood may all agree "that fishermen, as a class, are exceedingly unobservant of anything about fish which is not absolutely forced upon them by their daily avocations;" "that these witnesses do not know one-half of what they ought to know;" nevertheless this is all the testimony we can have upon a question of vital consequence until the Government devises some better means of ascertaining the truth. Meantime the evil, if it is an evil, goes on, to the prejudice of the fishermen and to the possible destruction of the fisheries.

Perchance this is one of those cases where the stopping the practices complained of is the only means of accurately knowing what the ultimate effect of their continuance will be.

Should the trapping and pounding of these fishes be suspended for a time, and the fish should thereafter steadily increase in numbers, the question would be settled.

The matter is of consequence enough. Would it not be worth while to try the experiment?

In this view of the case, all we have to show is, that these novel, and what we claim are improper, methods of catching fish, are a probable cause of the scarcity complained of, having first shown that the scarcity exists. The burden of proof is then logically shifted, and it is for the trappers to show that their methods do not consume these fishes faster than their natural increase.

They have then one further point to make—that by their wholesale modes of fishing they do not interfere with the rights of others, for nothing is clearer settled in the law than that all men have the right to catch fish in the bays, inlets, and arms of the sea, and that no man has the right to catch fish to the injury of others in their rights. Then we inquire—

Firstly, have the fishes under consideration become scarce?

Secondly, are the methods of catching them, by pounds, weirs, and traps, a probable cause of such scarcity?

In answer to the first, we claim that they have.

Both in Massachusetts and Rhode Island it was at first stoutly denied that there was any scarcity of the fishes named, yet it was testified to, by most of the witnesses in both States, and Mr. Atwood finds himself at last compelled to admit it, and then goes on to try to account for it.

The interrogatories put by the joint special committee of the general assembly of Rhode Island were in writing, and were eighty-two in number. They were answered in so far as they severally knew, by thirty-nine witnesses, under oath.

Twenty-eight of these interrogatories bear directly upon the question of scarcity, and thirty-seven of the witnesses swore that they had grown perceptibly scarcer year after year, except during two years, when the traps had been broken up by storms.

The testimony of the Massachusetts witnesses is not in print that I am aware of, but from my notes I find that every hook-and-line fisherman among them, except one, agreed with the Rhode Island witnesses upon this point.

Add to this the testimony of every amateur fisherman with whom I have conversed, many of whom are men of superior knowledge, accustomed to observe everything with regard to the fish they catch, some of whom have made their opinions public in works of standard merit, and we have evidence sufficient to establish the fact of the increasing scarcity of these fishes, beyond a reasonable doubt.

Again, and more conclusive than the testimony of all these witnesses, the scarcity of these fishes has become notorious. All along the shore, from Point Judith to Monomoy, it has been and is now a general cause of complaint. Everywhere you go, in any seaport town, the fishermen will tell you what they used to do, and all the inhabitants are lamenting the time when they could go out and catch a "mess of fish at any time." But now it is not so.

If there remained any doubt as to whether it was proved that these fishes have become scarce, the Massachusetts committee, in their report say that "it appeared in the evidence that the scup, tautog, sea-bass, and striped bass, in Buzzard's Bay, have diminished during the last few years, comparatively few having been caught in that locality;" and the joint special committee of Rhode Island, in their report, after a careful review of the whole subject, and in view of its "profound intricacy," say that "the oral and written testimony laid before the committee establishes the fact that, whereas scup were formerly abundant in the waters of Narragansett Bay, and constituted a cheap and nutritious article of food to the inhabitants, readily found and easily caught, they have gradually left these waters, until they are quite abandoned by this species of fish, and partially so by other species."

Then, from the testimony of all the witnesses in Massachusetts, except the trappers, and one Bearse, from Hyannis, who was not surpassed by any one on the stand in the exhibition of ignorance and prejudice, that these fishes had diminished in Vineyard Sound, and we have three very considerable and important fishing waters, in which these fish had formerly been abundant, where now they have become scarce.

The fact of the scarcity having been so entirely proved, the report of the "minority of the committee on fishes" in Rhode Island finds it necessary to say, "and if these fish do not come into the bay as plenty as formerly, we can only suppose that there are some conditions necessarily wanting;" and the committee in Massachusetts accounts for it in these four ways:

1. That they have merely disappeared.
2. By reason of the scarcity of food.
3. From impurities in the water.
4. The blue-fish have destroyed or driven them.

Let us review the evidence going to sustain these several positions in their order.

1. That they have merely disappeared.

The Massachusetts committee, in their report, say that it does not necessarily follow that when fish leave a locality they have been driven away by over-fishing; nor has any such thing been claimed. What is claimed is, that in these waters, and with reference to these particular fishes, they have been destroyed or taken in such large quantities just before or at the time of spawning that any increase is impossible. The significant fact is, that they have disappeared from these several waters at the same time, and have steadily, not suddenly, decreased.

If they have not been exhausted, but have only left the locality, is it not a little remarkable that these four different species of fish should not only have agreed to leave these several localities at one time, but that they should not have appeared in great numbers anywhere else?

Mr. Atwood says that "all agreed that the scup, tautog, sea-bass, and striped bass had, within a few years, diminished in Buzzard's Bay, but failed to show that over-fishing was the cause of the diminution." They were not bound to show any such thing. Having proved that the fish had become scarce, and that they had done so since the setting of the pounds and traps, it was the duty of the committee not to take sides with the trappers, but, acting under their oaths, on behalf of the people of the commonwealth, to force the trappers to show, as logically they were bound to do, that their novel and wholesale methods were not the cause of it.

There was not a particle of evidence before either of these committees going to show that these fishes had disappeared—that is, changed their ground—nor any evidence that they were of the kind of fishes that appear here in one place at one time, and then in another place at another time. On the contrary, all the evidence there was proved that they returned annually to the same grounds to spawn.

All there is upon this point comes from Mr. Atwood himself, after the evidence is closed, when he, "laying aside the evidence," becomes a witness before the senate of Massachusetts, and gives a very interesting account of what he had "noticed during a long life of practical experience in the fisheries."

This covers a period of fifty-one years, and is very important in this investigation, because it is the testimony of Hon. N. E. Atwood, of whom the Rhode Island commission says, he is a "practical fisherman of Provincetown, and a distinguished ichthyologist;" because, say the commissioners on inland fisheries in Massachusetts, it is the opinion "of a man who probably knows more of the habits of our cold temperate sea-fishes than any one in the country."

We have no longer ignorant and prejudiced fishermen on the stand, who "possess only a local knowledge of the fish with which they come in contact; who do not make the habits of fish a special study; who do not know one-half of what they ought to know;" but the great ichthyologist and the intelligent fisherman of fifty years' practical experience.

Let us see what "changes he has noticed" going to show that *these* fishes—the fishes under consideration; not other fishes, but the scup, tautog, sea-bass, and striped bass—have, or may have, merely left the localities they once frequented.

He first alludes to the scup, of which he is "informed that in examining the old shell-heaps that have been deposited by the aborigines, many years ago, the bones of this species have been found, showing that they were here before this country was settled by the Europeans."

If they were here then, it is quite as probable that they have remained here ever since, as that the "tradition" is true that they appeared in Buzzard's Bay in 1793.

The witnesses who stated that they had such tradition were the same witnesses of whose testimony on other points Mr. Atwood thought so little; and the tradition itself may, for aught we know, have had reference to some other species; but what is a great deal more probable is, that they then first began to be considerably fished for.

At all events, this is very feeble evidence to support a theory that this species of fish has appeared and then disappeared, driven away by none other than the "Indians, with their rude implements of fishing."

Since 1793 Mr. Atwood gives us no information that every year, for a period of more than seventy years, they have not, until recently, been abundant. And there was no evidence before the Rhode Island committee that they had not existed in the waters of Narragansett Bay since the settlement of the country, which, if they had not, would certainly have appeared, since the people of that State have always been interested in the subject of the fisheries, from the "earliest authentic history of the colony." As early as 1719 the general assembly passed an enabling act empowering each town council "to take care for the preservation of the fishery within their respective jurisdiction, and to remove all obstructions made in any rivers that may prejudice the inhabitants by stopping of fish from going up the stream."

The only other fish of the species under consideration of which Mr. Atwood gives us any information, is the striped bass, of which he says, that they have diminished in the vicinity of Cape Cod, as the blue-fish have destroyed the bait upon which they feed. This is only admitting the fact of the scarcity of these fish, and begging the question as to the cause of it.

This is all the information we have from Mr. Atwood upon the subject. What he says more has reference to fish of other *genera* and different habits, without the least connection to show that what has been true of them is also true of the species now being considered.

In order that nothing having any bearing upon this subject should be left out of the reckoning, let us see what Mr. Atwood says of the other fishes included in his list of "changes," and inquire what are the natural inferences to be drawn.

After his remarks upon the scup, he states that the chub mackerel, *Scomber dekayi*, disappeared long before a weir-trap or pound was used in our Massachusetts waters. The common mackerel, too, "come to us some years in great abundance; in other years they are comparatively scarce." In 1840, shad appeared, and, not long after 1842, "they then disappeared."

Precisely the same line of reasoning is to be followed here that was taken by Rimbaud in his Review of the Report of the English Commissioners. Mr. Atwood has fallen into the error of "compounding under the common name 'fish' of all the vertebrate class taken by fishermen." Rimbaud shows that a classification is necessary, a "classification founded not on anatomical characters, but on habits and localities."

Rimbaud makes four divisions. For the purposes of this discussion only two are necessary:

1. Wandering fishes, the most of which are surface-fishes.
2. Bottom fishes.

The difference chiefly to be borne in mind is this: That whereas the wandering fishes appear on our coasts only when migrating, and then in vast but uncertain troops, the "latter are especially domestic, and dwell and multiply on particular localities along the coast."

According to such classification, the chub mackerel, the common mackerel, and the shad, belong to the first division, of which there is no doubt they appear and disappear for no assignable cause. They come, they are gone, is all that can be said about them.

Not only do they change their ground one season after another, but in a single week or day in a locality where they have abounded not one can be found.

Not so with the bottom fishes. They return to the same places year after year, deposit their spawn, seek their feeding-grounds, and remain during their seasons. The fishermen all understand this, and have their bearings so that when once they have found a locality where they are feeding, they may and they do return to the same place again, as confident of finding the fish at any subsequent time as they are that they shall find the rocks near which they had been anchored. Did anybody ever hear of a fisherman's fixing his bearings for a school of mackerel; or, if any ever did, did he do it more than once?

With regard to what Mr. Atwood says of the haddock, there seems to be better ground for his analogy, but yet we are not sufficiently informed of their habits, nor so advised of the real facts in the case as to determine how far it may logically be used in support of his views of the subject. The fact, as he states it, is, that fishing with the trawl-line has been in use since 1850, and that this species of fish has been increasing year after year notwithstanding, until "they have increased in vast numbers; so much so that they are too plenty for the fishermen or dealers:" 621,953 pounds of cod and haddock were sold in Boston in a single day. Mr. Atwood does not infer that the trawl-lines are the cause of the increase, but says: "The present mode of fishing catches vast quantities of a species of flat-fish, (*Platessa dentata*,) which no doubt fed upon the spawn of haddock when the hand-line only was in use. Whether the flat-fish did feed upon the spawn of haddock we do not know as a matter of fact; but if they did, we shall see with what probable effect when we come to consider Mr. Atwood's remarks on the fecundity of fishes.

Reasoning from analogy is, after all, only showing a probability, and cannot be regarded as a very safe method from one class of fishes to another.

Mr. Atwood admits, with respect to the halibut, that they seem to be decreasing on all the fishing-grounds, and leaves the senators, who of course are not expected to know much about it, to decide whether or not over-fishing is the cause of it. Whether the senators ever have decided I do not know, but the fair inference would be, in the absence of any explanation of the matter, that the fishery of them, prosecuted as extensively as Mr. Atwood says it is, had something to do with it.

Mr. Atwood says: "It appeared in evidence before the committee that the fish known as the squeteague is increasing in the vicinity of Buzzard's Bay, and along the south shore of Cape Cod. Some sixty years since it was vastly abundant in the southern part of Massachusetts Bay, and though absent for so many years, it seems to be returning to its former haunts."

From such knowledge as we have of its habits, it seems to be one of the wandering fishes, and likely, therefore, to appear or disappear at any time.

One other fish concludes the list referred to by Mr. Atwood, a species of flat-fish, the *Platessa oblonga.*

What he says of the blue-fish will be passed here, as it comes more properly under another head of my subject.

This species, (the flat-fish,) he says, was exceedingly abundant along our shores before the blue-fish came. "It is a bottom fish, and does not come so directly in contact with the blue-fish as top-water swimmers; still, it has almost wholly disappeared, owing to the blue-fish having destroyed its favorite bait, which is the common squid."

Here, again, the scarcity of the fish is admitted, and here, again, the question of the cause is begged. Mr. Atwood, it is true, states it as a fact that the squid is its favorite bait, and that the blue-fish has destroyed the squid. Could he think of nothing else which destroyed its "favorite bait," after all the testimony before the committee showing the vast quantity of squid taken in the pounds and traps?

This, then, is all there is going to prove that the decrease of the species of fishes now under consideration is absence and not scarcity. We may now consider the evidence as all in, for if there had been any more, Mr. Atwood, with his declared purpose of "trying to show the danger of exterminating the race of fish, if there is any," would have stated it. From it, what are we fairly to conclude?

First. That a certain class of fishes, called wandering fish, appear in and disappear from certain localities without our being able always to assign the cause; that their decrease is, or may be, *absence*, not *scarcity.*

Second. That a certain other class of fishes, called bottom fish, including the scup, tautog, sea-bass, and striped bass, are domestic in their character, coming annually into the same waters to breed and dwell, migratory, and not wandering, in their habits, concerning which, if they decrease, it must be *scarcity*, not *absence.*

2. The decrease of these species of fish is accounted for by reason of the scarcity of food.

In both Massachusetts and Rhode Island the attempt to prove that the food of these fishes had become scarce, was a complete failure.

The fifty-seventh interrogatory of the joint special committee of Rhode Island had special reference to this point.

Twenty-two of the witnesses answered directly that there was no scarcity of food, and of the rest, I think there was not one, not even Mr. Tallman, who testified that it was not as abundant as it had been years before. Mr. Johnson goes so far as to say, "I never knew as much food for fish as at present." Mr. Matthewson says, "Mussels are fully as abundant now as I ever knew them to be; new beds have formed right in front of my place." Mr. Place says, "No scarcity of food; plentier now than ever." Mr. Rice says, "For mussels, &c., are plentier than ever." So the committee in Rhode Island, in their report, well say that, "in the opinion of your committee, the preponderance of evidence is that there is an abundant supply."

In Massachusetts there was less testimony on this point, and what there was went only far enough to show that the food may have changed ground, and that if there was scarcity of one kind, there was plenty of another.

It was from the very slightest testimony, therefore, that the Massachusetts committee concluded that the cause of the diminution of fish in Buzzard's Bay "may be a scarcity of the bait on which they are accustomed to feed, as large beds of mussels on which some of these species feed have been killed by star-fishes, (five-finger, so called by the fishermen.)" Mr. Atwood does not assign this as a cause, except that the blue-fish devours the food of other fishes; he does not anywhere say, nor commit himself to the opinion, that the food of these fishes has become scarce.

During the past year new beds of mussels are being formed, as we should infer would be the case, from the growing scarcity of the fish which consume it.

It will be observed, too, that the traps catch large quantities of the food of these fishes, so that if it has become scarce, they are one of the causes of it.

We are forced to the conclusion, from all the testimony concerning the food for these fishes, except of those kinds taken by the traps themselves, that it never was so abundant, while the fishes were never so few to consume it.

3. Impurities in the water.

If the testimony to sustain the scarcity of food, as a cause of the scarcity of the fish, established the fact that there was no scarcity, but abundance, so the testimony upon this point showed nothing so much as the weakness of the cause of the trappers, and the shifts they were put to to defend their wretched work.

The destructive effects of deleterious substances thrown into the water was attempted to be proved in Rhode Island and in Massachusetts, and in both cases without success.

One trapper in Rhode Island resorted to the novel and ingenious theory that scup were more sensitive to such influences than any other fish, and one witness in Massachusetts had known a small bed of clams near New Bedford to be tainted, and this, from one petroleum factory, was the cause of the scarcity of fish in the tide-waters from Palmer's Island to Noman's Land, a distance of more than thirty miles.

The same interrogatory (57th) and the 78th to 81st, put by the Rhode Island committee, covered this point. Nineteen witnesses testified that of their own knowledge no impurities existed in the waters with which they were acquainted, or that if there were any, they had failed to observe any injurious effects upon the fishes swimming in it. Allen says, "Waters are not impure on fishing-grounds that I am used to; would know if it was." Bassett says, "Barrington River was always famous scup-ground; Kickamuit River the same. I cannot find a person who knows of any impurities in those waters that were not there fifty years ago;" and, again, "I think the water south of Stone bridge as pure as the ocean." No witness, in all the thirty-nine, save Mr. Benjamin K. Tallman, the inventor of the traps, and Mr. Munro, of Portsmouth, also a trapper, who, in July, 1868, once in a while could see a fish (menhaden) on Pawtucket River come up on the top of the water, gape, and turn on its side and die. He supposed the cause of this was impurity of the water. Had been there for several years before 1868, and was there in 1869, but never saw any other instance of fish dying in this way on that river.

So the committee reported that, "in certain localities, doubtless the waters are impure; but the pollution does not extend so far by any means as some persons in all honesty contend."

One witness from East Greenwich, a fisherman, says, "The water is as pure as ever. My fish will keep as long near where the print-works water comes into the cove as anywhere, and clams, quahogs, &c., are as plenty as they have been for forty years."

The known reputation of Providence River oysters in the market for excellence of quality and flavor is another significant fact in the way of those who would account for the scarcity of fish from the injurious effect of poisonous substances thrown into the water from large cities.

And in Massachusetts no impurities could get into Buzzard's Bay or Vineyard Sound, except from New Bedford, and nothing deleterious goes into the Acushnet River, except from one petroleum factory and a copper-works, which did not thirty years ago. The Prussian-blue works has sent its refuse into that river for more than thirty-five years, and yet more was said about that than of any other of the causes.

It is a little remarkable that we hear of no destruction of the fishes from impurities in the waters of the Hudson or East Rivers, nor in the waters of Long Island, nor in the Schuylkill or Delaware.

Only when traps are set in the bays and arms of the great sea are the fishes diminished by the impurity of the waters.

Even Mr. Atwood could not be made to consent to this, and closes all the avenues to such an argument when he says, "But in the great sea man cannot pollute its waters by anything he can do."

Besides, if the pollution of the waters was, and is, a sufficient cause for the scarcity of fish, we should naturally expect to find the fish to become most scarce in the waters most affected, while the fact is that they have diminished just as rapidly in localities where there are not known to be any impurities which did not exist fifty years ago, and from that time ever since.

Lastly, the blue-fish as a cause of the scarcity. "But," says the Massachusetts committee, "the great cause that has driven many species of fish from our waters is the blue-fish;" and in support of this Mr. Atwood, in his speech, says: "But the great change that has taken place in our fisheries has been caused by the return of the blue-fish."

In his very interesting account of this fish, we are told that they frequented our waters in 1763 and 1764, in which latter year, coincident with a great pestilence which visited the island of Nantucket, the blue-fish disappeared, and Mr. Atwood has no knowledge of a specimen having been seen here for more than seventy years. "About 1832 they reappeared along the south shores of Cape Cod, but did not appear on the north side of the cape until 1847, when they drove away from our bay nearly all other species."

The bones of the scup found show that that fish was here when the country was first settled. So far as we know, they have always existed in the waters of Rhode Island; and we have also the tradition that they appeared in Buzzard's Bay in 1793, and no evidence that they have not frequented these waters ever since. They must then have been here when the blue-fish arrived in 1832. In 1847 they (the blue-fish) so affected the fishery, that that year was the last of the catch of mackerel, in which Mr. Atwood was then engaged in fishing with nets. Why then did not scup and tautog begin to grow scarce if the blue-fish is the cause? How happens it that the blue-fish which, in one year, drove all the mackerel out of Cape Cod Bay, did not trouble the scup and tautog on the south side of the cape for nearly twenty years? From 1832, when the blue-fish came, until 1848, when these fishes began to be very considerably diminished, the blue-fish, which had appeared in such abundance as to depopulate the waters of nearly all other fish, and depopulated Mr. Atwood's village and home, made no perceptible difference to the tautog and scup. Nor was any difference apparent until after the traps began to be set, which was in 1844.

The truth is, the blue-fish do not drive nor destroy the bottom fish to any considerable extent, and would not at all, but that the traps catch up their food and force them to attack every species that swims. The fishes which Mr. Atwood was catching were mackerel, surface fish. These the blue-fish would pursue, and these they could both destroy and drive.

I have no doubt the blue-fish has done much to drive other species of wandering fishes from one place to another. Undoubtedly they consume and destroy large numbers of other fish; they may indeed occasionally attack scup and tautog, and possibly consume the food which is eaten by the fishes of which we are now speaking, but there is no evidence that they do so to any considerable extent. Let us look at the testimony and see when this savage, this scapegrace for the trappers, this *Temnodon saltator*, does his work, and upon what.

It is not probable that he troubled the scup much in Mr. Atwood's bay, since he says that only a few straggling specimens venture into the colder waters north of Cape Cod; and we do not find that he disturbed them on the south side of the cape and in Narragansett Bay until they had lived peaceably together in the same waters for nearly a quarter of a century.

The forty-eighth printed interrogatory of the Rhode Island commissioners is as follows: "Please state, for the benefit of the committee, how a hook-and-line fisherman is employed during the season, what fish he takes at the beginning of the season, with time of commencing, and in order mention the different fish as they are caught, with the usual date of arrival and disappearance."

See also questions 4, and 68 to 71.

In answer to these questions, the witnesses agreed that flat-fish appeared the earliest, then the scup, then tautog, and after them the menhaden, which were soon followed by the blue-fish. It also appeared that scup and tautog were not taken with hook and line until after they had spawned, so that they must have spawned before the blue-fish arrived; consequently the blue-fish do not drive nor destroy these fish until after spawning. Unfortunately, therefore, if the blue-fish drive these fish to any considerable extent, which we have already shown they do not, or did not prior to 1844, they come altogether too late in the season to depopulate the waters south of Cape Cod, or lay waste any homes there; for when they come the scup and tautog have spawned, and they have gone to their feeding-grounds in deeper waters. Mr. Atwood himself conclusively shows the complete improbability of their being destroyed after that in what he says of the fecundity of fishes.

I repeat what he says on this subject: How vast is the number of eggs produced by a single fish; hundreds of thousands, which, if any considerable percentage should come to maturity, the waters would be filled to overflowing.

How vast, then, I submit, is that destruction which prevents the spawning of fish!

In order of time it also appeared from the testimony in both States that the traps, pounds, and weirs are set before the arrival of either of the fishes under consideration, and to catch them as they arrived, when they are coming with the shoaler and better ærated waters to spawn.

If, therefore, it was a matter of surprise to the senator that men professing to be acquainted with fish should come before the committee and say they did not know blue-fish ate any other fish but menhaden, it is more a matter of surprise that Mr. Atwood, the man who did know all about it, did not tell the senators when these food-fishes appear, in what order they come, when they spawn, and whether they did not go immediately into shoal water for that purpose. He could have told, too, when the blue-fish appear, and what fish they are pursuing when they come, and whether the traps were not set before the arrival of any of these fishes, and to catch them when they came near the shore to deposit their spawn. And, in my judgment, he would not have failed to do this if he had not seen the obvious effect of it upon the cause of the trappers, whom he was placed in his position to protect.

Whatever may be said about it by Mr. Atwood, scup, nor tautog, nor sea-bass, nor yet the food of any of the food-fishes of the New England coast are the natural or chief food of the blue-fish. Menhaden and herring are the fish which they mostly pursue, and upon these they chiefly feed. This all the witnesses testified to, and this everybody on the sea-coast knows, and, what is a significant fact about it, these fishes on the whole do not greatly diminish.

Again, as to this blue-fish, horse-mackerel snapper, or by whatever other name he may be called, Long Island Sound is full of them, and yet we do not learn that he has depopulated those waters of scup, tautog, sea-bass, or striped bass, nor laid waste any considerable towns or villages there. So we conclude that, bad as the blue-fish is, too much blame is laid upon his shoulders; and I am not sure that he does not furnish food enough, and that which is good enough, to pay for all he eats.

It is more than doubtful whether, in the arrangements of Divine Providence, any species of fish can be destroyed by any other agency than man, and not by him, unless he prevents their increase. He who gave the law to increase and multiply abundantly on the face of the earth, knew how to make its operation certain, and gave dominion to man alone to control it. It cannot be shown that any species of fish has been exterminated by any other cause than by preventing their increase. Salmon and trout feed upon their own spawn and upon their own young, and yet how did they abound, until prevented from spawning by improper modes and times of fishing?

Secondly. Are the modes of catching fish by pounds, weirs, traps, &c., a probable cause of the scarcity of any or all the fishes now under consideration?

It is evident that something has occurred during the past seventeen years to cause the food-fishes of the waters of Massachusetts and Rhode Island to become scarce. It has not been satisfactorily accounted for in either of the four ways above considered. During those years, but one other cause can be found which has existed in both States at the same time which did not exist before, and that cause is the unrestrained catching of these fishes by traps, pounds, weirs, heart-seines, and the like.

It is certainly very remarkable that these four fishes should all agree to become scarce in both States upon the setting up of the traps and to grow scarcer and scarcer, year after year, as the traps increased, if either of the above causes assigned for such scarcity was the true cause.

Was not a temporary absence of these fishes likely to occur before Mr. Tallman invented a pound? Was never food for these fishes scarce till trapping commenced? Were not the substances sent into the waters from Providence, Fall River, and New Bedford, deleterious till then? Has the nature of the blue-fish changed since the traps were set? Could he live in the same waters peaceably with all these fishes and not *before* become voracious and destructive? If not, even then ought the traps to be abolished, if by reason of them, however indirectly, the fish absent themselves, or their food becomes scarce, or the waters become poisonous, or the blue-fish becomes savage.

Such extraordinary effects, threatening the entire destruction of the fisheries, depopulating our waters, depriving us of food, ought not to be continued if the removal of the traps and pounds will prevent it. One point further, going to show that the traps and pounds are a probable cause of the scarcity complained of: the thirty-third interrogatory of the Rhode Island commission is, "Do you know of your own knowledge, or did you hear whether the traps at Seconnet Point were broken up during the year 1862, and also in 1867 or 1868, for how long a time were they displaced, and by what wind, and about what date, and what was the fishing for scup those seasons compared with the previous and suceeding year?

Twelve of the witnesses gave full or partial answers, and proved that the traps were broken up in 1862 and again in 1867, and that the catch of scup, by the hand-line fishermen, during those years, was greater than during the preceding or following years. I grant that these facts are not conclusive upon the point, but they are significant, and have sufficient bearing to entitle them to consideration in the case, and go to strengthen the testimony of most of the witnesses when asked to give their opinion as to the true cause of the scarcity about which they had testified.

It is not necessary to review particularly the evidence given as to the cause of the scarcity of these fishes. It is enough that in both Rhode Island and Massachusetts almost the unanimous voice of the witnesses was, that it is the traps and nothing but the traps.

Whether the opinions of these men are of little or much worth, they are, as I have before said, the best evidence we can have until the Government collects the statistics, and all the facts are ascertained. We are glad that some steps in the right direction have been taken, and that a man so well qualified for the work as Professor Baird has undertaken the investigation. That there are many and great difficulties attending the subject there can be no doubt, but they are never likely to be less, and the longer the matter is delayed the greater proportions they will assume.

In Mr. Atwood's remarks to the senate, he says, "If this legislature should pass an act to prohibit these modes of fishing that have been called novel and improper, what would be the practical workings?"

This, then, was the great point in the case—not what injury had been done and was still being done to the private rights of individuals, nor what the hazard to the fisheries, but what harm would the prohibition of the traps do to the monopolists—what was to be the effect on the Gloucester fishery, on the Wm. L. Bradley Manufacturing Company at Weymouth, on the Pacific Guano Company at Wood's Hole, on the Cape Cod Railroad Company, who had asserted, and who were defending what they called their right to all the fishes they could, by any means, catch.

Even supposing, for the sake of the argument, that these wholesale methods of taking fish do not, on the whole, injure the fisheries, by what right does any man, or set of men, take all the fishes of the sea which they can catch as his or theirs? Have the public no rights? Has not every individual some rights which these monopolists are bound to respect?

I wonder that the great injustice which is done to public and private rights by trapping did not move the legislatures of both Massachusetts and Rhode Island to prompt and immediate action to prevent it. No other so great public right could be trampled upon, no other private right would be so despised.

I wonder that the people have so long consented to be robbed, and for no better reason than that large moneys are invested in the business.

Are the fishermen to be driven from their fishing-grounds, are the people to be deprived of food, that a few men may be made rich out of the public treasury of the sea? And has he or they only the right to catch fish who can afford the extensive and costly apparatus of the trappers?

One would suppose it could hardly be necessary at this late day to discuss this question.

The right of every man to catch fish in the bays and arms of the sea has long since been settled. The denial of the right of any man to catch fish to the injury of the right of any other man has been maintained from the earliest history of the country.

I marvel at the presumption of those who, in derogation of every other man's right, stand boldly before the law-makers of the land, and ask to be protected in their unlawful business, or not hindered in pursuing it. Is it not a matter of surprise that these men should go before these legislative committees and parade the extent of their plunder as a justification of the robbery itself? See the hundreds of thousands of barrels of fish which they testified annually to have taken in their traps for market at home and abroad, for fertilizing phosphates, for bait for the mackerel and cod fisheries, the profits of which they pocketed, and to which they had no legal or moral right if their modes of fishing deprived the poorer fishermen of what was legally and morally theirs.

There can be little doubt remaining that these novel methods of fishing stop the fish from going into their accustomed waters to spawn; that they prevent their going, as was their wont, into the bays and rivers, and that they thus prevent those who live upon the banks of these waters from taking the fish as they formerly did, or compel them to longer voyages and to more expensive apparatus. What Mr. Atwood speaks of, therefore, as the practical working of any act to protect these fisheries or these fishermen, is, in fact, the practical wrong and injustice of the business, which he should have been the first and most active to punish.

But the people of the Atlantic shores, as a people, have some interest in the continuance of the fisheries themselves, and know and can know of no private or corporate interest so great as to be long permitted at the risk of their exhaustion. Enough has been proved to show that the traps and pounds are one great cause, if not the only cause of the scarcity of the food-fishes of the coast, and the people demand and have the right to demand that they be abolished altogether, or so regulated that the fish may pass along the shore to their accustomed places to spawn.

The trappers have had their way and filled their pockets during the past seventeen years, and the fishes have become scarce. Let the poorer hand-line fishermen have their way for a few years, and you will see that the fishes are as abundant as formerly. The proverb that "there are as good fish in the sea as have been caught," was only good until trapping began, and the theory that any scarcity of fish during one season will be made up by increased numbers from the great sea the next, is only a poor conjecture.

We admit that there is a great fishing interest involved in the trapping of fish, as the fishing business is now carried on, but we do not admit that sufficient bait for the mackerel and cod fishermen cannot be obtained in some other way not prejudicial to the other fisheries. A proper regulation of the traps with respect to the time of their being set and taken up would permit their use for catching menhaden, but were they prohibited altogether, there is no good reason to suppose that the Gloucester fishermen would suffer for want of bait. Let it be known when and where the bait was wanted, and thousands of our fishermen, with nothing now to do, with their shore-nets would supply it in the greatest abundance, at no higher cost, in better condition, and just where and when it was wanted.

Perhaps not so many fish would be cast upon the land or ground up into phosphates, but more would be for sale for food and as much for bait.

Nor will a law protecting the fisheries necessarily throw men out of employment, but, on the contrary, will make business for a much larger number. That great class of hardy fishermen so feelingly spoken of by the senator of the Cape district, will not only become more numerous, but be better rewarded by a proper regulation of the fisheries. How many hook-and-line fishermen equally as worthy as those who have lain down to rest in a Newfoundland fog, have been thrown out of employment by the greed of the trappers in their unconscionable, everlasting hunt after that "last dollar," and lain down to rest in as gloomy a solitude, in the fog of New England!

It is only necessary to prohibit the traps for awhile, and regulate the time and extent of such fishing hereafter, and it will result for the permanent good of the trappers themselves, for the good of these hardy fishermen on the whole, and for the benefit of the thousands who could once find a living on our shores, now so depopulated of the fishes the catching of which gave them employment and heretofore furnished them with food.

I am satisfied that further commissions and investigating committees will do no good. What availed the sixty-two thousand questions of the royal commission, or the eighty-two questions of the Rhode Island committee, or all the oral testimony of the Rhode Island and Massachusetts investigations? The trappers are always able to throw more influence into the scale than the fishermen. "Leave to withdraw" is the stereotyped report of the Massachusetts "committees on the fisheries," and bills to protect are everywhere quietly voted down.

Mr. Atwood closes his remarks by alluding to the antiquity of nets, and recites the simple and beautiful narrative of the calling of Peter and Andrew, James and John, the fishermen of the sea of Galilee, to make them fishers of men.

It does, indeed, show that nets were in use at that remote period, but it does not show the justness or lawfulness of the practice, and commits not the Master to its approval. For he said unto them, "Follow me." "And they straightway left their nets and followed him."

Once, indeed, in the ship, which was Simon's, he performed the miracle of the great draught of fishes, but while he compensated the disciples in that they had toiled all night and taken nothing, he destroyed their nets.

There is another class of persons interested in the continuance of the fisheries, to which I have but slightly alluded. What little was said by them or in their behalf before the committee in Massachusetts was sneeringly received, and they themselves contemptuously referred to. I mean the amateur fishermen. These men also have some rights of which the trapping of fish is a violation. Though they are anglers rather than fishermen, and pursue their finny game for recreation and not money, they are entitled to no little consideration. As a class they are rapidly increasing in numbers and in influence. Driven during the heated months of the summer season from our more crowded and unhealthy cities, rod in hand, they flock to the mountain-streams and the sea-side. Generally men of means, of leisure, of cultivated tastes, they form themselves into clubs or associations, build comely houses, and beautify their grounds. Lands long since worn out and become comparatively useless, and well nigh abandoned, they increase in value; they add to the revenue of the towns and State they visit; men of intelligence and culture for the most part, they study the habits of the fish they catch, and add not a little to the stock of our knowledge of a subject of which the people know so little.

In the investigation of this interesting subject, while we hope to find out more about the habits of the fishes upon our sea-coast, and what are the proper modes and times of catching them, we shall not altogether have wasted our time if we find out that there are some things valuable which do not pay, and some things worth considering which do not result in dividends.

Whether a case has been made out showing that the traps and pounds are solely responsible for the growing scarcity of fish, the methods of otherwise accounting for it, resorted to by the trappers and their defenders, are proved to be insufficient and unsatisfactory. Enough has been shown to demonstrate that, by these means, the "exhaustion of the sea-fisheries" as to these particular species of food-fishes is possible.

This is enough to entitle the subject to serious consideration, and to warrant the Government in early legislation to prevent it.

It will be better that the trappers should submit to some inconvenience—be put to some loss, indeed, rather than that action should be too long delayed.

It is easier now to interpose to save, than it will be by and by to replenish, our depopulated waters.

GEO. H. PALMER.

NEW BEDFORD, *January* 1, 1872.

V.—REPORTS OF STATE COMMISSIONS IN REGARD TO REGULATING THE SEA-FISHERIES BY LAW.

REPORT OF COMMITTEE OF RHODE ISLAND LEGISLATURE, MADE AT NEWPORT JUNE 15, 1870.

The committee,* at the first of its several meetings, (which have taken place at Providence, Tiverton, Seconnet, Newport, and Narragansett Pier,) chose Francis Brinley, of Newport, chairman. They found it necessary to obtain the services of a secretary who should aid them in recording the testimony of witnesses examined by them, and J. Talbot Pitman, esq., of Providence, consented to act in that capacity. The duties have been performed by him with accuracy and to the great satisfaction of the committee.

The process of oral examination was so exceedingly slow and tedious that the committee were soon convinced of the impracticability of continuing it if their labors were to terminate in season to report at the May session, and a series of eighty-two interrogatories was prepared, with printed instructions, (copies of which are annexed,) and widely distributed. The chairman has received prompt, sworn answers from many persons. As was anticipated, the statements are somewhat contradictory, and in some particulars utterly irreconcilable. These numerous documents have been carefully examined and considered by the committee with an anxious desire to get at the truth. It should always be borne in mind that the fisheries have, from the time of the charter of Charles II down to this present time, been considered deserving of recognition and special regard. The right of fishing belonged to each individual, and he could not and ought not to use it so as to infringe upon or destroy the right of another. Now, it is the alleged violation of this individual right, and of a common but sound principle of law as well as of morals, by the introduction of trap-fishing, that the people on the inland waters of the State complain.

The oral and written testimony laid before the committee, establishes the fact that whereas scup were formerly abundant in the waters of Narragansett Bay, and constituted a cheap and nutritious article of food to the inhabitants, readily found and easily caught, they have gradually left these waters, until they are quite abandoned by this species of fish, and partially so by other species.

To what cause shall this change be ascribed? The opinion is very generally expressed by witnesses, that it is owing to the interception of fish by the various traps and nets which are scattered in their way, so that some of the deponents entertain a belief that they will soon be utterly exterminated.

In this connection let us advert to the deposition of Mr. C. H. Bassett,

* The first part of the report is omitted as consisting of general considerations on the subject in the way of statistics, &c.

of Barrington, a very intelligent man. In answer to interrogatory 38, he says, "I have caught scup both side of Stone Bridge. These fish spawn in this bay; the fish caught in Kickamuit River had never been out of that river; they were spawned there, and if not disturbed would have returned there the next spring, as sure as the bird comes back to its old haunt." In answer to question 58, he adds, "My opinion is, these fish follow along the coast and would fill all the bays and rivers, where no obstruction was placed; as a drove of cattle going along the road will come into your fields if the bars are down, so these fish in their migration would fill our bay were it not for the traps." A portion of his answer to question 80 is, "For a fortnight past I have fished nearly every morning for two or three hours on Barrington Bridge, and have conversed with a great many carpenters, shoemakers, and other workmen who come to the bridge to catch a few tautog, if possible, for a dinner before going to their day's work; they say formerly they were able (when scup and fish were plenty) to come down here and catch all the fish they wanted before they went to their day's work. They all tell one story. Before traps were allowed, there were plenty of fish; could catch enough in half an hour. One very intelligent man thought it made one hundred dollars difference in the cost of living to those persons living on the shore and in the small towns on the bay, and, from my own experience, I have no doubt there are a thousand persons living near the shore to to whom it would make this difference, amounting to a loss to them amounting to one hundred thousand dollars each year, the loss in the high price of fish in Providence market not being taken into account."

It was in evidence that such vast amounts of scup were sent to New York, Philadelphia, &c., that the increased catch did not reduce the price for home consumption. Mr. Bassett, in his answer to the 50th question, states that "in former years Providence market was almost wholly supplied with fish from the bay. The bay and river was a vast reservoir from which we took out fresh fish from day to day, as we wished. I remember seeing a fisherman salting down a car-load of bluefish, because all he could get offered was one and a half cents per pound. A fish he was then glad to sell for twenty cents would to-day sell for $1 25. Under the hook-and-line system, we had scup from five to six months in the year at a very low price; now we get scuppaug for about fourteen days, and stale at that; when the fish were allowed to come in the bay, we had them near the city, and they came to our market 'live and kicking.' Under the present destructive system of trapping, not only is all our summer supply sent off, but the fish not being allowed to spawn, the natural increase is cut off." According to the testimony of Daniel L. Church, of Portsmouth, "up to noon of this 16th day of May, 1870, between nine and ten thousand barrels of scup, and about three hundred barrels of other fish, including fifty barrels of striped mackerel, have been caught between Brenton's Reef and here, (Seconnet,) and about two-thirds of this whole catch have been caught at Seconnet Point."

The scarcity of fish in the bay has by some witnesses been attributed to the impurity of the water arising from deleterious water poured into the bay from Taunton, Fall, and Providence Rivers, and other sources, where the residue of chemicals, &c., is permitted to mingle with the pure waters of the ocean. On this point, as on others, the evidence is very inconclusive and contradictory. In certain localities doubtless the waters are impure; but the pollution does not extend so far by any means as some persons in all honesty contend.

Mr. Bassett, in his answer to interrogatory 57, says, "As to the impurity of the water, Barrington River was always famous scup-ground; Kickamuit River the same. I cannot find a person who knows of any impurities in those waters that were not there fifty years ago; but no scup are now caught there to-day, and with the tide ebbing and flowing twice every day, the impurities falling into the bay are hardly more noticeable than a drop of ink into a hogshead of water."

Scarcity of food has been assigned as a reason why fish are not so numerous in the bay and rivers as heretofore. Again opinions differ, some persons believing there is no want of food, and others affirming its scarcity. In the opinion of your committee, the preponderance of evidence is that there is an abundant supply.

Mr. Bassett, in reply to question 57, says, "My opinion as to scarcity of food is, that there is the same amount as formerly; some have said muscles are scarce; on this point I can say, in the spring of 1868 I lived at the head of Bullock's Cove, and two or three mornings of the week went on to the muscle-bed off Nayatt or Bullock's Points, carrying a pair of rakes, and always pulled up all the muscles we wanted; they were so plentiful on Bullock's Point that a man in my employ, at a very low tide, shoveled into a sea-weed scow as many as two horses could draw, and put them into the manure heap."

In answer to the 80th interrogatory, Mr. Bassett says, "This trapping has destroyed a business which formerly was followed by many of our citizens. I do not know a man in the city of Providence who now follows fishing for a living, and for this reason: I think fish are so scarce in the bay they could not make a living. Boat-building was formerly carried on here by six or seven different concerns. I know of but two now, who build a few boats. All the business formerly connected with down the river boating-parties has been broken up, and our citizens go down to Maine or other places for fishing."

This witness presents the view which, in general, is that of the hook-and-line fishermen. In juxtaposition, the committee propose to place the evidence of Benjamin Tallman, of Portsmouth, well known as a fisherman of very great experience, and who may be considered as the inventor of trap-fishing. His examination by the committee was thorough and protracted. His oral reply to the 5th printed interrogatory was as follows: "The proportion of tautog to scup is very small. I don't suppose that the average of each trap would amount to four hundred pounds the whole season. In 1867, in nine days, I got $18,000; I have six traps; had three traps on one line; employed twenty-seven men on these three traps and twenty-seven on the other three; couldn't tell how many barrels; sold them at about $2 per barrel; should think about 10,000 barrels; got one morning $3,000 before breakfast. In 1868 did nothing. I had nine gangs, and expected to have got $30,000, but did not get over $6,000. The reason was it was owing to the northeast winds; cold storm all the time; kept the fish off the shore in deeper waters. In 1869 had six traps and six gangs; took about $6,000. Horse-mackerel came along about the 25th of May; the price averaged $2 per barrel; some sold for $1 and some for $3."

As to the number of traps, he stated, "There are nine setting-places, eight for double gangs and one for single gang, at Seconnet Point; there are three set further south than usual this year. There are seventeen gangs, of about ten men each, including the cook. At the Flints, on Sachuest Point, there are six gangs, having fifty-six men, between Sachuest Point and Easton's Point. Three at Gooseberry Island; one belongs at Newport, one at Tiverton, and one at Portsmouth. East of Brenton's Reef, single gang. Two traps at the Wash-Bowl, west of

Brenton's Reef; one owned at Newport and one at Portsmouth. There used to be *one* at Castle Hill—whether now there or not I cannot tell—small one. On west side of Conanicut, north of Beavertail, there is a trap owned by Gladding, as I understand; took three hundred pounds of menhaden yesterday there. Sometimes a trap is set this side and north of Point Judith, in pleasant weather; but not much is done with it."

That an approximate estimate may be made as to the cost of these traps and necessary apparatus, the committee refer to the following statements of Mr. Tallman. In answer to the 8th printed interrogatory he stated that "it takes about four hundred and fifty pounds of twine to make a trap, for the trap part alone; that's the average for an average-sized trap. The leader about two hundred fathoms long; that's the average of the leader at Seconnet Point; weight about six hundred pounds. We have a purse-seine used a year and then made into a leader. Twine costs now about $1 per pound; some is over that; most of the twine costs $1 15 down to 85 cents; worth about half-price when used as a leader. As a general thing, we use new twine for the trap and pound. Cables cost about $6 apiece; use ten for a trap; ten anchors to a trap, costing $15 each, and worth that. Cables would last two years good. Think the best way is to have a new cable; cable after being used one year would be worth $2. Three little boats (14 feet long) to each gang, and worth $65 apiece, new; they will last about six years; depends upon where you use them, somewhat. Two large boats (30 feet keel) to carry fish to vessel, to a gang. Boats worth $1,400 each will last ten years; could be used for other purposes. There are two boats (19 feet keel) to a gang, which are used to carry out the anchor-warps, set the traps, &c., cost about $165 each; these boats are also used for menhaden-fishing. New twine put into traps and taken good care of, would be good for another year."

To the 11th and 12th printed interrogatories, he answers that "there is a law among the trappers at Seconnet Point that no leader shall be more than two hundred fathoms; the leaders come out in a line ten fathoms beyond the one above it. At the Flints, the leader is five hundred fathoms from the beach, but the one on the Point is seventy-five fathoms. On the five hundred fathom leader three traps are set; on the one at the Point only one trap is set. The trap is about twenty-eight fathoms wide, so that a trap set in seven fathoms of water would be about fourteen fathoms across; the length is about thirty-four fathoms."

In regard to the diminished number of fish, Mr. Tallman testifies, in reply to printed interrogatories 23 and 24, that "sea-bass are not so plenty as fifteen years ago; then they were worth three cents per pound, and the same now. Tautog same price as fifteen years ago, three cents per pound. With the exception of scup, prices are the same. Scup are three times the price they were then. The first thing we did forty-five years ago, if we saw scup, we used to pull up the nets when fishing for menhaden and let them go, for fear they would cut the seine to pieces. Ten years after, we sold them at ten cents per barrel, for manure. Ten years after, we began to send fish to New York, packed in ice, and they were then sold for twenty-five cents per barrel. Not more than two vessel engaged in the business. Most of them used for manure were sold at about sixteen cents per barrel. About twenty years ago you could buy as many as you wanted for sixteen cents. About twelve years ago the price would average for shipping fish, fifty cents per barrel. Not more than one-fifth was used for food. Those sold for manure brought about twenty cents per barrel. No scup have been sold and used for manure for about eight years, to my knowledge. The price then would average about one dollar per barrel, I should think. The price has been constantly and gradually increasing ever since; the average price last year was about two dollars a barrel; they have brought \$4 50 per barrel. The price has been increased in consequence of increased demand and scarcity of fish, together with the facility of carrying them to market. I have seen seventy vessels taking in fish and waiting their turn, twelve loading at one time, at Seconnet Point." To the 25th interrogatory, he says, "I should think that about three thousand barrels of scup were carried to Providence. I should say not over one-fifth of the takings were used in the State for food, for the last three years." "Scup," he says, in answer to interrogatory 31, "were caught above Stone Bridge in 1825 and afterward. In the year 1823, or thereabouts, they were caught at Church's Cove. That is about the first seining that was done about Seconnet Point. From 1825 to 1845 any quantity of scup were caught; after that they did not so many come up the river as formerly."

Mr. Tallman is of opinion that if these methods of taking fish were disused, the market would not be better or fish more plenty, because the fish the trappers take would not have stopped in the bay; all the impurities of the waters at Fall River, Providence, &c., deleteriously affect the fish.

These two deponents may be said to fairly represent the opinions and convictions of the hook-and-line men on the one hand and of the trappists on the other. It will not escape observation that they agree on two important points: *first*, that there has been a gradual diminution of the number of fish entering the bay or river; *secondly*, that fish are not as cheap as formerly. They differ as to the cause of the decrease, but it must be admitted as a fact that contemporaneous with the introduction of traps was a decrease of fish. In this connection we may use the language of Professor Greene in his speech before the general assembly last winter: "Is it not an accepted principle of philosophical investigation that where two facts follow each other in this close order of sequence, they bear to each other the relation of cause and effect? Does the severest logic demand any other test than that the cause should be adequate, the effect evident? Is it not to reasoning like this that we are indebted for all that we know of the laws of animal and vegetable life? What is theory but the generalization of phenomena, and what do we require of these phenomena but that they should bear the most rigorous investigation? That investigation, in questions like this, is experiment. If the theory be just, the experiments will confirm it. If the theory be false, the experiments will reveal the falsehoods. And here," he continued, "I might rest my argument, for all that we ask is, that this question, so important to every citizen of Rhode Island, should be brought to the test of experiment."

This report had reached this point, when the chairman received a copy of the Yarmouth Register of May 27, in which there is a speech made by Mr. Atwood, of the Massachusetts senate, on the 19th of April last, in relation to the petitions for the prohibition of net and seine fishing on the coast of that State. Mr. Atwood was opposed to any prohibitory legislation, because he had not any apprehension that the fisheries could be exhausted; that fish were migratory, or rather not permanently local; they sometimes have a locality, and, after the lapse of years, reappear; that therefore the disappearance of fish of any kind is not proof of their exhaustion, but merely of absence. Mr. Atwood states, "The scup that has been so abundant for many years south of Cape Cod extends to Florida, and is caught in great numbers along the coast. It finds a ready sale in New York, and other markets, but in

Boston market it is not known as a marketable species, and is seldom seen there. Only a few straggling specimens venture into the colder waters north of Cape Cod. Witnesses stated before the committee that they had a tradition informing them that scup first appeared in Buzzard's Bay in 1793." If it be true that scup will avoid the colder water north of Cape Cod, the force of the argument that if they are not taken at Seconnet Point they will keep on eastward, and then be taken by the fishermen of Massachusetts, is essentially impaired.

It must not be overlooked that Mr. Atwood in his speech has in mind the fisheries of the coast of Massachusetts, and not of Rhode Island; besides, he was relieved from constitutional scruple, inasmuch as there is no constitutional provision in Massachusetts as in this State in reference to the right of fishing, the intent and design of which he could not disregard. It may be, therefore, that he is warranted in his belief that in Massachusetts there is no necessity for the passage of any general legislative act for the protection and regulation of the sea fish and fisheries; but it does not follow that there is no necessity for such action in Rhode Island. Finally, he makes this admission: "If fish have diminished in any of the small arms of the sea, I should have no objection to the passage of a local act, provided it did not interfere with the rights of others."

Now, as the testimony is ample and conclusive that scup and other bottom fish have diminished in the rivers and bay and arms of the sea of Rhode Island since the introduction of trap-fishing, it appears to the committee that some legislative restraint, as to the use of new instrumentalities for fishing, which impair or destroy individual rights, should be provided and enforced. The grave and complex question, how to adjust that restraint, has been most anxiously and carefully considered by the committee.

The boats, anchors, traps, and other apparatus required for the prosecution of trap-fishing are of heavy cost; some or all of these articles and materials could be used for various useful purposes, if trapping was prohibited. But this great interest should not be stricken down at once. Care must be taken, however, that in seeking for the reasonable preservation of that interest, the claims of another and large portion of the people should not be disregarded. Mechanics and other respectable persons who, by a cast of the hook and line, could, without interfering with their regular duties and employments, add a dish to their frugal tables, have not now the same chance as heretofore. It was in evidence that in certain localities boat-building was quite abandoned; that parties did not visit Narragansett Pier, Stone Bridge, and other watering places, or soon left them, because the attraction of good fishing was wanting; and that this was attended by the depreciation of real and other property.

After a careful and anxious investigation of the subject, the committee have come to the unanimous conclusion to recommend that the use of all traps and heart-seines, and other contrivances for catching fish, not including pike-nets, shore or purse seines, be prohibited in all the waters of Rhode Island northerly of a line drawn from the southerly point of the rocks at Brenton's Reef, to the southerly point of Point Judith, and north of the Stone Bridge at Howland's Ferry.

FRANCIS BRINLEY,
JOSEPH OSBORN,
JOSEPH W. SWEET,
HENRY T. GRANT,
JABEZ W. MOWRY,
Committee.

NEWPORT, *June* 15, 1870.

The committee recommend the passage of the following act:

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS.

January session, A. D. 1871.

AN ACT to prohibit trap and heart-seining of fish in the waters of Narragansett Bay.

It is enacted by the general assembly as follows:

SECTION 1. No trap, heart-seine, or other contrivance of any kind or description, other than pike-nets, purse-seines, shore-seines, scoop or hand-nets, and hook and line for catching fish, shall be set or drawn in any of the waters within the jurisdiction of the State, northerly of a line drawn from the southerly point of the rocks at Brenton's Reef, to the southernmost point of Point Judith, and north of the Stone Bridge at Howland's Ferry.

SEC. 2. That each and every person who shall be or shall have been engaged in setting or drawing any trap or other contrivance prohibited by the first section, shall be deemed guilty of a misdemeanor, and shall pay a fine of not less than fifty or more than three hundred dollars for the first offense, and for the second and every subsequent offense he shall be fined a sum of not less than five hundred nor more than one thousand dollars, and shall be imprisoned for not less than one month nor more than one year.

SEC. 3. That all and every the nets or other contrivances, apparatus, boats, and vessels of persons willfully and knowingly engaged or employed in violating the provisions of said first section, or in carrying off the fish so caught, shall be forfeited upon being condemned, as hereinafter provided, to and for the uses hereinafter provided.

SEC. 4. Complaint shall be made, or an information filed under oath or affirmation, by the mayor or city marshal of any city, the president of the town council, or any town sergeant, the sheriff and his deputies, and the city or town constables, whenever either of said officers has knowledge of the violation of the first section of this act within his jurisdiction, if no other complaint or information shall have been made or information filed against the same property for the same violation of said first section; and may make such complaint or file such information when the alleged violation has been committed in any place therein forbidden, and any such complaint or information shall set forth that the complainant or informant has reason to believe, or does believe, that the traps or other contrivances, apparatus, boats, and vessels, which shall be described as nearly as may be in such complaint or information, are being used, or have been used, engaged, or employed in violating the provisions of said first section, before any court of competent jurisdiction, and such proceedings shall be had therein as by law is prescribed for protection of personal property under the penal statutes.

SEC. 5. That any of the officers named in the fourth section may, without a warrant, seize and detain any traps and other property mentioned in the second section, found in use or engaged in violating the provisions, or which he has good reason to believe, and does believe, has been so used or employed, and shall convey the same to some proper place of security, and there to keep the same until said traps and other property mentioned in section second can be proceeded against as provided in the next preceding section; and upon said seizure the said complaint or information shall be made or filed within sixty hours after said property has been seized and secured as aforesaid; and when said information shall be filed in the office of the clerk of the court of common pleas within and for the county within which the said violation is alleged to

---

* This bill failed to become a law.—S. F. B.

be made, as provided in chapter 225, section 15, of the Revised Statutes, said clerk shall issue a warrant under his hand and the seal of said court, returnable at the term of said court to be held next after the expiration of twenty-one days from the time of filing said information, as provided in section sixteen of the last-mentioned chapter, and said clerk shall immediately issue notice of said information, as is provided in section seventeen of said chapter.

SEC. 6. Upon entry of judgment of forfeiture against said property so complained of or seized, the court, before whom the complaint or information shall be tried, shall enter up judgment that the same are forfeited to the State, which judgment shall be the judgment from which any appeal must be taken.

SEC. 7. Upon final judgment of forfeiture against such property, either in the original or appellate court, or upon forfeiture of claimant's recognizance to prosecute his appeal according to law, the court shall forthwith issue to the officer having such forfeited property in custody, or to some other proper officer, an order in writing directing him to sell the same at public auction, and pay the proceeds thereof into said court, and every such officer shall execute said orders and shall return the same with his doings thereon indorsed to said court within such time as said court shall direct.

SEC. 8. Whenever in such proceedings for forfeiture it shall appear to the court that there has been any irregularity in the service of any process issuing upon the complaint or information, or any omission to publish the notices required, or any defect or omission in the complaint or information or other proceedings, the court may permit the same to be amended, and direct such further service of process or publication of notice, as will, in the judgment of such court, be most effectual.

SEC. 9. No officer complaining or informing as aforesaid shall be required at the time of making such complaint to enter into recognizance, or in any way to become liable for the costs that may accrue thereon, or for any damages on account of such seizure, unless it be proved to the court that the complaint was made maliciously, and without good cause.

SEC. 10. All fines recovered, and proceeds of forfeiture made under this act, shall inure one-half to the State, to be applied for the purpose of protecting the fish in our waters, and the other half to the complainant.

SEC. 11. Any person convicted of any offense under the second section of this act may appeal from the sentence of the court to the appellate court then or next sitting: *Provided*, Such appeal be prayed for at the time of passing sentence.

SEC. 12. Upon such prayer of appeal, the appellant shall be required to give recognizance in the sum of   hundred dollars, with good and sufficient sureties, in every case so appealed, with condition that he will file his reasons of appeal, together with a copy of the case, in the court appealed to, on or before the expiration of ten days after the date of said prayer, if sitting, if not, in the office of the clerk thereof, that he will appear before said court, and there prosecute his appeal with effect, and abide and perform the order or sentence of said court in said case, and that he will not, during the pendency of said appeal, violate the provisions of said second section, which said recognizance such court shall forthwith certify to said appellate court.

SEC. 13. Any person interfering with, obstructing, or resisting any officer in the performance of the duties herein prescribed, upon conviction, shall be punished as provided in the eighth section of chapter 211 of the Revised Statutes.

SEC. 14. This act shall take effect from and after its passage.

ON THE POSSIBLE EXHAUSTION OF SEA-FISHERIES.

BY THEODORE LYMAN, MASSACHUSETTS COMMISSIONER OF INLAND FISHERIES.

[From the sixth report of the commissioner, 1872.]

Turn now the inquiry from river fishes to those that inhabit salt water only; and take a representative. The scup belongs to Rimbaud's division of "white fishes," (*poisson blanc*,) that is to say, those which retreat in cold weather to the off-shore depths, and return with the warm weather to the shallow water close to the coast. Of this group no representative has been more abundant on the south shore of Cape Cod than the scup. Early in May they used to make their entry into all the bays and fiords in great multitudes. Their route is not so well made out as it should be, but, according to the best observations, they make their advance through the gap, about fifty miles wide, between Montauk Point on the west and Gay Head on the east. Where they come *from* is a more difficult question; for the species is plenty as far south as Georgia,* and nobody can say how far south the Vineyard Sound scup retire during the winter. It has been guessed that they go to the edge of the Gulf Stream; and this is as good as any other good guess. The same remarks apply to our shad, which come round Montauk Point, and thence, according to the fisherman's belief,† oblique westward to enter Connecticut River. It is the received opinion that the scup, as they near the shore, "fan out" to the northward and eastward, filling Narragansett and Buzzard's Bays and Vineyard Sound. J. N. Luce, a very intelligent observer, testified, at the legislative hearing of 1870, that scup appeared first at the *west* end of the Vineyard, and coasted its northern shore, passing into the tidal ponds in succession, beginning with Menemsha Bight, (see plate 1,) and continuing eastward. The big fish, some weighing two pounds, were in-shore, and the smaller ones out in deeper water. They appeared first at Gay Head between April 25 and May 10, and then were full of spawn, but, by the end of June, all the females were shotten; and in August, the tidal ponds were crowded with the young. The first frost was a signal for old and young to leave these ponds; the latter in such vast numbers that whole windrows of them were sometimes thrown back on shore by the surf. Of these big scup in the salt ponds, he had seen none since 1865, and he noted a diminution, beginning at the *east* end of the island, as soon as pounds were set in the neighborhood, whence he argued that in their passage eastward they got completely cut off before reaching the extremity.

The scup arrive near Newport from the 10th to the 12th of May; at this season they push their way slowly, sometimes making no more than four miles in a day. They then are said to be "numb," and are thought to be blind. The origin of these absurd notions is the fact that they are full of spawn, and are feeling their way cautiously, like most fishes in like circumstances; moreover, the temperature of the water variously affects their movements. When a cold northeaster blows, they hold more in deep water, to the great loss of the trappers. Their mode of entering Narragansett Bay was a subject of dispute. Some of the Saugkonnet trappers, whose interest it was to show that they took the scup *coming out* of the bay, maintained that the fish entered by the west pas-

---

* Holbrook, p. 175, pl. xxv, Fig. 1.
† Report for 1867, pp. 8, 12, 49.

sage, past Point Judith, passed round the north end or across the south end, and coming down the east passage, fell into the traps,* whose mouths were always set to the *north*. The hook-and-line men, however, averred that the scup pushed up both passages at once, and in the middle also, and those that were taken at Saugkonnet were hugging the shore and got set into the traps by the tide. Both views may be correct; but the second one doubtless is, because the singular inroad of young scup, which took place this year, and which will presently be spoken of, struck first at Saugkonnet and *afterward* at Beavertail. It is usually thought that no scup came in through Muskeget Channel, but this, like the rest of the theory, is not well proved. The first specimen was taken at Waquoit, this season, as early as April 25, and the greatest numbers taken were on May 10 and 13. The season was peculiarly early, and the first "run" near Newport was on May 3, which would be a week's difference between these points, not enough, perhaps, for the slow scup to move so far. The dates for appearance for past years, (table,) suggest that the fish of that part of the coast must strike in through Muskeget Channel.

Within a few seasons, a great change has come over the numbers and movements of the scup. In bays and salt ponds they have become nearly extinct; while in the great channels and near the mouths of the bays they still are found in considerable though diminished quantities. Witnesses disagree as to the exact time when scup began to fall off; indeed, it is not probable that they diminished uniformly and in all places at once. Some aver that a falling off was to be noticed only four or five years after the first traps were set, which would make the year 1850. But most of the testimony goes to show that it was between 1856 and 1866. Certainly in 1860 scup were still plenty at Point Gammon and in Lewis's Bay, near Hyannis. Four causes are alleged for this diminution: 1. Impurities in the water. 2. Want of food. 3. Traps. 4. Blue-fish. As to the first, although gravely put forward by certain witnesses, it is too absurd to be for a moment entertained. The idea of poisoning all the waters of Buzzard's and Narragansett Bays by a few mills and print-works near Providence, Greenwich, and Fall River, is ludicrous in itself; and it is moreover well known that live fish are found in plenty in close proximity to these very manufactories, and that live clams lie directly in the track of the drainage of petroleum works.† As to want of food, it was stated that the five-fingers (*Asterias*) had destroyed certain great muscle-beds, which were feeding grounds. But the dredgings of Professor Baird, during the present season, have shown, not only that there are vast muscle-beds still existing, but that the tautog were no more plenty there than elsewhere; and, moreover, the sea-water was everywhere full of the salpæ, fish-eggs, minute crustacea, jelly-fishes, and small worms which are usually found in such localities. The real perplexities of the question are to be found when the effects of traps and of blue-fish come to be considered. The traps can diminish scup in the way they have been diminished, only under certain conditions, to wit: (*a*,) all the scup must stand in between Montauk Point and Gay Head; because any that advanced through Muskeget Channel would nowhere find enough traps to interfere much

* A trap is a simplified weir. The bowl is merely an oblong, rectangular pen, of large size, and the fish would immediately escape, did not the fishermen, as soon as a school had entered, pull up the net bottom and shut them in. A trap, therefore, requires constantly to be watched. This modification of the *Madrague* is said to be the invention of Benjamin Tallman.

† See also Report of Massachusetts Commissioners for 1865, pp. 18 and 53.

with them between Waquoit and Monomoy Point, and therefore they would have continued abundant within these limits, while they would have grown scarce in Vineyard Sound and in the two great bays; (*b*,) all, or nearly all, the fish must, as they come in, crowd toward the shore at certain points, and must pass within 1,200 feet of it, because that is the usual length of the trap-leader; (*c*,) all, or nearly all, these scup must be captured before they have spawned, otherwise the race would be abundantly continued, despite the capture of the parents. Each of these conditions is fulfilled, according to the opponents of traps.

The scup, they say, *do* all stand in as indicated above; they are full of spawn; and they encounter a different pressure and a varying temperature, which render them slow and lethargic; and, in this condition, they are swept by tides and eddies against certain points of the shore, or of themselves seek the sunshine in protected nooks and bays, where they are captured by hundreds and thousands of barrels. If, on the contrary, they were let alone, they would soon cast their spawn and then would spread far and wide, as a bottom fish, greedily taking the hook. Under the present system, vast quantities of gravid fish are thrown on the market in May, but in the summer and early autumn it is hard to get any. The trappers admit the chief facts, though not the inference. They agree that the scup come in altogether between the Vineyard and Montauk Point; that they are "numb" and full of spawn at that time, and that during warm spells they stand close in, often seeking quiet coves; while, in cold, easterly weather, they keep off in deeper water. They admit, further, that the quantity taken is very great,* but maintain it is but a small proportion of the whole. They are lame in two ways; in the first place, they could give no reasons, that were tenable, for a diminution they fully admitted. In the second, they were usually very shy about giving any testimony at all before the Rhode Island committee. Nevertheless, it does not follow that they have the wrong of it. The question must be answered by a collection and a comparison of *facts*. It is clear that the scup approaches the shore in a way differing from that of the alewife, a hardy, active fish, which does not spawn till later, and then in fresh ponds. It *may* therefore be that scup will fall *en masse* into a trap, which alewives would under certain circumstances avoid, as has been nearly proved in the case of the Waquoit weir.

The blue-fish theory is an old one, but new in its application to scup. Mackerel and menhaden are, as is well known, driven away by them, but it has always been maintained that scup were too spiny to be a favorite food, and practically were let alone in favor of fatter and less bony prey. The witnesses in the Massachusetts and the Rhode Island investigation were unanimous in their assertion that a scup in the stomach of a blue-fish was a very rare thing; Professor Baird, however, has found many scup in their maw. It is true that these were usually from scup-traps, and the blue-fish may have attacked them simply because they were the only prey at hand. On the whole, it will be perhaps pretty near the truth to say that, although the blue-fish blindly destroys almost everything that comes in his way, his *main* food is the soft fishes and mollusks, such as menhaden, mackerel, alewives, and squid. Scup were abundant when the whites first visted the country, certainly from 1621 to 1642. At some time after this, not yet ascertained, they *disap-*

* In 1867, six traps at Saugkonnet Point took 10,000 barrels of scup. Next year, however, by reason of bad weather, they got only about a third as many for the whole season.—(B. Tallman.) In 1870, about 6,000 barrels of scup were taken by the Saugkonnet Point traps before May 16.—(D. Church.)

peared wholly, and, toward the end of the last century, were not known in our waters. About 1794 they reappeared, and became abundant. In 1864 they decreased very much, and are at present comparatively scarce. If now the blue-fish are the cause of scarcity, there ought to be some correspondence in their dates of appearance and of disappearance. They were plenty near Nantucket from 1659 to 1764, when they *suddenly* and totally disappeared, to reappear in 1830. Now it would seem that scup did not reappear till thirty years *after* the blue-fish went away, to wit, in 1794, and when the blue-fish came back in 1630, they found scup abundant, and lived side by side with them for thirty years, before the latter began decidedly to decrease. It is hardly in accordance with what is seen in nature, to suppose that a cause so active would take so long to act, or that, when it ceased to act, so long a time would be needed to restore the original state of things. And now, in the midst of this theorizing and seeking for evidence, rises a phenomenon which puzzles both parties to the dispute. About the 1st of June of this year (1871) those trappers at Saugkonnet Point, who had kept their netting down until that time, were astounded to find their traps clogged with myriads of "dollar-scup," little fish about the size of a Spanish dollar. They were tipped out of the bowls by hundreds of barrelsful. This swarm struck first at Saugkonnet, then at Beaver Tail; and thence apparently it slowly worked up the bay, so that in July these little scup were schooling round the wharves of Greenwich and Providence. In August they were still among the shallows, and were plentiful in the more eastern waters, at the extreme head of Buzzard's Bay, and in the neighborhood of Hyannis.

The weir-owner at Wood's Hole had had his nets established for seven seasons, but had never before witnessed this spectacle; and the same sort of evidence was given by other weir men. Benjamin Tallman, in his testimony, already cited, speaks of a large quantity of such little scup taken by a seine in 1864; and of another considerable batch brought up from deep water in a purse-seine, about 1855. It is to be observed that this invasion is nothing but an abundant "late run" of yearling fish, coming in its due season. The army of scup advancing to its spawning-grounds in May is preceded by a few skirmishers, and is in two or three divisions, of which the first is usually the most numerous, and contains the oldest fish; at an interval of perhaps two weeks there follows the second, and then the third, which is usually fewer in numbers and of smaller individuals. Sometimes, and in some places, the great and the smaller scup come mixed together, and the "runs" are not well defined. As with most schooling fishes, the young scup doubtless come last; and the phenomenon of this year's run had two peculiarities; first, it is more abundant by many hundred-fold than anything that has been seen since a dozen or fifteen years ago, when all the shallows, in midsummer, were full of these little yearlings; second, instead of following the deep channels at the mouth of the bay, the swarm struck directly to the coast on entering, and fell into the traps and weirs which chiefly are there set. This last is, to be sure, an hypothesis, but will be useful as a guide to future investigation. Mr. Luce, in his testimony, stated that the big scup coasted the shore of the Vineyard, while the smaller ones moved *outside*, in deeper water. In other words, the spawning fish sought their grounds, while those that spawned later, or that were too young to spawn at all, kept in the offing. The yearlings (assuming that they do not carry spawn) would come in and spread over the warm shallows simply to seek food; and this, also, the old fish do *after* they have cast their spawn; only they spread out in deeper water, where they remain till the first frosts warn them to depart from the coast. Should such a view of their movements prove the correct one, the invasion of "dollar-scup" would simply be a normal movement of yearlings, which, owing to unusual warmth of water, or for some other reason, struck the first points of land on entering Narragansett Bay, instead of holding to the main central channels. The question would be narrowed down to accounting for their *vast numbers*, so sudden and so unwonted. The anti-trap men jumped to the conclusion that these little fishes were the progeny of *this* year's (1871) hatch; and accounted for the abundance by the very early appearance of the breeding-fish, which stood in by the last of April, whereas they usually do not appear till the 10th or the 12th of May. Consequently the trappers had not generally their lint on, and the first run, in good measure, escaped capture. But the "dollar-scup" were *last* year's (1870) hatch and not this year's, which, on the 1st of June, would not be larger than a squash-seed. The theory would properly account for an abundance of *this* year's hatch; and, as a fact, the little scup, two or three months old, might be seen in great numbers during August, feeding close to the shore. If, next year, (1872,) there should be a great run of two-year-olds, (hatch of 1870,) and if this run should spread over all the bays, and should be taken by hook and line during the entire season, as of yore, then it might fairly be laid down that the traps were *not* the cause, or not the chief cause, in the diminution of scup. In like manner it might then be said, though with less force, that the blue-fish were not a chief cause of the scarcity of scup; because, although blue-fish have notably diminished these last three or five years, and therefore scup might properly increase, yet the decrease in blue-fish has neither been so great nor so sudden as to warrant a *sudden* increase in scup, such as this would be. And, if neither traps nor blue-fish can be convicted, it will only remain to say that the diminution has been one of those changes in the numbers or the location of fishes, for which science can at present give no reason.

That there has been a change of location as well as a diminution is quite apparent; for whereas thousands of barrels are taken at Saugkonnet Point, along the south part of Aquidneck and at Beaver Tail, in the upper part of the bay they are nearly extinct. A change, too, there has been in their stay, for whereas the tautog grounds all over the bay were once so infested during the summer by scup that a hook could scarcely be got to the bottom, now they are on the shores during a part of May, and thereafter are seen no more. All this the anti-trap men explain very simply, by asserting that the big scup are practically annihilated each season by the traps, and that the supply is kept up only by the spawn which is shot in deep water before they strike the coast.

The same line of observation and reasoning that has been applied to scup, will, with little change, apply to tautog, rock-bass, striped bass, and other "white fishes" and "bottom fishes" whose decrease has been complained of. *Observations*, conducted through several seasons, by men of learning and impartiality, are the only means to real knowledge in this perplexed question. If the governments of the States of Rhode Island and Massachusetts have any forecast, they will see to it that such observations be made.

In this slight sketch, based, as it needs must be, on scanty and imperfect information, I have avoided dogmatic statements and rounded conclusions. I have tried to show the problem in all its crudeness, and to point out, both directly and by implication, the great gaps which must be filled before it can take on a scientific form.

FISHERIES ON THE COAST OF MASSACHUSETTS.

REMARKS OF MR. ATWOOD, OF THE CAPE DISTRICT, IN RELATION TO THE PETITION TO PROHIBIT NET AND SEINE FISHERIES.

SENATE CHAMBER, *April* 19, 1870.

The report (leave to withdraw) on the petition of T. D. Eliot and others, came up for acceptance by special assignment.

Mr. Hawes, of Bristol, arose and said that, as a large number of the petitions asking for a prohibitory fishery act came from his district, he was not ready to vote until he could have some further explanation.

Mr. Atwood, of the Cape district, chairman of the committee on the fisheries, arose and spoke at length, substantially as follows:

Mr. PRESIDENT: As so many petitions have been presented to this legislature and referred to your committee on the fisheries, asking for an act to prohibit certain modes of fishing now in use in the waters of this commonwealth, I feel it to be a duty incumbent upon me, as a representative of a district extensively engaged in this branch of industry, to occupy some time in giving somewhat in detail the reasons why your committee have unanimously reported leave to withdraw.

Early in this session, on the 12th of January, there was presented and referred to the committee on the fisheries, the petition of Charles W. Lovett, jr., and sixty-four others, claiming to be citizens and tax-payers of this commonwealth, asking for an act to prevent the taking of certain *salt-water* fish in weirs and pounds, and also that the taking of fish known as Spanish mackerel, and striped or sea-bass, in any seine or net, may be prohibited; but that the same may be taken between the first day of June and the first day of December, by hook and line only. On the following day the petition on T. D. Eliot and 1,225 others was presented and referred, and subsequently a large number of petitions in aid of the same, claiming that the practice of *pound-fishing*, *trap-fishing*, *drag-seining*, *purse-seining*, and *gill-netting*, is seriously and fatally prejudicial to the production and increase of fish. They pray that the legislature will, by suitable enactments, protect said fish and those of the community interested in their continuance and production, from these novel and improper modes of fishing. Also there has been presented and referred a large number of remonstrances against the passage of any general prohibitory act. For their number I refer senators to the printed report of the committee.

Though the two first petitions were not in aid of each other, still they were aiming to accomplish the same object, and they seemed to be inseparably connected; so much so that your committee deemed it expedient to hear the parties who would represent both at the same time. Accordingly all the parties were notified, and the hearing was commenced on the 15th of February. No less than 18 sessions of the committee were given to these hearings, during which time many witnesses testified, and very little was learned from the evidence that proved to the committee that fish were being exhausted. All agreed that the scup, tautog, sea-bass, and striped bass had within a few years diminished in Buzzard's Bay; but failed to show that over-fishing was the cause of the diminution. Like the many fishermen that I know, the witnesses were not well acquainted with the habits of fish. They study them no further than they contribute to their pecuniary interest. At most they possess only a local knowledge of the fish with which they come in contact. They prosecute the fisheries for their support, and do not make the habits of fish a special study. Sir, if any other matter upon which there were more than 11,000 names on the petitions and remonstrances should come before the legislature, what would the committee expect? They would expect that experts and men acquainted with all the practical workings would come before them. An ordinary committee on the fisheries might expect men to come before them on a subject of so much importance as our *sea-fisheries*, that possessed a knowledge of the geographical distribution, migrations, habits, food, time of depositing their spawn, growth and development of their young, as far as it could be known, and, besides, all the changes that have taken place during a long series of years. That if certain species had diminished in Buzzard's Bay, from whatever cause, is there danger of the race being exterminated? The fishes that inhabit our waters, and in their migrations visit our coast, differ widely from those that were upon our fishing-grounds when I first engaged in the fisheries.

Mr. President, allow me to lay aside the evidence before the committee, while I briefly allude to the changes that I have noticed during a long life of practical experience in the fisheries.

I can go back to no earlier date than 1816, when I entered the fishing boat and followed fishing as a business for a period of *fifty-one* years, during which time there have been many changes. I shall speak of only a few species. The scup that has been so abundant for many years south of Cape Cod, extends to Florida, and is caught in great numbers along the coast. It finds a ready sale in New York and other markets, but in Boston market it is not known as a marketable species, and is seldom seen there. Only a few straggling specimens venture into the colder waters north of Cape Cod. Witnesses stated before the committee that they had a tradition informing them that scup first appeared in Buzzard's Bay in 1793. If so, I ask was it then that they first came into existence, or did they come from some other locality? I have been informed that in examining the old shell-heaps that have been deposited by the aborigines of this country many years ago, the bones of this species have been found, showing that they were here before this country was settled by Europeans. If they were here at that time, is it to be supposed that they were driven away by the Indians with their rude implements of fishing?

When I first engaged in the fisheries, and for many years after, there was a species of mackerel that annually visited our waters, known by the name of Spanish mackerel, that were abundant. It was not the species now called by that name. It was about two-thirds the size of a common mackerel, known to science by the name of *Scomber Dekayi*. (Excuse me for using classic names, I do it for the reason that there are so many local names for the same species, I fear that I may not be understood by any who may be acquainted with ichthyological science.) This species, although plentiful for many years, has long since disappeared, and I have not seen a single specimen for the last twenty years. They disappeared long before a weir, trap, or pound was used in our Massachusetts waters. The cause of their leaving us is unknown. We can assign no reason. There have also been great changes in our common mackerel. While in some years they come to us in great abundance, in other years they are comparatively scarce. In 1831, 385,559 barrels were packed and inspected in this State, after which there was a falling off in the catch, so much so that from 1839 to 1844 the number of barrels caught did not exceed 75,000 in any one year, for five years in succession. In 1841 the quantity caught was only 50,992 barrels. They have since increased. During the last ten years the catch has been, with the exception of two years, upward of 200,000 barrels annually. Last season it was 234,000 barrels. It will be seen that the catch of fish from year to year differs as widely as the product of our land.

About 1840 there appeared on our coast, south of Cape Cod, large quantities of shad, which appeared to be the same species with those that visit the Connecticut and Merrimack Rivers annually, (*Alosa presta-bilis.*) Fishermen from Massachusetts, Connecticut, and Rhode Island engaged in this fishery, and found it profitable. In 1842 an act was passed by the legislature to prohibit fishermen from other States from fishing for shad within a line drawn from Monomoy Point to Point Gammon. I myself engaged in this fishery, but we found there was no need of the passage of such an act. The shad appeared in small numbers, so that not enough were caught to pay expenses. They were also caught in large quantities in the waters north of Cape Cod. They then disappeared, so that only a few straggling specimens have since been caught in these localities. Where were they before they appeared in our waters? What was the cause of their coming? Where are they now? All that can be said in answer, I can say in three words—they are gone.

Sir, I ask to be allowed to allude briefly to two species of fishes that are not caught by any mode of fishing that we are asked to prohibit. I do so for the reason that no less than four times petitions have been sent to the legislature asking for an act to prohibit fishing with trawl-lines (so called) in Massachusetts Bay. The report from the committee has always been "leave to withdraw." In 1858, when the report came up in the house of representatives, it was discussed at length, and it was there stated that if this mode of fishing was not prevented by legislative enactment, soon haddock would be as scarce as salmon. The report of the committee was accepted, and this mode of fishing has been in use since that time, and this species has been increasing from year to year, until they have increased in vast numbers, so much so that they are too plenty for the fisherman or dealer, and during the spawning season, which is the spring, they are sold at a low price—from two dollars down to fifty cents per 100 pounds. But it may be said the consumer pays a high price. I cannot help that; it is not that that I am discussing. I am trying to show the danger of exterminating the race of fish, if there is any, and do not intend to leave my subject, lest I may be called to order. When I first engaged in the fisheries, haddock was scarce on our coast, and in winter sold much higher than cod. They did not increase for many years after. They, however, became plentiful when the trawl-line was first used—about 1850—and every year they seem to be increasing. On the 4th of last March, when a large number of fishing-boats were out, the catch was larger than I ever knew before. The next day, 5th, there was brought to this city and sold at Commercial wharf, of cod and haddock, 621,953 pounds, as taken from the books of dealers that bought that day—a larger quantity than ever was sold of all kinds of fresh fish in a single day since Boston has been a city. What has been the cause of so great an increase? If I was asked how their numbers could be diminished, I have two ways now suggested to my mind: one is to introduce the beam-trawl, which has not been used in our waters, which is a large net-bag with a long beam across its open mouth, which is kept up some two feet from the bottom by an iron frame-work at each end of the beam, and as it is dragged along by the fishing-boat the fish pass into the net and are caught in the pockets at the sides as they attempt to pass out. This net being dragged over the bottom, would destroy the young fish as it passed over them, and might tend to diminish their numbers.

One other way would be to hire the fisherman to leave them, and to stand back and fold his arms and see nature perform her wonderful work without the interference of man. The present mode of fishing catches vast quantities of a species of flat-fish, (*Platessa dentata*,) which no doubt fed upon the spawn of haddock when the hand-line only was in use.

One other species, our common halibut, which is caught in the same way, have greatly diminished. When I first engaged in this fishery, Boston was supplied wholly with halibut caught between Cape Cod and Nantucket Shoals. The demand was limited—only a few could be sold. There were no railroads. Boston only wanted enough to supply the city and the surrounding towns. As facilities for transportation increased, and ice began to be used to keep them, they were sent further away. The supply would not meet the demand. The fishery was prosecuted by vessels from Gloucester, on George's Bank, and also on Brown's Bank, the western coast of Nova Scotia, and upon the Banks of Newfoundland, and voyages have been made to Greenland, and halibut have been caught in quantities as far north as the latitude of 68, on the western coast of Greenland. They seem to be decreasing on all the fishing-grounds. But I must pass them by, and leave senators to decide whether or not over-fishing has been the cause of the increase of the one and the diminution of the other of these two species.

It appeared in evidence before the committee that the fish known as the squeteague is increasing in the vicinity of Buzzard's Bay, and along the shore south of Cape Cod. Some sixty years since it was vastly abundant in the southern part of Massachusetts Bay, and although absent for so many years it seems to be returning to its former haunts.

But the great change that has taken place in our fisheries has been caused by the return of the blue-fish. This species was abundant on our coast many years ago. We are informed that in a journal of the first settlement of the island of Nantucket, written by Zacheus Macy, 1792, and contained in the Massachusetts Historical Collections, he says a great pestilence attacked the Indians of that island in 1763 and 1765, and that of the whole number, 358, 222 died. In that year, he says, the blue-fish disappeared, and I have no knowledge of a specimen being seen here for more than 70 years. We are informed that they are found in other localities. They are said to occur on the western coast of Africa, around the island of Madagascar, and also at Australia; if so, they are found over a wider geographical range than any other species with which I am acquainted, inhabiting the waters in both the torrid and temperate zones. After an absence of so many years, they returned, as appeared in evidence before the committee, about 1832, along the shores south of Cape Cod. They did not come north of the cape so as to affect our fisheries, until 1847, when they appeared in vast abundance, and drove away from our bay nearly all other species. I was at that time engaged in fishing for mackerel with nets. This was the last of our catch; and every year since, when our fishermen are engaged in this fishery, they appear. I have known them to appear as early as the second day of June, but usually they do not come until a few days later—from the 5th to the 15th. When they first appeared in our bay, I was living at Long Point, (Provincetown,) in a little village containing some 270 population, engaged in the net-fishery. The blue-fish affected our fishery so much that the people were obliged to leave the place. Family after family moved away, until every one left, leaving that locality, which is now a desolate, barren, and sandy waste.

These fish not only depopulated our bay of nearly all other species, but they depopulated my village and my home. It was a matter of surprise to your committee that men professing to be acquainted with fish should come before them and say they did not know that blue-fish eat any other fish but menhaden; and as they are not an edible species, no matter how many they destroyed; and also say they did not know that they drove other species away. Call them, sir, by whatever name we please; whether blue-fish, of Massachusetts Bay; snapper, of New Bedford; horse-mackerel, on the shores of Rhode Island; or tailor, in Delaware and Chesapeake Bays, they are the same *Temnodon saltator* still, and deal out destruction and death to other species in all the localities they visit.

One other, a species of flat-fish, which is called dab or plaice at home, but when we bring it to Boston and offer it for sale we call it turbot. It is the *Platessa oblonga*. This species was exceedingly abundant along our shores before the blue-fish came. It is a bottom fish, and does not come so directly in contact with the blue-fish as top-water swimmers; still, it has almost wholly disappeared, owing to the blue-fish having destroyed its favorite bait, which is the common squid. It seems to be nearly exterminated in the waters north of Cape Cod, only a few being seen.

The striped bass have diminished in the vicinity of Cape Cod, as the blue-fish have destroyed the bait upon which they fed.

The so-called Spanish mackerel, (*Cybium maculatum*,) Cuvier says, is an inhabitant of the Carribean Sea, extending southward to the coast of Brazil. Dr. Holbrook mentions it, in his Fishes of South Carolina, as being found in the waters along that coast. It has wandered southward until it has reached the southern coast of Massachusetts, and even specimens have been taken north of Cape Cod. It sells in our market at a higher price than other species. It is, no doubt, an excellent fish, but it is probably not so much better than our common mackerel as the prices seem to indicate. It has been selling in Quincy market for a few summers past at from fifty cents to one dollar per pound. It has been increasing in our waters for a few years, and the prospect is it will continue to increase, until it will be a fishery of considerable importance. There is no danger of destroying them by catching them by any way we can, when it is only the few wanderers that come to us from the localities where they inhabit. I think they need no legislative protection to increase their numbers.

Such are a few of the many changes that have taken place since I first engaged in the fisheries. Time will not allow me to go into detail of the some one hundred and fifty species found along our New England coast. They may be said to form one great chain, each species being a separate link, having its own peculiar history and habitudes.

I pass now briefly to notice their fecundity. We look with wonder and astonishment at the provisions in the animal economy. How vast is the number of eggs produced by a single fish; hundreds of thousands, which, if any considerable percentage should come to maturity, the waters would be filled to overflowing.

Take a few thousand specimens, and allow ten per cent. to come to maturity; multiply them together for ten years, and how great would be the number! And what is that when compared with the countless myriads that swarm our coast annually? Their numbers, how vast! Human ingenuity has invented no means by which they can be enumerated; their numbers are only known to Him who created them, who feeds them with a bountiful hand, and watches over them with more than parental care.

Sir, if we study them with reference to their longevity, we see marks on them indicating age: the loss of fins; scars, where they have at some time received wounds that have permanently healed; marks of physical debility, which appear to be the result of advanced age. I regret to say that no Linnæus nor Cuvier, nor all the researches of science have ever been able to give us any indication by which we may know the age that fishes live with any degree of certainty. They pass off and on the coast as the seasons change during their natural lives, however long that may be.

In view of all the foregoing facts, where is the danger of exhausting our fishes? I fail to see the danger of exterminating them.

The British commission that was appointed in 1863 to investigate the fisheries of Great Britain and Ireland visited nearly all the principal fishing-places in the United Kingdom, and made a thorough investigation; asked and received answers to nearly sixty-two thousand questions. They came to the unanimous conclusion that there was no danger of exhausting the fisheries, either in the open sea or in any of the arms or estuaries along the coast, with all that man could do, and finally made their report to the British Parliament in 1866.

There were persons that did not wholly agree with the British commissioners. One of the most prominent is J. B. A. Rimbaud, who has published a work on the fishes of the southern coast of France. Himself a fisherman, he says that the migratory species, that go off to sea in schools and return each season, cannot be diminished by over-fishing, but local fishes can be exterminated by constantly fishing for them, and such has been the case in the locality where he had been accustomed to fish.

Of the two I allow Rimbaud to be the best qualified to judge, as he has acquired his knowledge by practical experience in the fisheries, and the British commissioners had gained their information from others. Sir, I hope I may not be charged with undervaluing scientific research; no man has a higher appreciation of the labors of scientific men than myself. Their kindness to me in aiding me in my investigations of fishes has laid me under the greatest obligations. I owe to them a debt that I can never repay.

Sir, I call attention of senators at this board to the locality where Rimbaud has gained his information—the southern coast of France. France on the Mediterranean is not like our own coast. There the land is high, and deep water near the shores. The area of fishing-grounds is comparatively limited. Our own coast is low, and shoal-water extends off a great distance from the shore. Besides that, the great chain of banks, commencing with Nantucket Shoals and running eastward a thousand miles, and terminating with the great Bank of Newfoundland, gives us an immense area of fishing-grounds.

On the coast of France there is not so great change of temperature in the water from summer to winter as on our own coast. The Gulf Stream comes out through the straits of Florida, running up the coast to Cape Hatteras, from whence it turns eastward. As it passes it leaves our New England out in the cold; its course is onward until it reaches the shores of Western Europe, making the water comparatively uniform through the season. I ask, are not the fish on the coast of France more permanently *local* than those on our own coast, where there are great changes of temperature from summer to winter? Tell me, sir, how many are there of our fishes that are not more or less migratory. Senators will see that our fishes and fisheries are not like those of Europe.

Mr. President, lest I may be misunderstood, I desire to define my position. I firmly believe there is no necessity for the passage of any general legislative act for the protection and regulation of our sea fish and fisheries. If fish have diminished in any of the small arms of the sea, I should have no objection to the passage of a local act, provided it did not interfere with the rights of others; but I must confess that I am slow to believe that when fish have left a locality that any act on our statute-books will bring them back. If we wish to increase and stock our inland waters, it cannot be accomplished without protection. The building of dams across the streams, throwing of deleterious substances into the waters, have diminished the fish; but in the great sea man cannot pollute its waters by anything he can do. If this legislature should pass an act to prohibit those modes of fishing that have been called by the petitioners novel and improper, what would be the practical working? It would not only affect those directly engaged in them, but it would have also an indirect bearing. The large fleet of vessels belonging to Gloucester are a part of the season dependent on these fisheries for bait to be used in their bank-fisheries. The question was asked at the time of the hearing before the committee how the Cape Ann bank fishermen procured their bait before these modes of fishing came into use, but was not answered. When vessels from Gloucester first engaged in the halibut fishery on George's Bank they met there immense shoals of sea-herring, (*Clupea elongata.*) They could be taken in nets on the top of the water. After a few years they became less abundant, and were not seen schooling, but could be caught by sinking the nets several fathoms below the surface. Long since they have left that locality, and none have been caught there for several years.

Our mackerel fishermen require a large quantity of bait, to be used in the prosecution of this fishery, which is principally menhaden, caught in weirs or seines. Some 7,000 barrels of this fish was used by Provincetown vessels engaged in the mackerel fishery last season. Their whole catch of mackerel was about 25,000 barrels.

There is a large amount of capital invested in our fisheries, giving employment to a great number of men, who follow a life of hardship and exposure. They are a useful class of men, as they are producers. By their labors they bring to our tables a large amount of wholesome and nutritious food, which is a blessing to our people.

Sir, allow me one brief moment, while I allude to the life of a fisherman. He may enter the fishing-boat at nine years of age. Deprived of the advantages of school education, he follows his business from day to day. He may engage in some dangerous voyage. Follow him to the banks of Newfoundland, where he is not only exposed to gales and storms—he may in some seasons be surrounded by enormous icebergs, whose gigantic height and massive bulk adds to the danger. He is filled with fear lest his little bark may come in contact and sink beneath his feet. Beside this, the merchant-ship, on its passage to or from Europe, may, in some thick, dark, and stormy night, at one stroke put an end to his earthly voyage. What hardier occupation—what bolder daring can man display, than to lie down to rest shrouded in the gloomy solitude of a Newfoundland fog. As he leaves the cold, wet, and lonesome deck, at the end of his midnight watch, worn down by hardships and exposures, he lies down upon his bed, and while his cradle is rocked by the mountain billows, he courts that sleep that may know no waking. Day after day he looks forward with pleasing anticipation to the time when his voyage will end; when he will return; when he can rest from his toils, safe in the bosom of his home. Year after year, as his physical energies begin to relax, he dreads it more and more. He is still compelled to work for his support and those that may be dependent upon him. Few fishermen get rich, while a great many of us remain poor. He may abandon his business, and stop on shore. With a few nets, or some other implements of fishery, he may be able to procure means to supply his wants.

The great question is, What is the danger of exhausting our fisheries if these modes of fishing are continued?

Nets have been used from time immemorial. We have an authentic history, that has come down to us, that tells us that more than 1,800 years ago, Jesus, walking by the sea of Gallilee, saw two brethren—Simon, called Peter, and Andrew, his brother—casting a net into the sea, for they were fishers, and he said unto them, Follow me, and I will make you fishers of men; and straightway they left their nets and they followed him. And going out from thence he saw other two brethren, James, the son of Zebedee, and John, his brother, in a ship, with Zebedee, their father, mending their nets; and he called them, and they immediately left the ship and their father, and followed him. This not only shows that nets were in use at that remote period, but that they also needed mending, plainly indicating that they were somewhat like our nets.

From the foregoing considerations that I have so briefly stated, your committee came unanimously to the conclusion that it was their duty to report that the petitioners have leave to withdraw.

VI.—REPORT OF CONFERENCE OF UNITED STATES COMMISSIONER WITH COMMISSIONERS OF RHODE ISLAND AND MASSACHUSETTS.

REPORT OF CONFERENCE HELD AT BOSTON, OCTOBER 5, 1871, WITH FISHERY COMMISSIONERS OF MASSACHUSETTS AND RHODE ISLAND.

There were present at the conference: Mr. Reed, of Providence, commissioner of Rhode Island; Mr. Lyman, of Boston, commissioner of Massachusetts; Mr. Powel, of Newport, a member of the Rhode Island legislature, and Mr. Baird, United States commissioner. Such portions of the discussion as have no special bearing on the subject in question have been omitted.

Mr. SAMUEL POWEL. I think the trappers of Rhode Island would agree to the close time; and Governor Stevens, I think, would consent to it.

Professor BAIRD. I think the traps have a positive influence; but I still think that the blue-fish are a great cause of the trouble. A decrease of the blue-fish would give the other fish an opportunity to increase; but the young blue-fish are as much more plenty than usual this year as the young scup; so that I think it is expedient to try the experiment of a close time. If the blue-fish were to run out again, I think it would not be so imperative to adopt any restrictive measures. We cannot regulate the blue-fish, but we can control the traps.

Mr. REED. I think scup feed more or less on the small crustaceas, perhaps slugs, and a species of leech. I think they would feed on the small muscle. I have seen little scup, when the water was clear, bumping their noses against the rocks, as though they were picking something off. Some say that the salmon do not feed while not in the salt water, but I think they do. I have seen them strike the dragon-fly with their tails when it was skimming over the water.

The blue-fish will attack almost anything as long as he can eat, even a piece of rag he will bite. I think the "slick" on the water so often seen is, in many cases, produced by the oily matter proceeding from fish that have been attacked by the blue-fish, they first swallowing as much as they can, and then vomiting it up, so as to eat again.

As to the scup, I think the blue-fish attack them throughout the season, especially the small scup. I think the blue-fish feed near the surface.

Professor BAIRD. I think, as a general rule, that the blue-fish swims at the surface in the day-time and at the bottom at night. We find rock-crabs, eels, and sand-launces in their stomachs. We have found scup in the stomachs of the blue-fish from the 15th of June to the 1st of October.

Mr. REED. Two years ago we had an unusual run of blue-fish late in the fall. In half an hour I caught thirty-five, averaging about a pound each. We used a hook smaller than usual for blue-fish. We have plenty of food for scup in our bay.

Professor BAIRD. That element need not be taken into account at all.

Mr. REED. We have had scup away up to the mouth of the Narragansett River. It is a very filthy river, too, because there are so many manufacturing establishments, and among others that of hair-cloth, the clippings of which are thrown into the water. There are large manufacturing towns all the way up, and every kind of refuse is thrown into the water. All the manufactories make their own gas, and they saw wood, and so it is with all the branches of the river. But scup have been caught right at the mouth of the Forestdale River, where they have thrown in tar.

Professor BAIRD. The sea pollution cannot enter into the question, except merely locally. The only thing that is injurious in this refuse is the carbolic acid and tar, and this is so small in amount as to have little influence. In fresh water it is a different thing, but in the salt water I do not think it need be considered.

Mr. REED. The print-works empty everything into a narrow passage twelve feet wide, that is about one-sixteenth of a mile from where the tide comes in. I have seen little fish, two inches long, feeding right at the mouth of the river. And I have dug clams there so dyed that they looked red in consequence of the madder thrown down there. Prior to the building of the print-works, I have been told, there were no oysters up there, but the year after it was started there was an unusual number of oysters set in that little bay.

Professor BAIRD. I have come lately to the conclusion that the prime cause of the variation in the supply of food-fishes on this coast is to be found in the blue-fish; but then I am also satisfied that the trapping and pounding, coming at the heels of the mischief done by the blue-fish, have intensified the evil; and that, if we mean to restore the fish, we must regulate one or the other. I think that if the fish have a chance to reach their spawning-ground they will multiply fast enough for both hooks and lines and traps. We must exterminate the blue-fish or regulate the trapping, or the evil will increase. I can see very positively the relationship of the shore-fishing to the establishment of the trap.

Mr. REED. I was told by a gentleman of Providence that he was present the very day the traps were set this spring, at a certain place, and he said they were filled within fifteen minutes with scup and other fish. He said the season was a fortnight ahead of them. The effect has been that young scup have been caught this year away up the Seekonk River, so plenty that you could scarcely throw in the hook without catching one.

They have not been so plenty as this for a long time. They are spawned in shallow water, in the inlets and bays. I do not believe any scup would deposit spawn outside as far as off Point Judith. I doubt whether fish an inch long would be found accompanying the schools of big fish.

Mr. POWEL. I saw some this spring ranging from two to four or five inches in length, and I took some up to Professor Blake; I think it was the 25th of April. They were caught in a trap below Newport.

Professor BAIRD. I think the scup might have spawned off the Carolinas in March, and some of these might come along up with the older scup. But my impression is, that the largest part of what are now called "dollar scup," are this year's brood.

In the middle of August it took five of the last year's scup to weigh a pound, and now four will weigh a pound. They will come back next year weighing about a pound each.

While there are a great many scup of this year's growth, there are also many last year's scup. Therefore I ascribe a part of this change at least to the diminution of the blue-fish. For five years blue-fish have been growing more scarce; last year about three-fourths of the usual take, and this year the catch has been much less than last.

Of squeteague there are a dozen this year where there was one five years ago. In 1863, I collected fishes at Wood's Hole, and I did not see a squeteague, and when I spoke with the fishermen there about it, they did not know the fish. Four years ago a few were caught there, and last year a great many. This year, at Menemsha Bight, one caught five thousand at a single haul.

Mr. REED. I understand that the increase of the squeteague has been in proportion to the decrease of blue-fish.

Professor BAIRD. I think the blue-fish are continuing to decrease, thus leaving a better chance for other fish.

But it is not so much a matter of importance whether the blue-fish eat the scup or other fish. We know that the waters swarm with little fish that prey largely upon the spawn of other fish, and very young fish. They are just as plenty now as they ever were, and no trapping can affect their supply. They are bound to have a heavy toll out of something. When scup have been most abundant, they have furnished to these little fish the larger portion of their sustenance; and when they cannot get young scup they will take anything, and perhaps they take 75 per cent. of all the spawn of everything that is laid in the waters.

There is a certain balance of fish, there being plenty to feed all these scavengers, and to feed mankind also. Now, if you bring in the blue-fish, they disturb this balance; they take scup, sea-bass, &c., that should be permitted to spawn. Consequently the absolute amount of spawn is decreased, and the little fish will still secure their part from that which remains. If there is but a little spawn in the water, it makes little difference to them; they will have their share out of what is left.

Then, having disturbed the balance to that extent, we come in with our traps and reduce the number of spawning fish and of spawn still further; and where the blue-fish destroy many, we destroy even more; and then the little fish must take the spawn of anything they can get. If you take in the traps fish that would otherwise furnish spawn to the little fish, then these little fish will take the spawn of other fish. Therefore, I think the traps should be regulated, but need not be prohibited.

I think that a "close time," especially during the spawning season, will give the relief that we require. I understand that, as a general rule, the spawning fish run almost always at night. All the trappers tell me that they catch the breeding fish at night. But in the summer season they catch the Spanish mackerel and other pelagic fish in the day-time. My suggestion to the trappers was, that they should close the traps from six o'clock Saturday night till Tuesday morning. I want three nights and two days.

Mr. REED. I suggested from sunset Saturday till Tuesday morning—three nights and two days.

Mr. POWELL. I think that from Friday night till Monday morning will satisfy them better, as Sunday intervening would prevent the disposal of the fish caught Saturday. That is what I wanted to do last winter.

[Mr. REED agreed to that time as being better.]

Professor BAIRD. If the trappers will not assent to that, I would favor a law prohibiting the whole business.

Mr. POWELL. Rhode Island has waked up to the necessity for regulating her fishing. The fish are gone to such an extent that, at a clam-bake of some New Hampshire people in Rhode Island, they brought their fish along with them.

Professor BAIRD. Massachusetts people say, "What is the use of trying to catch fish with the hook and line while the trappers at Saughkonet are allowed to take our fish?"

Mr. POWEL. I would like to ask Mr. Reed whether it was usual or unusual for the large and small fish to come in together. The fishermen say it was unusual.

Mr. REED. I cannot tell in regard to scup. I know the scup have decreased very much for the last five years, since I came there.

Mr. POWEL. This year we have had the young scup coming in almost in their former abundance.

Mr. REED. There is no bay so peculiarly situated as Providence Bay. It has three outlets, and the fishing-grounds are numerous. You can put a trap down in certain places where the tide flows backward and forward, in such a way that your trap would be as effectual in stopping and catching the fish as a dam run right straight across the tide. The fish cannot get up except when the traps are lifted. They have come constantly to these places, trying to get up, but it has been impossible.

Professor BAIRD. Then you think that, apart from the capture of the fish, the presence of the nets has kept them out?

Mr. REED. Yes, sir.

Mr. POWEL. Your argument would be that the two weeks' supply has been the cause of the greater abundance of young scup?

Mr. REED. Partly so. Squeteague have been very scarce, and I do not believe there were five thousand pounds of blue-fish caught in the whole bay. Squeteague were not as plenty as they were last year. In fact, almost all the fish in our bay have totally disappeared.

I suppose the scup had a free run of two weeks, and when they struck that water free from traps they spread themselves, and could choose any kind of temperature or any kind of bottom, whether sandy, or rocky, or mud. Thus we have an unusual variety in the bay. At Prudence Island there are very bold rocks, and it is a great place for catching scup and tautog.

Professor BAIRD. If the intermission from catching for two weeks was sufficient to create so great a supply, it shows what we may expect if we keep up that intermission through the season. If we have the intermission of three nights and two days in a week, throughout the season, instead of the incidental two weeks, we may hope to restore an ample supply to all our waters.

Mr. POWEL. There are three well-described kinds of scup on our coast; and very probably each has a different habitat. There is something different in them, because they come one after the other. They are described as three different growths, when we know they come from somewhere about the Florida capes, to begin with.

Professor BAIRD. Do they?

Mr. POWEL. They come from somewhere down south, and they turn in, as they come along, into the different estuaries. Where do they go; and why don't they all go into the first place?

Some gentlemen tell us that fish always return to the waters in which they were spawned. How do they know it? They know it in regard to some fish, salmon, trout, &c. Then comes Mr. Agassiz, who tells us they are not pelagic fish; that they are born in fresh water, and we have no right to know that they ever absent themselves far from the fresh waters. But it is not so with the wandering fishes of the sea. Now, I have no theory on this subject, but I wish to call your attention to it.

Professor BAIRD. We have the fact that last year's scup are much more plenty than the experience of the past few years would lead us to suppose; and this year's scup are equally plenty. Now, what caused this state of things?

Mr. LYMAN. The scraps that I have picked up indicate that scup were here abundantly on the first arrival of the settlers in 1620. They were abundant, still, down to 1642, as mentioned by Roger Williams. Then there is a little gap. In 1642 they were abundant in all our borders. In 1659 the blue-fish were abundant about Nantucket, and Macy is very precise in this. There are seventeen years when the scup were abundant, as well as the blue-fish, in the same waters, and remained abundant until 1764. Then the blue-fish go away, disappear entirely, as far as regards Nantucket. Macy says they totally disappeared, and none whatever were caught in the seines. Now, we know that in 1790 the scup was unknown in Nantucket, because we have oral testimony collected by Professor Baird; and then, about 1794, the scup reappeared. There were thirty years, in round numbers, that the blue-fish disappeared, and then again became very abundant, and have continued so since, until about the year 1864, when everybody agrees that they fell off very much.

Now, the blue-fish, coming in 1830, have continued to the present time, though with decreasing abundance for a few years past. The blue-fish having diminished in 1764, it took thirty years for the scup to get back, and then they continued side by side without any diminution until recently, from 1830. At any rate, for twenty-five years the scup and blue-fish lived side by side in vast abundance.

What we know of nature does not indicate that the predatory fish that is going to clean out another kind of fish is going to take twenty-five years to do it; that is to say, when it does it, it is not to be done with a jump. I would illustrate it by saying that I find in testimony from different witnesses, independent of each other, that in 1841 and in 1856 there was an exceedingly cold snap coming on suddenly in the autumn, the consequence of which was that immense quantities of the bottom fish, tautog, rock, bass, &c., were killed throughout the waters of the southern shore, and drifted ashore; and the next year these species in many localities were almost extinct. But in three or four years the fish had returned to their normal abundance. There is an instance of a cause annihilating the local fish, and in three or four years there is a return. It is an illustration that in nature the supply does not take very long to recover itself.

Professor BAIRD. It is "nip and tuck" between the blue-fish and the scup. For instance, take the abundance of scup that existed twenty years ago, and no man would have said it was possible, by any agency, to make them scarce, because they thronged everywhere in Vineyard Sound and Buzzard's and Narragansett Bays. Suppose one scup produces a hundred thousand young—that was more than all the blue-fish could manage. They did all they could, but the scup were too many for them. But the blue-fish kept preying upon them, and we can imagine that year by year they finally cut down the supply to such a point that, after all the little prowlers had got their share, then the blue-fish cut them "down by the run."

Mr. POWEL. And the very epidemic which has sometimes influenced the larger classes of families may also affect their pabulum too, and the consequence would be that the scup would have to tighten their sword-belts. I want you to bear in mind the magnificent run of scup that has burst upon us, on account of the opportunity to run into the waters freely for two weeks.

Mr. LYMAN. I think that it is non-proven that blue-fish feed on scup generally. Although scup have been taken out of blue-fish captured in pounds, still the universal testimony of the fishermen before the legislative committee was, that scup were never—some said rarely—found in blue fish. Therefore, I do not believe that the blue-fish follows the scup as its normal food. I do not think it is proven at all, and I don't think any mathematical theories, multiplying so many blue-fish, eating so many scup in a season, have anything in them.

But I do really think that there is evidence to show—to make us suspect very strongly—that the blue-fish and pounds have had something to do with it; and with the really insufficient evidence we have, my private opinion is, that two-thirds of the diminution should be charged to the pounds, and one-third to the blue-fish.

Professor BAIRD. It is very easy for the fishermen to say that they did not find scup in the blue-fish; because there were no scup at all to be caught.

Then, how do you know there were any blue-fish at Nantucket while the scup were absent there?

Mr. LYMAN. Macy tells you the month and the year, and says they were taken from June to September in great abundance; and he says that thirty would have filled a barrel.

Professor BAIRD. They may have been some other fish.

Mr. LYMAN. Neither are we certain that what Roger Williams calls bream was a scup, though I presume it was so. It may have been something else than the blue-fish.

Professor BAIRD. We all agree, I think, that fish are scarce, and that something should be done as an experiment for their restoration. I have made a draught, with a memorandum, in regard to this question of regulation, which I will read. It seemed to me that, as a preliminary to all legislation, the whole question of pounding and trapping should be under State control; that the State commissioners should be required to give licenses, and that it should be illegal to carry on the fishing in pounds without such a license.

[The draught of the law was then read, and afterward discussed.]

Mr. LYMAN agreed that the putting of the subject in the hands of the commissioners was a good thing. It will work well, if we can say to the trapping people, we protect as well as check you.

Mr. REED. I believe that we shall not repeat what we did last year. Failing in that undertaking the people have more liberal views. The trappers are very willing to concede, and the others also. I think that if the question were taken of traps or no traps, the traps would be killed; that is simply my opinion.

Mr. LYMAN. I think some such act, thrown into a strictly legal form, will be a good thing. The main features, I think, we may consider as agreed upon, and that the differences, if any, shall only be in putting it into form.

Professor BAIRD. Would Captain Atwood consent to the "close time?"

Mr. LYMAN. Yes, sir; he thinks you cannot lessen the sea-fish, but he has no objection to the protection of fish that breed in the bays, nor to the "close time," if reasonable. But he does not think it proper nor feasible to cut off the bait from the cod-fishermen.

Professor BAIRD. Shall it be carried throughout the season, or only during the spawning season of the shore fish?

Mr. LYMAN. That is very important. I think it would lessen the opposition to the passage of the law if we give the traps a chance to catch herring and menhaden. These are needed for the Gloucester fishermen. I would rather put a limit on the beginning of the season than the end. Catching the herring early I do not think injures the fishing much.

Professor BAIRD. Supposing they did not catch quite as many fish for the first year, would they not catch enough more in future years to compensate them? And supposing this applies only to the south side of the cape, could not they supplement the loss from the "close time" by other means of catching? Ten years ago there was only a single trap for ten miles around Wood's Hole, and yet they managed to get all the bait they wanted.

Mr. LYMAN. The George's fishing has been growing up under the system of getting bait from weirs more particularly. Let us leave it so that the time shall be cut off at the beginning, and not the end of the season.

Professor BAIRD. But let the law run through the season?

Mr. LYMAN. I think so.

Professor BAIRD. There is this consideration to the advantage of this regulation, that there is much less probability that fish will be lost or wasted. The Messrs. Luce, of Menemsha, said that if fish were sent off only five days in the week, they would be better cared for, and they would get a better price for them, while there would be no difference to the consumer. I am quite sure the supply will be more equally distributed, less fish wasted, and as much money made by all parties.

Mr. POWEL. It will diminish opposition, to have the "close time" cease by the end of the scup-fishing, because Spanish mackerel and squeteague are not caught with hooks, and they come after the scup. I think I can get through such a law.

Mr. LYMAN. I think we had better cut it at both ends.

Mr. POWEL. I know the people of Rhode Island will accept it.

Mr. LYMAN. From the 10th of May to the 15th of June will give sufficient time for the scup.

VII.—DRAUGHT OF LAW PROPOSED FOR THE CONSIDERATION OF AND ENACTMENT BY THE LEGISLATURES OF MASSACHUSETTS, RHODE ISLAND, AND CONNECTICUT.*

A BILL TO REGULATE THE USE OF STATIONARY APPARATUS IN THF CAPTURE OF FISH.

SEC. 1. The commissioners on inland fisheries are hereby empowered to license individuals and corporations to erect, establish, and use, in the waters of this commonwealth, whether navigable or unnavigable, fixed nets, traps, pounds, pots, fykes, weirs, or other stationary apparatus, for the purpose of capturing fish, upon application for such license, duly made as hereinafter conditioned and provided.

SEC. 2. All persons seeking such licenses shall make written application to said commissioners, specifying the locality in which they desire to use stationary apparatus as aforesaid, the exact character of the said apparatus which the applicant proposes to use, including, if of netting, the proposed sizes of mesh, as also the proposed length of the leader, or fence, together with all other details and particulars necessary for an exact understanding of said apparatus; and upon examination of such applications, and after public hearing, if they deem necessary, the said commissioners shall grant the license desired, provided the application be made on or before the first day of March in each year, subject to the conditions hereinafter mentioned, it being understood that parties last in lawful possession of any fishing-station shall have preference in its assignment, unless barred by a violation of this act.

SEC. 3. The license shall be in writing, signed by a majority of said commissioners, and shall state clearly and minutely the locality within which the same shall have effect, and no license shall have effect in any locality other than that mentioned and described therein, and, if for netting, the minimum size of the mesh of the different parts of the net, and the length of the leader, and shall prescribe such other limitations and directions as said commissioners shall deem proper; and no license shall take effect until the same shall be left for record with the clerk of the town or city within which the same is to have effect, nor until the recording fee of said clerk, being the same as that established by law for recording mortgages of personal property of equal length, shall be fully paid.

SEC. 4. The said licenses may embrace any period not exceeding one year; but, whenever given, they shall expire on the first day of January next following their date, and the clerk of each city or town in

* The draught, as originally prepared, was first discussed at the conference with the commissioners of Massachusetts and Rhode Island, and then submitted to several eminent legal gentlemen for consideration; among others, to Mr. Henry Williams and Mr. Geo. H. Palmer, of Boston, from whom important criticisms and suggestions were received and incorporated.

which said licenses have been recorded shall, on the first day of April in each year, make return to said commissioners of the said licenses then in force and the localities to which the same relate.

SEC. 5. Every person who shall have received a license in the manner herein provided shall, before the first day of January following the date of said license, make accurate return to said commissioners of the numbers and the kinds of fish captured by him during each day of the season by virtue of said license, and shall furnish accurate information of all other facts relating to said license which said commissioners may require, and no license shall be renewed until said report shall have been made to the satisfaction of said commissioners.

SEC. 6. No person enjoying such license shall take, or allow to be taken, any fish by means of stationary apparatus from the twentieth day of April until the fifteenth day of June in each year in the interval of time between the hours of six o'clock on Friday evening and six o'clock on the following Monday morning; and every person enjoying such license shall lift up at least twenty yards of the outer or seaward end of the leader or fence of his apparatus, or otherwise open it, so as to secure a free passage for the fish from the surface of the water to the very bottom, and shall at the same time place a gateway of netting over the "heart" or entrance into the inclosure, and, in general, take whatever precautions may be necessary to prevent the entrance of fishes into the same during the period of time aforesaid; and, generally, shall comply with any and all regulations made by the commissioners for the purpose of securing the accomplishment of the object of this section, namely, to allow and secure an unobstructed passage of the fish through or by the apparatus in question during the time specified.

SEC. 7. No license granted under the provisions of this act shall be construed as authorizing the grantee of the same to enter upon the land of individuals without their permission, nor to interfere in any way with private property.

SEC. 8. Whoever sets or uses, or causes to be set or used, in the waters of this commonwealth, whether the same are navigable or unnavigable, any weir, pot, pound, yard, trap, or other stationary apparatus whatsoever, for the purpose of capturing fish, except by virtue of a license duly issued, and for that particular locality, under the provisions of this act, shall forfeit and pay for each day during any part of which said apparatus is so set or used a sum not less than two hundred dollars nor more than five hundred dollars, and shall forfeit all apparatus so used, including nets, stakes, boats, &c., which shall be sold, and the proceeds of such sale placed in the treasury of the commonwealth.

SEC. 9. Whoever, having received a license under the provisions of this act, shall neglect or refuse to comply with the provisions of the same, or of his license, shall forfeit and pay for each offense a sum not less than two hundred dollars nor more than five hundred dollars, except that, in case of his violation of section six of this act, he shall forfeit and pay for each day during any part of which his offense is committed the sum of five hundred dollars, and shall forfeit all apparatus used in violation of said section, which shall be sold, and the proceeds of such sale be placed in the treasury of the commonwealth.

SEC. 10. All actions and prosecutions under this act shall be commenced within six months after the offense is committed, and one-half of the fine or penalty recovered in any action or prosecution aforesaid shall be paid to the person who shall first bring an action of tort therefor, in his own name, or shall make complaint in any criminal case, and the remaining half in either case shall be paid into the treasury of the commonwealth.

SEC. 11. Whenever a person who has received a license hereunder shall be convicted of any offense under this act, or of violation of his license, he shall be forever disqualified from receiving another license within this commonwealth, and the license then held by him shall become void; and the said commissioners, on re-issuing a license in place of the same, shall prefer the party furnishing the evidence or making complaint against the party so offending, unless they shall see good reason to the contrary.

SEC. 12. No apparatus for capturing fish shall be set in such manner or in such place as to obstruct navigation with boats or vessels; but no one shall be permitted wantonly to destroy fishing apparatus lawfully set and managed, and for which the required license has been given, under penalty of not less than fifty nor more than five hundred dollars, to be recovered as aforesaid.

SEC. 13. It shall be at the discretion of the commissioners to revise or annul a license to establish fixed apparatus for capturing fish, when, in their opinion, and that of the governor of the State, the establishment or continuance of such apparatus may interfere with the passage of salmon, shad, herring, or alewives into fresh water for the purpose of spawning.

SEC. 14. This act shall take effect from and after its passage.

VIII.—MISCELLANEOUS CORRESPONDENCE AND COMMUNICATIONS ON THE SUBJECT OF THE SEA-FISHERIES.

NANTUCKET ISLE, GRAND MANAN,
November 21, 1870.

SIR: I received your letter, and I notice what you say about the fish, &c. In regard to the herring, so long as the mother herring is left to lay her eggs, there will be a good supply of young herring. Thus, sir, it is good for Government to stop netting. Last fall, and this fall also, was the best fishing ever known at Grand Manan. I think the wiers, if tended properly, will not destroy the herring; but if the female herring are taken, then all are gone. Codfish are led by herring, as they are choice food for cod. Last summer cod were scarce in the bay, plenty on the banks. In the summer, in drought, and when the water is warm, the herring stay in the deep waters; when fall rains come, and the water and weather cool, the herring come into shoal water, and the codfish follow them. Last winter was the best cod and herring fishing ever known at Grand Manan, and was good this fall when the weather was suitable for fishing; but there have been more gales this fall than I ever knew, so that there was great difficulty in fishing. Government has done nothing about the weir fishing, but forbids netting for three months (July 15 to October 15) at the south head of Grand Manan. The abundance of cod is affected in this way. If the herring are destroyed in one place the cod go to another in search for them. For this reason the seed-herring should be left. There was a report during the last summer that cod were plenty, and every vessel that went on the bank from Grand Manan and Eastport was loaded with fish. The cod prefer living or fresh-killed herring for food. Last Thursday I caught a cod five and one-half feet long that chose to bite at a herring-bait when full of sea-crabs, thirteen in number, and other small things. Cod live on crabs, scallops, and the jellies on the bottom, and a small fish in the form of a shrimp, but four or five times as large. Large cod eat small flounders, small pollock and hake, small salmon, sea-perch, cunners, and a great many things found at the bottom of the water, but always prefer the herring. Some come in schools and eat the herring-spawn. Cod lay their eggs in November and December, as near as we can tell, and we catch them sometimes when their spawn is so ripe as to run from the fish when dying. Some cod caught in the winter have small spawns in them. Some think they spawn in March or April. The small cod, which never grows to a large size, spawn in the fall months, the same as the large cod. The herring at south head of Grand Manan spawn in August, September, and October. Over at Campbell's they catch large herring in winter with spawn in them, which would be hatched in spring. Down at the East Bay they are found in the same condition. I never heard of a blue-fish being caught at Grand Manan. I think the set-lines an injury to the halibut, the females being caught in them, which cannot be caught by hand-lines. People complain of the injury to halibut and cod from the set-lines.

Yours, truly,

SIMEON F. CHENEY.

NASHUA, NEW HAMPSHIRE,
February 24, 1871.

DEAR SIR: Allow me your attention for a few moments. I was a fisherman for several years on the cod-fishing line. You are well aware that different kinds of cod use different food. There is the poogie cod, the herring-cod, and the clam-cod. The best, and what has always been relied on, is the poogie-cod, which is fast going out of existence, and the fisheries will eventually be ruined if there is nothing done to prevent it by the Government. They have tried to legislate it in Maine, but, you know, "money makes the mare go," and these oil mill owners have more than fishermen; therefore the effort will fail unless the friends of fishermen take hold of it. It is unnecessary for me to explain how many thousand barrels of this food of the poogie-fish is consumed in a year to make oil of; it is sufficient to know that it is destroying all the food, and with very little recompense. The Government ought to pass an act prohibiting the seining of poogies on the coast, especially on Government waters, to make oil or manure of.

I have the honor to be, your obedient servant,

WINSLOW P. EAYRS.

The fish here referred to as the Pogie is the Menhaden, or Moss Bunker, (*Brevoortia menhaden.*)

NASHUA, *December* 28, 1871.

DEAR SIR: Every other year, when the pohagen or poogies (menhaden) come into the mouths of the rivers, we find thousands of them thrown on shore, dead. There is a great deal of speculation in regard to them, and as to the cause of their death. I think, however, I can solve the mystery. I notice that all the print-works, dye-houses, and factories discharge into the water tons of dyes, poison culch, in fact, everything which ought to be buried, such as copperas and other chemicals. You know what they are, and that they fill the water with poison. Even the card-factory here in this city throws tons every year into the Merrimac. Fish being so easily destroyed, I believe that is the reason, and that the practice ought to be stopped. I believe that is the reason that salmon, shad, &c., do not come up the river as they used to. Is not my idea reasonable? Not only the fish are affected in this way, but the city of Lowell are drinking the water. We may soon know that the people are dying, while the cause is not understood.

The idea that dye-stuffs settle, and the water runs clear, is all bosh, in my estimation. Am I not right? I think this too important to fish and people not to be looked into. But I know of no one who has even mentioned it, or, as far as I know, even thought of it. Does that not come under the fish question?

Very truly,

WINSLOW P. EAYRS.

UTICA, *February* 21, 1871.

DEAR SIR: When I was a lad I lived twenty miles from Bellows Falls, and shad were brought to my home and sold for 10 cents each. They could not surmount the falls; but salmon went north, to Canada, and were worth 3 cents per pound. In my grandfather's time salmon were taken in plenty three miles from our place, at the head of the Contokook River. There is not a doubt but the obstructions of the Connecticut River can be removed; but the smaller streams carry less water by the clearing of the land, and, I fear, cannot be *re-populated.* But the noble brook-trout can be produced at a very cheap rate where butchers are plenty.

Yours, truly,

E. JEWETT.

COPY OF MEMORIAL OF CITIZENS OF HYANNIS ADDRESSED TO CONGRESS, PRAYING THAT LAWS BE PASSED PROHIBITING THE USE OF FIXED APPARATUS FOR CAPTURING FISH.

We, the undersigned citizens of Cape Cod, humbly entreat your honorable body to become interested in making laws to regulate the fishing business, so as to secure to the fishermen a compensation for the toil and danger accompanying the business. Pounds, weirs, and traps have about used it up. Many of the fishermen have been driven into fishing for a living. It is not uncommon to find two or three men on board a small fishing-vessel. Ten years ago they were in command of as good ships as floated. Steam has robbed us of our first occupation. Pounds, weirs, and traps have served us as bad as steam. We contend that the rich man's dollar, while he is asleep, should not be allowed to catch all the fish, while our lines, which are well baited and tended, find no fish to bite at them. We contend we can put as many and better fish into the markets where fish are sold than are sold in those markets. If any of you doubt it, let him visit the places where fish are induced to go and deposit their eggs. You will find fish taken in such quantities that, after taking care of all they can, the balance are thrown into the farmers' wagons that stand waiting to take them away to dress the land; catching as many fish at one time as it would take to supply all the markets for months; destroying hundreds of what would become fish where one fish is taken.

Shall the rich man's dollar be allowed to drive us from our home and all that is sacred to us in memory? Must we look on, and see the rich man's dollar rob our children of bread and clothing? It will be hard work. We have contended with old ocean from our youth, but the rich man's dollar we cannot manage in a lawful way. Why should we not have good laws that would encourage rather than discourage the poor man while toiling to earn bread for his family? God grant that your wisdom may be guided in the right direction.

Very respectfully,

HATSEL HANDY,
Hyannis, Massachusetts.

JOSEPH G. LORING.	JAMES ELLIS.
DANIEL HUMES.	CHARLES DENISON.
DUSTIN TAYLOR.	HENRY E. BAXTER.
OSBURN HALLETT.	NELSON BAXTER.
LEVI L. BUCK.	JERVIS W. EDDY.
WM. C. WHELDEN.	PRENTISS LINNELL, JR.
GEO. H. SMITH.	JOSHUA HOPKINS.
ARUNAH WHELDEN, 2d.	REUBEN BAKER.
BENAGER WHELDEN.	TIMOTHY CROCKER.
ALEXANDER CROWELL.	HIRAM HAMBLIN.
ELEAZER BAKER.	TIMOTHY HAMBLIN.
BENJAMIN BAXTER.	SIMEON HAMBLIN.
ELLERY E. BARTER.	WILLIAM HAMBLIN.
EBENEZER CROWELL.	WALTON HOLMES.

HYANNIS, *Massachusetts*, 1871.

IX.—EUROPEAN AUTHORITIES ON THE SUBJECT OF REGULATING THE FISHERIES BY LAW.

ON THE FISHERIES OF THE GULF OF NAPLES.

BY ACHILLE COSTA.*

CONSIDERATIONS ON THE SYSTEMS OF FISHING.

Among the inhabitants of the sea the spinous-rayed fishes (to which almost all the best kinds of eatable fishes belong) are without doubt immensely prolific, more so than animals of any other class, and this fact is in harmony with a general law observed throughout nature, namely, that fruitfulness is in direct ratio to the means of destruction that animals meet with in nature, which destruction fishes find in the sea and within the sphere of their own class; the carnivorous devouring not the vegetable-feeders alone, but also those of their own kind which are smaller than themselves. If to these natural causes of destruction we add the artificial modes invented by man for his own use, we can readily appreciate the nature of the drain to which the families of fishes are subjected, and the necessity of an enormous fertility to maintain the supply at a given average.

Indeed, in spite of such fecundity, it has been observed in numerous localities that marine productions are on the decrease. In regard to the Gulf of Naples, no exact statistics are on record by which to determine the precise amount of this decrease; but, taking into consideration the local conditions of the sea, it is easy to prove that the product of fishing is very inferior to what it should be. This fact is accounted for by the avidity of fishermen, who, valuing present utility only, make no account of the injury done to the future, and who, thus ignoring their own interest, instead of being the jealous preservers of the source from which they derive their constant industry, are its destroyers, and invent new means of destruction instead of preservation. As this is a subject which regards the public welfare, owing to the loss arising therefrom to consumers, the attention of the governments of different nations has been called to it, in order that every precaution may be taken to protect this highly-important branch of industry by every means dictated by science and experience. A royal council, to which we have the honor of belonging, is already engaged in investigating all that relates to the subject in question in our country, and a law on fishing throughout Italy is in course of preparation. We do not deem it necessary here to expound in advance all the special views which we consider a subject of discussion for the council

* Atti del reale istituto d'incorraggiamento alle scienze naturali economiche e tecnologiche di Napoli. 2do serie. Tomo VII. 1870. P. 89.

itself; nevertheless we deem advisable not to overlook any of the general considerations which are the result of direct and experimental observations made on the systems of fishing in the Gulf of Naples. If, on one side, we view these considerations as only partial regulations relating to local facts, on the other side we find them placed among the general facts which furnish the elements of the law itself.

In order to judge of the fitness of the systems of fishing, we must consider them under three aspects: the means to be employed, the proper seasons, and the proper places; three things that are so united that one cannot be separated from the others, and means which in themselves might be harmless if employed in proper seasons and places, become very injurious to marine productions when used out of season and place.

The general rules which a wise regulation for fishing must prescribe, are:

1st. Fishes should not be molested during the time of spawning.

2d. The eggs should be left to rest where they were deposited, so as not to be disturbed during their development.

3d. The young must not be destroyed till they have reached a certain size.

4th. Fishes must not be destroyed in mass, by means of poisoning.

From these incontestable principles it follows, as an evident deduction, that a regulation for fishing must prescribe:

1. That fishing must not be carried on in times and places when and where fishes meet for the deposition of eggs or spawn.

2. Dragging-nets must not be used in seasons and places in which eggs are in process of hatching, or embryos undergoing development.

3. Nets with too close meshes must not be used, because they gather the very small fishes, and thus prevent them from developing sufficiently to become useful to consumers.

4. No substance must be used which, when thrown in the sea, produces such changes in the water as to cause the death of all the fishes therein.

The third and fourth of the above rules find their application equally in every country, but the first two require for their application an exact knowledge of the instincts of fishes in regard to their spawning, and of the nature of the bottom of the sea.

The general rule, that fishing must be carried on in such a manner as not to affect the continued production, contains certainly, in itself, all that can be required. It often happens, however, that general rules are easier in theory than in practice.

As regards the apparatus of fishing, the greatest care has been deemed necessary, from remote times, in the use of trawl-nets, which, raking over the bottom of the sea so as to gather up the mud in seasons in which the eggs are deposited, destroy everything, thus causing much damage to the reproduction of the species. Hence the permanent prohibition of the use of such nets from April till October, which is found in the fishing regulation in the old Neapolitan provinces. The fact of the damage which is caused to marine productions by the use of trawl-nets in the seasons above mentioned is so evident to us that it seems useless to attempt to argue the question, especially as we would only be repeating what has already been demonstrated so learnedly by others. We think, however, that in examining such arguments we must not confine ourselves to the trawl-net, but must take into consideration the whole category of meshed nets. We must undoubtedly make a distinction between those which drag heavily the bottom of the sea, thereby gathering up all they meet with, including mud itself, as the trawl drags it, and the other nets which rest lightly on the bottom of the sea, like the seines in their modifications, &c. If, however, the former are the most injurious, the latter are none the less hurtful in certain seasons, for, while the former destroy the eggs and the embryos, the latter gather up the young when scarcely able to swim. In fact, the seines and hand-trawls, and similar nets, are precisely the kind that take enormous quantities of young of various kinds of fishes, which are brought to market by the ton, under the name of *fravaglie*, and which are the young of anchovies, mullets, gurnards, &c. While this immense quantity of fishes brings but a very scant profit, it subtracts from the sea the elements which, in the following seasons, would prove a source of sustenance to the people and profit to fishermen. It is owing to this principal reason, as we have stated before, that, while the Gulf of Naples furnishes the most favorable conditions to the prosperity and increase of its inhabitants, the fact is, that the fishes sent to market are not sufficient for the wants of the people, so that, in spite of the considerable quantities derived from the gulf, if we except a few rare cases of a small variety, the prices are such that the masses cannot afford to procure them. Another effect of this excessive fishing is, that in the Gulf of Naples (with few exceptions) the species never attain any considerable size; hence, for example, flounders and many other kind never attain half the size of those in the Adriatic. It is necessary, therefore, to forbid the use of nets which injure the inhabitants of the sea, of whatever kind.

ON THE POSSIBILITY OF EXHAUSTING THE SEA-FISHERIES.*

BY JAMES G BERTRAM.

The idea of a slowly but surely diminishing supply of fish is no doubt alarming, for the public have hitherto believed so devoutly in the frequently-quoted proverb of "more fish in the sea than ever came out of it," that it has never, except by a discerning few, been thought possible to overfish; and, consequently, while endeavoring to supply the constantly-increasing demand, it has never sufficiently been brought home to the public mind that it is possible to reduce the breeding-stock of our best kinds of sea-fish to such an extent as may render it difficult to re-populate those exhausted ocean colonies which in years gone by yielded, as we have been often told, such miraculous draughts. It is worthy of being noticed that most of our public writers who venture to treat the subject of the fisheries, proceed at once to argue that the supply of fish is unlimited, and that the sea is a gigantic fish-preserve, into which man requires but to dip his net to obtain at all times an enormous amount of wholesome and nutritious food.

This style of writing on the fisheries comes largely into use whenever there is a project of a joint-stock fishing company placed before the public. When that is the case, obscure little villages are pointed to as the future seats of enormous prosperity, just because they happen to be thought of by some enterprising speculator as the nucleus of a

* Extracted from "The Harvest of the Sea, a contribution to the natural and economic history of the British food-fishes. London. John Murray, 1865."

fishing town; and we are straightway told that Buckhorn, or Kirksalt, or some equally obscure place, could be made to rival those towns in Holland, whose wealth and prosperity originated in even smaller beginnings. We are likewise informed, on the occasions of giving publicity to such speculations, that "the sea is a liquid mine of boundless wealth, and that thousands of pounds might be earned by simply stretching forth our hands and pulling out the fish that have scarcely room to live in the teeming waters of Great Britain," &c. I would be glad to believe in these general statements regarding our food-fisheries, were I not convinced, from personal inquiry, that they are a mere coinage of the brain.

There are, doubtless, plenty of fish still in the sea, but the trouble of capturing them increases daily, and the instruments of capture have to be yearly augmented, indicating but too clearly to all who have studied the subject, that we are beginning to overfish. We already know, in the case of the salmon, that the greed of man, when thoroughly excited, can extirpate, for mere immediate gain, any animal, however prolific it may be. Some of the British game-birds have so narrowly escaped destruction that their existence, in anything like quantity, when set against the armies of sportsmen who seek their annihilation, is wonderful.

As has been mentioned in a previous chapter of this volume, the supply of haddocks and other *Gadidæ* was once so plentiful around the British coasts that a short line, with perhaps a score of hooks, frequently replenished with bait, would be quite sufficient to capture a few thousand fish. The number of hooks was gradually extended, till now they are counted by the thousand, the fishermen having to multiply the means of capture as the fish become less plentiful. About forty years ago the percentage of fish to each line was very considerable. Eight hundred hooks would take about 750 fish; but now, with a line studded with 4,000 hooks, the fishermen sometimes do not take 100 fish.

It was recently stated by a correspondent of the John O'Groat Journal, a newspaper published in the fishing-town of Wick, that a fish-curer there contracted some years ago with the boats for haddocks at 3*s*. 6*d*. per hundred, and that, at that low price, the fishing yielded the men from £20 to £40 each season, but that now, although he has offered the fishermen 12*s*. a hundred, he cannot procure anything like an adequate supply. As the British sea-fisheries afford remunerative employment to a large body of the population, and offer a favorable investment, it is surely time that we should know authoritatively whether or not there be truth in the falling-off in our supplies of herring and other white fish. At one of the Glasgow fish-merchants' annual soirees, held a year or two ago, it was distinctly stated that all kinds of fish were less abundant now than in former years, and that in proportion to the means of capture, the result was less. Mr. Methuen reiterated such opinions again and again. "I reckon our fisheries," said this enterprising fish-merchant on one occasion, "if fostered and properly fished, a national source of wealth of more importance and value than the gold-mines of Australia, because the gold-mines are exhaustible; but the living, propagating, self-cultivating gift of God is inexhaustible, if rightly fished by man, to whom they are given for food. It is evident anything God gives is ripe and fit for food. 'Have dominion,' not destruction, was the command. Any farmer cutting his ripe clover grass would not only be reckoned mad, but would, in fact, be so, were he to tear up the roots along with the clover, under the idea that he was thus obtaining more food for his cattle, and then wondering why he had no second crop to cut. His cattle would starve, himself and family be beggared, and turned out of their farm as improvident and destructive, who not only beggared themselves, but, to the extent of their power, impoverished the people by destroying the resources of their country. The farmer who thus destroys the hopes of a rising crop by injudicious farming, is not only his own enemy, but the enemy of his country as well."

Such evidence could be multiplied to any extent if it were necessary, but I feel that quite enough has been said to prove the point. It is a point I have no doubt upon whatever, and persons who have studied the question are alarmed, and say it is no use blinking the matter any longer—that the demand for fish as an article of food is not only beginning to exceed the supply, but that the supply obtained, combined with waste of spawn and other causes, is beginning to exceed the breeding-power of the fish. In the olden times, when people only caught to supply individual wants, fish were plentiful, in the sense that no scarcity was ever experienced, and the shoals of sea-fish, it was thought at one time, would never diminish; but since the traffic became a commercial speculation, the question has assumed a totally different aspect, and a sufficient quantity cannot now be obtained. Who ever hears now of monster turbot being taken by the trawlers? Where are the miraculous hauls of mackerel that used to gladden the eyes of the fishermen? Where are now the wagon-loads of herring to use as manure, as in the golden age of the fisheries? I do not require to pause for the reply—echo would only mock my question by repeating it. Exhausted shoals and inferior fish tell us too plainly that there *is* reason for alarm, and that we have, in all probability, broken at last upon our capital stock.

What, then, if this be so, will be the future of the British fisheries? I have already, and more than once, in preceding pages, hinted my doubts of the existence of the enormous fish-supplies of former days; in my opinion, the supposed plentifulness of all kinds of fish must in a large degree have been a myth, or at least but relative, founded, in all probability, on the fluctuating demand and the irregular supply. Were there not an active but unseen demolition of the fish-shoals, and were these shoals as gigantic as people imagine them to be, the sea would speedily become like stirabout, so that in time ships would not be able to sail from port to port. Imagine a few billions of herrings, each pair multiplying at the rate of thirty thousand per annum! picture the codfish, with its million ratio of increase; and then add, by way of enhancing the bargain, a million or two of the flat-fish family throwing in their annual quota to the total, and figures would be arrived at far too vast for human comprehension. In fact, without some compensating balance, the waters on the globe would not contain a couple of years' increase! If fish have that tendency to multiply which is said, how comes it that in former years, when there was not a tithe of the present demand, when the population was but scant, and the means of inland carriage to the larger seats of population rude and uncertain, the ocean did not overflow and leave its inhabitants on its shores? Were we better acquainted with the natural history of fish, it would be easy to regulate the fisheries. The everlasting demand for sea-produce has caused the sea-fishing, like the salmon-fishing, to be prosecuted at improper seasons, and fish have been, indeed, are daily, to a large extent, sold in a state that renders them quite improper for human food. Another cause of the constantly-lessening supplies may be also mentioned. Up till a recent period, it was thought *all* fish were migratory, and the reason usually assigned for unsuccessful fishing was that the fish had removed to some other place. Thus the fact of a particular colony having been fished up was in some degree hidden, chiefly from ignorance of the habits of the animal. This migratory instinct, so far as our principal sea-fish are concerned, is purely mythical. The rediscovery of the Rockall cod-bank must tend to dissipate these old-fashioned suppositions of our naturalists. All fish are local, from the salmon to the sprat, and each kind has its own abiding-place. The salmon keeps unfailingly to its own stream; the oyster to its own bank; the lobster to its particular rock; and the herring to its own bay. Fishermen are beginning now to understand this, and can tell the locality to which a particular fish belongs, from the marks upon it. A Tay salmon differs from a Tweed one, and Norway lobsters can be readily distinguished from those brought from The Orkneys. Then, again, the fine haddocks caught in the bay of Dublin differ much from those taken in the Frith of Forth, while Lochfyne herrings and Caithness herrings have each distinct peculiarities.

Our great farm, the sea, is free to all—too free; there is no seed or manure to provide, and no rent to pay. Every adventurer who can procure a boat may go out and spoliate the shoals; he has no care for the growth or preservation of animals which he has been taught to think inexhaustible. In one sense it is of no consequence to a fisherman that he catches codlings instead of cod; whatever size his fish may be, they yield him what he fishes for—money. What if all the herrings he captures be crowded with spawn? What if they be virgin fish, that have never added a quota to the general stock? That is all as nothing to the fisherman as long as they bring him money. It is the same in all fisheries. Our free, unregulated fisheries are, in my humble opinion, a thorough mistake. If a fisherman, say with a capital of £500 in boats, nets, &c., had invested the same amount of money in a breeding-farm, how would he act? Would he not earn his living and increase his capital by allowing his animals to breed? and he would certainly never cut down oats or wheat in a green state.

EXTRACT FROM THE LONDON FIELD, 1871.

The Americans, like ourselves, have begun to find that fisheries will die out if the fish are hindered from spawning, and are taken at all times and of all sizes. Incited thereto, perhaps, by our example, and by the movement which has taken place in Canada in respect to the fisheries, the Americans have begun to look rather sharply into the condition of their own rivers. We have received various reports from the United States of the proceedings which have been and are being taken in reference to their fisheries. Last year an inquiry was held respecting those of Massachusetts, at the instance of certain petitioners; but the inquiry failed, as it was stated by the committee that there was no sufficient cause shown for enacting any special measures. When a failure of this kind happens with us, we generally know on whose shoulders to put it; the opposition has been too strong, and the perpetrators of the mischief, whatever it may be, have made sufficient interest to keep things *in statu quo*. We do not say that this is the case over in Massachusetts. Fortunately, however, the example set by that State has not been followed, for Connecticut has come to a different conclusion, and has ordered that fixed engines shall be done away with on the southern coast of the State after the 1st of January, 1871; while now we have a report from Rhode Island, forwarded to us by Mr. Spencer F. Baird, in which it seems the committee have arrived at a similar opinion. The report will not bear much dissecting, as it consists chiefly of a series of questions answered by a number of different persons. From their evidence it seems to be clearly proved that the methods of fishing by means of traps, pounds, gill-nets, &c., are too severe for the fish, and that few of them can now reach their spawning places, while every year the total falls off; that whereas formerly scup, tautog, and other fish were very abundant, they are now (particularly scup) growing very scarce; and therefore the committee recommend the State to pass a very stringent act, prohibiting the setting of such traps and contrivances, under penalty of a fine of not less than $50 nor more than $300 for the first offense, and not less than $500 nor more than $1,000, with imprisonment for not less than a month nor more than a year, for every other. These are something like penalties, and prove that when our cousins mean to prohibit a thing they are in earnest.

EXTRACTS FROM THE REPORT OF THE COMMISSIONERS APPOINTED TO INQUIRE INTO THE SEA-FISHERIES OF THE UNITED KINGDOM; PRESENTED TO BOTH HOUSES OF PARLIAMENT BY COMMAND OF HER MAJESTY. LONDON, 1861.*

To the Queen's Most Excellent Majesty:

We, the undersigned commissioners, appointed by Your Majesty to inquire into the condition of the sea-fisheries of the United Kingdom of Great Britain and Ireland, and especially instructed by the terms of Your Majesty's commission to ascertain, firstly, whether the supply of fish is increasing, stationary, or diminishing; secondly, whether any modes of fishing which are practiced are wasteful or otherwise injurious to the

*This commission, composed of James Caird, Professor T. H. Huxley, and George Shaw Lefevre, was appointed in 1863 by the Queen, to inquire into the following points:

1st. Whether the supply of fish from the sea-fisheries is increasing, stationary, or diminishing.

2d. Whether any of the methods of catching fish in use in such fisheries involve a wasteful destruction of fish or spawn; and, if so, whether it is probable that any legislative restriction upon such method of fishing would result in an increase of the supply of fish.

3d. Whether any existing legislative restrictions operate injuriously upon any of such fisheries.

The conclusions to which the commissioners arrived have been vigorously assailed by many writers, both in this country and in Europe; chief among the latter is a French author, Rimbaud, whose protest is referred to in the report of the Massachusetts commissioners of fisheries for 1869, p. 60, and by Mr. G. H. Palmer, (p. 94,) of the present report. It is upon the conclusion of Professor Huxley and his associates that Captain Atwood mainly relies for his argument in favor of free fishing, without any restrictions. As has been shown by the first-mentioned writers, and in my own report, a distinction is to be drawn between the shore and the outside or deep-sea fisheries, and while the arguments of the British commissioners apply essentially to the latter, the questions in connection with the fisheries of the south side of New England are related almost exclusively to the former.

S. F. B.

supply of fish; and, thirdly, whether the said fisheries are injuriously affected by any legislative restrictions, humbly submit the following report of our proceedings to Your Majesty:

We first proceed to state the results of our inquiries into the matters to which Your Majesty's commission especially directs our attention. And, first, whether the supply of fish from the sea-fisheries is increasing, stationary, or diminishing.

Though there has been much conflicting evidence on this point, we have had no difficulty in coming to the conclusion that, on the coasts of Great Britain, the supply of fish is increasing, and that it admits of progressive increase.

It fluctuates according to the locality and the season of the year. In the autumn of 1863 the northeast coast of England yielded a meagre inshore fishing, while, in the following year, we found on the east coast of Scotland the haddock fishing had been one of the best ever known. And at the time that the inshore fishing was unproductive in 1863, that carried on by the decked vessels farther to sea was yielding an abundant supply.

The evidence where strongest in favor of a gradual decline in the yield of fish was nearly always accompanied by statements showing a progressive increase in the number of men and boats engaged in the fishing. And not only have these numbers uniformly increased, but there has also been an increase in the length of each fishing-line and the number of hooks upon it, in the length and depth of the nets, and in the size and sea-going qualities of the boats. The machinery for fishing has been increased in efficiency, while, in proportion to that efficiency, the cost of working it is actually diminished. There is likewise abundant proof of the continued productiveness of the nearest and most frequented fishing-grounds. The principal London salesmen concurred in their testimony to that effect. Not only are the fishing-vessels constantly being increased in number, but the take of each vessel is increasing, and, from the speedier means of transport, the quality of the fish is improving. On the western part of the Dogger bank it is not uncommon for a single trawl vessel to take, in a three hours' trawl, from two to three tons' weight of fish; and a smack-owner mentioned a recent case in which five of his vessels caught 17 tons of fish in one night. Similar testimony is borne to the prolific character of the fishing-banks of Scarborough, Flamborough Head, Grimsby, and the coast of Norfolk. In the English Channel, the famous fishing-ground of Rye Bay, which has for a long period of years been constantly trawled over by both English and French fishermen, was stated to have yielded more fish in 1863 than in any previous year. In some of the bays on the south coast signs of over-fishing have been alleged to exist, but in the deep sea the well-known trawling-grounds are constantly fished over with daily returning success.

The second question submitted to us is, whether any of the methods of catching fish in use in the sea-fisheries involves a wasteful destruction of fish and spawn; and, if so, whether it is probable that any legislative restriction upon such methods of fishing would result in an increase of the supply of fish?

Of the many methods of taking sea-fish described in the appendix, (No. 1,) very few have escaped complaint from one source or another; and our minutes of evidence would have been far less voluminous had we not considered it our duty to encourage the complainants to state their views fully, and to sift out, by careful and varied questioning, the amount of truth contained in their multitudinous allegations.

As these complaints have usually been brought against one class of fishermen by others, who, rightly or wrongly, conceived themselves to be unjustly injured in their most important interests; and as they have been rebutted by persons whose means of living, largely or wholly, depend upon their power to continue the alleged wrongful practices, it will not be a matter of astonishment that the evidence, so far as it records merely personal convictions, and assertions that can be neither proved or disproved, is of the most conflicting character.

In making this remark, we have no wish to reflect in the slightest degree upon the veracity of either side. On the contrary, we desire particularly to acknowledge the frankness with which the fishermen generally gave their evidence, and the intelligent manner in which they stated their views. But fishermen, as a class, are exceedingly unobservant of anything about fish which is not absolutely forced upon them by their daily avocations; and they are, consequently, not only prone to adopt every belief, however ill-founded, which seems to tell in their own favor, but they are disposed to depreciate the present in comparison with the past. Nor, in certain localities, do they lack the additional temptation to make the worst of the present, offered by the hope that strong statements may lead the state to interfere in their favor, with dangerous competitors.

Leaving out of consideration the comparatively few cases in which private rights of sea-fishery exist, it may be laid down as a broad principle that, apart from the restrictions prescribed by international law, or by special treaties, the produce of the sea is the property of the people in common, and that methods of fishing are fitting subjects for legislation only so far as such legislation can be shown to be necessary to secure the greatest possible advantage to the whole nation from the sea-fisheries, either by suppressing wasteful and uselessly destructive modes of fishing, or by removing legislative obstacles in the way of improved modes of fishing, or by preserving peace and order among fishermen.

Keeping these principles in view, all the tenable complaints against methods of fishing which have been brought before us may be classified under two heads:

I. Complaints that a given mode of fishing is wasteful, and tends to diminish the supply of fish permanently.

II. Complaints that a given mode of fishing interferes with the lawful occupations of fishermen of another class, or of other persons.

In discussing the first series of complaints, three distinct issues will have to be considered:

a. Does the alleged waste take place, and to what extent?

b. Can the waste which occurs be shown to have affected the supply of fish?

c. If waste have occurred to a sufficient extent to affect the supply of fish, how far is it desirable to interfere by direct legislation, and how far is it better to trust to natural checks?

And as regards the second series, we shall find it necessary to inquire—

a. Does the alleged interference occur, and to what extent?

b. If the interference occurs, does the public interest require the intervention of the state?

I. Complaints that a given mode of fishing is wasteful, and tends to diminish the supply of fish permanently.

The chief methods of fishery against which complaints of this kind have been brought are—

1. Beam-trawling in the open sea.
2. All kinds of sweep-net fishing, (beam-trawling, shrimping, seinings

circle-net fishing,) and fishing with small meshed nets and weirs in bays and estuaries.

Trawling is alleged to be a wasteful and destructive mode of fishing—

1. Because the whole, or the majority of the fish brought up in the trawl, are dead, and so much damaged as to be unwholesome or otherwise unfit for human food.

2. Because the beam and net, dragging along the sea-bottom, tear up or destroy the spawn of fish.

3. Because the net brings up a vast quantity of the fry of fish, or of fish so small as to be unsalable, which is all thrown back dead into the water.

4. Because, in consequence of the latter effects of trawling, all the grounds over which the trawlers work are becoming rapidly exhausted; so that not only are line-fishermen unable to obtain any fish there, but the trawlers themselves are obliged to seek other localities, and are in fact rapidly becoming ruined.

1. The assertion that trawled fish is always, or commonly, brought up not only dead, but so much damaged as to be unwholesome and unfit for human food, has been made and strongly persisted in by several witnesses; but we feel bound to express our conviction that the statement is incorrect, and, indeed, absurd.

2. The statement that the beam and the net of the trawl dragging along the ground tear up and destroy the spawn of fish, has not been justified by the evidence adduced. Many of the unhesitating assertions which have been made before us on this head, in fact, are only intelligible upon the supposition that the witnesses were ignorant of the real mode of working the trawl-net, and of the true nature of many of the substances brought up by it.

In conclusion, we are clearly of opinion—

1. That fishing by the use of the beam-trawl is the source of by far the greatest and most progressive supply of fish, other than herring, to the principal markets of this country; that certain descriptions of fish, such as soles and plaice, could not be largely supplied by any other mode of fishing; that it engages the largest capital, employs the most numerous body of hardy fishermen, is the least under the control of the weather, and obtains the greatest returns of fish for the labor and capital employed.

2. That there is no reason to believe that trawling in the open sea destroys the spawn of fish.

3. That trawling in the open sea involves the capture of a certain very variable proportion of small fish, which is wasted or not, according to circumstances.

4. That there is no evidence to show that trawling has permanently diminished the supply of fish from any trawling-ground, but that there is proof to the contrary.

5. That trawling in the open sea has not interfered with the supply of fish from line-fishermen; unless it be by catching, in a more expeditious and regular manner, fish which the line-fishermen might have taken.

6. That trawling in the open sea is not shown to be a wastefully-destructive mode of fishing, but the contrary.

7. That any legislative restriction upon trawling in the open sea would result in a very great decrease in the supply of fish.

X.—NOTICES IN REGARD TO THE ABUNDANCE OF FISH ON THE NEW ENGLAND COAST IN FORMER TIMES.

"*An account of two voyages to New England. A description of the country, natives, and creatures. By John Josselyn Gent.*, 1675.

[Reprinted in Collections of the Massachusetts Historical Society, 3d series, III., 1833.]

"The Sea that *Piscina mirabilis* affords us the greatest number, of which I shall begin first with the Whale, a regal fish, as all fish of extraordinary size are accounted; of these there are (as I have said in another place) seven kinds—the Ambergreese *Whale* the chiefest. *Anno Dom.* 1668, the 17 of *July*, there was one of them thrown up on the shore between *Winter-harbour* and *Cape-porpus*, about eight mile from the place where I lived, that was five and fifty foot long. They are Creatures of a vast magnitude and strength."—(P. 271.)

"The *Sea-hare* is as big as a *Grampus* or *Herrin-hog*, and as white as a sheet. There hath been of them in *Black-Point* Harbour, and some way up the river, but we could never take any of them; several have shot sluggs at them, but lost their labor."

"The sturgeon is a Regal fish, too; I have seen of them that have been sixteen foot in length; of their sounds they make isinglass, which, melted in the mouth, is excellent to seal letters."

"The *Sea-horse* or *Morse* is a kind of monster-fish, numerous about the Isle of *Sables; i. e.*, the Sandy Isle. An amphibious creature, killed for their Teeth and Oyl; never brings more than two at a birth; as also doth the Seal and Manate or Cow-fish, which is supposed to be the Sea-monster."

"The small *Sword-fish* is very good meat; the *Sea-bat* or *Sea-owl* is a kind of flying fish."—(P. 272.)

"The *Mackerel*, of which there is choicefull plenty all summer long; in the spring they are ordinarily 18 inches long; afterwards there is none taken but what are smaller."

"The Herrin, which are numerous, they take of them all summer long. In *Anno Dom.* 1670. They were driven back into *Black-Point* Harbour by other great fish that prey upon them so near the shore that they threw themselves (it being high water) upon dry land in such infinite numbers that we might have gone up half-way the leg amongst them for near a quarter of a mile. We used to qualifie a pickled *Herrin* by boiling of him in milk."

"The *Alewife* is like a *Herrin*, but has a bigger bellie; therefore called an *Alewife;* they come in the end of April into fresh Rivers and Ponds; there hath been taken in two hours' time by two men without any Weyre at all, saving a few stones to stop the passage of the River, above ten thousand."—(P. 273.)

"The Basse is a salt-water fish too, but most an end taken in Rivers where they spawn; there hath been 3,000 *Basse* taken at a set; one writes that the fat in the bone of a *Basse's* head is his braines, which is a lye."

"The *Salmon* likewise is a Sea-fish, but as the *Basse*, comes into Rivers to spawn. The *Salmon* the first year is a *Salmon-smolt;* The second a *Mort;* The third a *Spraid;* The fourth a *Soar;* The fifth a *Sorrel;* The sixth a *forket-tail;* and the seventh year a *Salmon*. There are another sort of *Salmon* frequent in those parts, called White *Salmons*."

"*Capeling* is a small fish like smelt."—(P. 274.)

"The *Frost-fish* is little bigger than a *Gudgeon*, and are taken in fresh brooks; when the waters are frozen they make a hole in the Ice, about half a yard or yard wide, to which the fish repair in great numbers, where, with small nets bound to a hoop about the bigness of a firkin-hoop, with a staff fastened to it, they take them out of the hole. I have not done with the fish yet, being willing to let you know all of them that are to be seen and catched in the Sea & fresh waters of *New England;* and because I will not tire your patience overmuch, having no occasion to enlarge my discourse, I shall only name them and so conclude."

"Aleport,
Albiocre,
Barracha,
Barracoutha,
Blew-fish,
Bull-head,
Bur-fish,
Cat-fish,
Cony-fish,
Cusk,
Clam,
Rock-Cod,
Sea-Cod,
Divers kinds of Crabs,
Sea-cucumber,
Cunner,
Sea-Darts or Javelins,
Flail-fish,
Flounder or Flowke,
Flying-fish,
several kinds,
Sea-Flea,
Grandpisse,
Hake,
Haddock,
Horse-foot,
Hallibut,
Hen-fish,
Lampre,
Limpin,
Lumpe,
Maid,
Monk-fish,
Sea Mullet,
Nun-fish,
Perch,
Polluck,
Periwincle,
Pike,
Pilot-fish,
Plaice,
Porpisse,
Prawne,
Purple-fish,
Porgee,
Remora,
Sea-Ravens,
Sail-fish,
Scallop,
Scate,
Stingray,
Sculpin,
Shadd,
Spurlin,
Sheath-fish,
Smelt,
Shrimps,
Sprates,
Star-fish,
Sword-fish,
Thornback,
Turbet,
The Vlatife or Saw-fish,
Sea-Vrchin,
Sea-Vnicorn."
—(Pp. 276, 277.)

New England's rarities discovered in Birds, Beasts, Fishes, Serpents, and Plants of that country, etc. By John Josselyn, Gent. 1672.

[Reprinted in Archæologia Americana, vol. IV., 1860.]

"The wobble, an ill-shaped bird; having no long feathers in their pinions, which is the reason they cannot fly; not much unlike the pengwin. They are in the spring very fat, or rather oyly; but pull'd and garbidg'd, and laid to the fire to roast, they yield not one drop."*—(P. 146.)

"The Sturgeon; of whose sounds is made isinglass,—a kind of glew much used in physick. This fish is here in great plenty, and in some rivers so numerous that it is hazardous for canoes and the like small vessels to pass to and again; as in Pechipscut River to the eastward."—(P. 164.)

"The scarlet muscle. At Paschataway, (a plantation about fifty

* This refers to the Great Auk, *Alca impennis*, now extinct.—S. F. B.

leagues by sea eastward from Boston,) in a small cove called Baker's Cove, there is found this kind of muscle, which hath a purple vein; which, being prickt with a needle, yieldeth a perfect purple or scarlet juice; dying linnen so that no washing will wear it out, but keeps its lustre many years. We mark our handkerchiefs and shirts with it."—(P. 167.)

Blew Fish or Hound-fish, two kinds. Speckled hound-fish, and blew hound-fish, called horse-fish.—(P. 158.)

Blew-fish or horse. I did never see any of them in England. They are big usually as the salmon, and better meat by far. It is common in New England, and esteemed the best sort of fish, next to rock-cod.—(P. 229.)

Advertisements for the inexperienced Planters of New England, or anywhere. Or, the Pathway to experience to erect a Plantation. By Captaine Iohn Smith. London, 1631.

[Reprinted in Collections of the Massachusetts Historical Society, III., 3d series, 1833.]

At the sole charge of foure Merchants of London and my selfe, 1614, within eight weekes sayling I arrived at *Monahigan* an Ile in *America* in 43. degrees 39. minutes of Northerly latitude. Had the fishing for Whale proved as we expected, I had stayed in the country; but we found the plots wee bad, so false, and the seasons for fishing and trade by the unskilfulnesse of our Pylot so much mistaken, I was contented, having taken by hookes and lines with fifteene or eighteene men at most, more than 60,000 cod in lesse than a moneth.—(P. 19.)

The seven and thirty passengers miscarrying twice upon the coast of *England*, came so ill-provided, they onely relyed upon the poore company they found, that had lived two yeares by their naked industry, and what the country naturally afforded; it is true, at first there hath beene taken a thousand Bayses at a draught, and more than twelve hogsheads of Herrings in a night; of other fish when and what they would, when they had meanes; but wanting most necessaries for fishing and fowling, it is a wonder how they could subsist, fortifie themselves, resist their enemies, and plant their plants.—(Chap. 7, p. 19.)

One ship this summer with twenty cattell, and forty or fifty passengers, arrived all well, and the ship at home againe in nine weekes: another for all this exclamation of want, is returned with 10000. corfish, and fourescore kegs of Sturgion, which they did take and save when the season was neare past, and in the very heat of summer, yet as good as can be.—(Chap. 13, p. 42.)

A Description of New England: or, the Observations & Discoueries of Captain John Smith (Admirall of that Country) in the North of America, in the year of our Lord 1614; *with the successe of sixe Ships, that went the next yeare* 1615; *& the accidents befell him among the French men of warre: with the proofe of the present benefit this Countrey affoords: whither this present yeare,* 1616, *eight voluntary Ships are gone to make further tryall. At London: Printed by Humfrey Lownes, for Robert*

Clerke; & are to be sould at his house called the Lodge, in Chancery lane, ouer against Lincolnes Inne.—1616."

[Reprinted in Force's Historical Tracts, vol. ii. Contents, p. 3, Tract 1.]

"The seasons for fishing approoued. In March, April, May, & halfe June, here is Cod in abundance; in May, June, July, & August, Mullet & Sturgion; whose roes doe make Cauiare & Puttargo. Herring, if any desire them, I haue taken many out of the bellies of Cods, some in nets; but the Saluages compare their store in the sea, to the haires of their heads: & surely there are an incredible abundance upon this Coast. In the end of August, September, October & Nouember, you haue Cod againe to make Cor fish, or Poore John: & each hundred is as good as two or three hundred in the *New-found Land*. So that halfe the labor in hooking, splitting, & turning, is saued: & you may haue your fish at what Market you will, before they can have any in *New-found Land;* where their fishing is chiefly but in June & July: whereas it is heere in March, April, May, September, October, & Nouember, as is said. So that by reason of this plantation, the Merchants may haue fraught both out & home: which yeelds an advantage worth consideration."

"The Mullets heere are in that abundance, you may take them with nets, sometimes by hundreds, where at *Cape blank* they hooke them; yet those but one foot & a halfe in length; these two, three, or foure, as oft I have measured: much Salmon some haue found vp the Riuers, as they haue passed: & heer the ayre is so temperate, as all these at any time may well be preserued." (*Vol. II*, *p.* 10, *Tract* 1.)

"Of Beuers, Otters, Martins, Blacke Foxes, & Furres of price, may yearely be had 6 or 7,000: & if the trade of the *French* were preuented, many more: 25,000 this yeare were brought from those Northern parts into France; of which trade we may haue as good part as the *French*, if we take good courses." (*Vol. II*, *p.* 12, *Tract* 1.)

WOODS.—"The cheefe headlands are onely *Cape Tragabigzanda* & *Cape Cod*."

"Oke, is the chiefe wood; of which there is great difference in regard of the soyle where it groweth: firre, pyne, walnut, chesnut, birch, ash, elme, cypresse, ceder, mulberrie, plumtree, hazell, saxefrage, & many other sorts."

BIRDS.—"Eagles, Gripes, diuerse sorts of Haukes, Cranes, Geese, Brants, Cormorants, Ducks, Sheldrakes, Teale, Meawes, Guls, Turkies, Diue-doppers, & many other sorts, whose names I knowe not."

FISHES.—"Whales, Grampus, Porkpisces, Turbut, Sturgion, Cod, Hake, Haddock, Cole, Cusk, or small Ling, Shark, Mackerrell, Herring, Mullet, Base, Pinacks, Cunners, Pearch, Eels, Crabs, Lobsters, Muskles, Wilkes, Oysters, & diuerse others, &c." (*Vol. II*, *p.* 16, *Tract* 1.)

BEASTS.—"Moos, a beast bigger than a Stagge; Deere, red, & Fallow; Beuers, Wolues, Foxes, both blacke & other; Aroughconds, Wild-cats, Beares, Otters, Martins, Fitches, Musquassus, & diuerse sorts of vermine, whose names I know not. All these & diuerse other good things do heere, for want of vse, still increase, & decrease with little diminution, whereby they growe to that abundance. You shall scarce finde any Baye, Shallow Shore, or Coue of sand, where you may not take many Clampes, or Lobsters, or both at your pleasure, & in many places lode your boat if you please; Nor Iles where you finde not fruits, birds, crabs, & muskles, or all of them, for taking, at lowe water. And in the harbors we frequented a little boye might take of

Cunners, & Pinacks, & such delicate fish, at the Ship's sterne, more than sixe or tenne can eate in a daie; but with a casting-net, thousands when wee pleased: & scarce any place, but Cods, Cuske, Holybut, Mackerell, Scate, or such like, a man may take with a hooke or line what he will. And, in diuerse sandy Baies, a man may draw with a net great store of Mullets, Bases, & diuerse other sorts of such excellent fish, as many as his Net can drawe on shore: no Riuer where there is not plentie of Sturgion, or Salmon, or both; all which are to be had in abundance obseruing but their seasons." (*Vol. II, p.* 17, *Tract* 1.)

"And is it not pretty sport, to pull vp two pence, six pence, and twelue pence, as fast as you can hale & veare a line? He is a very bad fisher, cannot kill in one day with his hooke & line, one, two, or three hundred Cods: which dressed & dryed, if they be sould there for ten shillings the hundred, though in *England* they will giue more than twentie; may not both the seruant, the master, & marchant, be well content with this gaine? If a man worke but three days in seauen, he may get more then hee can spend, vnlesse he will be excessiue." (*Vol. II, p.* 21, *Tract* 1.)

"*New England's Trials. Declaring the successe of* 80 *ships employed thither within these eight yeares; and the benefit of that Country by Sea and Land. With the present estate of that happie Plantation, begun but by* 60 *weake men in the yeare* 1620. *And how to build a Fleete of good Shippes to make a little Nauie Royall. Written by Captain John Smith, sometimes Gouernour of Virginia, & Admirall of New England. The Second Edition. London: Printed by William Iones.*—1622."

[Force's Historical Tracts, vol. II, Tract 2.]

"With two ships sent out at the charge of Captain Marmaduke Roydon, Captain George Langam, M. John Buley, & W. Skelton, I went frō the Downes the third of March, & arriued in New England the last of April, where I was to haue stayed but with ten men to keep possession of those large territories. Had the whales proued, as curious information had assured me & my adventurers, (but those things failed.) So having but fortie-five men & boyes, we built seven boates, 37 did fish; myself with eight others ranging the coast, I took a plot of what I could see, got acquaintance of the inhabitants; 1,100 Beuer skins, 100 Martins & as many Otters. 40,000 of drie fish we sent for Spaine with the salt fish, traine oile & Furres. I returned for England the 18 of July, & arriued safe with my company the latter end of August." (*Vol. II, p.* 9, *Tract* 2.)

"The country very pleasant & temperate, yeelding of it self great store of fruites, as vines of diuers sorts in great abundance; there is likewise walnuts, chesnuts, small nuts & plums, with much varietie of flowers, rootes, & herbs, no lesse pleasant then wholsome & profitable: no place hath more goose-berries & straw-berries, nor better, Timber of all sorts you haue in England, doth couer the Land, that affoords beasts of diuers sorts, & great flocks of Turkies, Quailes, Pigeons & Partriges: many great lakes abounding with fish, fowle, Beuers & Otters. The sea affoords vs as great plenty of all excellent sorts of sea-fish as the riuers & Iles doth varietie of wilde fowle of most vsefull sorts." (*Vol. II, p.* 14, *Tract* 2.)

"What is already writ of the healthfulnesse of the aire, the richnesse of the soile, the goodnes of the woods, the abundance of fruits, fish, & fowle in their season, they stil affirm that haue bin there now neare 2 yeares, & at one draught they haue taken 1,000 basses, & in one night twelve hogsheads of herring." (*Vol. II, page* 16, *Tract* 2.)

"*Gov. Thomas Dudley's Letter to the Countess of Lincoln, March,* 1631. *With explanatory Notes, by Dr. John Farmer, Corresponding Secretary of the New-Hampshire Historical Society. Washington: Published by Peter Force.*—1838."

[Reprinted Force's, Historical Tracts II., Tract 4.—1838.]

"Vpon the 8 of March, from after it was faire day light untill about 8 of the clock in the forenoone, there flew over all the tounes in our plantacons so many flocks of doues, each flock conteyning many thousands, & some soe many that they obscured the lighte, that it passeth credit, if but the truth should bee written. (*Vol. II, page* 17, *Tract* 4.)

"*New English Canaan; or, New Canaan, containing an abstract of New England.—Composed in three Bookes. The first setting forth the Originall of the Natives, their Manners & Customs. Together with their tractable Nature & Love towards the English. II. The Natural Indowments of the Countrie, & what Staple Commodities it yeeldeth. III. What People are planted there, their Prosperity, what remarkable Accidents have happened since the first planting of it: together with their Tenants & practise of their Church. Written by Thomas Morton, of Clifford's Inn, Gent. Upon ten Yeers Knowledge & Experiment of the Country. Printed by Charles Green.*—1632."

[Reprinted in Force's Historical Tracts, Vol. II, Tract 5.]

"And first of the Swanne, because she is the biggest of the fowles of that Country. There are of them in Merrimack River, & in other parts of the country, greate Store at the seasons of the yeare."

"There are Gesse of three sorts, vize, brant Geese, which are pide, & white Geese which are bigger, & gray Geese, which are as bigg & bigger then the tame Geese of England, with black legges, black bills, heads & necks black."—*Vol. II, p.* 46, *Tract* 5.)

"Ducks, there are of three kindes, pide Ducks, gray Ducks, & black Ducks in greate abundance."

"Teales, there are of two sorts greene winged, & blew winged."

"Widggens there are, & abundance of other water foule."

"Simpes, there are like our Simpes in all respects, with very little difference."

"Sanderlings are dainty birds, more full bodied than a Snipe."

"Cranes, there are greate Store." (*P.* 47, *Tract* 5.)

"Turkies there are, which divers times in great flocks have sallied by our doores. Of these there hath bin killed, that have weighed forty-eight pound a peece. I had a salvage who hath taken out his boy in a morning, & they have brought home their loades about noone. I have asked them what number they found in the woods, who have answered Neent Metawna, which is a thousand that day; the plenty of them is such in these parts. They are easily killed at rooste, because the one being killed, the other sit fast neverthelesse, & this is no bad commodity."

"There are a kinde of fowles which are commonly called Pheisants, but whether they be pheysants or no, I will not take upon mee, to determine. They are in form like our pheisant-henne of England. Both the male & the female are alike; but they are rough footed: & have stareing fethers about the head & neck, the body is as bigg as the pheysant-henne of England; & are excellent white flesh, & delicate white meate, yet we seldome bestowe a shoote at them."

"Partridges, there are much, like our Partridges of England, they are of the same plumes, but bigger in body. They have not the signe of the horse shoe-shoe on the brest as the Partridges of England; nor are they coloured about the heads as those are; they sit on the trees. For I have seen 40. in one tree at a time; yet at night they fall on the ground, & sit until morning so together; & are dainty flesh."

"There quailes also, but bigger then the quailes in England. They take trees also: for I have numbered 60. upon a tree at a time. The cocks doe call at the time of the yeare, but with a different note from the Cock quailes of England." (*P.* 48, *Tract* 5.)

"There are Owles of divers kindes: but I did neve heare any of them whop as ours doe."

"There are Crowes, kights & rooks that doe differ in some respects from those of England. The Crowes (which I have much admired, what should be the cause) both smell & taste of Muske in Summer, but not in Winter." (*P.* 49, *Tract* 5.)

"There is a curious bird to see to, called a hunning bird, no bigger than a great Beetle; that out of question lives upon the Bee, which he eateth & catcheth amongst Flowers: For it is his Custome to frequent those places, Flowers he cannot feed upon by reason of his sharp bill, which is like the poynt of a Spanish needle, but Shorte. His fethers have a glosse like silke, & as hee stirres, they show to be of a chaingable coloure; & has bin, & is admired for shape, coloure, & size." (*P.* 50, *Tract* 5.)

"There are in this Country, three kindes of Deares of which there are greate plenty, & those are very usefull. First, therefore I will speake of the Elke, which the Salvages call a Mose: it is a very large Deare, with a very faire head, & a broade palme, like the palme of a fallow Deares horne, but much bigger, & is 6. footewide betweene the tipps, which grow curbing downwards: Hee is of the bignesse of a great horse. There is a second sort of Deare (lesse then the redd Deare of England, but much bigger then the English fallow Deare) swift of foote, but of a more darke coloure; with some griseld heares. When his coate is full growne in the summer season, his hornes grow curving, with a croked beame, resembling our redd Deare, not with a palme like the fallow Deare." (*P.* 51, *Tract* 5.)

"There is likewise a third sorte of deare, lesse then the other, (which are a kind of rayne deare,) to the southward of all the English plantations, they are excellent good flesh. And these also bring three fownes at a time, & in this particular the Deare of those parts, excell all the knowne Deare of the whole world."

"The next in mine opinion fit to be spoken of is the Beaver; which is a Beast ordained, for land & water both, & hath fore feet like a cunny, her hinder feete like a goese, mouthed like a cunny, but short eared like a Serat, fishe in summer, & wood in winter, which hee conveyes to his howse built on the water, wherein hee sitts with his tayle hanging in the water, which else would over heate & rot off."—(P. 52, *Tract* 5.)

"The Otter of those parts, in Winter season, hath a furre as black so jett, & is a furre of very highe price; a good black skinne is worth 3. or 4. Angels of gold. The Flesh is eaten by the Salvages: but how good it is I cannot shew, because it is not eaten by our Nation. Yet is this a beast, that ought to be placed in the number amongst the Commodities of the Country."

"The Luseran or Luseret, is a beast like a Catt: but so bigg as a great hound: with a tayle shorter then a Catt. His clawes are like a Catt's. Hee will make a pray of the Deare. His Flesh is dainty meat, like a lambe; his hide is choise furre, & accompted a good commodity."

"The Martin is a beast about the bignes of a Foxe. His furre is chestnutt coloure, & of those there are greate Store in the Northerne parts of the Country, & is a good commodity." (*P.* 53, *Tract* 5.)

"The Racowne is a beast as bigg, full out, as a Foxe, with a Bush-tayle. His Flesh excellent foode: his oyle precious for the Syattica, his furre course, butt the Skinnes serve the Salvages for coats, & is with those people of more esteeme, then a coat of beaver, because of the tayles that (hanging round in their order) doe adorne the garment, & is therefore so much esteemed of them. His fore-feete are like the feete of an ape; & by the print thereof, in the time of snow, he is followed to his hole, which is commonly in a hollow tree, from whence hee is fiered out, & so taken."

"The Foxes are of two coloures; the one redd, the other gray, these feede on fish; & are good furre, the doe not stinke, as the Foxes of England, but their condition for their pray, is as the Foxes of England."

"The Wolfes are of divers coloures: some sandy coloured; some griselled, & some black, their foode is fish which they catch when they pass up the rivers, into the ponds to spawne at the Spring time. The Deare are also their pray, & at Summer, where they have whelpes, the bitch will fetch a puppy dogg from our dores, to feed their whelpes with." (*P.* 54, *Tract* 5.)

"The Beare is a tyrant at a Lobster, & at low water will downe to the Rocks, & groape after them with great diligence. His hide is used by the Salvages, for garments, & is more commodious then discommodious, as may passe (with some allowance) with the rest."

"The Muskewashe, is a beast that frequenteth the ponds. What he eats I cannot finde."

"This Country, in the North parts thereof, hath many Porcupines, but I do not finde the beast any way usefull or hurtfull."

"There are in those Northerne parts many Hedgehoggs, of the like nature, to our English Hedghoggs."

"Here are greate store of Conyes in those parts, of divers coloures; some white, some black, & some gray. Those towards the Southern parts are very small, but those to the North are as big as the English Cony; their eares are very short. For meate the small rabbit is as good as any that I have eaten of elsewhere."

"There are Squirils of three sorts, very different in shape & condition; & is gray, & hee is as bigg as the lesser Cony, & keepeth the woods feeding upon nutts."

"Another is red, and he haunts our houses, & will rob us of our Corne, but the Catt many times, payes him the price of his presumption." (*P.* 55, *Tract* 5.)

"The third is a little flying squirill, with bat-like wings, which hee spreads when hee jumps from tree to tree, and does no harm."

SNAKES.—"The general Salvage name of them is Ascowke. There is one creeping beast, or longe creeple (as the name is in Devonshire,) that hath a rattle at his tayle, that doth discover his age. I have had my dogge venomed with troubling one of these; & so swelled, that I thought it would have bin his death; but with one saucer of salet oyle powred downe his throat, he has recovered, & the swelling asswaged by the next day. The like experiment hath bin made upon a boy that hath by chance troad upon one of these, and the boy never the worse. Therefore it is simplicity in any one that shall tell a bugbeare tale of horrible or terrible Serpents that are in that land.

"Mise there are good store, & my Lady Woodbees black gray malkin may have pastime enough there: but for rats, the Country by Nature is troubled with none." (P. 56, *Tract.* 5.)

"*Of the Fishes, & what commodity they proove.*

"Among Fishes First I will begin with the Codd, because it is the most commodious of all fish, as may appeare, by the use which is made of them in foraigne parts."

"The Codd fishing is much used in America, (whereof New England is part) in so much as 300. Sayle of shipps, from divers ports, have used to be imployed yearely in that trade."

"I have seene in one Harboure, next Richmond Island 15. Sayle of shipps at one time, that have taken in them, driyed Codds for Spaine, & the Straights (& it has bin found that the Saylers have made 15. 18. 20. 22. p. Share for a common man."

"The Coast aboundeth with such multitudes of Codd, that the inhabitants of New England doe dunge their grounds with Codd; & it is a commodity better than the golden mines of the Spanish Indies; for without dried Codd the Spaniard, Portugal & Italian, would not be able to vittell of a shipp for the sea; & I am sure at the Canaries it is the principall commodity; which place lyeth neere New England very convenient, for the vending of this commodity, one hundred of these being at the price of 300. of New found land Codds, great store of traine oyle is mayd of the livers of the Codd, & is a commodity that without question will enrich the inhabitants of New England quickly; & is therefore a principall commodity."

"The Basse is an excellent Fish, both fresh & Salte one hundred whereof salted (at market) have yielded 5. p. They are so large, the head of one will give a good eater a dinner, & for daintinesse of diet, they excell the Marybones of Beefe. There are such multitudes, that I I have seene stopped into the river close adjoining to my howse with a sand at one tide, so many as will loade a ship of 100 tonnes."

"Other places have greater quantities in so much, as wagers have bin layed, that one should not throw a stone in the water, but that hee should hit a fish."

"I myselfe, at the turning of the tyde, have seene such multitudes passe out of a pounde, that it seemed to me, that one might goe over their backs drishod."

"These follow the bayte up the rivers, & sometimes are followed for bayte & chased into the bayes, & shallow waters, by the grand pise[1]: & these may have also a prime place in the Catalogue of Commodities."

"The Makarels are the baite for the Basse, & these have been chased into the shallow waters, where so many thousands have shott themselves a shore with the surfe of the Sea, that whole hogges-heads have been taken up on the Sands; & for length they excell any of other

---

[1] Grampus, (S. F. B.)

parts: they have bin measured 18. & 19. inches in length & seaven breadth: & are taken with a drayle, (as boats use to pass to & froe at Sea on businesse) in very greate quantities all along the Coaste."

"The Fish is good, salted; for store against the winter, as well as fresh, & to be accounted a good commodity."

"The Sturgeon in England is *regalis piscis*, every man in New England may catch what he will, there are multitudes of them, & they are much fatter than those that are brought into England from other parts, in so much as by reason of their fatnesse, they do not look white, but yellow, which made a cook presume they were not so good as them of Roushea: silly fellow that could not understand that it is the nature of fish salted, or pickelled, the fatter the yellower being best to preserve."

"Of Salmons there is a great abundance: & these may be allowed for a commodity, and placed in the catallogue."

"Of Herrings, there is great store, fat, and faire; & (to my minde) as good as any I have seene, & these may be preserved, and made a good commodity at the Canaries."

"Of Eeles there is abundance, both in the Saltwaters & in the fresh: & the fresh water Eele there (if I may take the judgment of a London Fishmonger) is the best that hee hath found in his life time. I have with jieele potts found my howsehold, (being nine persons, besides doggs) with them: taking them every tide, (for 4. moneths space) & preserving of them for winter store; & these may prove a good commodity."

"Of Smelts there is such abundance, that the Salvages doe take them up the rivers with baskets, like sives."

"There is a Fish (by some called shadds, by some allizes[1]) that at the spring of the yeare, passe up the rivers to spaune in the ponds; & are taken in such multitudes in every river, that hath a pond at the end, that the inhabitants doung their grounds with them. You may see in one township a hundred acres together, set with these Fish, every acre taking 1,000 of them: & an acre thus dressed will produce & yeald so much corne as 3. acres without Fish: & (least any Virginea man would inferre hereupon, that the ground of New England is barren, because they use no fish in setting their corne, I desire them to be remembered, the cause is plain in Virginea) they have it not to sett. But this practice is onely for the Indian Maize (which must be set by hands) not for English graine: & this is, therefore, a commodity there.

"There is a large sized fish called Hallibut, or Turbut: some are taken so bigg that two men have much a doe to hall them into the boate; but there is such plenty, that the fisher men onely eate the heads & finnes, and thow away the bodies: such in Paris would yeeld 5. or 6. crownes a peece: and this is no discommodity."

"There are excellent Plaice & easily taken. They (at flowing water) do almost come ashore, so that one may stepp but halfe a foote deepe, & pick them up on the sands: & this may pass with some allowance."

"Hake is a dainty white fish, & excellent vittell fresh; and may passe with other commodities, because there are multitudes."

"There are greate store of Pilchers: at Michelmas, in many places, I have seene the Cormerants in length 3. miles feeding upon the Sent."

"Lobsters are there infinite in store in all parts of the land, & very excellent. The most use that I made of them, in 5. yeares after I came there was but to baite my Hooke for to catch Basse, I had bin so cloyed with them the first day I went a shore."

---

[1] Alewives, (S. F. B.)

"This being knowne, they shall passe for a commodity to the inhabitants; for the Salvages will meete 500, or 1,000, at a place where Lobsters come in with the tyde, to eate, & save dried for Store, abiding in that place, feasting & sporting a moneth or 6. weekes together."

"There are greate store of oysters in the entrance of all Rivers; they are not round as those of England, but excellent fat, and all good. I have seene an Oyster bank a mile at length."

"Mustles there are infinite store, I have often gon to Wassaguscus; where were excellent Mustles to eate (for variety) the fish is so fat & large."

"Clames is a shellfish, which I have seene sold in Westminster for 12. pe. the skore. These our swine feede upon; & of them there is no want, every shore is full, it makes the swine proove exceedingly, they will not faile at low water te be with them. The Salvages are much taken with the delight of this fishe; & are not cloyed (notwithstanding the plenty) for our swine we find it a good commodity."

"Raser fishes there are. Freeles there are, Cockles, and Scallopes, & divers other sorts of shellfishe, very good foode."

"There are, in the rivers and ponds, very excellent Trouts, Carpes, Breames, Pikes, Roches, Perches, Tenches, Eeles, and other fishes such as Engiand doth afford, & as good, for variety; yea many of them much better; & the natives of the inland parts doe buy hookes of us to catch them with, & I have knowne the time, that a Trout's hooke hath yielded a beaver skinne, which hath bin a good commodity to those that have bartered them away."

"*New England's Plantation, or a short & true description of the Commodities & Discommodities of that Countrey. Written by a reverend Diuine* [*Mr. Higgeson*] *now there resident. London. Printed by T. C. & R. C. for Michael Sparke, dwelling at the signe of the Blue Bible in Greene Arbor in the little Old Bailey*, 1630."

[Force's Historical Tracts. Vol. I, Tract XII: also, collections of Massachusetts Historical Society for the year 1792. Vol. 1. Boston: 1806.]

"For Beasts there are some Beares, & they say some Lyons also; for they have been seen at Cape *Anne*. Also here are severall sorts of Deere, some whereof bring three or foure young ones at once, which is not ordinarie in *England*. Also Wolues, Foxes, Beauers, Otters, Martins, great wild Cats, and a great Beast called a Molke as bigge as an Oxe. I have seen the skins of all these Beasts since I came to this Plantation excepting Lyons. Also here are great Store of Squerrels, some greater, & some smaller & lesser: there are some of the lesser sort, they tell me, that by a certain Skin will fly from Tree to Tree though they stand far distant." (P. 8.)

"*New England* hath Water enough both salt & fresh, the greatest Sea in the World, the *Atlanticke* Sea runs all along the Coast thereof. There are aboundance of Islands along the Shore, some full of Wood & Mast to feed Swine; & others cleere of Wood, & fruitful to beare Corne. Also we haue store of excellent harbours for Ships, as at Cape *Anne*, & at *Masathulets* Bay, & at *Salem*, & at many other places: & they are the better because for Strangers there is a verie difficult & dangerous passage into them, but unto such as are well acquainted with them, they are easie & safe enough. The aboundance of Sea-Fish are almost beyond beleeuing, & sure I should scarce haue beleeued it except I had seene it with mine owne Eyes. I saw great Store of Whales & Crampusse, & such aboundance of Makerils that it would astonish one to behold, likewise Cod-Fish aboundance on the Coast, & in their season are plentifully taken. There is a Fish called a Basse, a most sweet & wholesome Fish as euer I did eat, it is altogether as good as our fresh Sam mon, & the season of their comming was begun when we came first to *New-England* in June, & so continued about three months space. Of this Fish our Fishers take many hundreds together, which I haue seene lying on the shore to my admiration; yea, *their Nets ordinarily take more than they are able to hall to Land*, & for want of Boats & Men they are constrained to let a many goe after they haue taken them, & yet sometimes they fill two Boats at a time with them. And besides Basse we take plentie of Scate & Thornbacke, & aboundance of Lobsters, that the least Boy in the Plantation may both catch & eat what he will of them. For my owne part I was soone cloyed with them, they were so great, & fat, & lussious. I haue seene some my selfe that haue weighed 16 pound, but others haue had diuers time so great Lobsters as haue weighed 25 pound, as they assured me. Also here is aboundance of Herring, Turbut, Sturgion, Cuskes, Hadocks, Mullets, Ee les, Crabs, Muskles & Oysters."—(P. 9.)

" Here are likewise aboundance of Turkies often killed in the Woods, farre greater than our English Turkies, & exceeding fat, sweet, & fleshy, for here they haue aboundance of feeding all the yeere long, as Strawberries, in Summer all places are full of them, & all manner of Berries & Fruits. In the Winter time I haue seene Flockes of Pidgeons, & haue eaten of them; they doe flye from Tree to Tree as other Birds doe, which our Pidgeons will not doe in *England:* they are of all colours as ours are, but their wings & tayles are farr longer, & therefore it is likely they fly swifter to escape the terrible Hawkes in this Countrey. In Winter time this Countrey doth abound with wild Geese, wild Ducks, & other Sea Fowle, that a great part of Winter the Planters haue eaten nothing but roastmeat of divers Fowles which they have killed."

Chronicles of the Pilgrim Fathers of the colony of Plymouth. 1692–'25. *By A. Young*, 8 *vo.*, *Boston*, 1841.

" In five or six hours [in Cape Cod Bay] we pestered our ship so with cod fish that we threw numbers of them overboard again." *Journal of John Brereton, May*, 1602.

[He was then with Gosnold, on the voyage in which Cape Cod was discovered. Page 101.]

" We saw daily [in Cape Cod Harbor, Nov.–Dec., 1620] great whales, of the best kind for oil & bone, come close aboard our ship, and in fair weather swim & play about us." P. 146.)

" Before the brook [Town Brook, Plymouth, Mass.] was so much impeded by dams, vast quantities of alewives passed up through it annually to Billington Sea. In a single season 800 barrels have been taken." P. 172, *note* 3.)

" Having but one boat left, we divide the men into several companies, six or seven in each; who take their turns to go out with a net and fish, and return not till they get some, though they be five or six days out; knowing there is nothing at home, & to return empty would be a great discouragement. When they stay long or get but little, the rest go a digging shell fish." [Plymouth, Mass., summer of 1623.] Bradford in Prince, p. 216. P. 348, *note* 1.)

History of Scituate, Massachusetts, from the first settlemént to 1831. *By Samuel Deane,* 8 *vo. Boston,* 1831.

"In 1680, Cornet Robert Stetson, of Scituate, and Nathaniel Thomas, of Marshfield, hired the cape fishery for bass and mackerel. In 1684, the court enacted a law "prohibiting the seining of mackerel in any part of the colony;" and the same year leased the cape fishery for bass and mackerel to Mr. William Clark for seven years, at £30 per annum. Subsequently to 1700, it is certain that the mackerel were very abundant in the Massachusetts Bay. It was not uncommon for a vessel to take a thousand barrels in the season. The packing, as it is called, was chiefly done at Boston and Plymouth until late years. The vessels of Scituate now pack at one harbor. George Morton, who came from Plymouth in 1730, was the first cooper of whom we have heard, at Scituate harbour. Our vessels now find them less abundant, and farther from their former haunts. They used to set into the bay early in May, and again in autumn: but now they are found at Block Island channel in May—at George's Bank and Nantucket shoals in the summer, and at Mount Desert and along the shores of Maine in the autumn. Those first taken are lean, and favour the commonly received opinion, that they lie in the muddy bottom in the winter but towards the winter they are found well fed, fat, and delicious. The full-grown mackerel vary in weight from one to two and three pounds. The fattest, taken in the autumn, are not generally of the largest size."

New-Englands Plantation. Or, a short and trve description of the commodities and discommodities of that countrey. Written by a reuerend Divine [*Francis Higginson*] *now there resident. London,* 1630.

[Foree's Historical Tracts, I, 1836, No. 12.]

The abundance of Sea-Fish are almost beyond beleeuing, and sure I should scarce have beleeued it except I had seene it with mine owne Eyes. I saw great store of Whales and Crampusse, and such aboundance of Makerils that it would astonish one to behold, likewise Cod-Fish aboundance on the coast, and in their season are plentifully taken. There is a Fish called a Basse, a most sweet and wholesome Fish as ever I did eat, it is altogether as good as our fresh Sammon, and the season of their comming was begun when we came first to New-England, in June, and so continued about three months apace. Of these Fish our Fishers take many hundred together, which I have seene lying on the shore to my admiration, yea, their nets ordinarily take more then they are able to hale to Land, and for want of Boats and men they are constrained to let a many goe after they have taken them, and yet sometimes they fill two Boats at a time with them, (p. 9.)

Nerv Englands Prospect. A true, lively, and experimentall description of that part of America, commonly called Nerv England: discovering the state of that countrie both as it stands to our new-come English Planters and to the old native inhabitants. By William Wood. London, 1634.

[Publications of the Prince Society. Boston, 1865.]

The Sammon is as good as it is in England, and in great plenty (p. 38).

Of these fishes [the Basse] some be three and some foure feet long, some bigger, some lesser; at some tides a man may catch a dozen or twenty of these in three houres, the way to catch them is with hooke and line. The Fisherman taking a great Cod-line, to which he fasteneth a piece of Lobster, and throwes it into the Sea, the fish biting at it he pulls her to him, and knocks her on the head with a sticke. These are at one time (when Alewives passe up the Rivers) to be catched in Rivers, in Lobster time at the Rockes, in Macrill time in the Bayes, at Michelmas in the Seas. When they use to tide it in and out to the Rivers and Creekes, the *English* at the top of an high water do crosse the Creekes with long seanes or Basse Netts, which stop in the fish; and the water ebbing from them they are left on the dry ground, sometimes two or three thousand at a set, which are salted up against winter, etc. The Herrings be much like them that be caught on the *English* coast. Alewives be a kind of fish which is much like a Herring, which in the latter end of Aprill come up to the fresh Rivers to spaune, in such multitudes as is almost incredible, pressing up in such shallow waters as will scarce permit them to swimme, having likewise such longing desire after the fresh water ponds, that no beating with poles, or forcive agitations by other devices, will cause them to returne to the sea, till they have cast their spawne. The Shaddes be bigger than the *English* Shaddes, and fatter. The Macrells be of two sorts, in the beginning of the yeare are great ones, which be upon the coast; some are 18 inches long. In Summer as in May, June, July, and August, come in a smaller kind of them, (p. 38.)

Codfish in these seas are larger than in new found land, six or seaven making a quintall, whereas there they have fifteene to the same weight. The chiefe fish for trade is Cod.

A little below this fall of waters, the inhabitants of Water-towne [near Boston] have built a Wayre to catch Fish, wherein they take great store of *Shads* and *Alewives*. In two Tydes they have gotten one hundred thousand of those Fishes, [p. 44.] * * * I have seen ten thousand [Alewives] taken in two houres by two men, without any weire at all, saving a few stones to stop their passage up the river, [p. 46.] * * * The Basse continuing from the middle of Aprill to *Michaelmas*, which stayes not above half that time in the Bay; besides here is a great deal of Rock-cod and Macrill, insomuch that shoales of Basse have driven up shoales of Macrill from one end of the Sandie Beach [Swampscott] to the other, which the inhabitants have gathered up on wheelbarrowes, [p. 47.] * * * In this river [*Merrimacke*] is Sturgeon, Sammon, and Basse, [p. 49.]

A Topographical Description of Truro, in the County of Barnstable. 1794.

[Collections of the Massachusetts Historical Society for the year 1794. Vol. III. Boston, 1810.]

"A traveller from the interiour part of the country, where the soil is fertile, upon observing the barrenness of Truro, would wonder what could induce any person to remain in such a place. But his wonder would cease, when he was informed, that the subsistence of the inhabitants is derived chiefly from the sea. The shores & marshes afford large & small clams, quahaugs, razor shells, periwinkles, muscles, and cockles. The bay and ocean abound with excellent fish and with crabs and lobsters. The sturgeon, eel, haddock, cod, frost-fish, pollock, cusk, flounder, halibut, bass, mackerel, herring, and alewife, are most of them caught in great plenty, and constitute a principal part of the food of the inhabitants. Besides these fish for the table, there is a great variety of other fish: among which are the whale, killer or thrasher, hump-back, finback, skrag, grampus, black fish, porpoise, (grey, bass, and streaked,) snuffer, shark, (black, man-eating, and short-nosed,) skate, dog-fish, sun-fish, goose-fish, cat-fish, and sculpion; to which may be added the horseshoe and squid. The cramp-fish has sometimes been seen on the beach. This fish, which resembles a sting ray in size and form, possesses the properties of the torpedo, being capable of giving a smart electrical shock. The fishermen suppose, but whether with reason or not the writer will not undertake to determine, that the oil extracted from the liver of this fish is a cure for the rheumatism."

A short Journal of the first settlement of the island of Nantucket, with some of the most remarkable things that had happened since, to the present time. By Zaccheus Macy.

[Collections of the Massachusetts Historical Society for the year 1794, vol. III. Boston, 1810.]

The natives of Nantucket were a kind people, and very friendly to each other. There were no poor persons among them. For when any of them grew old & helpless, and went to a neighbor's house, they were made welcome to stay as long as they pleased. If the English entered their houses whilst they were eating, they would offer them such as they had, which sometimes would be very good. At their feasts they had several sorts of good food, and very good strong beer. By drinking rum their numbers were so much reduced that in the year 1763, there were but three hundred & fifty-eight left on the island. In that year an uncommon mortal distemper attacked them. It began the 16th of the eighth month, 1763, and lasted till the 16th of the second month, 1764. During that period two hundred and twenty-two died. Thirty-four were sick and recovered. Thirty-six who lived among them, escaped the disorder. Eight lived at the west end of the island, and did not go among them: none of them caught the disease. Eighteen were at sea. With the English lived forty, of whom none died.

The Indians are now reduced to four males and sixteen females. Before this period, and from the first coming of the English to Nantucket,[1] a large fat fish, called the blue fish, thirty of which would fill a barrel, was caught in great plenty all round the island, from the 1st of the sixth month till the middle of the ninth month. But it is remarkable, that in the year 1764, the very year in which the sickness ended, they all disappeared, and that none have ever been taken since. This has been a great loss to us.

Extracts from a Petition from New Shoreham (Block Island) for assistance to make a harbor there in 1773.

Having stated many reasons why the island was suffering for want of a good harbor, they say further: "That they also suffer greatly by the loss of the cod-fishery, which formerly, while the channel was kept open between the sea & a large salt pond on the west side of the island,

---

[1] *Note by Theodore Lyman:*

In 1659.	Therefore, the Blue Fsh	were	present at Nantucket,	1659–1764—103	years
	" " "	"	absent "	1764–1830—66	"
	" " "	"	present again, "	1830–1871—41	"

was so considerable that they used to catch fish enough for their own consumption, and to supply *Newport* & divers other places with fresh fish; but that, the channel being now filled, the small fish or bait which used to go into the pond, have left the island, & the cod-fish with them; so that at present the inhabitants cannot get near enough for their own eating, and that these inconveniences have such an effect upon the real estates on the island that land will not sell or rent for more than half the sum which land of the like quality will sell or rent for in other parts of the colony.

A Key into the language of America, or an help to the Language of the Natives in New England, London, by Roger Williams; 1643.

[Reprinted in the collections of the Rhode Island Historical Society, vol. 1, 1827.]

OF FISH AND FISHING.

Namaùs, suck.	Fish, Fishes.
Pauganaùt, tamwock.	Cod, Which is the first that comes a little before the Spring.
Qunnamáug-suck.	Lampries, The first that comes in the Spring into the fresh Rivers.
Aumsûog, and Munnawhatteaûg.	A Fish somewhat like a herring. [The alewife and menhaden.]
Missúckeke-kequock.	Basse.

The Indians (and the English too) make a daintie dish of the Uppaquontup, or head of this fish; and well they may, the braines and fat of it being very much, and sweet as marrow.

Kaúposh-shaûog.	Sturgeon.

OBS: Divers part of the Countrey abound with this Fish; yet the Natives, for the goodnesse and greatnesse of it, much prize it, and will neither furnish the English with so many, nor so cheape, that any great trade is likely to be made of it, untill the English themselves are fit to follow the fishing.

The Natives venture one or two in a Canow, and with an harping Iron, or such like Instrument, sticke this fish, and so hale it into their Canow; sometimes they take them by their nets, which they make strong of Hemp.

Ashòp, their nets. Which they will set thwart some little River or Cove, wherein they kill Basse (at the fall of the water) with their arrows, or sharp sticks, especially if headed with Iron, gotten from the English, &c.

Aucùp.	A little Cove or Creeke.
Aucppâwese.	A very little one.
Wawwhunnekesûog.	Mackrell.
Mishquammaúquock.	Red fish, Salmon.
Osacóntuck.	A fat, sweet fish, something like a Haddock. [Not identified.]
Mishcùp-paûog. Sequanamâuquock.	Breame. [Scup.]

OBS: Of this Fish there is abundance, which the Natives drie in the Sunne and smoake: and some *English* begin to salt, both wayes they keepe all the yeere; and it is hoped it may be as well accepted as Cod at a Market, and better, if once knowne.

Taut-aûog.	Sheeps-heads. [The tautog.]
Neeshaûog.	Eeles.
Tatackommmâûog.	Porpuses.
Pôtop-paûog.	Whales.

Which, in some places, are often cast up; I have seene some of them, but not above sixtie foot long; The Natives cut them out in severell parcells, and give and sende farre and neere for an acceptable present or dish.

Ashaunt-teaug.	Lobsters.
Opponenaûhock.	Oysters.
Sickissuog.	Clams. [Soft clam. *Mya arenaria.*]

Obs: This is a sweet kind of shellfish, which all Indians generally over the Country, Winter and Summer, delight in; and at low water the women dig for them. This fish, and the naturall liquors of it, they boile, and it makes their broth and their nassaúmp (which is a kind of thickened broth) and their bread seasonable and savoury, instead of Salt: and for that the English Swine dig and root these Clams wheresoever they come, and watch the low water (as the Indian women do) therefore of all the English Cattell, the Swine (as also because of their filthy disposition) are most hateful to all Natives, and they call them filthy cutthroats, &c.

Sequnnock. Poquaûhock.	A Horse-fish. [Hard clam; quohog. *Venus mercenaria.*]

Obs: This the English call Hens, a little thick shell fish, which the Indians wade deepe and dive for, and after they have eaten the meat there (in those which are good) they breake out of the shell, about half an inch of a blacke part of it, of which they make their Luckaúhock, or black money, which is to them precious.

Meteaûhock.	The Periwinckle. [Probably *Pyrula*, (Hammond.)]

Of which they make their *Wómpam*, or white money, of halfe the value of their *Suckáwhock* or black money, of which more in the Chapter of their Coyne.

Moamitteaūg.	A little sort of fish, halfe as big as Sprats, plentifull in Winter. [Murmchogs or cypronodonts.]
Paponaumsūog.	A winter fish. [Tom cod.]

Which comes up in the brookes and rivulets; some call them Frost fish, from their comming up from the Sea into fresh brookes, in times of frost and snow.

Qunôsuog.	A fresh fish. [The pickerel.]

which the Indians break the ice in fresh ponds, when they take also many other sorts: for, to my knowledge, the Country yeelds many sorts of other fish, which I mention not.

On some early notices of New England fishes. By J. Hammond Trumbull.

HARTFORD, CONNECTICUT, *December* 30, 1871.

MY DEAR SIR: * * * * *

As to Williams's *tautauog*, the fact that the Indian name comes down to us associated always with the "blackfish" or tautog, and nowhere with the *Sargus ovis*, convinces me that the former was the "Sheepshead" of Williams and of Josselyn, (in New England Rarities, p. 69, of Tuckerman's edition,) and the latter, if known at all to the Narragansett Indians in Williams's time, was not common enough to bring its Indian name to his notice. In a manuscript vocabulary obtained by President Stiles in 1762, "from a Pequot Indian at Groton, Connecticut," I find "*Tautauge*, Blackfish," which removes all doubt as to the appropriation of the name. In the same vocabulary, or list of names rather, are these: "*Umpsauges*, Alewives," [=*aumsuog*, R. W.,] "*Cachauxet*, Cunners," [our "Chogset,"] "*Aquaunduut*, Blue Fish."

This last I have not found elsewhere. Its occurrence here shows that the *Temnodon saltator* was no stranger in Fisher's Island Sound in 1762.

While at Edgartown last summer, I heard old fishermen call flounders and plaice "buts," distinguishing the species by a prefix. I did not before know that this old English and Dutch name had survived, in popular use, to our time. Palsgrave translates the French "plye" [plie] by "*Butte* fysshe," and Steendam, the Dutch poet, names the "*Bot*, en Sneck"—plaice and pike—among the fishes of New Netherlands in 1661. The Halibut is the "holy-but," (German, heilige-butt,) and we have the same ground-word in "Thorn-butt," and "Turbot," though the lexicographers stick to the old etymology from Latin, *turbo*, a top; and in the English "Burt" or "Birt."

I forget whether or not I made a note for you on the alleged derivation of "alewife," from "*aloof*." Dr. J. V. C. Smith, in his Natural History of the Fishes of Massachusetts, 1833, was perhaps the first to record the suggestion that "*alewife* is derived from the Indian word *aloof*, signifying a *bony fish*." Dr. Bartlett's Dictionary of Americanisms, Webster's, and, I believe, Worcester's, Dictionaries accept this etymology, and Professor Schele De Vere, in his recently published volume of "Americanisms," is misled into recognizing in "alewife" a "most ludicrous corruption of the Narragansett term *aloof*," though he appears to have been struck by the objection that neither *l* nor *f* can have a place in a Narragansett word, and he suggests that the original name may have been *ainoop*.

The Narragansett and Massachusetts name of the alewife and herring (common to several species) was *Aumsu-og*, (plur.,) as noted by Roger Williams and, with slight dialectic variation, by President Stiles, as you have seen. The only authority for "aloof" is a letter of (the se,cond John Winthrop, printed in the Philosophical Transactions for 1678, (No.) 142,) in which he mentions the use of "the fishes called *aloofes*" for manuring corn-fields. If we could refer to Winthrop's manuscript, I am confident we should find that a copyist or printer had substituted "aloofes" for "*aloofes*," *i. e.*, *aloses* or *alizes*. The modern English "allis" was in old French and old English "alouze" or "aloose,' nearer than the modern form of the name to Latin *alausa*. Morton's New England Canaan, (1637) mentions the use of the "fish by some called *shadds*, by some *allizes*," as fertilizers.

Forty years before Winthrop's letter was written from Connecticut, Wood, in New England's Prospect, (London, 1634,) catalogues "big-bellied Alewives," with "consorting Herrings and the bony Shad," among the fishes of Massachusetts; and Josselyn (New England Rarities, p. 23) names the "Alize *Alewife, because great-bellied*," with the synonymes "Olafle, Oldwife, Allow." In his "Voyages" (1674) he describes this fish as "like a Herring, but has a bigger bellie, *therefore called* an Alewife."

Couch, I see, gives "*Alewife*" and "*Maid*" as popular names of the larger and smaller English shads—the allis and twait, (iv, 117.) Perhaps I have wasted too many words and too much paper on this name, but I am tired of the re-appearance every now and then of Dr. Smith's spurious Indian "*aloof*."

"En decembre, vu, pour parler plus juste, pendant les deux dernieres lunes, un poisson appellé *Ponamo* vient frayer *sur* les glaces, et on en prend autant qu'on veut; je crois que c'est une espèce de *Chien de Mer*."—(*Tom. I, p.* 127.)

"Vers la fin de mars, les poissons commencent à frayer, et entrent dans les rivieres en si grande quantité, qu'on ne peut le croire, quand on ne l'a point vû. Le premier qui paroît est l'*Eplan*, lequel est trois fois plus grand en ce pays-là, qu'en Europe. A la fin d'Avril le *Hareng* donne," *etc.*—(*Ibid.*)

Charlevoix, *Histoire générale de la Nouv. France, (Paris*, 1744,*)* borrows this account of the fishes of Acadie from Father Biard's Relation de la Nouv. France, 1611–13. Biard writes:

"En decembre (admirable providence de Dieu) vient un poisson appellé d'eux *Ponamo*, qui fraye *sous* la glace, (p. 10.) Sur la my-mars, le poisson commence à frayer et à monter de la mer en haut contre certains ruisseaux, souvent en si grande abondance, que tout en fourmille. . . . . . Entre ces poissons, l'*Esplan* est le premier. Cet esplan est deux ou trois fois plus grand que l'est le nostre de rivière." (P. 10.)

You will observe that Charlevoix, by mistranscription, makes the *Ponamo* spawn "*sur* les glaces" instead of "*sous* la glace," and confounds it with some species of "*chien de mer*," and, oddly enough, Dr. J. G. Shea, in his new translation of Charlevoix, mistranslates "*chien de mer*" by "*seal*," an error to be noted in his errata.

The *Ponamo* is the Tom-cod or Frost-fish (M. *tomcodus*, Mitch.,) of which the modern Micmac name is *Boonamoo*. It is not confounded by Biard or Charlevoix with the *other* "frost-fish," the Smelt, (Eperlan.)

The name *Ponamo* means "winter fish," or, more exactly, "fish taken in the winter."

Biard's relation will be found in the reprinted "Relations des Jésuites," (Quebec, 1858,) vol. 1, to be found in the Congressional Library.

The notices of fishes of New England in Wood's "New England's Prospect," (London, 1634, and reprinted, Boston, 1865, by the "Prince Society,") you have probably noticed; and, of course, Josselyn's list of New England fish, in his "Account of Two Voyages to New England," (London, 1675,) as well as in his "New England Rarities," (1672.) In the former work (pp. 112, 113) he describes the "Frost-fish," "a little bigger than a Gudgeon," &c.; but in his list (p. 89) includes the "Smelt" by name.

Captain John Smith, in "The Description of New England," 1616, (reprinted, Boston, 1865,) gives a short list of the fishes of New England, (p. 48,) which includes "Cole, Cusk, or small Ling, Mullet, *Pinacks*, [very plenty,] *Cunners*," &c.

"Pinak" is, I suppose, the old English "Pinck" or "Pink," meaning any "small" or "delicate" fish, and still in use as a name for the minnow. (Dutch *pinck, pinky?* the little finger.) "Cunner," in the seventeenth century, belonged to the Golden Wrasse, (*Crenilabrus Donovani*, Cuv. and Val., *Labrus cornubius*, Don.,) rather than to the *other* "Gilt Head," the *Sparus aurata*, of Linn.—*Chrysophrys aurata*, Cuv. and Yarrell. The former was common, the latter rare, on the southern coast of England; and I have no doubt that Smith and Josselyn both transferred the name of "conner" (see Yarrell, ii, 498) from the *Wrasse*, not from the *Gilthead* proper. But it is very likely that the Dutch name of the American fish Bergall (Holl. *Verguld* and *Bergylt*) came from another species, though the Dutch name of the European *Gilt-head* was *Zeebraassen.*

Jacob Steendam's poem in "Praise of New Netherland," (*'t Louf van Niew-Nederland,*) 1661, printed, with an English translation by Hon. Henry C. Murphy, for the Bradford Club, of New York, (Anthology of New Netherland: Brad. Club Series, No. 4,) 1865, pp. 52, 55, contains a considerable list of the fish of New York, and is useful for its Dutch names, among which are the "Elft," "Twalf," and "Dertien"—shad, striped bass, and drum-fish, as Murphy translates; "Knor-haan," "Swart-vis," "Schelvis," "Weekvis," and "Masbank," (our mossbanker or Menhaden.)[1]

In the "History of Hadley," Massachusetts, by Sylvester Judd,

[1] By the kindness of Mr. L. E. Chittenden I am enabled to give both the original poem of Steendam, and the translation of most of the stanzas, by Mr. Murphy:

"Die groote Zee bespoeld uw Voorste-strand;
Die (als een dijk) zieh voor u Velden Kant:
Door-aderd, met veel killen: die het Land,
En 't Bosch verfrischen.

"Die van 't gebergt, en heuvels neder-vliên
En 't Molen-werk, bequame plaatsen biên
Op d'oevers van u stromen. Waard te sien:
Gepropt met Visschen.

"En Prik, en Aal, en Sonne-vis, en Baars:
Die (blank en geel u Taaf'len als wat raars)
Vercieren kan: ook Elft, en Twalft met schaars,
Maar overvloedig.

"Steenbrassem, Steur, en Dartien, en Knor-haan,
En Zee-baars, die geen Vorst sal laten slaan:
En Kabellau: en Salm die (wel gebraan)
Is vet, en voedig.

"Swart-vis, en Roch, en Haring, en Makreel,
Schelvis, Masbank, en Voren die (se veel)
Tot walgens toe, de Netten'vuld: en heel
Min ward ge-eeten.

"So gaat het hier: dat 's Werelts overvloed,
(Waar meê de Mensch word koninglijk gevoed
Door gulle gunst des milden gevers) doet
Hem vaak vergeeten.

"Weekvis, en Schol, en Carper, Bot, en Snoek,
Ja gy en hebt geen poel; geen water-hoek,
Of't krielter vol von Visschen: die (te soek)
Licht zinj te vinden.

"En Kreeft, en Krab, en Mossels: Oesters, die
Een beter is als Europa drie
In veelheyt heel on-kenbaar voorhem, wie
't Mocht onderwinden.

"De Schild-pad, en de Zee-hond, en den Hay,
De Walvis, en Torijin speeld in u Bay:
En toond Gods Macht, en wonderheden. Fray
Om an te merken.

"De seldsaamheên in 't Banelose diep:
De diepte, van de Wijsheyt, die het schiep:
Die noyten slaapt, noch nimmermeer en sliep:
Maar werkt, in 't werken.

* * * * *

'The lamprey, eel, and sunfish, and the white
And yellow perch, which grace your covers dight,
And shad, and stripéd bass, not scarce, but quite
Innumerable.

(Northampton, 1863,) is a good article on "The Shad and Salmon Fishery" in New England, (pp. 313–318,) containing notices of "great hauls" in the Connecticut, and facts respecting early fisheries collected from the records and other manuscript authorities.

You will observe that Josselyn (New England's Rarities, 1672, p. 96) mentions the "*Blew Fish*, or *Horse*," as "*common* in New England, and esteemed the best sort of Fish next to Rock Cod;" "as big usually as the Salmon, and better meat by far." Elsewhere (p. 24) he catalogues "two kinds" of "Blew Fish or *Hound* Fish," the "Speckled Hound Fish," [is this the Weak fish, *Otolithus ?*] and the "Blew Hound Fish, called Horse Fish." I am inclined to think that Roger Williams's "*Osacóntuck*, a fat, sweet fish, something like a haddock," may be the *Otolithus*, though in a note to the name, Key, p. 105, I suggested "pollack, whiting, or cusk."

Very truly, yours,

J. HAMMOND TRUMBULL.

Professor SPENCER F. BAIRD,
Washington, D. C.

Documents relative to the colonial history of New York, procured in Holland, England, and France, by J. M. Brodhead. Quarto, vol. iii, p. 182, 183. *Albany*, 1853–1858.

[Mr. Maverick to Colonel Nicolls.]

NEW YORK, *July* 5, 1669.

* * * * * * *

Now give mee leave to acquaint you a little how things goe heere at Yorke. Tryalls have been made severall times this spring for cod fish, w^th^ very good success; a small ketch sent out by y^e^ Governour hath found severall good fishing bancks; amongst y^e^ rest one not above 2 or

---

"The bream and sturgeon, drum-fish, and gurnard,[1]
The sea-bass,[2] which a prince would not discard,
The cod and salmon, cooked with due regard,
Most palatable.

"The black and rock fish, herring, mackerel,
The haddock, mossbanker, and roach, which fill
The nets to loathing; and so many, all
Cannot be eaten.

"And thus it happens here, that in the flood,
Which, rolling from the Fountain of all Good,
O'erwhelms weak, mortal man with royal food,
He is forgotten.

"You've weak-fish, carp and turbot, pike and plaice;
There's not a pool or tiny water-trace
Where swam not myriads of the finny race,
Easily taken.

"Crabs, lobsters, mussels, oysters, too, there be,
So large, that one does overbalance three
Of those of Europe; and in quantity,
No one can reckon.

"The tortoise, seal, and shark; and, in your bay,
The mighty whale and porpoise, sporting, they
The power, and wondrous works of God display,
For our beholding."

[1] "Gurnard." Murphy thinks this was certainly the "porgy." As the latter was not known in Europe, Steedam used the name of the European species which most resembled it, (*Trigla hirundo.*) It however more probably refers to the sea-robin, (*Prionotus.*)

[2] The name *Zee-baars* is now applied in Holland to the representative of our striped bass.

2 leagues from Sandy Hook, on which, in a few houres, 4 men took 11 or 12 hundred excellent good codd the last time they were out, and most of y^e vessells that goe to and from Virginia take good quantityes. That vessell is to goe from Newfound Land to gett fishermen, lines, hookes, and other necessaryes for fishing: I doubt not but this coast will afford fish in abundance.

On y^e east end of Long Island there were 12 or 13 whales taken before y^e end of March, and what since wee heare not; here are dayly some seen in the very harbour, sometimes within Nutt Island. Out of the Pinnace, the other week, they struck two, but lost both, the iron broke in one, the other broke the warpe. The Governour hath encouraged some to follow this designe. Two shallops made for itt, but as yett wee doe not heare of any they have gotten.

* * * * * * *

A Perfect Description of Virginia: being, a full & true Relation of the present State of the Plantation, their Health, Peace & Plenty: the number of people, with their abundance of Cattell, Fowl, Fish, &c. With several sorts of rich & good Commodities, which may there be had, either Naturally, or by Art & Labor, &c. London. Printed for Richard Wodenoth, at the Star under Peter's Church, in Cornhill, 1649.

[Force's Historical Tracts, II, tract 8.]

Now these are the several sorts & kinds of Beasts, Birds, Fish, in Virginia.

Beasts great & small, as followeth: above 20 severall kinds.

1. Lyons, 2. Beares, 3. Leopards, 4. Elkes.	But all these foure sorts are up in the higher parts of the Countrey, on the hills & mountains, few to be seene in the lower parts, where the English are; the Elkes are as great as Oxen, their horns six foot wide, & have two Calves at a time; the skins make good Buffe, & the flesh as good as Beefe.

5. Deere.
6. Foxes.
7. Wilde Cats.
8. Raconnes, as good meat as Lambe.
9. Passonnes. This beast hath a bagge under her belly, into which she takes yer young ones, if at any time affrighted, & carries them away.
10. Two sorts of squirrels: One called a flying one, for that she spreads like a Batt, a certaine loose skin she hath, & so flyes a good way.
13. A Muske Rat, so called for his great sweetnesse & shape.
14. Hares.
15. Beavers.
16. Otters.
17. Doggs, But barke not, after the shape of a Wolfe, and Foxes smell not; Wolves but little, neither not fierce.
18. Wolves.
19. Martins, Poule Cats, Weesels, Minks: but these Vermine hurt not Hens, Chickins, or Eggs, at any time.
20. A little beast like a Conny, the Foxes kill many of them.

Birds are these, viz., above 25 severall kinds:

1. Eagles.
2. Hawkes, of six or severall kinds.
3. Parteridges, many.
4. Wilde Turkies, some weighing sixtie pound weight.
5. Red Birds, that sing rarely.
6. Nightingales.
7. Blue Birds, smaller than a Wren.
8. Black Birds.
9. Thrushes.
10. Heath Cocks.
11. Swannes.
12. Cranes.
13. Hernes.
14. Geese.
15. Brants.
16. Ducks.
17. Widgeons.
18. Dottrells.
19. Oxeyes.
20. Parrots.
21. Pidgeons.
22. Owles.

Many more that have no English Names; for one called the Mock-bird, that counterfeits all other severall Birds cryes and tunes.

Fish are in these, in their kind, above Thirty sorts.

1. Codde.
2. Basse.
3. Drummes, six foot long.
4. Sheepshead, this Fish makes broath so like Mutton-broath that the difference is hardly known.
5. Conger.
6. Eeles.
7. Trouts.
8. Mullets.
9. Plaice.
10. Grampus.
11. Porpus.
12. Scates.
13. Sturgeons, of 10 foot long.
14. Stingraes.
15. Brets.
16. White Salmon.
17. Soles.
18. Herring.
19. Conny-fish.
20. Rocke-fish.
21. Lampres.
22. Cray-fish.
23. Shads.
24. Perch.
25. Crabbs.
26. Shrimps.
27. Crecy-fish.
28. Oysters.
29. Cockles.
30. Mussels.
31. St. George Fish.
32. Toad-Fish.

Trees, above 20 kinds, and many no English names.

1. Okes, red & white Wood.
2. Ashe.
3. Wallnut, two kinds.
4. Elmes.
5. Ceader.
6. Cypres, three fathomes about.
7. Mulbery Trees, great & good.
8. Chesnut Trees.
9. Plum Trees of many kinds.
10. The Puchamine Tree.
11. The Laurell.
12. Cherries.
13. Crahes.
14. Vines.
15. Sassafras.

Fruits they have, Strawberies, Gooseberies, Raspices, Maracokos, Puchamines, Muskmillions, Pumpions; And for Fruits brought thither & planted, Aples, Peares, Quinces, Apricoks, Peaches; & many more kindes excellent good, &c. Pp. 15–18.

Newes from the Bermudas.

"BERMUDA, *July*, 1609."

"In half an houre he tooke so many fishes with hookes as did suffice the whole company [150 men] one day."

"Fish is there so abundant, that if a man steppe into the water, they will come round about him; so that men were faine to get out for fear of byting. These fishes are very fat & sweete, & of that proportion & bignesse that three of them will conveniently lade two men: those we called rock-fish."

"Besides there are such abundance of mullets, that with a seane might be taken at one drought, one thousand at the least, & infinite store of pilchards, with divers kinds of great fishes, the names of them unknowne to me: of tray fishes very great ones, & so great store, as that there hath been taken in one night with making lights, even sufficient to feed the whole company (150 men) a day."

"We were no sooner come within a league of the land," &c. (Page 18.) (July, 1612.)

"Hogges, Turkles, Fish, & Fowle do abound as the dust of the earth." (Page 20.)

"Angell-fish—very strange & beutiful to behold." (Page 21.)

Whale, Sword fish & Threasher.—"The sword fish swimmes under the whale, & pricketh him upward: The Threasher keepeth above him, & with a mighty great thing like unto a flaile, hee so bangeth the whale, that hee will roare as though it thundered, & doth give him such blowes, with his weapon, that you would thinke it to be a crake of great shot." (Page 22.)

"The whales come in Februarie & tarry till June."

The Remembrancer, London. Part 2, 1776, *page* 79.

"Madrid, April 22, [1776.] Several of our frigates have been sent from Acapulca to make discoveries and propagate the gospel among the Indians to the North of California; in which expedition, in the month of July, 1774, the Spaniards navigated as high upon the coast as the latitude 58 deg. 20 min., (six degrees above Cape Blanco.) They discovered several good ports and navigable rivers upon the West coast of this great continent. In one of the largest ports they have established a garrison, and called the port Presidio de San Carlos, and have left a mission at every port where inhabitants were to be found. The account mentions the Indians to be a docile sort of people, agreeable in the countenance, honest in their traffic, and neat in their dress, but at the same time idolaters of the greatest degree, never before having any intercourse with Europeans. M. Bucarelli, viceroy of New Spain, has received his Catholic Majesty's thanks for the discoveries, as they were made under his directions, and the several navy officers upon that service have been preferred. It is imagined that those new discoveries will be very advantageous, as the coast abounds with plenty of whales, as also a fish equal to the Newfoundland cod, known in Spain by the name of bacallao.[1]—*Madrid Gazette, published by authority.*"

[1] First (?) mention of occurrence of cod-fish on the Pacific coast of North America.

XI.—STATISTICS OF FISH AND FISHERIES ON THE SOUTH SHORE OF NEW ENGLAND.

TABLE 1.—*Account of fish taken by Jason Luce & Co., at Menemsha Bight, Martha's Vineyard*

Kind.	1869—April 4 to June 7.	1870—April 14 to June 8.	1871—April 14 to June 9.	1872.
	No.	*No.*	*No.*	*No.*
Herring	52, 500	*61, 200	22, 100	143, 600
Tautog	275	500	1, 242	1, 000
Dog-fish	79, 000	53, 000	64, 162	127, 500
Striped-bass	125	150	250	400
Scup ... barrels	380	70	684	1, 011
Shad	300	550	125	....
Mackerel	15, 900	†150, 000	60, 800	2, 050
Sea-robin ... barrels	2, 500	2, 500	2, 500	....
Menhaden ... barrels	1, 590	1, 375	3, 200	3, 800
Sea-bass	300	6, 400	500	1, 500
Salmon	‡2	....	....	3
Squeteague or weak fish	....	14, 000	23, 000	45, 700
Blue-fish	....	4, 000	7, 000	1, 000
Flounders ... tons	....	....	....	10
Spanish mackerel	....	....	....	470
Cero	....	....	....	12

* One-third English. † 1,000 barrels. ‡ 1 April 27; 1 May 19.

Sea-bass are usually taken last of May. More taken in 1870 than for five years previous.

Seventy barrels of scup (1870) is the smallest catch in any year since we have been in the business.

More shad taken in 1870 than in all previous years taken together. Usually taken from April 25 to May 10.

Striped bass average 3 pounds. We call them sand-bass.

Usual number of sea-robins, 2,500 to 2,000 barrels. They are turned over the side of the pound as being worthless.

First blue-fish in 1871 caught May 26.

Menhaden are taken from April 21 to May 25; two in advance in 1871.

Scup taken from April 25 to May 18; in 1871, ten to fifteen days earlier than usual.

Striped bass in 1871, taken from April 18 to May 5; mackerel from April 18 to May 27; rock-bass from April 14 to May 10.

Blue-fish are first seen schooling in our bay by the middle of June. Very few are taken here, for the reason that they appear to be at home, and not traveling. Fish cannot be trapped unless they are on a course. I have seen acres of them all around our trap in the bay; but when the trap is hauled we get only fifty or a hundred.

Mackerel first taken in 1872, May 11; first scup taken May 10; squeteague, July 4; cero, September 15; salmon, May 29; sea-bass, May 28.

TABLE II.—*General return of the Waquoit weir for* 1871.

Day.	Weather.	Temperature.		Scup.	Mackerel.	Blue-fish.	Tautog.	Plaice, flat-fish, turbot.	Alewives.	Shad.	Menhaden.	Dog-fish.	Skate.	Squid.
		Air.	Water.											
March 24									1, 840					
April 3									357					
6									6, 400					
10									5, 850	1				
11									2, 340					
14									13, 250					
17									7, 000	23				
18	Fine	54	50		1		6	314	4, 056	11			89	
19	Cloud	51	50				9	215	4, 100	5			60	
20	Breeze. Rain	51	49				22	500	2, 600	16			200	
21	Clear. Fog	59	52				5	230	2, 300	2	6, 000		110	6
22	Cloudy	69	51		1		9	568		1			20	
23	Cloud. Breeze	56	50											
24	Clear. Breeze	55	51				1				13, 300			
25	Clear. Cloud	59	51	1	1		6	125	30			30	197	6
26	Clear	63	52		1			1					5	
27	Cloud. Breeze	50	52		2		11	26	30			212	132	
28	Breeze. Rain	50	51				7	30				204	20	
29	Cloud	54	51	3			27	64				476	80	
30	Cloud. Clear	57	53											
May 1	Cloud. Clear	56	52	6			5	103			17, 420	381	200	400
2	Clear	58	54				3	35				201	179	2, 500
3	Cloud	64	54					75		1		716	220	6, 000
4	Wind. Rain	44	52											
5	Thick. Rain	56	52					49			35, 920	162	170	200
6	Cloud. Breeze	48	52											
7	Cloud. Breeze	54	52											
8	Cloud. Gale	56	52											
9	Cloud. Breeze	55	52	2				42			10, 020	988	525	
10	Cloud. Rain	59	52	27				2		3	16, 800	307	158	400
11	Clear. Cloud	58	53								14, 945			
12	Clear. Cloud. Breeze	60	54											
13	Cloud. Breeze	56	53	59	4			5		6	14, 200	1, 026	151	600
14	Cloud. Breeze	56	53											
15	Cloud. Clear. Breeze	59	54		8		3	15		17	7, 300		39	2, 000
16	Clear	66	54		5		12	4			900		22	3, 000
17	Cloud	66	55					20						
18	Clear. Breeze	55	56		58		6	4		24	1, 280		33	6, 000
19	Clear	63	58		23		3	15		5	1, 040		20	4, 000
20	Clear	72	58		32			11		4	7, 600	6	10	5, 000
21	Clear. Breeze	68	60					16						
22	Cloud. Fog	73	61		85					4	6, 000	50	40	1, 500
23	Smoky	75	62		6			16			26, 000	25	16	2, 000
24	Smoky. Breeze	69	57			9		7			2, 205	3	7	
25	Clear. Smoky. Breeze	65	57	2			3	7			780	1	9	2, 000
26	Cloud. Rain	65	58											
27	Cloud. Breeze	62	60			11	2	7				2	34	
28	Clear. Breeze	65	62											
29	Clear. Breeze	67	62	1		63							31	
30	Thick. Breeze	72	62											
31	Cloud. Showers	78	62			2	1			1	40, 300		22	
June 1	Cloud	65	62			11	1				13, 260		3	
2	Fog. Breeze	66	63	1		83							5	
3	Fog. Breeze	73	63			66		1					3	
4	Cloud. Thunder	82	63											
5	Clear. Breeze	68	63			76	2						6	
6	Cloud	73	66			10	1						5	
7	Cloud. Rain. Breeze	76	66											
8	Fog. Rain Breeze	68	66			1		20						
9	Hazy. Clear	80	66			27							30	
10	Clear. Breeze	75	67	48		25	2	1			7, 540		20	
11	Rain. Breeze	81	67					40					20	
12	Fog. Breeze	64	67					10						
13	Clear. Cloud. Breeze	70	65	1		127							27	
14	Cloud. Breeze	70	66			68	1				27, 300		2	
15	Cloud. Rain	60	64											
16	Cloud	73	65			81					93		3	
17	Clear. Cloud	75	64			31					19			
	Total			151	227	691	148	2, 578	50, 153	124	270, 222	4, 790	2, 923	35, 612

NOTE.—The statistics of the Waquoit weir (Tables II to V) are taken from the report of the Massachusetts commissioners of inland fisheries for 1871. This weir was leased by the commissioners for the purpose of securing exact statistics on the subject of pound-fishing.

TABLE III.—*Return of dog-fish and blue-fish at Waquoit Weir for seven years.*

	DOG-FISH.							BLUE-FISH.						
	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1865.	1866.	1867.	1868.	1869.	1870.	1871.
April 9	1													
13	1				1									
15			1											
16														
17														
18		1												
19		1												
20		1				1								
21						1								
22	6													
23														
24														
25							30							
26	42													
27	15						212							
28	50						204							
29							476							
30														
May 1	208						381							
2	50						201							
3							716							
4														
5							162							
6			100											
7														
8														
9							988							
10							307							
11														
12	1,500													
13							1,026							
14										2				
15					1,000			100						
16													14	
17														
18			700		500								25	
19					1,000	500								
20			800		500		6	200		15				
21		800	2,000									100		
22							50							
23		200	200				25	203	1		230			
24		200	100				3	270		400				9
25							1	67		300	200	160		
26							2	62			200			
27								164			150	295		11
28										246	160	135		
29								94		164		150		63
30								146	6					
31								220						2
Total	1,871	1,203	3,901	......	3,001	502	4,790	1,526	7	1,127	940	840	39	85

TABLE IV.—*Consolidated returns of alewives, shad, menhaden, bass, blue-fish, and dog-fish, at Waquoit Weir, for seven years.*

Date.	1865.	1866.	1867.	1868.	1869.	1870.	1871.
ALEWIVES.							
March 17 to April 20	323, 610	63, 749	46, 914	7, 837	30, 604	52, 717	47, 793
April 20 to May 29	85, 050	7, 500	11, 900	27, 680	3, 900	22, 755	2, 360
Total	408, 660	71, 249	58, 814	35, 517	34, 504	75, 472	50, 153
SHAD.							
April 8 to 20	26	33	63	13	7	62	56
April 20 to May 15	645	269	340	1, 642	439	523	30
May 15 to 31	....	....	....	400	....	....	38
Total	671	302	403	2, 055	446	585	124
MENHADEN.							
April 21 to May 15	175, 300	213, 730	82, 680	45, 706	66, 680	152, 590	136, 005
May 16 to June 2	35, 800	104, 780	121, 060	79, 020	79, 030	255, 340	99, 256
Total	211, 100	318, 510	203, 740	124, 726	145, 710	407, 930	235, 270
BASS.							
April 14 to 20	35	....	....	....	....	....	69
April 21 to May 15	81	7	111	65	25	51	10
May 15	10	....	18	....	....	....	7
Total	126	7	129	65	25	51	68
BLUE-FISH.							
May 14 to 31	1, 526	7	1, 127	940	840	39	85
DOG-FISH.							
April 9 to May 6	373	3	101	....	1	2	2, 382
May 7 to 31	1, 500	1, 200	3, 800	....	3, 000	500	2, 408
Total	1, 873	1, 203	3, 901	....	3, 001	502	4, 790

TABLE V.—*Days of first appearance of alewives, scup, blue-fish, and menhaden, at Waquoit Weir, for thirteen years.*

Year.	Alewives.	Scup.	Blue-fish.	Menhaden.
1859	April 7	May 5	May 16	May *6
1860	April 3	May 2	May 15	May 4
1861	April 1	April 27	May 17	May 1
1862	March 30	May 10	May 13	May 6
1863	March 29	May 8	May 15	May 2
1864	March 28	May 6	May 17	May 5
1865	March 29	May 1	May 16	May 1
1866	April 2	May 8	May 15	May 7
1867	March 28	May 4	May 14	May 3
1868	March 30	May 10	May 19	May 15
1869	March 31	May 7	May 17	May 10
1870	March 28	May 2	May 16	May 8
1871	March 24	April 25	May 24	April 21

* Dates when first plenty. The weir takes alewives when first set; probably some come a little earlier.

TABLE VI.—*Account of blue-fish caught with a line by Josiah C. Pease about Edgartown, Massachusetts*, 1865–1871.

Month.	First fish caught.	Last fish caught.	Number of days in month.	Sum total of days.	Number of fish.	Sum total of fish in season.	Average per day in month.	Average per day in season.
1865.								
May	24th		6		58		9	
June			20		626		31	
July			15		796		53	
August			15		1, 790		53	
September		24th	10		349		35	
October								
				66		2, 619		40
1866.								
May								
June								
July	18th		11		913		83	
August			18		1, 792		99	
September		24th	7		323		46	
October								
				36		3, 028		84
1867.								
May	27th		5		176		35	
June			17		1, 518		89	
July			21		1, 695		80	
August		30th	11		333		30	
September								
October								
				55		3, 722		67
1868.								
May	25th		5		392		78	
June			13		757		58	
July			18		1, 148		63	
August			22		2, 029		92	
September			17		464		27	
October		23d	13		208		16	
				88		4, 998		57
1869.								
May								
June	1st		15		1, 314		87	
July			22		1, 913		86	
August			22		1, 352		61	
September			16		304		19	
October		23d	8		15		2	
				83		4, 898		59
1870.								
May	30th		1		61		61	
June			14		557		39	
July			16		713		44	
August			21		942		45	
September			15		274		18	
October		18th	6		273		45	
				73		2, 820		39
1871.								
May	29th		2		55		27	
June			23		962		42	
July			20		1, 370		68	
August			19		1, 570		83	
September		28th	15		500		33	
October								
				79		4, 457		56

SUMMARY.

1865	May 24	Sept. 24		66		2, 619		
1866	July 18	Sept. 28		36		3, 028		
1867	May 27	Aug. 30		55		3, 722		
1868	May 25	Oct. 23		88		4, 998		
1869	June 1	Oct. 23		83		4, 898		
1870	May 30	Oct. 18		73		2, 820		
1871	May 29	Sept. 28		79		4, 457		
				480		26, 542		55

TABLE VII.—*Account of fish landed at Baxter's Wharf, Hyannis, Massachusetts.*

*1870.	Flat-fish.		Scup.		Blue-fish.		Bass.	
	Pounds.	Price.	Pounds.	Price.	Pounds.	Price.	Pounds.	Price.
April	10, 463	$142 81						
May	2, 113	26 15	†13, 866	$226 92			9, 246	$151 28
June			25, 209	619 98			16, 808	413 13
July					‡28, 151	$563 04		
August					31, 147	797 13		
September					14, 618	405 15		
October	§31, 851	797 10						
November	14, 217	427 10						
Total	58, 644	1, 393 16	39, 075	846 90	74, 016	1, 765 32	26, 054	564 41
¶1871.								
April	9, 412	94 12						
May	1, 841	18 41	4, 953	83 73			3, 306	55 86
June			35, 063	572 85			11, 687	190 95
July					36, 251	625 02		
August					12, 503	250 06		
September					10, 513	251 17		
Total	11, 253	112, 53	40, 016	656 58	59, 267	1, 126 25	14, 993	246 81

* Highest number of boats employed, 13.
† First scup caught May 21.
‡ About all catching blue-fish.
§ All catching flat-fish October 10.
¶ Highest number of boats employed, 25.

AGGREGATES.

	Pounds.	Price.
1870	197, 786	$4, 569 79
1871	125, 529	2, 142 17
Excess in 1870 over 1871	72, 260	2, 427 62

TABLE VIII.—*Account of Austin Taylor, Hyannis, Massachusetts.*

*1870.	Pounds.	Price.	1871.	Pounds.	Price.
April	2, 285	$24 10	April	829	$8 29
May	1, 777	35 54	May	569	9 12
June	2, 957	59 18	June	1, 203	24 06
July	2, 203	55 07	July	1, 518½	30 37
August	2, 087	62 61	August	996½	19 83
September	208	24 27	September	847	21 10
October	1, 481	57 47			
November	613	18 37			
Total	13, 611	336 61	Total	5, 961	112 77

* Kinds not given.

AGGREGATES.

	Pounds.	Price.
1870	13, 611	$336 61
1871	5, 961	112 77
Excess of 1870 over 1871	7, 650	223 84

TABLE IX.—*Account of Timothy Crocker, Hyannis, Massachusetts.*

	Pounds.
Shipment of fish by railroad to New York, in 1867	115,500
Shipment of fish by railroad to New York, in 1868	109,500
Shipment of fish by railroad to New York, in 1869	137,100
Shipment of fish by railroad to New York, in 1870	83,250
Shipment of fish by railroad to New York, in 1871	82,800

Men and boats employed: 12—15 each season.

TABLE X.—*Account of J. G. Loring, Hyannis, Massachusetts.*

	Number of pounds.	Average per M.
Shipment of fish by railroad to New York, in 1867	82,800	$69 00
Shipment of fish by railroad to New York, in 1868	91,800	76 50
Shipment of fish by railroad to New York, in 1869	104,100	86 70
Shipment of fish by railroad to New York, in 1870	119,850	77 20
Shipment of fish by railroad to New York, in 1871	85,050	56 70

About twelve men and boats were employed in 1867–1869; and fifteen in 1870, 1871.

TABLE XI.—*Shipment of fish by railroad from Hyannis, monthly, to New York, furnished from the books of the company, by Luther Chase.*

Months.	1866.		1867.		1868.		1869.	
	Barrels.	*Boxes.*	*Barrels.*	*Boxes.*	*Barrels.*	*Boxes.*	*Barrels.*	*Boxes.*
January	21	15	8	6	1	1	65	13
February	47	8	5	1	2	2	28	12
March	23	14	3	4	1	2	50	23
April	5	8	30	4	49	5	31	13
May	435	114	135	67	165	66	267	29
June	432	265	251	71	753	183	636	221
July	16	32	139	141	260	166	429	230
August	8	....	39	5	41	53	176	59
September	24	1	106	14	77	29	26	15
October	36	8	148	2	74	4	116	1
November	15	2	41	3	79	7	42	10
December	18	11	30	15	25	8	57	10
Total	1,080	478	935	333	1,527	526	1,923	636
Total in pounds*	305,400		240,000		386,700		479,100	

Months.	1870.		1871.		Total.	
	Barrels.	*Boxes.*	*Barrels.*	*Boxes.*	*Barrels.*	*Boxes.*
January	5	10	11	14	....	....
February	3	10	12	12	....	....
March	15	17	44	22	....	....
April	186	13	236	34	....	....
May	295	23	292	17	....	....
June	1,154	366	551	391	....	....
July	233	214	170	269	....	....
August	119	193	119	71	....	....
September	94	17	94	†17	....	....
October	263	4	263	4	....	....
November	111	10	111	10	....	....
December	26	13	26	13	....	....
Total	2,504	890	1,939	874	9,908	3,717
Total in pounds*	642,600		552,900		2,606,700	

* According to the usual estimate at Hyannis, the box of fish weighs 300 pounds; the barrel 150.
† The record for 1871 only extends through August; we therefore take the figures of 1870 for the same months.

The above table includes the shipments by Messrs. Taylor, Crocker, Loring, Handy, and others, and consist in greater part of fish taken with the line. The figures for June, July, August, September, and October, relate almost exclusively to blue-fish.

TABLE XII.—*Statement of fish caught in the pound at Wood's Hole, Massachusetts, in 1872, by Wood's Hole Weir Company.*

1872.	Herring.	Dog-fish.	Scup.	Mackerel.	Menhaden.
April 25	1,000	1	1		
27	2,000	22			
30	3,500	21			
May 3	1,000	4			
4	500	35			
7		107		1	
8		2,249		35	
9		3,650		4	
10		1,800	Few	15	
11		2,845	do	127	
12		6,074		131	
13		3,411		3	
14		516		1,800	
15		225	Few	146	
16		130	do	162	
17			*10	1,700	*80
18			38	185	60
19			Few	150	150
20			do	80	200
23	Very few fish caught to June 4.				
25					2,000
June 5	Heavy gale from northeast.				
9			*150		
10			†75		
11			40		
12			80		
18	Took lint off; plenty small scup; few weak-fish.				

1872.	Spanish mackerel.	Ceros.
July 31	2	
August 2	1	
5	4	
8	2	
10	1	
13	7	
19	4	
20	3	
21	2	
22	4	
23	596	5
24	69	4
25	76	14
28	11	1
29	13	Few.
30	3	3
Sept. 2	37	6
4	9	Few.
6	30	
9	29	
11	11	
13	1	
16	13	
19	8	
21, 29 ‡	28	2

* Barrels. † Barrels; mostly small. ‡ Eight boxes with blue-fish.

TABLE XIII.—*Catch of fish at pound of Thomas Hinckley, West Falmouth,* 1872.

	Alewives.	Tautog.	Horned dog-fish.	Sturgeon.	Shad.	Mackerel.	Scup.	Menhaden.	Sea-bass.	Smooth dog-fish.	Blue-fish.	Flounders.
April 26, 1872	3,000	1	1									
April 27, 1872	2,000	1	3									
April 29, 1872	200	1	9									
April 30, 1872	1,000		3									
May 1, 1872		3	14									
May 2, 1872	500	4	18									
May 3, 1872			2	1								
May 4, 1872	500	3			6							
May 5, 1872		2	5			1						
May 6, 1872	200	200	27			3	3					
May 7, 1872			5,000			3						
May 8, 1872			2,500			1	1					
May 9, 1872		5	2,000			8						
May 10, 1872			5,000			12	2	1				
May 11, 1872		400	1,500		½ bbl.	168						
May 12, 1872		600	100		½ bbl.	240						
May 13, 1872		600				500	5	2				
May 14, 1872	3 bbls.	600				66		3	3			
May 15, 1872			12									
May 16, 1872								75 bbls.				
May 17, 1872								250 bbls.				
May 18, 1872								450 bbls.				
May 19, 1872								600 bbls.				
May 20, 1872	Pound	full of	menhad	en.								
May 29, 1872	More	than	could be	sold								
May 30, 1872										100		
May 31, 1872								150 bbls.	2	800	3	
June 1, 1872								350 bbls.		800	10	
June 3, 1872								300 bbls.			1	3 bbls.
June 4, 1872									½ bbl.		15	
June 7, 1872								100 bbls.	5	50	45	
June 8, 1872								200 bbls.				
June 12, 1872								800 bbls.				

TABLE XIV.—*Date of first appearance of fish at the pounds and weirs on the south side of New England.*

	Dog-fish.	Mackerel.	Menhaden.	Alewives.	Tautog.	Blue-fish.
Newport, R. I						
New Bedford, Mass		1871, Apr. 25			1871, Apr. 10	
Wood's Hole, Mass		1871, end April	1871, Apr. 23	1871, Apr. 14	1871, Apr. 19	1871, May 20
West Falmouth, Mass.	1872, Apr. 22	1872, May 9	1872, May 18	1872, Apr. 25	1872, May 9	
Menemsha Bight, Mass.*	1872, Apr. 26	1872, May 5	1872, May 10 1871, Apr. 21	1872, Apr. 26 1871, Apr. 12	1872, Apr. 26	1872, May 31 1871, May 26
Waquoit, Mass	1871, Apr. 26	1872, May 11 1871, Apr. 18	1871, Apr. 21	1871, Mar. 24	1871, Apr. 18	1871, May 24
Nantucket, Mass						1871, May 29
Hyannis, Mass						

	Scup.	Shad.	Herring.	Squeteague.	Sea-bass.
Newport, R. I	1871, Apr. 18				
New Bedford, Mass	1872, May 15 1871, Apr. 24	1871, Apr. 15	1871, Mar. 25		
Wood's Hole, Mass	1871, Apr. 27			1871, June 1	1871, May 20
West Falmouth, Mass	1872, May 10				1872, May 13
Menemsha Bight, Mass.*	1872, May 6 1871, Apr. 25	1872, May 4 1871, Apr. 25			1872, May 14 1871, end May
Waquoit, Mass	1872, May 10 1871, Apr. 25	1871, Apr. 10		1872, July 4 1871, May 9	1872, May 28 1871, May 24
Nantucket, Mass					
Hyannis, Mass	1871, Apr. 22				

* Situated on north side of Gay Head, end of Martha's Vineyard.

XII.—SUPPLEMENTARY TESTIMONY AND INFORMATION RELATIVE TO THE CONDITION OF THE FISHERIES OF THE SOUTH SIDE OF NEW ENGLAND, TAKEN IN 1872.

A delay in the printing of the present report renders it possible to bring the inquiry into the fisheries of the south side of New England through the season of 1872, for which purpose I revisited Wood's Hole and Newport, in October, and sent Mr. Vinal N. Edwards, my able assistant at Wood's Hole, to Hyannis, Nantucket, and Martha's Vineyard, with a similar object. The following memoranda, obtained by myself and Mr. Edwards, will be found to contain some important statements:

NOTES TAKEN BY THE COMMISSIONER.

NEWPORT, RHODE ISLAND, *October* 10, 1872.

Mr. T. LEE, fish-dealer, said that fish were more plenty in Newport this year than last. Scup, weighing from one-fourth of a pound to a pound, were very plenty.

Bass have not been quite as plenty as last year, but they were quite plenty last year.

Spanish mackerel have been more plenty, and squeteague very plenty. Spanish mackerel have been as low as 15 cents a pound; they were never less than 50 or 75 cents a pound before; they were almost as common as blue-fish at one time.

Bonito have been abundant this year.

Several ceros have been caught here. I bought one for 5 cents a pound and sold it for 8; and the man who bought it of me sold the fish for $12.

Mr. CURRY, a fish-dealer, said fish generally had been tolerably plenty this year. Blue-fish are plenty, but we do not get many sea-bass this fall. Squeteague, bonito, and Spanish mackerel have been more plenty than usual.

Scup are plenty, some of fair size, weighing about half a pound. There were very few of the small-sized scup this year corresponding to those here last year.

Sheepshead have been about as plenty as usual.

No regular mackerel have been caught off the coast.

Several salmon were caught in Saughkonet River, and shad were plenty over at Second Beach, and several were taken in other places.

SAMUEL ALBRO, a fish-dealer, considered fish as plenty as they were last year. He gave the catch of one fisherman, George Crabb, from which the following amounts are taken, as caught with hook and line:

July 11	100 pounds tautog.
Another day	154 pounds tautog.

Another day .. .. 198 pounds tautog.
Another day .... 175 pounds tautog.
Another day .... 128 pounds tautog.
Another day .... 162 pounds tautog

From the account of fishing by WILLIAM RECORD, it appears that he took in a pound, on different days, 80, 120, 211, 272, and 310 pounds. August 1, 121 pounds; 5, 35 pounds blue-fish; 7th, 54; 8th, 33; 9th, 133; 13th, 9; 14th, 48; 15th, 138; 16th, 19; 19th, 185; 26th, 21; 27th, 31; 28th, 519, 29th, 48. September 2, 28; 3d, 54; 6th, 27; 9th, 116; 11th, 17; 12th, 37; 14th, 135; 22d, 14. October 1, 51.

Blue-fish are bought of the fishermen for 5 cents a pound. George Crabb averaged 100 pounds a day. In the month of June, last year, he caught 1,109 pounds of tautog.

Mr. J. M. K. SOUTHWICK, a dealer in fishing-tackle, nets, &c., said that small scup had been observed almost every fall about Saughkonet River. A gentleman of Tiverton remembered that many years ago there was precisely such a run of small scup as last year. The hook-and-line fishing is now connected with lobstering, and the lobsters are the most important part to that class of fishermen.

EDWARD M. GLADDING, pilot and fisherman, said line-fishing had not been much attended to this year. He had tried all summer, and could not catch many. It is much poorer fishing than it was last summer; as much worse as you can think. You cannot catch a mess in all day. Tautog'ing has been good for nothing this summer. He had not caught any blue-fish this summer. He had fished more or less for fifty years. No man ever saw the fish so scarce as they are now. He had not caught more than four scup this summer. Two-thirds of the fishermen with set-seines have not made anything; but thousands of fish have been carried to New York and thrown overboard. The heart-seines are death on fish; they catch anything and everything. The West Bay trap never caught more than this season; fish were plenty in the spring, and then they caught them. One trap caught 1,500 pounds in one day. The first fish of the season are tautog. Fifty years ago sea-bass were plenty about the Vineyard, and he used to fish there; but no sea-bass are caught there now. We used to get some nights over one hundred big bass, and sell them at New Bedford.

SAMUEL SOUTHWICK was a trapper three years ago, at Coddington Cove, and had seined more or less for forty years. Used to catch scup, menhaden, alewives, and pretty much all kinds of fish. Large scup are now scarce, but other fish are about as plenty as they have been. Last spring more tautog were taken at one haul than he ever took at two in the same place. Twenty years ago the market for fish was better than now. We did not formerly catch Spanish mackerel. He once caught two near Brinton's Reef, which he sold for a dollar apiece, but did not know what they were.

Bulls-eye mackerel were very plenty here fifteen years ago and more. They were considered better than ordinary mackerel. They were fat and small. When found now they are with the small mackerel.

Squeteague first appeared about twenty years ago; and they grew more and more plenty. About thirty-five years ago the people did not know what blue-fish were. One night he got 200 and put them on the wharf, and nobody would carry them off.

Mr. WILLIAM CHAMPLIN had a number of tinker-mackerel, which he had just caught. He thought they belonged to a different race from the round mackerel. He thought the fishing this summer as good as it was last summer. Lobstering has been better; there are as many lobsters now as there were fifteen years ago. They weigh only about two pounds each.

The tinker-mackerel are worth about fifteen cents a dozen.

P. B. HUDDY said the stripes on the bulls-eye mackerel are more green than on the common mackerel. There have been about the same number of fish caught with the hook and line this summer as last.

Codfish come in at Christmas time and stay till May. Never saw menhaden here in the winter. Mr. Tallman once caught 1,600 barrels on the 3d of December.

English herring come in here in the fall and stay all winter; never noticed any spawn in them. Scup have not been so plenty for four years as they have been this summer.

MARTIN GLADDING has a heart-seine in West Bay. Had found squeteague and scup more plenty this year than for ten years past. The scup are large enough to market, and send to New York every day. They correspond to the so-called second run of scup. Never knew the big scup to stop here in the spring. He thinks the second run of scup spawn. Never saw any spawn run from them.

Blue-fish have not been as plenty as common this season.

Tautog are caught, weighing from one to ten pounds; but the small ones have spawn running from them. They will bite as well when spawning as at any time. They spawn in July.

Got a great many shad this season, and alewives. The shad were caught in May.

Catches squeteague now altogether, and will take them all this month. He gets from four to eight hundred pounds a day. They are much more plenty than last year. He caught so many he could not sell them, and let them go.

The scup that used to be caught years ago were about the size of those taken this year. There was this year a large run of scup so small that they would go right through the meshes; were about an inch and a half long; and there were those of different sizes, up to a pound, all mixed together. There were not so many small ones this year as last; but hundreds of barrels were turned right out of the seine at a time.

Fall before last tautog were very plenty.

Governor STEVENS.—Fish of all kinds, generally speaking, have been more plenty this year than usual. Blue-fish have not been so plenty as sometimes; about the same as last year. Spanish mackerel more plenty. Never saw anything like the number of shad on the coast. They were moving east. They were caught all through this region, and so plenty they could not be sold in New York.

The Spanish mackerel did not last a great while. The scup that were caught were large enough to market. The large ones came a little in advance. The small ones are here now. Occasionally some of the large ones were mixed in with the small. They were more than twice as large as the run of small scup that came last year. I saw this year two days' catch of the largest scup I ever saw; some of them would weigh four pounds. That was about the first of the run. The fish they used to talk about as being so plenty were just like the run of scup we are getting now. The fish they used to catch weighed three-quarters of a pound to one pound.

We get full-sized English herring here; they are taken in gill-nets. I never saw any spawn about them. They used to catch them here in the winter. They are not plenty.

I got boneto plenty this year; sometimes got one hundred at a time. They brought about six cents a pound in New York. They are not worth as much in New York as blue-fish. I got a good many cero.

WOOD'S HOLE, MASSACHUSETTS, *October* 9, 1872.

Captain THOMAS HINCKLEY, who has a pound at West Falmouth, and whose testimony, taken in 1871, is printed on page 59, stated that all fish had become unusually scarce in 1872, with the exception of alewives, menhaden, and dog-fish, (*Acanthias americanus.*) Alewives and menhaden were in such abundance that it was impossible to dispose of them; especially as the fishing smacks which formerly came in for bait for mackerel are now in the habit of securing their own supply by means of nets that they carry with them. Blue-fish are scarcely one-fourth as numerous as last year, and are of very small size, this scarcity perhaps having some relation to the abundance of herring. Squeteague, too, are considerably more scarce; so much so that both they and blue-fish for a fortnight brought 10 cents a pound at wholesale, an unusually high price.

The small scup, so abundant in the summer of 1871, made their appearance as one year older, and were caught readily on the proper grounds. These averaged $5\frac{1}{2}$ ounces each, or nearly double the weight of last year. There were, however, few or no scup corresponding in size to the small ones of the year before. Unintermitted fishing by the children from the wharves, in the summer of 1872, failed to make any captures. [From this it would appear that the astonishing supply of young scup in 1871 was rather sporadic in its character, and that, from whatever cause it proceeded, the same conditions did not prevail this season. Where these fish actually came from, it is extremely difficult to say; whether an unusually large number of the breeding-scup succeeded in evading their enemies in 1870, or whether fish bred in more southern waters appeared on the coast in 1871, and moved in a body northward, covering the ground where they did not originally belong.

In reference to the young scup of 1871, some light may possibly be thrown upon the subject by the statement of Thomas James, the proprietor of two heart-seines in Narragansett Bay, that late in the fall of 1870 he was astonished at finding in his nets immense numbers of young scup, evidently spawned during that summer. These would represent, of course, the three-ounce scup found in the summer of 1871, and the six-ounce scup of 1872.

The scup of 1872 correspond to what are usually called the "second run" of scup, and were caught in sufficient quantity to market, being sent to New York in large numbers. Should nothing interfere with them, these fish will probably make their appearance in 1873 as spawning fish. Whether they will be permitted to deposit their eggs in peace, and thus keep up the supply, will depend probably upon the question whether the close time recommended is adopted.

While there did not appear to be any new pounds or traps erected in Narragansett Bay during 1872, many additions were made to the number in Buzzard's Bay and Vineyard Sound. Thus, four new ones were established in Menemsha Bight, one in Lombard's Cove, and one at Paintville, on the north side of Martha's Vineyard, two or more in Kettle Cove, on the north side of Naushon, and one about the middle of the north side of Nashawena, making nine in addition to the number which were there before. The result has been that, with the increasing scarcity of fish in these waters, scarcely one of them has made a sufficient profit to pay for the outlay and labor, and it is therefore probable that, with or without regulation, a smaller number will be hereafter established. Captain Hinckley thinks that the future of pound-fishing is closely connected with its regulation, and, as a representative of that class, is quite willing to accept any law that promises to secure a continuance of the business. He advises, as the best method of preventing the capture of fish, that the opening to the bowl of the pound be completely closed, and that the entire netting of one side of the heart be taken from the stakes. In his opinion, neither the removal nor the replacing of the net will require more than fifteen minutes to half an hour in each operation.—S. F. B.]

NEW YORK, *October* 15, 1872.

Messrs. MIDDLETON, CARMAN & CO., fish-dealers, state that the supply of fish in the New York market has been full up to that of last year.

Striped-bass have not been quite so plenty. Squeteague of medium size have been quite plenty, and at one time large ones, from Vineyard Sound, were plenty.

Blue-fish are obtained principally for the New York market, off Rockaway and the New Jersey shore, and as far south as Norfolk.

The price of blue-fish and squeteague has been about the same—from four to eight dollars per hundred pounds, at retail.

There were a good many scup off the Jersey shore. There have not been so many brought from Narragansett Bay as in former years. A great many very small scup have been brought from that direction, so small that three or four would weigh only a pound.

Sea-bass have not been quite as plenty as formerly, though many small ones have been taken off New Jersey.

Prices have averaged a little less for fish this year than last.

Spanish mackerel have been quite plenty at one time, for a few days, and then they were off again. There are no pounds in this vicinity.

Mr. E. G. BLACKFORD, a fish-dealer, said pound-fish were not as plenty as last year.

ROGERS & EDWARDS, wholesale dealers, said there had been more than the usual quantity of some kinds of fish, a good supply of large-sized squeteague. The larger ones came from Buzzard's Bay and Vineyard Sound. Blue-fish have not been as plenty as last year. They are mostly caught in this vicinity, and some from Block Island and Sandy Hook.

There have been a great many small scup brought in, more than could be sold. Large ones have not been as plenty as before. The small ones come from Narragansett Bay, principally. Something should be done to prevent the taking of the small scup; it would be an advantage to the trade. There have been few large scup this season. Bonito have come in from Block Island, Newport, and down the Sound.

REPORT OF VINAL N. EDWARDS.

NANTUCKET.

Professor S. F. Baird :

DEAR SIR: I went to Nantucket Tuesday. When I arrived there the net-men got together and agreed to tell the same story, that the fish were more plenty than last year. I heard this from net-men who did not agree with them. The report of the net-men was the same as that of Gershom Phinney and C. E. Snow. But all the others, hook and line fishermen and seine-net men say that fish are growing less every year, and think that nets are using the fish up. A large number of fishermen say that the blue-fish came into harbor to spawn every year, until this year, when there were so many nets that no fish got into the harbor. They begin to catch blue-fish by the middle of May.

I have seen a large number of the younger fishermen of Nantucket, all of whom tell the same story that fish are growing less every year.

Two of the net-men whom you examined last year were absent, and have been gone fishing all summer. Gershom Phinney and C. E. Snow say they had the same number of nets as last year, but other fishermen say they had double the number this year that they had last. The testimony given, is as follows:

GERSHOM PHINNEY, C. E. SNOW.—Think blue-fish have been plenty. They, together, caught in their nets in 1871, 5,500 blue-fish. In 1872, 7,518 blue-fish. They ran two weeks longer this year than in 1871.*

Captain C. B. GARDNER and Captain BATES fished together throughout the season. They report:

In 1870, caught 4,000 blue-fish.
In 1871, caught 3,350 blue-fish.
In 1872, caught 3,495 blue-fish.

They fished more than two weeks longer this year than for a number of years before. They fished on the south side; could get none on the north side.

WATSON BURGESS, a line-fisherman, says there were not half as many blue-fish on the north side this year as the last; that there were twice as many nets on the north side, but did not get as many fish as last year. A line-fisherman could not get one-fourth as many blue-fish this year as the last, in the same time. He went off a number of times and did not get a bite; did not get a large scup; little ones were plenty. Cod and alewives were more plenty.

---

* Professor N. S. Shaler, during a recent visit to Nantucket, was informed by C. E. Snow that with the same means and labor as many blue-fish could be caught in 1872 as last year; thinks if there had been no more fishermen than last year, should have caught three times as many. The fish are larger on the whole than last year. There are three different sizes observable. The largest size includes about one-fourth the whole number of fish, and averages in weight about nine pounds. The next size weigh about five pounds, and includes about half the fish. The smallest size weighs about three pounds, and takes the remaining fourth. Some have been caught weighing from twelve to twenty pounds. Since the 7th of September blue-fish have been more abundant than ever before. Scup were plentier than at any time during the last ten years; they were smaller but in good condition. There had been a decided gain in the number of cod-fish; they are larger than last year. Weak-fish were about twice as numerous as last year. Spanish mackerel has not gained in numbers. Alewives were more abundant.

JOHN ORPINS, a line-fisherman, has been fishing for thirty years and never knew fish so scarce as at present. Every year they grow less and less.

Captain WINSLOW, a line-fisherman, has not caught half as many fish this year as last. The nets were so thick that the blue-fish did not get by. None got into the harbor to spawn. Formerly large numbers have spawned in the harbor. He had been off a number of times, and found none; never knew such a thing before. There have been no large scup this year, but plenty of small ones.

Captain G. DUNHAM, E. DUNHAM, and C. DUNHAM, line-fishermen say: We did not catch any large scup this season; there were plenty of little ones at Long Hill. We could get but very few blue-fish on the north side, and had to go to the south shore for them. They were not as plenty as in past years on the south shore. We had to go to Great Point for blue-fish; could catch 25,000 to 35,000 fish in a season formerly; but last year could not catch any fish. Since the fish-pounds have been set, we can get scarcely any fish.

DAVID ANDREWS, a line-fisherman, thinks there have not been more than half as many blue-fish on the north side as last year; they have been becoming scarcer every year for four or five years. There were not so many on the south side as last year; and though the weather was better and the season longer, he did not get as many fish. He did not catch a large scup this summer; little ones were plenty at Long Hill, but few in the harbor. He went fishing several times for blue-fish on the north side, but did not get a bite; never did it before in his life.
David Andrews is regarded in Nantucket as an entirely truthful man.

SYLVANUS ANDREWS, a line-fisherman, had been off fishing several times on the north side of the island, and did not get a bite; never knew such an occurrence before. The nets took all on the north side, so that he could not catch any. The nets did not get as many as last year, the fish having been growing scarcer for eight or ten years. He did not catch a large scup this season, but got a large number of small ones.

J. G. ORPINS, line-fisherman, went blue-fishing part of the season on the south side; the fish were not so plenty as last year. On the north side the nets stopped all hook-fishing.

WILLIAM WOOD, line-fisherman, had been fishing many years; never saw so few fish as this year; on the north side there was no line-fishing; the nets took all or kept them off. Fish were not so plenty on the north side as last year.

CHARLES GARDNER, a line-fisherman, said blue-fish were so scarce on the north side of the island he did not fish for them; caught a large number of small scup. For the last few years blue-fish and scup grow less and less.

MOSES BEATMAN, a net-fisherman, said that in 1871 he caught some large scup; but this year caught but four large scup; plenty of little ones at Long Hill. No blue-fish in the harbor, as in former times; very few on the north side; none to be caught with the hook and line; the nets did not do as well as last year.

Very few of the fishermen keep any account of their catch. At the custom-house an account was kept of the number of pounds of blue-fish caught at the island. The report is as follows:
1871, from April 1 to June 30, 75,000 pounds.

1871, from June 30 to September 30, 149,000 pounds.
1872, from April 1 to June 30, 55,000 pounds.
1872, from June 30 to September 30, 139,250 pounds.

WOOD'S HOLE, *November* 9, 1872.

EDGARTOWN, MASSACHUSETTS.

I have just returned from Edgartown, and have seen the fishermen. Captain Francis Pease is dead; died last September. I saw the rest of the men, besides other fishermen. The record of Captain JOSIAH PEASE is as follows:

		Number of blue-fish.
1871,	June	1,021
	July	1,471
	August	1,600
	September	1,101
	October, to 17	1,014
	Total	6,207
	Sea-bass during the year	312

		Number of blue-fish.
1872,	June	1,616
	July	1,005
	August	937
	September	976
	October, to 13	174
	Total	4,708
	Sea-bass during the year	17

Captain Pease says he fished nearly double the time this year that he did in 1871; had very good fish-weather this season; better than usual. He had been accustomed to go into the harbor and catch blue-fish; but there were none there this year, and he had to go outside for them.

Little scup were plenty early in the season, but none in the latter part. No large scup and no tautog were caught by him. Captain Pease keeps an account of his catch every season.

Captain RUFUS PEASE did not keep an account, but knew that not more than two-thirds as many fish had been caught as last year, by all the fishermen in Edgartown. All kinds of fish have been very scarce. He thinks that if the decrease continues for three or four years, there will be none to be caught with hook and line.

Captain GEORGE COFFIN thought fish had fallen off one-fourth since last year, and nearly one-half since the year before. The blue-fish had always come into the harbor to spawn, but this year the nets took them, and none got in to spawn. Five years ago he could go down the harbor, and in three or four hours could catch three hundred blue-fish. This year he could not catch any. Other fish have decreased in the same manner.

Dr. Fisher, Seth Marchant, and W. Huckford, of Edgartown, all confirmed the statements of others as to the condition of the fishing.

At Holmes's Hole (Vineyard Haven) they caught twenty-three English herring on the 12th of November, but they had no spawn in them. The fishermen say that those that come later have spawn in them.

There have been no whiting yet, but plenty of frost-fish, with spawn in them.

No menhaden or tinker-mackerel were caught later than the 15th of October, and there were no menhaden caught with spawn in them in the neighborhood of Wood's Hole.

WOOD'S HOLE, *Massachusetts, November* 10.

HYANNIS, MASSACHUSETTS.

I have been to Hyannis and got the report of the fishermen, though not much of an account has been kept by them this year. Hatzel Handy has only kept an account of the number of barrels—160 pounds to the barrel. I saw a large number of men, but they say they keep no account; though they say they have not caught more than two-thirds, and some say one-half, as many as last year.

ALEXANDER CROWELL, a line-fisherman, in 1871 caught 8,000 pounds of scup, sea-bass, and blue-fish; in 1872 he caught 5,000 pounds only of the same kinds of fish. He says there were but few large scup, and about half as many sea-bass as last year; that there were but few blue-fish caught with the hook; the nets took nearly all that were taken.

ALMORAN HALLETT, line-fisherman, had no account for 1871; in 1872 he caught, according to his best judgment, 6,000 pounds. Has never known fish to be as scarce as this year.

HATZEL HANDY, a shipper or dealer, received, as shown by his books, the following fish in 1872:

	Barrels.
May, mackerel and scup	124
June, sea-bass, scup, and blue-fish	238
July, blue-fish	106
August, blue-fish	65
September, blue-fish	56
October, blue-fish	54
Total	643

He says he kept a strict account of the number of barrels. He had a larger number of nets this year, and that if it were not for the net-fishing he could not have done anything this year, the hook and line men have done so poorly. In May and part of June the fish were caught in nets and pounds. Blue-fish were caught until the 15th of October. Very many of the scup taken were small.

TIMOTHY CROCKER, a dealer, received in 1871, scup and sea-bass, 250 barrels: blue-fish, 400 barrels; in 1872, scup and sea-bass, 200 barrels: blue-fish, 300 barrels.

He had more net-men fishing this year than last. The hook-men did about one-half or two thirds as well as last year. The scup were generally small.

JOSEPH LORING, a dealer, received, this year, sea-bass and scup, 208 barrels; and of blue-fish, 305 barrels.

He had more nets than last year, and the same number of hook-men, (25.) The hook-men did about two-thirds as well as last year. Very many of the fish taken were small scup. No tautog. Blue-fish were taken till October 14. Says the whole number of his twenty-five men will state that they got about two-thirds as many fish as last year.

While coming up in the cars this morning from Hyannis, I met Arnold Luce, of Jeremiah Luce's fish-pound at Lambert's Cove. He says his father did not do more than half as well as last year. He said he had himself been connected with the fish-pound three years, but sunk money this year. He said that he caught two of those large bill-fish and two saw-tail sharks, (by his description;) that the tail was longer than that of the switch-tail shark.

WOOD'S HOLE, *November* 12, 1872.

MARTHA'S VINEYARD.

I have been to Menemsha and to Lambert's Cove, and saw all the fishermen that are at home. Some are not willing to give an account of what they catch, but say they did not get as much as last year. The Paint-Mill fish-pound men were all away, but the owners say they did not do half as well as last year. There was no run of scup, sea-bass, or tautog. Of blue-fish, they caught about one-fourth as many as last year.

B. TILTON, of the Menemsha Luce pound, said that they did not catch one-half as many scup and sea-bass and tautog as last year; of blue-fish, about half as many. Squid were more plenty; bait very plenty.

HIRAM POOL and LEMUEL REED, of Menemsha, net-men, of Prince Stewart's pound, said that they did a little better on scup this year than last. Their leader was twice as long as last year.

Of tautog and sea-bass they did not take one-fourth as many as last year, nor of blue-fish in the same length of time. They kept their pound down a good deal longer this year. Striped-bass were quite plenty in October. The 1st day of November, the day they took up the pound, they caught blue-fish, striped-bass, squeteague, cod-fish, and shad.

E. FLANDERS, of Menemsha, a net-fisherman, said he never saw fish so scarce since he had lived there as this year. He always could catch plenty of scup, sea-bass, and tautog there with hook and line; but could not catch any this year. Five years ago there were plenty of scup at Menemsha Pond, but none this year. He tended a fish-pound this season, and never knew fish so scarce. There were no blue-fish to be caught with the hook, and very few in the pounds. Squid quite plenty; very few mackerel this year. WILBUR FLANDERS, of the same fish-pound, confirmed the statement made by E. Flanders.

LAMBERT'S COVE.

SETH LUCE and JEREMIAH LUCE, net-men, said they did not keep any account of fish, but knew they did not catch more than one-half as many blue-fish as last year; of scup, sea-bass, and tautog not more than one-fourth as many. Menhaden and squid were about the same. Did not get more than one-tenth as many mackerel as last year.

VERNAL CLIFFORD, net-man, set his pound for the first time this year, but did not do anything; did not get any run of tautog, sea-bass, or scup. Blue-fish were very scarce; some squid; very few mackerel. Plenty of fish were formerly taken here with hook and line, but this year none could be caught.

E. COTTLE said there were very few scup; no tautog; very few sea-bass and mackerel last season; about half as many blue-fish as last year. Squeteague and small scup quite plenty.

THOMAS NORTON, net-man, did not do much this year. The net was taken up early in the season. There was no run of scup, sea-bass, or tautog, and the business did not pay, and he was compelled to take up the pound. They could not catch any fish with hook and line.

JOHN LOAK kept no account this year, but did not do much. Blue fish were very scarce this year. Tautog, sea-bass, and scup were very few. Squeteague were plenty. No run of mackerel.

VINEYARD HAVEN.

B. D. CROWELL, overseer of herring fishery, had had charge of the herring fishery six years. When he first took the river he caught 800,000 to 1,000,000 in a season; but every year since the fish-pounds were set at Lambert's Cove the herring have been growing less. Last year he caught only 108,000. The scarcity is the same in all the rivers on the island.

B. CROMWELL, net-man, said blue-fish were very scarce there last season. Four years ago plenty of large scup could be taken in the immediate neighborhood, but they could get none this year. Very few sea-bass or tautog had been caught.

P. S.—I saw some of the fishermen in New Bedford yesterday, (November 26.) They say the tautog were very scarce at the mouth of the bay this fall. At Wood's Hole we obtained none after the 25th of October; all were very small.

A few blue-fish were taken at Nomans Land, on the 2d of November, with hook and line, while fishing for cod. English herring (*Clupea elongata*) have been very plenty there lately. Some of those taken were full of spawn.

VINAL N. EDWARDS.

WOOD'S HOLE, *November* 25, 1872.

ADDITIONAL NOTES TAKEN BY THE COMMISSIONER.

WOOD'S HOLE, *October* 8, 1872.

Captain J. B. EDWARDS says there has been a falling off of all kinds of fish this year as compared with last year, except herring, or alewives. They were more abundant in the spring than they had been for twenty years.

Blue-fish have not been caught anywhere in the sound as much as last year; and at Hyannis it has been the same. They have not caught as many this year as last.

Tautog fell off half in the early part of the season, and there have not been anything like as many caught this year as last.

English herring do not come here much in the spring, but in the fall they are taken for bait in gill-nets. November appears to be their running month.

The small scup, of the size that were plenty last year, have been quite scarce this year. A man can catch forty or possibly one hundred in a day on the best grounds here; but before we had pounds I could catch boat-loads in a day.

The pounds at Waquoit did not do much this year, but at the pounds below Falmouth they caught a great many herring. The alewives have been much more plenty than usual this season. I think Captain Spindel got five hundred and sixty Spanish mackerel at one time, and they got three hundred at Menemsha at the same time. Cod were much more plenty in the bay formerly than now.

Captain ISAIAH SPINDEL took up his pound last week, Tuesday, October 1. It did not pay as much this year as last, as there was no market for the menhaden. He had seen menhaden with spawn in them, not ripe, late in the spring. There is no spawn in them now, and they must have spawned some time since last spring. Menhaden are as large and fat in October as at any time.

We take a few English herring in the spring, possibly a thousand; they are what we call "blue-backs;" they come about the 10th or 12th of May. I have seen schools of the same fish in the bay, and have caught them in a purse-net in the spring. They come a little before the menhaden, among the early fish. We never catch any in the fall in pounds, though they are frequently taken in gill-nets.

The fishing was later this year than last. We got 35 barrels of scup about the 30th of May, very large, some weighing 4 pounds.

We did not get as many fish generally as last year; about as many tautog, not so many sea-bass nor scup; blue-fish, about one-fourth as many; squeteague, not one-fourth as many. We got eight hundred more Spanish mackerel than last year. The price of these averaged 20 cents a pound. We got five porpoises and many pilot-fish. We got twice as many ceros as last year, some of which weighed 23 pounds. We got 12½ cents a pound for them. The price for fish generally was about the same this year as last, though not quite so good for mackerel. They are always poor in the spring.

The blue-fish we got this year were small, averaging 2½ to 3 pounds, though we got a few that weighed 10 to 12 pounds.

I was on the coast of North Carolina last winter, and they said they got mackerel about the 20th of March. The run of mackerel that come inside of Massachusetts Bay are much larger than those outside. They do not bite, but are taken in seines and gill-nets. They weigh 3 pounds, many of them; are very fat, and a splendid fish. They are sold fresh.

They are the mackerel that are poor in the spring. They get them in Massachusetts Bay in January.

The small scup that were here last year now weigh not far short of half a pound; but there are not so many small ones, though I have some very small.

VINAL N. EDWARDS did not meet with many small scup like those seen a year ago, but there are many half-pound scup. He had not seen any mullet this season. There are many young menhaden. As he caught tautog with the hook, about the 1st of July, he had seen the spawn running out. The eggs are about the size of No. 3 shot. A part of the eggs seem to ripen at a time. The Quisset men told me they had not done half as well this year as last. Peter Davis, of Noank, who fished on Naushon, said he had not done half as well.

I did not find any menhaden with ripe spawn in them this summer, and I examined them carefully. I caught some last Saturday, but they had no spawn in them. We never see any young menhaden till July or August. I have caught them not more than an inch or an inch and a quarter long.

NEW BEDFORD, *October* 9, 1872.

MR. CLARKE, fish-dealer, of the firm of Clarke & Bartlett, says blue-fish are as plenty in market this year as they were last, even if scarcer in the sound.

Scup have not been very plenty here. Ten years ago a man could load a boat with scup, here in the bay, in a day.

Fish, generally, are growing more and more scarce every year; and we can see a positive difference in the numbers between this year and last. The scarcity has been increasing for five years. The little scup that were here last year are not so plenty this year.

In this vicinity tautog are about run out; they are not worth fishing for.

The smacks are about killed off; they used to get a load in two weeks, but now they cannot get half a load in three weeks. We depend on traps mostly for fish. In the spring they catch the large tautog and glut the market with them, and after that they have to throw them away.

The regular retail price for tautog is 10 cents a pound. Cod retail at 8 cents, and scup about 8 cents, dressed.

We have had blue-fish in market all the time this season.

I think it would be better for the fishermen and all concerned if there were no traps in the world. As long as they can, the trappers will hire men to go before committees of the legislature and swear that fish grow more plenty all the time. The trap-men make all the money, while the smack-men make nothing all summer. I know two smack-men who have not made enough all summer to pay for their bread and butter, and they tried hard, too. There have been no large scup for about four years. Many poor families in this city suffer for the want of bread in consequence of the traps.

We got some pompanos this summer, for which we got 25 cents a pound. They came here last year, first, of any account.

MR. WILLIAM A. BASSETT, a dealer in fish, says small scup are more plenty this year than last, (evidently referring to scup that weigh about 5 ounces.)

I think blue-fish have been as plenty as last year, but they are generally small, weighing $2\frac{1}{2}$ to 3 pounds.

They do not get as many squeteague on the Vineyard shore as last year, though small squeteague have been rather plenty this year. We get a few pompanos. Tautog are rather scarce.

English herring are brought here from about Noman's Land. They are about half as large as the alewives that we get in the spring. They are caught about the last of October.

Menhaden have been very plenty this year. There have been very few boats fishing in our harbor this year. Our common alewives were never more plenty than this spring; we could not sell them, they were so plenty; they could be bought for 25 cents a barrel. The Vineyard fishermen turned out a great many, because they could not sell them.

In Clarke's Cove the pound-men did pretty well, as the herring helped them out in the spring. There are seven pounds between this city and Mishaum Point.

Six of the small scup in the shop were weighed, amounting to 2 pounds and 1 ounce, or an average of a little over 5 ounces each.

Dates when the fish were first brought in.

Herring, April 3, from Westport. In 1870, from Edgartown, six hundred herring, April 1. *Tautog*, April 17, from North Tisbury, and one shad. *Mackerel*, about 2d of May. *Striped bass*, May 4, from the Vineyard. *Scup*, May 7. *Blue-fish*, about June 1; most plenty from 10th to 14th of June.

Mr. Bassett said he had no doubt that the pounds had caused the decrease in the fish.

Mr. Presbrey Luce, of Martha's Vineyard, says he has a pound on the north side of the Vineyard, at Paintville. Scup were quite plenty there this year and last; he got 50 barrels at one time.

Blue-fish were more scarce about the Vineyard this year than last. The business of pound-fishing there has been overdone, and the pounds generally there have not done as well this year as the last. Mr. Luce thought the proposition in regard to a close time, as proposed in the bill prepared last year, a fair one, and did not think there would be any material opposition to such a law.

XIII.—PLEADINGS BEFORE THE SENATE COMMITTEE ON FISHERIES, OF THE RHODE ISLAND LEGISLATURE, AT ITS JANUARY SESSION OF 1872.

[I have already, on page 104, given the argument by Mr. Powel, before the Legislature of Rhode Island, on the subject of regulating the fisheries by law, as also the report of the special committee of the legislature on the same subject. The testimony and arguments presented to a subsequent committee have not been published, and I therefore embrace the opportunity, afforded by the courtesy of Mr. Pitman, to print from his manuscript the argument presented by him in January, 1872, in favor of legislation. I also give the substance of a lecture delivered by Captain Nathaniel Atwood, of Provincetown, Massachusetts, before the same committee, with the special object of showing that no such interference was necessary or proper.

As will be seen from my own report, I do not agree entirely with either line of argument thus presented, although both gentlemen present considerations worthy of careful consideration.—[S. F. BAIRD.]

ARGUMENT OF J. TALBOT PITMAN IN FAVOR OF A LAW PROHIBITING THE USE OF TRAPS AND POUNDS IN RHODE ISLAND.

MR. CHAIRMAN: I do not propose to go into an examination in detail of the evidence presented at this inquiry further than is necessary in the course of the remarks I shall offer.

The record of this evidence, although necessarily imperfect, from the impossibility of taking down all that was stated by the witnesses, is in your hands, and where it is defective your recollection will doubtless supply the omissions.

The remarks will be chiefly confined to the discussion of the main points of the general question, in the endeavor, by the assistance of the information within my reach, and by the comparison of the facts presented with each other, to lead the minds of the committee to the conclusion that the grounds and theories upon which the trappers base their claim to continue this fishery, are unreliable and fallacious.

I shall take it for granted that the report of the joint special committee of 1870, and also the testimony of the witnesses annexed to it, although not allowed to be introduced in this inquiry, will not be entirely ignored by your honors, and that you will read that report and some of the testimony, especially that of Joseph Church, Daniel Church, Benjamin Munro, and Benjamin Tallman, all the witnesses presenting themselves on the part of the trapping interest; and also of Jeremiah B. and

William C. H. Whaley, C. H. Bassett, John Steere, John D. Swan, and George S. Burleigh, because all the evidence presented in that report ought to have as strong a claim to be considered as much of the testimony presented by the other side.

But before entering upon the subject, I wish to give a brief

HISTORY OF THE INVESTIGATION AS TO TRAPPING.

This question has been before the general assembly five times at least; was referred thrice to a committee of the house, once to a joint committee of both houses, and it is now before your honors as a committee of the senate.

In 1856 a petition was referred to Samuel B. Wheaton and others, a house committee, as would appear from the report, in relation to the effect of trapping on other fish; and in said report, made in 1857, recommending that the petitioners have leave to withdraw, it is stated—

"Your committee were satisfied that the fisheries * * should not be interfered with or restrained unless it seriously interfere with the fishing in the other waters of the State, or some other very important reason."

Again:

"But there was no evidence submitted to the committee that the number or size of these fish (scup) were injuriously affected by the trap or seine-fishing."

The inquiry, as now asked for, was not entered into by that committee, nor, so far as I can learn, by another committee, appointed in 1864, of which the late Hon. Samuel Ames was a member. I understand that the report made by this committee cannot be found among the files of the proceedings of the general assembly, and I have been unable to find any printed report in the papers of the day.

In 1870, upon a petition signed by a large number of citizens of the State, a third committee was requested to investigate and inquire into the scarcity of scup, and to report whether any legislation was proper.

After a long and patient hearing of the parties interested, four out of five joined in a report recommending the passage of an act prohibiting the use of traps and heart-seines, but excluded Seaconnet Point from the operation of the law, for the reasons, as are to be inferred from the report, viz, that—

"It was contended by remonstrants that the fish caught by the traps *at Seaconnet were leaving the waters of the State and would not return.* Also, that they were never *known to go up Seaconnet River and through Stone Bridge into Mount Hope Bay*," &c.

And the majority of this committee could not decide whether this was so or not, from the conflicting evidence, but they "were of the opinion, from the evidence, that the impurities in the water did not interfere with the fish spawning, feeding, or staying in the bay below Nayal Point."

The act recommended, after being amended, was passed by the house, but defeated in the senate.

And the matter was then referred to a joint special committee at the same January session.

This committee made a unanimous report, in which it is stated—

"It appears to the committee that some legislative restraint as to the use of new instrumentalities for fishing, which impair or destroy individual rights, should be provided and enforced.

"After a careful and anxious investigation of the subject, the committee have come to the unanimous conclusion to recommend that the use of all traps and heart-seines, and other contrivances for catching fish, not including pike-nets, shore or purse-seines, be prohibited in all the waters of Rhode Island northerly of a line drawn from the southerly point of the rocks at Brenton's Reef to the southerly point of Point Judith, and north of Stone Bridge at Howland's Ferry."

Although satisfied with the conclusions thus unanimously arrived at by the committee, the act recommended by it did not meet the approval of many of the friends of the measure, for the reasons, that as Seaconnet Point and vicinity, excluded from the action of the proposed law, caught nine-tenths of all the scup trapped, it seemed to them that this locality was the very seat of the evil complained of, and it would be more fair to reverse the exclusion; that this exclusion made the law partial in its effects, and would be so distasteful to the common sense of the people of the State, on account of its injustice, that it could never stand; and that it was the opinion that the question, whether trapping was one of the chief causes of the scarcity, could only be tried by experiment, and to do this properly and fairly, all trapping should be prohibited during the time necessary to try it. Under the act as proposed, this question could never be decided; and upon its failure, as was sure to be the case, the trappers would then turn round and ask to have the act repealed, on the ground that, under our law, it was evident that some other cause than trapping was the chief cause of the scarcity. With this feeling, the act was amended in various ways in the house; it was passed and sent to the senate, and there defeated.

The present inquiry, for want of the act introduced at the last May session and referred to your committee, is raised under a petition to the same effect as those presented in January, 1870.

In investigating a business about which the committee had little or no personal knowledge, you would naturally rely upon that class of men whose occupation it is, for information upon all matters connected with it, and if reliable, your views and opinions would be much governed by their statements.

It would be presumed that, from their opportunities of observation and personal experience, the trappers would possess a large amount of correct knowledge as to the habits, food, modes of spawning, habitations in winter and summer, &c., of these fish, and be able to satisfy you upon the various questions that must necessarily arise in an inquiry whether scup and other fish have been diminished by the use of traps, or by other causes beyond or under the control of the legislature.

That these fishermen should know so little as to these fish, *beyond what is connected immediately with their pecuniary interests*, would have been a matter of surprise to me, had not this been already affirmed to be the case by Captain Atwood, who made the statement nearly two years ago, and re-affirmed it before you the other day. And not only is it his opinion, but it is that of the British commission, whose report will subsequently be referred to; and I shall endeavor to show that this is also confirmed by their own representations made to your honors.

For this reason any statement or theory emanating from the trappers is *presumptively made in favor of their pecuniary interests*, and, as such, should be thoroughly examined, subjected to all the tests by which it may be affected, and its soundness proved beyond a reasonable doubt, before it is accepted.

These are to be tested chiefly by the information received through the writings of those acquainted with these or similar fish, or obtained from the personal observation and experience of fishermen, but particularly by the examination of facts which, apparently isolated, may have been accidentally brought out without the knowledge of their effects upon the subject-matter.

By comparing and examining these, it not unfrequently happens results are produced that completely overthrow the theory they were expected to support.

In order to arrive at a rational, careful, and correct judgment of the effect of traps upon these fish, I shall endeavor, by the light of the limited information we are able to obtain, and of some of the facts as to the habits of fish, to show that the theories upon which the trappers mostly rely are deceptive and unsound.

And, as a part of the information, I shall refer to various books on the general subject, and in relation to the particular subject-matter, to the report of the joint special committee, and to some of the statements of the witnesses accompanying it; the latter, however, to be taken as hearsay testimony, if no greater weight can be accorded them.

In an inquiry of the character now under consideration, the committee must, from its very nature, depend in a great degree upon the statements of the persons appearing before it, of whom many, if not all, are more or less interested, but none so much as the trappers and those connected with them. In the testimony of these last, much has been stated upon information derived from others. Desiring that the committee should be possessed of all the information the question afforded, I have not objected to the reception of such hearsay testimony, except for the reason that the testimony *taken under oath* before the joint special committee was ruled out.

I am yet to be convinced that this testimony, so taken, and for the purpose for which it was taken, is not as fully entitled to credit as much that was presented to the committee, especially since there has been nothing adduced to question its authenticity and correctness, or to contradict the facts or opinions therein stated, any further than the evidence at that inquiry on the part of the trappers tended.

With all due deference to the committee, I must confess that I am still of the opinion, particularly after conferring with gentlemen conversant with the usage prevailing in such investigations before committees of either house, that the committee was incorrect in its decision, and did not follow the customary practice usual and necessary in such cases.

Inasmuch as the question is one affecting the interests and rights of every citizen of the State, it would seem but reasonable that witnesses coming before the committee should be paid for their time and expenses; but as the honorable Senate declined to provide for this, and as there was no other way to procure the evidence of persons acquainted with the subject of and interested in the hook-and-line fishing, except by their voluntary appearance, I had to content myself with the few that did appear, and who were sufficient, and all, that in my opinion, were necessary to establish the main points of our case, trusting to prove the remainder by the testimony of the witnesses on the other side.

Several very important witnesses reside at such distances that they could not be expected to present themselves at their own expense.

I hold that the trappers are and have been endeavoring to establish, as the main support of their cause, two principal theories, viz:

1. That scup and other similar fish cannot be affected, as to numbers and size, by any kind or any amount of fishing.

2. That scup, when caught at Seaconnet Point in the traps, are on their way to the eastward, out of the waters of the State.

A third, subordinate to and connected with the last, is—

3. That scup found above Stone Bridge are lost fish, coming in by the

west passage and not by Stone Bridge, and to regain their course will not go down to the sea through Stone Bridge, but return by the west passage round Brenton's Reef, and then eastward.

All these are presented to subserve the purpose, and the only purpose, of preserving the great trapping-ground at Seaconnet Point from being interfered with. So long as the trapping at this locality is not restrained, the main opposers to a law to this end are indifferent, and do not care what the law is.

Not a word has been said in defense of trapping at other places, except so far as these interests could not be separated.

As this locality is the great head and front of the trapping interest, my attention will be chiefly confined to the discussion of matters connected with it.

The actual facts, shown by the testimony of the trapping interest, are substantially these:

That scup begin to appear at Seaconnet Point and along the coast in schools, and in three runs, of which the first remains about a week, the second follows immediately after and remains about ten days, when it is followed by the third.

That the two first runs are full of spawn, some of them spawning when taken; are sluggish, not moving faster than two or three miles an hour; will not bite at the hook; apparently do not eat; and when opened, nothing is found within them.

That at this period they are a surface fish. After they have spawned, the schools break up and scup become a bottom fish.

That the first run is to the second run as about 1 to 50.

That the traps are set so as to take the fish coming, as they allege, but do not prove, from the eastward.

That they were first set at Seaconnet Point in 1845, and none were set west of Brenton's Reef until after 1860.

That from 1823 to 1845 scup were very plenty above Stone Bridge, and from 1845 they have gradually been growing scarcer.

That in 1870 and 1871 from 15,000 to 20,000 barrels were caught each year.

FISHING.

Upon the evidence it is shown, that about the year 1823 purse-seines were used both at Seaconnet Point and also above Stone Bridge, about Common Fence Point, and at the latter place scup were caught in great quantities. That in 1845 or 1846 traps were first set at Seaconnet Point. That from the year 1845 scup began to diminish in numbers, especially above Stone Bridge, and a few years back purse-seining had been abandoned at this neighborhood on account of the scarcity.

In the opinion of Messrs. Rice, Barney, Steere and Thurber, the only witnesses who appeared on the part of the hook-and-line interest, this scarcity is attributable to the traps of all kinds. On the part of the trappers it is denied that the traps at Seaconnet Point (the only interest represented) have any effect on the number, but that it is owing to the impurities of the water, want of food, destruction by horse-mackerel and other fish, and that the scup are changing their grounds and seeking new homes; and in the opinion of some, that the passage of steamboats up and down the river frightens them off. These are not alluded to in the respondent's argument, nevertheless I believe it important for me to do so.

IMPURITIES OF THE WATER.

The two committees (as shown in the majority report of 1870 and that of the joint committee) that have preceded you, were satisfied that this was not the case.

Their opinion was based, I presume—at least that of the majority report—upon the report of the committee of the legislature in 1860, to investigate the subject of the effect of impurities from gas-works, &c., on the fish, &c., in our waters; upon the report of Professor Hill as to his analysis of the waters above Field's Point, and upon the opinion of many of the witnesses.

That putrid waters appear to be innocuous (J. C. Rep., p. 12) has been shown in various ways, but it is conclusively proved that fish will thrive and grow fat in waters which will affect them so as to render them unpalatable to man as food. The Hon. E. C. Clarke, of South Kingston, stated in his seat in the house, that he once caught fish in Robinsonville Pond, Attleborough, Massachusetts, that were handsome and very fat, but when opened, emitted so strong an effluvium of gas that they could not be eaten.[1] In the newspapers it was stated, that off New Bedford clams were dug for a chowder, and when the dish was set before the party it was so impregnated with gas flavor, produced from the clams, that no one could eat it.

The trappers attempt to establish their view by endeavoring to show that fish brought in wells to the Providence market will not live so long as formerly, and ascribe this to the increased impurity of the water. On the other side, it is in evidence that fish will not live in wells or smacks far down the river in warm weather, unless the vessels are frequently kept in motion, so as to change the water and the air. Besides, there is no question but what the current of the river at the Great Bridge has been weakened from what it was before the dam was put in; when the tide had free scope, and the water near where the State prison now stands was 6 to 8 feet deep.

Mr. Atwood, in his address, gives a sufficiently good reason why fish would not long live in this manner, especially if bottom fish, in the change from cold to warm water, and, he might have added, from salt to fresher water; yet if the change was a gradual one, he believes fish would live. He also thinks that the effect of impurity of water in driving away fish would arise more from the effect it produced on their food than from any direct influence.

WANT OF FOOD.

There is no evidence showing scarcity of food. It is shown that muscle-beds are constantly forming, dying out, and re-forming; and they do so in streams into which the waste water from the print-works in Apponaug is constantly thrown, and grow abundantly. Even this proof of the fact of the growth, however, establishes nothing beyond this, that where muscles grow and flourish, other food would be likely to be equally abundant. From the kind of teeth belonging to scup, it is doubtful whether they are able to feed upon muscles, except when young and their shells can be easily crushed. They probably feed upon the spawn of these and other shell, and of other fish, and animalcules and small shell-fish found with the sea-weeds, and upon the sea-weeds themselves.

---

[1] Mr. Clarke informs me that he visited this locality in February, 1872, and there learned that the same peculiarities still attach to the fish, so that they cannot be eaten.

It may be also assumed, that if food was plenty when scup were so abundant, the growing scarcity of the latter would allow of the greater increase of the former. And without some direct proof of such scarcity, and as we know that clams and other shell-fish are still found in abundance, in spite of the increased demand upon them, we believe there is no want of food.

HORSE-MACKEREL (BLUE-FISH).

These fish are known as a surface fish. Their teeth are formed not for grinding, but simply for cutting, and their food is taken in and swallowed whole. Their principal food is the menhaden, also known as a surface fish.

Scup are a bottom fish, except at the time of spawning and before the mackerel come in. Their armor of bristling fins renders them an uncomfortable morsel to swallow; their short, chubby form, in contradistinction to that of the long, slim blue-fish, enables them to turn more quickly than the latter, and to elude the attacks, if made, while their habitation in the eel-grass shelters them still more from the attacks of their enemies.

There is no doubt that blue-fish will capture a scup when the opportunity offers and it is hungry, for it will seize a bright piece of metal or a bit of rag; but I think he is equally sorry he has made the mistake, whether he finds he has taken a hook or the sharp fins of the scup. The blue-fish, as well as other fish, may take scup when small, and, from the evidence, I have no doubt do so; but these keep generally in shallow water and among the eel-grass.

ENEMIES OF SCUP.

I do not pretend that scup have no enemies and are not destroyed in vast numbers. It was for this reason the Creator provided them with such immense powers of reproduction.

The water-animals, like those on land, prey upon each other, and, in many cases, on their own species, the large destroying the small.

Nor do I maintain that they are not liable to disease or other destroying causes, independent of other direct enemies.

Otherwise, if thus undisturbed, they would increase in such numbers as to overbalance and upset the order established by nature's laws.

These fish are intended as an article of food for man, to be used at a season of the year when other fish are seeking cooler waters, and when the appetite has a distaste for the more solid food, and craves a lighter and more digestible diet, to conform to the state of inactivity induced by the hot weather.

Now, while admitting that scup and all other similar fish have numerous destroyers, and that their numbers are greatly decreased by them, we say that enough are provided for the use of man, provided they are taken at the time he needs them and in the ordinary mode. This time is when the warm weather continues, and the ordinary mode of hook and line has hitherto been able, until recently, to supply as large a quantity as can readily be consumed.

When, however, man resorts to these traps and catches them in large quantities, and at a time they are spawning, (as we expect to show,) the supply cannot meet the draught, and, it is contended, must gradually be diminished, until exterminated or the trap-fishing is no longer worth following, like the purse-seining at Stone Bridge.

The same assertion, now made by the trappers, was formerly used in regard to salmon, shad, herring, to the wild fowl and the buffalo. It was thought nothing could affect the supply. The salmon are no longer found in our rivers, the shad are fast disappearing, and a very perceptible decrease as to the herring and the buffalo has taken place, showing that in time, unless the wanton destruction of the buffalo and the indiscriminate modes for taking shad and herring are prohibited, they will soon be among the things that were.

The Indian cared for the buffalo and regulated their destruction, with jealous care, killing only what was absolutely necessary for food, and in this way their numbers were kept up. But the white man destroyed them regardless of the consequences, and for no other purpose, apparently, than the mere love of destroying. The result is, that in some sections of the country they have entirely disappeared, and everywhere largely decreased.

The same cause and effect exist in regard to scup. In 1857 the trappers admitted to the committee that 60,000 barrels were taken in their traps, of which 45,000 were sold for food at 30 cents per barrel, and 15,000 for manure at 18 cents per barrel. But Mr. W. C. H. Whaley, at that time engaged in trapping, says that in 1856 150,000 were taken from Watch Hill and Seaconnet Point; in 1857 about 160,000; in 1858 about 115,000 barrels, and each season since the quantity has decreased. In the year 1869, as near as can be ascertained, only about 20,000 barrels were taken; in 1870 (9,000 to 10,000 up to May 16) about 12,000, and in 1871 about the same number, or perhaps a few more.

Is it to be supposed, in the face of the fact that these fish, in consequence of the foreign demand, are worth on the average $2 per barrel, (nearly seven times the price of 1857,) that the trappers do not catch all they can? Is it not self-evident that the reason they do not catch more is that they are not to be found, and that they have actually decreased in numbers to this extent?

HABITS OF SCUP.

In order to comprehend the questions involved in the inquiry in which you are now engaged, it will be necessary to consider the habits of other fish in relation to reproduction and how far the habits of scup coincide with them. To do this properly, we have to ascertain what are the habits of these other fish, and whether these habits are like those known of scup; that is to say, if we find that scup and other fish have certain known habits in common, we may conclude from the analogy between them that the former have certain other habits identically the same with those we know these other fish possess.

In making this examination, we must select those fish whose modes of spawning most nearly resemble the fish in question. For this reason we would consider those, for instance, that frequent our rivers and streams, such as the salmon, shad, herring, &c.

It is admitted that these fish enter our rivers in the early spring from the ocean, proceed to the place where they were born, to deposit their spawn, and having deposited it, that the herring break up the schools and disperse to their feeding-grounds.

We assume as a fact which cannot be disputed by any evidence, and which is supported by much, that scup, having hibernated not a great distance from the coast, on the approach of spring awake from a dormant state, and approach the coast for the purpose of spawning. Some of them take up their ground at Block Island, others at other favorable localities; some come to Seaconnet Point, others in the neighborhood of

Sichuest Beach, and some formerly came up to Mount Hope Bay; all coming to the place of their birth. They come in schools, remain so for a time, and then break up and disperse themselves over the feeding-grounds. That while in these schools and frequenting the shore of Church's Cove, we say that the first run of scup are spawning, and when this is finished they break up. We come to this conclusion, because the first run of scup are caught within a week; during this time they are sluggish in their movements, seem almost unconscious of danger, eat nothing, and the anal passage appears to be sealed up; they are full of spawn and are spawning—so Captain Benjamin Tallman himself states

The Report of the Commissioners of River Fisheries of Massachusetts, of 1869, page 17, says: "All fishes that go to fresh water to breed, seek their proper birth-place, and they are there concentrated and crowded together, and are, moreover, very tame, so that it then becomes possible to capture them in vast quantities and in a limited space; and unless they be at that time protected, they are liable to extinction in the particular waters where such wholesale destruction goes on."

Mr. Atwood stated, with regard to mackerel, some facts that throw strong light upon this point. He says that these fish begin to appear the middle of May, a few at a time, then in abundance, which, I suppose, means in schools. They will not touch the bait on the hook at this time, and are taken by nets out in the bay. From about the 28th of May to the 4th of June they were depositing spawn, and by the last date had finished and left for feeding-grounds.

The habits of mackerel, thus stated, as to assembling, refusing bait, and breaking up, and the time they are together, agree so well with those of scup while at Church's Cove, that if unsupported by any other evidence, most inquirers would be satisfied that scup were spawning while there, and that their disappearance was owing to their having completed their mission and dispersed to feed in the vicinity.

On the other hand, the trappers at Seaconnet Point require us to believe that these fish come into Church's Cove by accident on their way from Watch Hill, where they first took the coast on their way eastward to Buzzard's Bay and Nantucket Shoals. To the committee of 1857 they stated that they were bound there for the purpose of spawning, but they have since modified this, and now allege simply that they are bound there.

The reason why this has been so pertinaciously persisted in is, that as these fish were thus leaving the waters of the State it was contended the people of the State could not be injured by the taking of them, and therefore traps at this locality ought not to be interfered with. Therefore, if this theory could be successfully controverted and overthrown, no real ground would remain why these traps should be treated differently from the others, or should be allowed to continue in operation.

I have always argued that this theory was untrue, principally upon the belief that the instincts of fish were unerring and certain guides; that if it was ever intended they should summer in Buzzard's Bay, these instincts would have carried them there in a direct course from their winter-quarters. And this belief has been confirmed by facts that came out at the former committee investigations. One of these was the statement made by Captain Joseph Church, that upwards of twelve years ago he bought a barrel of scup caught at Waquoit Pond, five or eight days before scup were caught at Seaconnet Point, where the traps were set. This was self-evident proof that the scup caught at Waquoit Pond did not reach there by the way of Seaconnet Point. Another was, that scup were caught in Long Island Sound, at Gardner's Island, and other places, in great abundance, several years ago. Every one admits that they did not get there by the way of New York and Hell-gate, but came in around Montauk Point; so that with regard to these fish, the theory that scup moved always toward the *east* was not true, as they went *westward*.

This belief has, at the present investigation, been still more strengthened by the honest and straightforward testimony of Lorenzo Tallman, who says that the trappers' theory is based solely on the ground that scup are usually caught at Watch Hill before they are caught at Newport, and at Newport before being caught at Seaconnet.

And further, he says that last season scup came in, to a breadth of sixty miles, at or about one time, and that a vessel-load of scup from Nantucket was brought into Newport Harbor, and immediately after, another from Seaconnet, before any were caught by the traps off Newport, and that the theory is completely upset.

SPAWNING.

In connection with and in order to understand all the bearings, it is necessary to consider the manner of *spawning*.

In the book called "Fishing in American Waters," we find considerable general information, and I propose to cite a few passages from it, not only in relation to scup, but with regard to some other fishes that are the subjects of this inquiry:

"These fish replenish their species by laying eggs, which are vivified by the milt of the male, and then, after a time, the eggs hatch in the water. This process is common to all egg-laying fishes; but while eggs of the *Salmo* genus require from three to four months to hatch, those of the *Clupea* genus hatch in as many days. Seth Green hatched *shad* artificially on the Connecticut River in forty hours from the time the ova and milt fell into the hatching-boxes in the stream. (Page 41.)

"The striped bass is eminently domestic in its habits. * * The female deposits her eggs in fresh and brackish waters, but never in the sea. In November the bass shoal and congregate in brackish-water ponds, or back waters of tidal rivers, or in the bays and bayous of rivers which have an outlet to the sea, after which time it will not take bait until the following spring, after having spawned and returned to active waters. (Page 47.)

"Upon the breeding-times of different fishes, and their resorts at certain seasons in the year to hibernate, there are no fixed data. (Page 406.)

"Most white-meated fish spawn in the spring, yet the fish known as the *white-fish* spawns early in the autumn. All members of the genus *Salmo* spawn in autumn.

"*Shad.*—It winters in the ocean, dallies among the nets in the estuaries during spring, after which it lays its ova in the sand above the tide-waters, and returns to salt water to recuperate. (Page 324.)

"The porgee ('scup') is supposed to spawn on the weedy banks, with sea-bass and tautog, early in spring, when the last year's hatch leave for the estuaries, purveying to the head of tide-waters." (Page 110.)

According to the best information I have been able to obtain, I am led to the conclusion that scup frequent the mouths of, or in, rivers into which fresh water empties, or in fresh-water streams, at the time of spawning, and nowhere else, for the benefit they derive from the fresh or brackish water, especially since it is shown by the experiments of the Coast Survey that salt and fresh water or waters of different temperatures do not readily unite. The Gulf Stream is an example of water of different temperatures, and it is reported by the Coast-Survey that in the Hudson River a counter-current of salt water is found underlying the outward current of brackish water. This view receives some strength from the fact that scup keep near the surface while in the schools, and, as we believe, in the act of spawning. But however large the part this may play in the process of spawning, we desire to present some other phases of equal or greater importance.

I am informed by a gentleman that he once witnessed trout, kept in an aquarium, in the act of spawning; the whole process occupied three days. At intervals the female would eject a stream of ova into the water, and immediately the male would emit a quantity of fluid. When an egg came in contact with a particle of this fluid, it would sink to the bottom, while those that did not, rose to the top; the former was said to be impregnated and the latter were not, and were consequently lost.

If the same process takes place with regard to scup, (and I have no reason to doubt it,) one of the conditions to a successful spawning is to select water most protected from the wind, most exposed to the sun, and out of the reach and action of the tide, where it shall be as quiet as possible. Seaconnet River presents, especially at Church's Cove, these conditions more perfectly than either of the other passages of the river. There is, comparatively, less current, on account of the obstruction made by Stone Bridge; the water is shallow, and the eddy or counter-current at Church's Cove creates comparatively still water and is protected from the northeast wind, while the other passages are open to this wind, and the water is deeper. Another condition seems to be that as the males are to the females about as one to four, it is necessary for the impregnation of the ova that these fish should concentrate as closely as possible. By this mode a larger number of the eggs would be vivified than if they were separate and isolated.

Undoubtedly, particularly if the waters are in more than ordinary motion, caused by the winds, a very large proportion of the spawn escapes this fluid, and it is then only useful as food for other fish in attendance upon them. The vivified ova sink to the bottom, among the crevices formed by the rocky bottom, where they remain until hatched. This is the real cause, it seems to me, why scup are found at this period at Church's Cove.

Great stress is laid by the trappers on the fact that the traps are set with their mouths so as to take the fish coming down the shore. They assert that the fish are skirting the shores until they come to the mouth of the river; they then strike across until they reach the shores at Church's Cove, when they turn southwardly, down stream, and on their course are taken in the act of leaving the State waters and going to the eastward. Let us see whether this is actually the case.

It is admitted that the traps at Seaconnet Point take nine-tenths of all the fish trapped between Newport and this locality.

If the fish were following the shores as asserted, it would seem probable that a larger proportion would be caught by the other traps on the Newport side of coast; as this is not the case, the inference to be drawn is that they did not reach Seaconnet Point from that direction.

Further, from the evidence that the fish were caught this season at Nantucket and Seaconnet Point, respectively, before they were caught at the traps off Newport, the conclusion is, that of the two directions, eastward and westward, they came from the latter, if either.

Now, in this latter case, *the mouths of the traps should have been set the other way, but they were not*, and as about the same quantity were taken last season as the one before, it is evident that they came neither from the east nor west, but direct from their winter-quarters to their summer-homes, and if unmolested would have spawned in our waters.

The truth is that these fishermen have studied the habits of these fish so far only as they contribute to their pecuniary interests, as suggested by Captain Atwood, and upon their knowledge of these habits, these traps are set where the fish most do congregate, and in such a manner as to catch them.

They profess that because these traps do not completely close the mouth of the river, they do not obstruct the fish going up it. It is undoubtedly the case that these fish, like other animals, have their roads and pathways, and any obstruction placed in these roads would be as effectual to bar their progress as if the river were completely closed.

It is a remarkable fact, taken in this connection, that while we are assured that acres and acres of scup are seen outside and away from the traps, and while it is the custom to unite two gangs, so that while one of them attends the traps, the other, with purse-seines, are out on the river looking for and catching menhaden, yet we never hear of their catching scup, which are so much more valuable, by these purse-seines.

To prove that the fish at Seaconnet Point are not connected with those above Stone Bridge, until after they have left the latter place, the trappers have set up another theory, which we shall attmept to show has no better foundation than the one last discussed. It is stated that some of the schools on their way eastward, from Watch Hill to Buzzard's Bay, lose their road and go up the west passage into Mount Hope Bay, toward Fall River; here they find they are off their course, and to regain it skirt along the southern shore of the bay until they reach Seaconnet River, then down along the eastern side of the river until they find the bridge, and the passage through which being too narrow, (although Captain Church admits that they have been seen going down, but not up,) they cross and go up on the west side to Common Fence Point. From the time they enter this river, until and up to Common Fence Point, they used to be caught in purse-seines, but from this place they disappear; it is held that they then go down the west passage, pass around Brenton's Reef and reach Seaconnet Point about a week after they allege they left Common Fence Point on their way eastward.

This entire theory is based on the *allegation* that scup used to be taken at Seaconnet Point about a week after they had disappeared at Common Fence Point; it is simply a bare allegation, and is unsupported by the least tittle of evidence. To believe this, one must accept as true that the scup, whom instinct has led them to, our shores, have suddenly lost it; that they must have passed quietly, unseen, and beneath the surface of the waters, when they had previously been on the surface, up through the west passage and through Mount Hope Bay, and did not appear in sight until they found they were on the wrong road, when they first appear on the surface, I suppose *to look round and see how the land lies;* they then keep near the surface, while skirting along the sides of the river, until they reach Common Fence Point, where they again disappear beneath the waters, and are not seen again until the sea is reached. It is not pretended that all the schools do this, for the others, better informed or led by a more experienced pilot, keep along the coast until they reach Seaconnet Point.

How this can be reconciled with the fact that the unlost schools are being taken as soon as they arrive at Seaconnet Point, several days or a week before the lost schools regain their proper course, coupled with the fact that the first run of scup do not continue more than a week at the most, I cannot conceive.

I shall attempt to account for the appearance of scup above Stone Bridge, and their gradual disappearance in another way.

I think there can be no doubt that formerly scup came up to Stone Bridge, by the way of Seaconnet Point, for the purpose of spawning, and did spawn there.

After the traps were set at Seaconnet Point, vast quantities were taken there, and many of the schools were broken up; and perhaps, if the idea prevalent among the trappers themselves is true, that each school had an old and experienced guide, they lost their leader, became thus disorganized, bewildered, and obstructed, and having lost their course spawned in that vicinity; while others, escaping the traps, reached their true spawning-ground, where they were taken, or deposited their spawn. But the reproduction there was not sufficient to fill up the deficiency at Stone Bridge caused by the purse-seining, so that the numbers gradually year after year diminished, until seining was abandoned in that vicinity. Only those would return who were born there, while the fish spawned at Seaconnet Point would deposit their spawn in that vicinity.

The statement of Mr. Lorenzo Tallman was that the fish at Stone Bridge remain there about a week; this would be about the time necessary after their appearance to complete the operation of spawning, and then, instead of going down the west passage, they disperse to their feeding-grounds. This to me appears the only reasonable way of accounting for their disappearance.

Allowing them a week there, and a week to reach Seaconnet Point, the season for this run, which does not, as is stated, continue much more than a week, must have taken, if this be true, a much longer time.

By comparing this assertion with the other facts admitted by the trappers, I am satisfied not only that the theory is unsound, and not supported by these facts, but that, on the other hand, it is completely controverted.

Why is it necessary, except for the purpose of sustaining a theory, under which alone can the continuance of the traps be justified, to assume that scup avoid during the summer the coast and our beautiful bay and river, when they are found in abundance on each side of us?

Mr. Scott, in his book, Fishing in American Waters, already quoted from, says of this fish, (page 109:)

"It is a greedy little shining sinner, which is both herbivorous and carnivorous, foraging on both fish and vegetable diets, and shoaling with the *omnium gatherum* of bottom fish, which make their *summer* habitation among the weedy banks called by their name all along the coast from Maine (?) to Georgia, from three to six miles from shore, purveying everywhere from their homes into all the estuaries and tidal back-sets for provender. The porgee is one of the most numerous of coast fishes, and as greedy as it is plenty. Dr. Brown, in his Anglers' Guide, states that the steamboat which runs daily to the porgee banks near Sandy Hook, in the summer, returns with many thousand porgees, beside the sea-bass and tautog averaging from six to ten thousand as their daily catch with the hand-line."

The trappers alleged that they were to be found in Buzzard's Bay and Vineyard Sound, &c. But I think Mr. Scott is in error when he says they are found on the coasts of Maine; I am inclined to believe they are not found on the other side of Cape Malabar.

Mr. Daniel Church says they are found the whole season off Charleston or Savannah; and the hook-and-line fishing in Hudson River and vicinity has at some seasons greatly interfered with him in the market.

Does it not seem contrary to reason and common sense to suppose that these fish would or could not remain in our waters from the spawning-season through, during the summer season, until they remove to their winter-quarters, if allowed to?

Can there be any question as to the purity of the water, at least from the coast-shore to a distance of three or six miles from the shore, or as to its suitableness as a habitation, as to depth, and character of the bottom? The Coast Survey charts represent our bottom and that of the Shoals and Buzzard's Bay to be the same, mostly of yellow, black and gray sand, with here and there clusters of rocks.

If, as now alleged, for the first time with any force, the scup are changing their grounds, and diminishing gradually from other causes, and will ultimately disappear, because there is a tradition that they had once before disappeared, about one hundred years ago, and without any known cause, I have merely to say that if this is to be the case, let us not hasten the evil day, by reducing their numbers every year while they do remain, through means of these traps. Let us preserve and protect them from all these modes of reckless destruction, at least while spawning. Perhaps by care they may be induced to remain with us entirely.

I do not believe, however, that when fish are about to leave a locality, they leave it gradually; when they go, all leave at once; I think this is in accordance with the experience in relation to the desertion of other fish.

CAPTAIN ATWOOD'S REMARKS.

I wish to say a few words respecting Captain Atwood's opinions and remarks.

I have a copy of the Yarmouth Register, May 27, 1870, which contains his speech before the Massachusetts senate, on the 19th of April, 1870, in relation to the fishery question then before that body. The language and tenor of his remarks are so nearly identical with what he said a few days since, before this committee, that I shall trespass on your time in citing a portion.

Speaking of the witnesses before the committee of which he was chairman, he says:

"Like the many fishermen I know, the witnesses were not well acquainted *with the habits of fish*. They study them no further than they contribute to their pecuniary interest; *at most* they possess only a local knowledge of the fish with which they come in contact. They prosecute the fisheries for their support, and do not make the habits of fish a special study."

AS TO CAUSES OR MODE OF DIMINISHING THE SUPPLY.

"One is to introduce the beam-trawl, which has not been used in our waters. * * This net being dragged over the bottom would destroy the young fish as it passed over them, and might tend to diminish their numbers."

I ask whether the use of traps to catch fish while in the act of spawning "*might not tend to the same result.*"

Again he says:

"If fish have diminished in any of the small arms of the sea, I should have no objection to the passage of a local act, provided it did not interfere with the rights of others."

If this is his opinion, he *would certainly be in favor of prohibiting the traps of Seaconnet Point.*

It will be recollected that his general remarks related entirely to sea-fishing, and to those fish that are caught in the sea, while in relation to scup or tautog, he says that he did not know anything about them.

From the statements of the trappers it would be presumed that Buzzard's Bay and Nantucket Shoals would swarm with scup, if they all arrive at the localities whither they allege they are bound. And it is therefore with some astonishment I find in the report of the Massachusetts senate committee on fisheries, and of which Mr. Atwood was chairman, made April 14, 1870, the following paragraph:

"Scup, tautog, sea-bass, striped bass, and other kinds of fish that are not used for bait, are caught by the weirs in our waters south of Cape Cod only in small quantities, and as a secondary and incidental matter; the amount of these kinds of fish caught by such weirs is too small to have any considerable effect upon the increase or diminution."

And in his remarks:

"All agreed that the scup, tautog, sea-bass, and striped bass had within a few years diminished in Buzzard's Bay, but failed to show that over-fishing was the cause of the diminution."

It is a little singular that Captain Atwood, unless he refers in his remarks *entirely* to sea-fishes, which seldom or never enter our rivers or streams, should be so blind to the fact that many fishes have been diminished by over-fishing, but I am inclined to think he includes these fishes also, for he says:

"If we wish to increase and stock our inland waters, it cannot be accomplished without protection. The building of dams across the streams, and throwing of deleterious substances into the waters, have diminished the fish. *But, in the great sea, man cannot pollulte its waters by anything he can do.*"

I am inclined to apply to him the same observation he makes with regard to the witnesses who appeared before his committee, just quoted, and believe he willfully shuts his eyes to every fact that tends to show that man can diminish any species of fish by over-fishing.

That such is the case seems too well known and understood to need any illustration. Salmon have totally disappeared. The shad have in many rivers been completely, in others nearly, extirpated. Great apprehension exists that the same effect will be produced upon the white-fish of the lakes; and the report of the commissioners of river fisheries, made to the General Court of Massachusetts for the year ending January 1, 1869, shows that such is their belief. They say (page 17) that unless fish that go to fresh water to breed are "at that time protected, they are liable to extinction in the particular waters where such wholesale destruction goes on."

Mr. Atwood, in his report of 1870, already referred to, seems to rely greatly upon the report of the British commission of 1865, as showing the correctness of the conclusion drawn by his committee.

This report of the British commission is very closely and admirably criticised by M. Rimbaud, and his views seem to be fully believed and adopted by the commissioners of river fisheries of Massachusetts, in their report for the year ending January 1, 1870. And the joint special committee of Rhode Island, in their report, made May, 1870, have quoted largely from the Massachusetts report.

Before we refer more particularly to Rimbaud's facts and conclusions, let us see what Mr. Atwood's opinion is of this gentleman. He says in his remarks, that—

"There were persons who did not wholly agree with the British commissioners; one of the most prominent is J. B. Rimbaud, who has published a work on the fishes of the southern coast of France. Himself a fisherman, he says that *the migratory* species, that go *off to sea in schools* and return each season, cannot be diminished by over-fishing, but *local fishes* can be exterminated by constantly fishing for them, and such has been the case in the locality where he has been accustomed to fish. Of the two, I allow Rimbaud to be the best judge, as he has acquired his knowledge by practical experience in the fisheries, and the British commissioners had gained their information from others."

Without questioning the value and correctness of Mr. Rimbaud's statement, Mr. Atwood goes on, for the purpose of undervaluing and showing the inapplicability of his conclusions as to the division and habits of fish to those of Massachusetts waters, to state that the extent of the French fishing-grounds and the range of temperature are limited, and the character of the shores are different, when compared with our fishing-grounds. This is offered to prove that fish on the coast of France are more permanently *local* than ours.

"Tell me, sir, how many are there of our fishes that are not more or less migratory?" is his last question; and answers, "Senators will see that our fish and fisheries are not like those of Europe."

In attempting to answer this question I will refer him to Cuvier, to whom he referred me, who shows that from the form, mouth, bones, teeth, and fins, we can decide as to the habits and mode of life of a fish. He and his disciples have carried comparative anatomy to that perfection that they can come to this conclusion from a single one of these elements. It is not therefore from their investigation too much to say that all fish similar in construction and organization have similar habits; that if a certain tribe of fishes in one part of the world are wandering fishes, other species of the same tribe in another quarter have the same habits. To a certain extent the temperature may act upon them, and some may be to a certain degree migratory in colder climates, so far, for instance, that they may seek their winter quarters at some short distance from the coast, but do not, like the wandering fishes, go to the extreme south for a warmer climate, and, as the warm weather comes on, take their course back again.

The reason that underlies and sustains the belief that wandering fishes as a general thing cannot be diminished by fishing, however destructive, is that these fish cannot be taken in nets in quantities while they are in spawn; for, as an exception, herring, which are classed as a wandering fish, are taken in schools and while in spawn by nets in our waters, and we know that their numbers in many localities have greatly decreased.

It is immaterial, however, in our view, whether they are simply bottom, white, or wandering fishes. If they are taken in large quantities and while in spawn, fishing may and will diminish their numbers.

In this connection the Massachusetts commissioners of river fisheries say, (referring to the British commission and Rimbaud):

"And while we cannot say that either party to the discussion has *proved* anything, the points indicated are the following:

"That no amount or kind of fishing can diminish the 'schooling' or wandering fishes *of the high sea*, such as herring, *(Clupea elongata,)* mackerel, *(Scomber vernalis,)* menhaden, *(Alosa menhaden,)* cod, *(Morrhua americana,)* &c.

"That the local and bottom fishes which are peculiar to certain limited areas near the shore may be greatly reduced or even practically annihilated, in certain places, by improper fishing, such as the tautog, *(Tautoga americana,)* the sea-perch, *(Ctenolabrus cœruleus,)* the flounder, *(Platessa plana,)* the striped bass, *(Labrax lineatus,)* and the scup, *(Sparus argyrops,)*" &c.

It would seem that the question whether they may be diminished by fishing depends upon their *localization* at the time of breeding.

Whether the breed is destroyed when in spawn by traps, or, as on the coast of Spain when hatched, by the *trawl beam*, the mode suggested by Atwood, the effect will be to effect a diminution.

And we cite from the commissioners' report, (page 20,) another paragraph taken from the report of the river fisheries:

"We see that in 1831 Malaga caught less than any except San Lucar, but in 1861, *she took more than the three put together.* Further, Malaga took fifty per cent. *more fish to each man* than did others. On the Malaga coast, fishing with the great trawl net *(aux bœufs)* has been *prohibited* since 1828, while in the three other departments it has been *allowed* and much practiced."

A single other fact, and I will leave this part of the case.

In the American Angler's Guide, page 178, in the article on tautog or black-fish, it is remarked:

"The black-fish abounds in the vicinity of Long Island, and is a stationary inhabitant of the salt water."

"He may be kept for a long time in ponds or cars, and fed and even fatted there. When the cold of winter benumbs him, he refuses to eat any more, and a membrane is observed to form over the vent and close it. He begins to regain appetite with the return of warmth in the spring." (Page 179.)

Now we know that tautog hibernate among the rocks near the coast and in our rivers, and it has been stated by Mr. L. Tallman or Mr. Daniel Church that, some years ago, after a very cold snap, not only many tautog were washed ashore frozen stiff, but afterward quantities were also found dead among the rocks off the coast.

If, during the winter, they do not feed as stated above, and this membrane closes them up, the conclusion must be that they remain in a state of torpor or sleep during the cold weather.

Now it happens that the scup, when first taken by the traps, are in a similar state of torpor; they neither eat nor have any passage; it is probably sealed up like the tautog, and nothing in the shape of food is to be found within them. Some say they are blind, and they seem hardly able or willing to move.

The inference then is that scup have also been hibernating within a short distance of the coast, in the same state as the tautog. This would account for the stray scup mentioned by Mr. Southwick as having been occasionally found in March. A warm day wakes him up, and he visits the shore for a day or so and then returns.

To my mind this is a more reasonable way for accounting for his presence than to assume that he has been left behind.

If these facts are as stated, it is to be presumed that scup are a local fish, and do not leave their localities any more than tautog, about the propriety of the classification of which as a local fish there is no question.

HEART-SEINES AND FYKE-NETS.

It does not seem necessary to discuss the effect of these modes of fishing. Nothing has been said in their favor, nor does any one appear to represent parties interested. The heart-seines are of the same character as the traps proper, and more or less take the place of the traps after the spawning season of scup is over. Through the whole season they are gobbling up what fish may have escaped the traps; and "*all is fish*" that comes to these nets; nothing however small escapes from them. The testimony of Mr. Steere proves beyond a doubt the effect of fyke nets upon flat fish and upon others also, and that they are set during the colder months preceding and succeeding winter.

SEA-BASS AND TAUTOG.

In May, 1870, I happened to be at Wakefield, South Kingston, and saw several cart-loads of small striped-bass, about 8 inches long, which, I was told, were going to the manure heap. They had been taken near Point Judith in traps; and with the permission of the committee, I will read some observations made by a gentleman having considerable acquaintance with the subject, and as they fully coincide with my own belief, I adopt them as a part of my argument:

"DEAR SIR: The bass taken by the traps (especially at Point Judith) are of a size varying from 6 ounces to 1 pound each. They are taken, when taken at all, in immense numbers.

"It is a fact, well known among fishermen, that these fish, at this age and size, cannot be taken by hook and line, shore-seine, or in any other way than by these wholesale and destructive engines.

"During the trapping seasons, within six or eight years, immense quantities of these small bass have been sold in South Kingston and vicinity for *manure*.

"Were these 'small fry' allowed to grow to a size suitable for market, and until which time they could not be taken by any other method than by traps, &c., these same fish would average from five to twenty times their size *when so destroyed*.

"Aside from the destruction of the older bass, when in spawn, by traps, the above wanton waste is well worth consideration.

"*Tautog.*—This fish it is not pretended is a wanderer. As soon as they commence to move in spring they skirt the coast, following the rocky shores and bottom.

"Every fisherman knows the above to be a fact, and that in May they are caught along the shore rocks, and off shore, on the sunken ledges, in any quantity.

"The effect of trapping is to 'gobble up' almost the entire 'spring run' of this fish.

"It cannot be (I believe is not) denied that our Rhode Island waters, where they were formerly so abundant, are depleted of tautog; while we have only to go from five to fifteen or twenty miles west of Point Judith to find these fish in their season as abundant as ever.

"I account for this upon this theory that the tautog, during winter, becomes dormant or torpid.

"All fishermen of experience agree, that late in fall a membrane forms and covers the vent, and that after the closing of the vent they will not bite at bait even the most tempting; that in their torpid state they are, of course, helpless, and by instinct seek safety for themselves in still water; that the major part at least 'winter' in the bays, salt ponds, coves, creeks, and estuaries, connecting with the open sea.

"I believe that the numerous bays and harbors in Long Island Sound and our own bay are natural winter-quarters of these fish.

"In proof of this, tautog were always caught in spring several days earlier at Pomham Rocks than at the mouth of the bay or at Point Judith, while in autumn they are caught at Bonnet Point and Boston Neck Point (mouth of bay) several days after the supply fails at Point Judith.

"I believe that the traps capture in spring nearly the whole supply that remained in the bay during the winter previous, besides destroying the increase; that in consequence comparatively none are left to supply our waters, while, as I have said, west of Point Judith (trapping being not followed in the bays, &c., of Long Island Sound) those waters are abundantly supplied.

"*Facts.*—During the past and previous seasons, the fishermen who have supplied the market at Narraganset Pier with tautog could not earn their salt east of Point Judith, while by going from six to twenty miles west of Point Judith (as far as yet ascertained the farther the better) they could and have caught as many tautog as they wanted.

"If 'scup' were entirely out of the question, this state of things ought of itself, as it seems to me, to be enough to warrant the interference of the legislature.

"E. C. CLARKE.

"P. S.—If nature has appointed bounds beyond which, in the matter of increase, fish cannot pass, and has appointed and supplied for every species their natural enemies, which, governed by laws of appetite not to be controlled, are still in effective operation; and if their natural enemies and diseases, to which every species is subject, are of themselves sufficient to hold each species in check and within the proper limits, why, I ask, will not such wholesale destruction, in addition to natural causes and at the very moment, effectively destroy the parent fish and the whole prospective increase? Why, I say, will not all, together, diminish their numbers?

"If traps, in destroying scup and other fish, would but destroy their enemies, and annihilate the diseases to which fish fit for food are subject, then, and in that case, there might be some doubts in this question; as it is, there cannot be.

"Your point on the vent closing and non-feeding of tautog at certain seasons, and its application to scup, in proof that scup, like tautog, are not wanderers, is a new one, but, in my opinion, exceedingly good. I don't believe the Tallmans can shake it. Had I the time I would wish, I would say much more, but (meaning no flattery) I consider your argument a good and strong one.

"E. C. C."

With regard to the appearance of small scup in our bay and rivers last season, I am not prepared to give a decided opinion. I think that their appearance does not, nor will, affect any of the conclusions set forth, nor show that scup are going to be more plenty in our rivers than before.

I believe that they were spawned close on the coast, and afterward, in purveying for food, aspreviously stated by Mr. Scott, and for protection, came up into the bay, and remained there during the warm weather. Whether they were spawned in March, or in the previous fall, cannot be proved. From the fact that March was unusually warm, I am inclined to believe the former was the case.

One of the reasons why I believe scup are not going to be any more plenty is that they will follow the same road into the bay (up Seaconnet River) as their ancestors, and will be taken in the traps; for it has been stated that this last season the traps at one time appeared to be full of scup, and, upon drawing them, it was found that they were small fish, and all escaped through the meshes except 5 barrels. This year they will be bigger, and cannot get through so easily.[1]

A few words as to the value of Mr. Southwick's testimony upon the points I have been discussing:

Mr. Southwick presents himself in the character of an expert, from having, as he says, closely investigated the question, in a practical point of view, ever since the beginning of this controversy. He himself has been interested in a trap for six years, but last season turned it into a heart-seine. I have simply to remark that, with all his practical investigation of the subject, he makes no allusion to one fact, that, in my opinion, is of very great importance, viz: That scup did not come from the westward this last season, as stated by Lorenzo Tallman. He gives an opinion, positive and direct, that the nets at Seaconnet Point were set so that they could not catch scup coming from any other direction than from the westward.

As the nets were set last season the same way as they always had been; as about the same quantity of scup were caught last season as the season before; and as these fish came on to the coast last season not from the westward, but, if from either direction, from the eastward, his opinion is completely contradicted by the facts themselves.

The theory that scup, when taken, were leaving the waters of the State, is a mere assertion founded on false premises, and is destroyed by the following facts:

Scup first appear in a state of semi-torpor, sluggish, unwilling apparently to move; with nothing in them; in a state of readiness to spawn and some of them spawning; will not bite at the hook; and the first run are seen about a week before they disappear.

Other egg-bearing fishes, when about to spawn, are in like condition at the place of spawning as to motion, eating, and appearance.

We are informed by Captain Atwood that mackerel take about a week to spawn, during which time they will not bite, and after this they disperse to their feeding-grounds.

From these circumstances we are led to believe that, when taken, scup are in the vicinity of or in the place where they intend to spawn.

This view is sustained by facts developed as to the direction from which they are alleged to arrive at this place. The trappers' statement, that they come from the west and southwest is supported solely on this, that they are usually caught at Watch Hill, and then at Newport, before they take them at Seaconnet Point. But this last season, as Mr. L. Tallman says, this theory has been knocked all to pieces, for the reason that, if they came from either, it was from the east. This fact does not stand alone, for Mr. Joseph Church has stated that some twelve years before, scup were caught in Waquoit Pond several days before they were caught at Seaconnet Point, and it cannot be doubted that they took an eastward course to get into Long Island Sound. Moreover, the fact that the traps last season, although set the same way as always, caught about as many fish as the season before, shows that the catching does not depend on the direction from which the fish come.

The opinion that scup are a migratory fish has nothing to support it, except their absence; while, on the contrary, when we consider the condition of scup when they first appear, and observe how closely it resem-

[1] As further evidence to sustain the view that all scup came the same road as the rest, it was stated that small scup were found in the traps last season in such quantities as almost, apparently, to fill them. When, however, the trap was lifted, most of them were small enough to pass through the meshes, and only about 5 barrels were taken.

bles that of the tautog, a fish admitted to be local, it must be conceded that the evidence is in favor of classing them as local fish also.

The opinion or theory that the scup found at Common Fence Point are lost fish trying to find their way back to the sea, is based solely on the fact that they disappear from that neighborhood after staying there about a week. This disappearance can be more rationally and satisfactorily accounted for upon the presumption that, having deposited their spawn there, they had dispersed to their feeding-grounds like the mackerel, and, as we think is proved, like the scup at Seaconnet Point.

The assertion that fish cannot be diminished by any kind of fishing is not warranted by the facts. The history of the salmon in our waters shows that they have been exterminated. The same is the case with shad in some of the rivers, and in many they are very much diminished. Herring have diminished also. Rimbaud and Bertholet, mentioned in the joint-committee report, testify to the same result in the waters with which they were acquainted. In our own waters the striped bass and many other fish have become scarcer. The fact that scup were found in abundance up to 1845 above Stone Bridge, and since that time have been gradually diminishing until purse-seining has been abandoned there, shows that something has operated to produce this state of things. And as traps were first set at Seaconnet Point in 1846, and there, only, until 1860; and as nine-tenths of the scup were and are taken at that place, it is a conclusion not to be avoided, that the traps are this obstruction, and have produced the effect complained of.

And who are those that appear to oppose this prohibition? Are they the poor fishermen, whose daily bread would be snatched from their mouths should this kind of fishing be stopped, and for whom the sympathy of the community and this legislature is demanded?

There are about two hundred and fifteen men engaged in these gangs, and their earnings vary, according to the best estimates obtainable, from \$175 to \$40 per season. But these men do not appear here. The men who are now represented by counsel before you and appear as witnesses are owners of nets and buyers of fish. These men have an interest far exceeding those of the actual takers of the fish.

Perhaps we can form some opinion of the amount of this interest by estimating the value of their profits. One of this firm of buyers states, he and his partners bought 4,500 barrels of fish from the traps, at the average price of \$2 per barrel, this past season \$9,000.

Each barrel averaging 150 pounds, gives 775,000 pounds, at 5 cents per pound		\$38, 750
Deduct original cost of 4,500 barrels, at \$2	\$9, 000	
Transportation of 4,500 barrels, at \$1	4, 500	
		13, 500
		25, 250

For three weeks' fishing.

This is the real head of the opposition, which, under the cloak of desiring to preserve the rights of the fishermen, are fighting for these profist.

VALUE OF TRAP PROPERTY.

Mr. Lorenzo Tallman says:

That of the gangs in which he is interested (4) each has 450 fathoms of leader, weighing 300 pounds to 80 fathoms, worth from \$1.05 to 25 cents per pound, or, as he suggests, an average of 65 cents.

1,682 pounds, at 65 cents		$1,093 30
400 pounds twine for each of 2 traps, 800 pounds; 200 pounds twine for each pound, 400 pounds—1,200 lbs., at $1.05		1,260 00
12 anchors, averaging 50 to 250 pounds, costing from $2 to $10, averaging $6		72 00
3 small boats		140 00
2 large boats		1,100 00
Purse and mate boat		140 00
1,800 fathoms of lines, at 15 to 21 cents per pound, estimated by Mr. Sisson		200 00
		4,005 30
From this I deduct entirely the 2 large boats and the purse and mate boat, because they admit that they are also used in the menhaden fishery; consequently if not used here, they would last the longer in that business		1,240 00
		2,765 30
Mr. Tallman then said, the usual course was that all the leader and one of the traps and pounds were used up at the close of each season.		
The leader is worth	$1,093 30	
One trap and one pound	630 00	
		1,723 30
		1,042 00
The other trap and pound being new at the commencement of the season, and lasting only *two* seasons, would *now* be worth one-half of its original cost, or	$315 00	
The anchors weighing 1,600, would be worth as old iron 2 cents, or one-half	36 00	
The three small boats, may be safely estimated at one-half that	70 00	
The lines lasting but two years would be worth only one-half	100 00	
		521 00
Whole value now of the trap		521 00
From this is to be deducted value of 2,282 pounds old twine, say 4 cents per pound		91 28
Actual loss of property if trapping was prohibited *now*		429 82
24 gangs, at $429.82		$10,315 68

Which represents the actual loss of property if the law is passed *now*.

EFFECT UPON THE MARKET.

It is not denied that but few of these fish taken in traps are consumed in the State, most all being transported to New York, Philadelphia, and other ports, by vessels employed for the sole purpose; that while our markets, during the trapping season, are supplied at reasonable prices, there is no supply for the remainder of the year.

Under this condition of things, the question naturally presents itself to the other co-tenants and owners of the fish in the waters of the State, *not engaged in trap-fishing*, whether the manner in which the privileges heretofore allowed these fishermen have been managed, is for the interest of the State and the people at large; whether it is most beneficial that an immense amount of fish, taken *in about seventeen days—while in spawn*—and *in such quantities that the major part must be sent to foreign markets or used for manure*, and our own markets for the few weeks overstocked and at low prices, and at a time when such food is not so much desired as afterward, when none can be had, and the price of fish becomes exorbitant, or that our markets, relying upon other fish until about the first of June, shall be supplied for the rest of the summer and fall, five months at least, with these fish at reasonable prices.

On the one hand, while the trappers are reaping the harvest, or rather taking the crop when at its least value, a large number of men, fishermen by *trade*, some from *choice*, many from *necessity*, poor, disabled from other labor, relying for their daily food for themselves and families in a great measure upon fishing—besides those who fish for amusement, and to this end give employment to a large number of boatmen—are deprived of their just and lawful rights and privileges in consequence of this general destruction. The number of men engaged in this river-fishing was estimated at 800, as their daily avocation, ten or twelve years ago.

On the other hand, if these fish are allowed to come up the river as formerly, they will come to the market at *the right season* in abundance, and from the competition that will naturally arise the price will be kept low.

A larger number will be enabled to pursue fishing with the prospect of a fair remuneration for their labor. The poor man can be supplied with a wholesome and cheap food. The boatman will ply his boat for fares, cheerfully paid by persons in pursuit of health and pleasure, who will employ him with the certainty of finding good fishing. The regular fisherman can earn his $2 to $4 per day, and the State will be richer by at least $200,000 per annum more than what is received by trapping.

Those who are benefited by trapping are about 216 fishermen, who, taking the value of the fish caught last season at $40,000, 20,000 barrels, at $2 per barrel, receive two-thirds, or about $124 each on the average; next, the owners of the traps, of which there are about 24 according to Mr. Benjamin Tallman's statement, among whom is to be divided the one-third, or $13,333, giving $444 to each trap.

This sum of $444, according to the estimate already given as to the cost and depreciation of the twine, &c., if correct, is not sufficient to cover the loss, and these owners, if this is all the benefit derived by them from it, ought to be obliged to the legislature, if it will prohibit this fishing.

But the fact is, as has before been shown, that it is the buyers and shippers of these fish that derive the great gain, and it is for this reason they are so *particularly* anxious to have it continue.

The low price of scup would create a ready market and relieve the demand for other articles of food, as demand, in a great degree, regulates their prices. In a short time, the supply being the same, the seller would find it necessary to reduce his prices, and all food would be affected and brought within the means of those who are now restricted by their narrow incomes.

As a matter of political economy, it is for the welfare and general interest of the State that the legislature should, by every legal and reasonable means, in those matters over which it has jurisdiction, provide for the community, so that it may obtain good and healthy food at the lowest possible prices.

The true theory of government, mindful of the welfare of the governed, is to direct and provide such laws and regulations as will effect the greatest good to the greatest number.

This appears to be one of the cases in which it should so act that, by prohibiting the trap-fishing, although, perhaps, to the detriment of a few who have embarked their property in an enterprise from which they have already received ample compensation, and have continued to invest regardless of the results of the movements to stop it, the legislaure will open to the whole community a free fishery, and afford employment to an infinitely larger number of men who are obliged now to seek other avocations for a livelihood, and occupy branches of industry that could be filled by others who are seeking employment without success, by reason of the pre-occupation. Further, from public policy no business should be encouraged by a State whereby a large amount of food is destroyed or carried beyond the reach of the community when such food is required for its support.

Upon such ground the use of grain, in times of scarcity or apprehended scarcity, for conversion into spirits, has, at various times, been prohibited.

RIGHTS UNDER THE CHARTER AND CONSTITUTION—JURISDICTION OF THE UNITED STATES.

One of the reasons upon which I find the remonstrants claim the right to trap fish without restriction is based upon constitutional grounds, and upon the rights originally granted under the charter of Charles II.

It is undoubtedly true that the United States, as contradistinguished from an individual State, have, by the powers conceded to it by the several States, exclusive control and civil jurisdiction over the tide-waters, but it is only in questions involving the rights of commerce, post-roads, and navigation; and all its powers over the tide-waters arise under and as incidental to the right to regulate commerce and navigation, and to make post-roads, but under no other authority nor for any other purpose.

"It is admitted * * that the States may by law regulate the use of fisheries and oyster-beds within their territorial limits, though upon the navigable waters, provided the free use of the waters for purposes of navigation and commercial intercourse be not interrupted." (Kent, Com., I, p. 439.)

Upon this construction Massachusetts has passed laws prohibiting seining in her bays and rivers, and regulating the taking of fish. Connecticut has exercised the same right.

Our own State has assumed the same in prohibiting and regulating the fisheries in parts of our bay, as at Wickford for instance, and also in Seekonk River and elsewhere, and particularly as respects oysters, and the right has never been questioned.

In respect to the jurisdiction over the waters on the coast, if I understand the common law, it is that the jurisdiction extends to a marine league, or three miles, from and beyond a line drawn from headland to headland. Beyond that is what is termed the high seas, and there the General Government has exclusive and unlimited jurisdiction over every question that could arise there.

In the case, The City of New York *v.* Melis, (11 Peters, 102,) it is stated as settled that—

"All those powers which relate to merely municipal legislation, or which may be properly called internal police, are not surrendered by the State or restrained, and consequently in relation to those the authority of a State is complete, unqualified, and exclusive."

In case Fuller *v.* Spear, (2 Shepley, 417,) Weston, Chief Justice, gave the opinion of the court, and stated:

"It is undoubtedly competent for the legislative power," (meaning State legislative power,) "as well in these as in other waters, to appropriate and regulate fisheries otherwise public."

It would appear from these authorities as well settled that the State has the exclusive and unlimited authority to regulate the fisheries within its waters.

Any claim to exercise the right of fishing founded upon the charter of Charles II is derived from the following words:

"But they and every, or any of them, shall have full and free power and liberty to continue and use the trade of fishing upon the said coast, in any of the seas thereunto adjoining, or any arms of the seas or salt-water rivers and creeks, where they have been accustomed to fish," &c.

After summing up and specifying the different kinds of grants, among which are "rivers, waters, fishing," the *habendum* is as follows:

"To have and to hold the same unto the said governor and company, and their successors," (which is now the State in respect to such questions,) "forever, upon trust, for the use and benefit of themselves and their associates, freemen of the said colony, their heirs and assigns, to be holden of us, our heirs and successors, as of the manor of East Greenwich, in our county of Kent, *in free and common soccage*, and not in *capite* nor by knight-service."

Soccage is an old English term, now obsolete, and is understood to be "a tenure of lands for certain inferior or husbandry services to be performed for the lord of the fee." Free soccage is defined, where the services are not only certain but honorable, and means the same as if written *free and common tenure or tenancy*; that is to say, that the governor and company, and associates, freemen of the colony, were all *free tenants in common* of the "*rivers, waters, and fishing.*"

The constitution of the State adopted November 5, 1842, contains in its seventeenth section of Article I this provision:

"The people shall continue to enjoy and freely exercise all the rights of fishing and the privileges of the shore to which they have been heretofore entitled under the charter and usages of this State. But no new right is intended to be granted, nor any existing right impaired, by this declaration."

By this provision, then, no new rights are granted nor existing ones impaired, and the people shall continue to enjoy and freely exercise all the rights of fishing, as under the charter and usages.

As to the manner of exercising these rights, we presume it is the unquestionable right of the State to determine that no one has a right to fish in such a manner as will be detrimental to others; that each citizen has the same and an equal right (though it may remain unexercised) as another, but no more nor no less. Whoever takes fish must have some consideration for the rights of others; at least, if having been allowed to take more than his share, and no objection had been made to it for many years, yet when objection is made, and such objection is reasonable and based upon sufficient grounds, he ought to cease the offensive mode.

This is the state of things at present. And upon the petitioners coming in and asking, for the reason shown, that the legislature shall stop a mode of fishing by which they are enabled to take not only more than their reasonable share, but to the detriment and injury of the other tenants in common, the remonstrants set up a right to continue, upon the ground that they have, by continual uses, acquired a prescriptive right thereby, and of which they ought not to be deprived.

However this might be between individuals, it is well settled that no right of this kind can be set up as against the State, nor against individuals if objection is made within the time limited by law.

To illustrate: Suppose a town owns a piece of land to be used in common by the inhabitants for the pasturage of cows. For some reason but few avail themselves of the privilege, who continue to use it for a number of years exclusively, and without any interference on the part of the others.

In time, finding the pasturage is more than is necessary for their cattle, these few conceive the field could be made more profitable, and conclude to turn the grass into hay, and in this manner they have not only enough for their own cows, but can send a large amount to market.

This course continues, but by and by some of the others wish also to avail themselves of their right, and undertake to turn their cows into the field. Upon this the old occupiers object, and say they have so long used the land for raising hay that no new occupiers can come in, or at least if they do they must wait until the crop is first gathered.

To do this would deprive them of most of the season, and the pasturage would be merely nominal or nothing.

Under a privilege to catch fish under the charter, to be exercised and enjoyed equally and reasonably with the remainder of the people, certain persons, not satisfied with the ordinary hook-and-line method, introduce purse-seines in or about 1822, continue this until 1846, when, finding another method by which they can take them in larger quantities than with seines, they introduce the trap-seines. This is so effectual that, it would appear by the statements of reliable persons, they have caught, *apparently*, every scup of any size that was formerly in the bay. And the petitioners, after remaining quiet for several years, after it was evident to them that scup were decreasing in numbers yearly, and that this decrease, in their opinion, was entirely owing to the trap-fishing, when they now come and ask for legislative action to stop the extermination, they are met by the trappers' assertion that they have a right to go on and continue, for the reason that they have acquired the right under the charter and constitution.

If this be sound doctrine, every one else, under the present state of the fish, is deprived of the rights granted him under the charter; *for the privilege of fishing where no fish are to be found, is equivalent to no right to catch fish.*

The right of fishing, when in common, must be construed to be confined within reasonable bounds; and what bounds and what is reasonable must and can only be determined by the legislature.

This fishing, as carried on, is a monopoly. There are twenty-eight traps or places for setting traps, and these have been in the hands of the same parties for nearly, if not quite, twenty-five years. It is so arranged among these parties, that it is practically impossible for any other to gain admission into this close-borough system. Let others attempt to occupy their ground, and from whom would we hear, or, if not hear, how soon would we understand the different view they would take of the doctrine they now set up?

It would no longer be the free power and liberty of fishing. The ground they would then assume would be, that they had acquired, by long usage, a prescriptive right to occupy these places to the exclusion of all others.

It will be borne in mind that the committee who were appointed to make the investigation which was reported at the January session, 1857, and which report I have read to you, were appointed upon the petition, as we are informed by Mr. Childs, who was himself a member of that committee on the part of the senate, of persons engaged in tautog-fishing at and about Newport.

In their report they say that "no evidence was offered to the committee that these kinds of fishing in other parts of the bay were injured by the trap or seine-fishing in Seaconnet River;" and that they were satisfied that these fisheries "should not be interfered with or restrained, unless it seriously interfered with the fishery in the other waters of the State, or some other very important reason."

This opinion comprehends by implication also this, that if the fisheries in the other waters of the State were seriously interfered with by the trap-fisheries, then these last should themselves be interfered with and restrained; but there was no evidence of this nature brought before them.

Nearly fifteen years have passed away since this investigation was made, and now complaint is made by those interested in the fishery throughout the whole bay. Their opinion is clear and positive, that the trap-fishery has not only seriously affected the scup-fishing, but has destroyed it; and whether it can be revived and restored to the state it was when the former committee was sitting, depends, in their opinion, upon the recommendation of this committee.

In concluding this presentation of the various questions that have arisen under and are necessarily connected with the inquiry referred to you by the legislature, I am sensible that I have not exhausted the subject, and that much more might *pertinently* be said to strengthen and support the position assumed by the petitioners; but rather than exhaust your patience, I will rely upon your own recollection of the various statements of those you have examined, with confidence that where I may have omitted to state correctly or to mention all the evidence bearing upon the points I have attempted to maintain, or upon others, you will not fail to give them their proper weight.

In the course of the investigation as to the cause of the scarcity, it is evident that not only does such scarcity prevail, but that the same is the case with the other fish caught in these traps, viz, sea-bass and tautog; and the conclusion is forced upon us that if, as the remonstrants contend, this scarcity is caused by the scup changing its former haunts for new ones; that the sea-bass and tautog are doing the same; and that our waters are to be deserted, or if this is not so, then that the scarcity is caused by the traps and heart-seines.

All the witnesses not interested in traps, I believe, without exception, some who have been engaged in the business, and some who are engaged in seining, are strongly of the opinion that trapping causes the scarcity, and that it ought to be prohibited.

And this leads me to observe that the efforts of the remonstrants have been entirely directed to prevent any interference with the Seaconnet traps, and, as it appears to me, they are ready to throw over all the outsiders if they can gain their object.

Should the committee think proper to report in favor of the petitioners, and to recommend the passage of an act prohibiting or regulating trap and other seine-fishing, I would urge that they be not excepted from such provisions.

There is no question but what these trap-fishings have been important and valuable, but, in my judgment, they are destructive and to the detriment of bay fishing just in proportion to their value.

It has been suggested outside that the traps might be allowed to take fish three days out of a week.

In answer to this, I would simply say that if one of my theories is true, viz, that the same schools remain in the same locality, then these fish could *all* be taken just as well in three days as in a week, and the privilege would be as injurious as if they continued as formerly.

If the committee is satisfied that the breaking up of the traps at Seaconnet Point in 1862, and the comparative abundance of scup the same season in the bay, have any relation or connection with each other, I would respectfully say that this is sufficient ground to predicate a just claim on the part of hook-and-line fishermen and others, that the experiment shall be tried again.

These trappers have enjoyed the privilege of catching fish freely and uninterruptedly for nearly or quite twenty-six years. We now ask that, upon the evidence and opinion as to their injurious effect on other fishings, the opposing interest may be allowed a reasonable time to prove, by a full and unobstructed trial, whether the traps are the chief cause of this scarcity. From the probable fact that scup live about three years, that length of time ought to be taken. If at the end of that period our waters do not satisfactorily show, an abundance of scup, I for one will cheerfully abandon all further opposition to the employment of any and all kinds of traps.

That the experiment should be fairly made, it is essential that all the waters should be protected, otherwise no one will be satisfied or convinced by any trial that may be made.

ABSTRACT OF AN ADDRESS BY CAPTAIN NATHANIEL E. ATWOOD, IN OPPOSITION TO LEGISLATION.

Before the senate committee of Rhode Island legislature, January session, 1872.

We find upon examination that changes take place in a series of years in the great category of fishes, for which we can assign no reason. In Massachusetts Bay and along the coast of our State the kinds of fish are not the same to-day that they were in the days of our boyhood. Those that were most abundant then have suffered great diminution, and sometimes have totally disappeared, perhaps never to return; while other varieties have perhaps, after gradually diminishing more and more for a series of years, increased again and become as abundant as before. Other species have come among us that were utterly unknown in our youthful years.

It is very important that in studying the science of fisheries, we should make ourselves familiar with the habits of migration of fish, the peculiarities of their food, and their times of depositing their spawn. This last is very difficult to ascertain with regard to many species. The statements of fishermen concerning it are not to be relied upon; for, as a class, they notice the fish which they take only in so far as their own pecuniary interest is concerned.

One of the most important among the fishes of our New England coast is the common mackerel. It is well known that mackerel are a migratory fish and are only with us a part of the season. At the present time of the year they are absent from our waters. North of Cape Cod, as, for instance, in the southern portion of Barnstable Bay, we find them beginning to appear about the beginning of May, at first a few straggling specimens, and then in a few days a vast abundance. They cannot be taken by hook-fishermen, but by means of a long string of nets, made about eighteen feet deep, which hang vertically in the water and drift with the tide. Considerable quanties are thus taken in the night-time.

In 1855 a resolution was passed by the Massachusetts legislature authorizing the governor to appoint three commissioners to inquire into the practicability of the artificial breeding of fish. I was expecting to be appointed on that commission, and, as I had a great desire to know at precisely what time the mackerel deposited their spawn, I devoted considerable attention to the subject. While fishing for these mackerel, I found that about the 20th of May, and from that time to the 3d or 4th of June, they were spawning. As we took the fish into the boat the spawn was running freely from them. In a few days after that time they repaired to the feeding-ground, fed voraciously, and soon commenced to be fat. In a few days after this school had disappeared I received my commission, and thirty days after the height of their spawning-season I found immense schools of little mackerel in our bay. I caught some specimens and put them in alcohol, as I had before put the mature eggs, marking the date. Twenty-five days after that I went again into the bay, and found that they had grown to be some two inches in length, showing that it required not nearly so much time for the growth and development of this fish as for many other species. I took specimens to Professor Agassiz, who was very much delighted at the discoveries I had made.

Besides the large full-grown mackerel, there is the smaller kind, that come in later in the season. Dr. Mitchell and other writers have considered that these are two species, calling them "spring mackerel" and "flock mackerel;" but I am convinced that they are simply different ages of the same species. When the second school, or Dr. Mitchell's flock mackerel, arrive they are of very different sizes, and in the Boston market are designated as "full grown," "second size," "tinkers and blinks." The line of demarkation is so prominently drawn between these several sizes that people do not differ much in the designations given to them in the markets of different towns. Now, these mackerel that I watched for fifty-five days after they were spawned until they had grown to be three inches in length, before they left us in the fall had grown large enough to be rated as number "four," under the Massachusetts inspection laws. Those that come the next season are the "blinks," and, as we believe, were from the spawn of the preceding year. The next size, or the "tinkers," we believe were the "blinks" of the year before, and so on.

The question is asked, Where do mackerel stay in the winter? I do not think they stop in the Gulf stream, but somewhere short of that, probably in water deep enough to afford a congenial temperature.

During some seasons this fish is very much more plentiful than in others. In 1831 there were inspected, in Massachusetts, 383,559 barrels. From that time they began to diminish in numbers, and from 1839 to 1844 the number of barrels inspected did not exceed 75,000 and a few hundred per year. They continued to decrease for ten years, when the yearly catch was only 50,000 barrels. They then increased again, and in 1869 there were 234,000 barrels caught, the largest quantity previous to that time since 1831. In 1870 there were caught and inspected

318,000 barrels, being 83,000 barrels more than in any previous year for twenty years. This last year there was a falling off of 50,000 barrels.

I pass now to speak of our menhaden. In my early manhood I looked with surprise upon the vast quantity of these fish that visited our coast annually and then went away. At that time they seemed of no use, except that the fishermen used them occasionally for bait. But since they have become valuable for their oil and as a fertilizer, the question has been discussed with much interest whether they will be exterminated in consequence of the great extent to which this fishery is prosecuted. The Maine legislature some few years ago passed a law prohibiting the seining of them, and, after it had been in force a single year, the same parties who had signed the petition for the law were very desirous of having it repealed. I was called before a committee of that legislature, and gave it as my opinion that the efforts of man would have but little tendency to exterminate this species of fish, the number caught being but very trifling compared with the immense quantities that were produced in the waters. The legislature did not repeal the law, but they authorized the county commissioners along the coast to grant permits—for the sum of twenty dollars each—allowing parties to fish for the menhaden in the prohibited localities. The fishing has gone on since that time, and, so far from the menhaden being exterminated, I am informed that they were very abundant last year.

When do menhaden spawn? The mass of them, as is well known, pass off the coast in the latter part of the autumn. They keep passing out; and, in our Provincetown Harbor, where the land crooks round so as to detain them, we catch them a month later than that. When we look at the last of the menhaden we find that the ovaries begin to swell, and that the eggs begin to grow. When they get off the coast of Virginia, immense quantities of them spawn. The mass of the menhaden go away so far south that they do not get to our coast in the fall, but are off the capes of Delaware, above and below. I believe that the last ones that come out deposit their spawn soon after their departure, so that their young return to our harbor very soon afterward, for we find often one or two hundred there about that time. But when the year comes around again, we find the full-grown menhaden coming in in vast abundance.

Again, take the sea-herring. When the Georges fishermen went to the Georges Banks, there were great schools of them there, but they have long since disappeared, and now fishermen cannot get enough to bait their hooks with. They come up about the islands of Boston Harbor, and to another locality off Scituate, where they are, in the fall, in immense quantities depositing spawn. A fisherman who put out six nets had them all carried to the bottom the first night. They were filled with such vast numbers of fishes that he could raise only two of them, and from these he obtained enough fish for the rest of the season. This shows to how great an extent these fish change their localities.

Now, this depletion of fish at certain points is not caused by overfishing. We know that it has not resulted from the setting of any weirs, traps, or pounds, because none of these have been used in these localities.

In the days of my boyhood, my neighbors often spoke of a fish called "the drummer," which is the same variety that you call the squeteague, which were so plentiful that they could be taken by the boat-load. But in 1816, when I first went into a fishing-boat, they had disappeared, and I did not see a single specimen for many years. Since that time, however, they have commenced returning in considerable numbers, and we shall probably have them back again as you are having them upon your coasts.

In Provincetown Harbor, from a very early period until the horse-mackerel made its appearance, the fish called "whiting" was immensely abundant. Since the horse-mackerel has appeared, they have been gradually driven out, and now a specimen is hardly ever seen. The horse-mackerel has driven out a great many other kinds of fish, for it is the avowed enemy of every species it can master. These fish first appeared south of Cape Cod about the year 1832. I was thirty years old before I saw a specimen. Finally they found their way into our harbor, and completely destroyed the mackerel fishery for a time, and even now render it nearly unprofitable.

If over-fishing were possible, it seems to me that we should see some of its results where great changes have taken place in the modes of our fisheries of cod and haddock in Massachusetts Bay. What is called "trawl-fishing" was first introduced about 1850, and it resulted in the taking of a vast number of fish of these varieties. In consequence of the competition in the business, the Swampscott people petitioned the legislature for a law prohibiting trawl-fishing, on the ground that it would exterminate the haddock. At that time I proved before the legislature that haddock was much more abundant than it had been at any previous time, and that I was selling them at $37\frac{1}{2}$ cents per hundred pounds. That fishery has been going on ever since, and the amount taken was greater this last winter than for many years past. A fisherman in a dory fifteen feet long has often brought in as much as 1,800 pounds in a single day. There are eighty boats fishing out of the harbor, and 83,000 pounds have been caught in one day. This increase has taken place in spite of the constant practice of the new mode of fishing, by which twice as many are taken in the same time as formerly.

Perhaps the committee will ask if I do know of any fish that has diminished while I have been fishing. I would say that I do. I allude to the halibut. When I was twenty-five or thirty years old I was engaged in fishing along the Nantucket shore, and at that time halibut were much more plentiful than now. Whether the diminution is owing to over-fishing or not I am unable to say.

In regard to the effect produced in the way of driving out fishes by emptying impurities into the water, I am inclined to believe that as respects ocean waters it would be very trifling; in rivers, I think the effect would be considerable. At New Bedford there are works that throw deleterious substances into the water, but the driving away of the fish there was, in my opinion, effected by the destroying of the bait upon which they fed. I presume that fish that had never been in impure water, if they should rush into it suddenly would be much more effected by it than by a gradual fouling of the water. Fish need to be acclimated by degrees to any change of temperature in the water, and it is only by degrees that they can learn to live in impure water. In rivers where there are saw-mills, the sawdust from which is thrown into the water, when the water becomes so charged with it that the gills of fishes are clogged, they must of necessity be driven away. When the Massachusetts fishery commissioners were appointed, I was applied to to investigate the condition of the river fisheries. It was surprising to me that fish would come in from the broad ocean and pass up these narrow rivers filled with mud and with every possible obstruction, year after year, for the purpose of depositing their spawn. Yet they will invariably return annually to the same stream in spite of all the deleterious substances thrown into it.

The idea presented in the report of Professor Huxley to the British Parliament that man cannot destroy a race of fishes by over-catching has been scouted, by a distinguished naturalist, who says that certain species of fish have been destroyed and caught out. But this was on the southern coast of France, where there is only a very small area of fishing-ground. And this naturalist himself says that these wandering fishes which go off in schools and return cannot be diminished by man's catching. We have an immense area of fishing-ground on our coast, which is flat and everywhere running off shoal. Look, for instance at the great chain of banks from the Nantucket shoals to the banks of Newfoundland. France, on the Mediterranean, has no such fishing-ground as that.

When I was a boy, great quantities of Spanish mackerel came into Provincetown Harbor. They afterward began to diminish in numbers, and I have not seen a specimen now for twenty years. They went away before the blue-fish came, and before a weir, trap, pound or anything of the kind was set in New England waters. I think the great enemy of the fish of our waters is the blue-fish. They are ready to eat almost every fish that they can take. We know that they drive almost everything.

It is my candid opinion that man cannot destroy a race of fishes. They go off from our coasts only to return again and bring us innumerable blessings. The fisheries of our coast are of immense value. They afford a vast amount of wholesome food to the people, as well as employment to a great number of men. Our fisheries are a nursery for seamen, and by accustoming those who engage in them to the hardships of the sea, they train them for service in our navies in time of war, as well as upon the decks of our merchantmen.

I hope that the fish peculiar to your waters will continue to be abundant, and that if the scup leave you some other variety equally valuable will come in and supply its place.

XIV.—NATURAL HISTORY OF SOME OF THE MORE IMPORTANT FOOD-FISHES OF THE SOUTH SHORE OF NEW ENGLAND.

I.—THE SCUP.

Stenotomus argyrops, (Linn.,) Gill.

Common names: Porgy; porgee;[1] scup; scuppaug; mishcup.

This species has a lesser variety of names than most others belonging to our coast, it being known in the Southern States, and northward to New Jersey, as porgy; while in Long Island Sound, and on the south coast of New England, it is the familiar scup or scuppaug, from mish-cùp-paûog of the Narragansett Indians.[2] In the time of Roger Williams its English appellation was bream, from the resemblance to the British fish of that name. Its southern range, as stated by Dr. Holbrook, extends to Cape Florida, and it occurs on the southern coast throughout the year, most abundantly, however, in June and July. It makes its appearance, at least in considerable quantity, on the coast of New England, about the middle of May, although the advance guard of very large fish arrive sometimes as early as the middle of April, and it is most abundant toward the 1st of June, and arrives in successive detachments or "runs," differing in size, the smallest fish coming last. The first run on the southern coast of New England, as stated, takes place about the beginning of May, and consists of large breeding fish, weighing from 2 to 4 pounds, and measuring up to 18 inches or more in length. The spawn is quite well developed at that time, and is said to be at first red, but gradually to become light yellow as it matures. The particular time and place, however, of laying the eggs, is not yet known, although it is probable that this occurs early in June, since the schools are said to break up about the middle of that month, and the fish to scatter. It is thought probable that the spawning takes place in the eel-grass which covers the shoal waters of Narragansett Bay and Vineyard Sound.

According to the fishermen generally, the scup, on first coming into the shores, do not take the hook readily, being apparently too much occupied in the business of reproduction, and two weeks usually elapse before they can be caught in this way. They present themselves in large schools of immense extent, and moving very slowly, at about the rate of three miles an hour. From the testimony presented before the committee of investigation of the Rhode Island legislature, they appear to come from the south and west, as when they enter Narragansett Bay they strike the western shore and move up along its edge. They are said, however, to drift slowly backward and forward with the tide, especially at the entrance of this bay. At this time they are very sluggish, and are said sometimes to appear as if blind, and can frequently be taken with the hand or a very short scoop-net.

---

[1] Not to be confounded with pogy or poagie, which is the menhaden.

[2] Roger Williams. Key to the Language of America, London, 1643. (Publications of Narragansett Club, I, page 138, 1866; J. H. Trumbull, editor.)

According to Captain Edwards, of Wood's Hole, in proceeding to their breeding-grounds, on the coast of New England, they are taken at Montauk Point three weeks earlier than at Wood's Hole, and a week earlier at Wood's Hole than at Hyannis, still farther east.

The scup feed upon a great variety of marine animals, such as worms, small crustaceans, mollusks, &c., and take the hook very freely during the greater part of their stay; in fact, the smaller ones become veritable nuisances to the fishermen, from the readiness with which they pounce upon the baited hook whenever thrown overboard.

The flesh of the scup is very much prized by most persons, as it is firm and flaky, and usually sweet, although occasionally a bitter flavor detracts from its palatability. Since the settlement of the coast by the whites, it has been by far the most important food-fish of Fisher and Vineyard Sounds, Narragansett Bay, and of Buzzard's Bay; and the rapid diminution in number has caused the greatest solicitude.

The scup is but little known, as far as accounts go, on the north side of Cape Cod; indeed, Dr. Storer states that they were introduced into Massachusetts Bay about 1833, and that they are taken only occasionally at the present date. Of their abundance on the south coast of New England in former times, almost incredible accounts are given. Thus, according to J. D. Swan, of Newport, at one place in Narragansett Bay, where the schools ran over a point where the water was 9 feet deep, they were so thick as to crowd each other out of the water. (See page 12 of the present report.) Mr. E. E. Taylor could catch five hundred fish in the morning and return in time to peddle them off in Newport, and then go out in the afternoon and get as many more. (Page 27.) Six hundred barrels have been taken at one haul of the seine at Tuckernuck, near Nantucket. (Page 40.) Captain Hallett has taken in one morning eight hundred scup, weighing 500 or 600 pounds, and eighteen boats have loaded a smack in a single day, (page 48.) Mr. Ryder, at the head of Buttermilk Bay, which opens out of Buzzard's Bay, twenty years ago could catch three boat-loads in a tide. In 1861, at Seconnet, 700 barrels were turned out of the traps because there was no sale for them. A subsequent capture netted only 18 cents a barrel.

The testimony of residents along the coast all tends to show that, until within not more than eight or ten years, scup, of large size, could be taken with a hook throughout the summer, at any point near the shore, from Point Judith to Cape Cod, almost as rapidly as a line with two baited hooks could be thrown over and hauled in.

The case, however, at the present date, is very different. Large numbers, it is true, are caught in traps and pounds for a few days in the spring, as the fish are on their way to their spawning-ground; after which only scattering individuals are taken in nets, and so few by lines as to remove them entirely out of the speculations of the fishermen, except, perhaps, on the coasts of New York and New Jersey.

In 1871 the diminution, even as compared with that of 1870, was very evident in most localities; Captain Hallett, of Hyannis, stating that not one-fourth as many were taken as in the previous year. (Page 48.)

The scup is a fish that grows with rapidity, and at two years is almost of sufficient size to be marketable. Throughout the summer young fish of the spring spawning are to be seen floating around in the eel-grass and over the sandy bottoms, having attained a length of from $2\frac{1}{2}$ to $3\frac{1}{4}$ inches by the 1st of October. When these fish re-appear the next season, thus completing one year of existence, they measure about 6 inches, six to eight or nine weighing a pound; and by the 1st of September attain an average length of 8 inches, including the tail, and a breadth of

3 inches. (Twelve individuals, measured on the 31st of August, measured from 7.75 to 9 inches in length, and from 2.75 to 3.25 inches in breadth, not including the dorsal and anal fins.) On the 8th of September twenty-five of this age weighed $4\frac{3}{4}$ pounds, or an average of little over 3 ounces each. In the third year of existence, or at the age of two years, they have increased considerably, though not so rapidly as was once supposed, measuring, on their re-appearance, about 10 inches, with an average weight of one-half pound. Six weighed in New Bedford, October 9, averaged but little over 5 ounces each, while the average of those on the stalls in New York, October 17, was a little over 8 ounces. After this they grow more quickly. One hundred and ninety-nine, presumed to be three years' fish, weighed on the 6th of September, averaged $1\frac{1}{2}$ pounds each, and measured about 12 inches in length by $4\frac{1}{2}$ inches in width, some individuals being larger and some smaller. The female fish of the second year not unfrequently contains mature eggs. It is in the fifth year, or after the lapse of four years from birth, that the scup presents its finest development; specimens believed to be of this age measured 14 or 15 inches by 5 to 6 inches or more, with a weight of $2\frac{1}{2}$ to 3 pounds. They, however, still continue to grow, specimens being not unfrequently met with 18 inches long, and weighing 4 pounds and even more. The dimensions may belong to fish of six or more years of age; more probably, however, of five years. It is, of course, impossible to do more than give average estimates of the weight and size of fish of the same age, the differences probably depending on the fact whether they were spawned by old or young fish, and the period when the eggs were laid, this extending over a considerable length of time in each locality, although the great majority of fish undoubtedly spawn at nearly the same season.

Abundant as the scup has been during the greater part of the present century, there appears to be good evidence to show that prior to the year 1800 there was at least one period, if not more, when it was extremely rare. According to Mr. Southwick, (page 11,) there is a tradition that they first occurred at Newport about 1793, the sheep's-head disappearing about the same time. Mr. Lyman, in an article on the possible exhaustion of the sea fisheries, written in 1871, also quotes some negative evidence of the absence of this fish at Compton, Rhode Island, from 1794 to 1803, the "sheep's-head" (more probably the tautog is meant) being spoken of as common, and the scup not mentioned.

Mr. John C. Parker, an octogenarian of Falmouth, Massachusetts, states that the scup were observed there, according to his father's statement, sometime after 1790, and had become quite abundant by 1814. On the other hand, however, in 1621, again quoting from Mr. Lyman, Massasoit entertained his half-famished Puritan visitors with "fishes like bream, but three times so big, and better meat;" this fact, with the description, being applicable to no other fish than the scup. The European sea bream is very similar to the scup, and would readily be referred to the same species by the unobservant traveler.

Again, Roger Williams, in his "Key to the Language of the Indians," speaking of the scup says, "mushcup, the bream." "Of this fish there is abundance, which the natives dry in the sun and smoke, and some English begin to salt. Both ways they keep all the year, and it is hoped they may be as well accepted as cod at market, and better if once known." We find no reference to the occurrence of the fish from this date, 1642, up to 1794.

The time of the arrival of the scup on the coast varies with the locality. The young probably spend the winter in our southern waters or out in the Gulf Stream, but in the spring commence their migration either along the coast or from the deep seas toward the waters on the south coast of New England. The latter supposition is the more probable, as no scup are taken on the southern coast of anything like the size of the breeders that visit New England, making their appearance at once in a huge body, extending, apparently, from Block Island to Martha's Vineyard.

The western division of this army appears to strike first at Watch Hill, to the west of Point Judith, and to make its way slowly along eastward, the smaller or eastern division moving through Vineyard Sound. According to Captain Luce, the Menemsha pounds take the scup three days or a week earlier than the pounds at Lombard's Cove, and nearly two weeks earlier than at the guano-works at Wood's Hole. The progress of this fish is at first very slow, scarcely exceeding a few miles a day, and their movements appear to be largely regulated by the flow of the tide, going forward with the flood, and partly retrograding with the ebb. According to Mr. Whalley, (page 24,) of Narragansett Pier, it occupies about four tides, or two days, in moving from Point Judith to Seaconnet Point.

The precise period of their reaching the coast varies with the season, although their abundance generally occurs from the 5th to the 12th of May. In 1871 the fish appeared much earlier than usual, and were on the shore before traps were down in readiness for their capture. Their occurrence was about the 15th to the 25th of April. Breeding-scup were taken at Hyannis the same year on the 27th of April, at least two weeks earlier than usual. They were taken in the fish-pound at Wood's Hole on the 27th of April, but were most abundant on the 8th of May. In 1872 the season was late, and a few scattering scup were taken at Wood's Hole from the 10th to the 13th of May, but were most abundant at a later date. On the 17th of May 10 barrels were taken, and 150 barrels on the 9th of June. Some of those captured in the middle of May were of unusual size, weighing 4 pounds and over. At Newport they were most abundant on the 15th of May, or two days earlier than at Wood's Hole. Here, too, the number of mature fish was less than usual, but the average size greater. Over 1,000 barrels were taken in Luce's pound, at Menemsha Bight. It is mentioned as an unusual occurrence, that in the spring of 1872 large fish were caught in purse-nets five or ten miles off the shore of Newport, mostly with spawn, although very poor and thin.

As already remarked, the fishermen on the coast distinguish three runs of scup: the first, consisting of mature breeding fish, coming in from the 10th of April to the 20th of May, according to the season, varying in size from 1½ or 2 to 4 pounds; these represent the fish of three years old and upward. A second and separate run is said to be about ten days later, (sometimes nearly simultaneous,) and embraces fish of about a pound. This run is the largest in point of numbers, and, as already stated, has many spawning-fish in it, although not generally as many as the first run. Both these runs, according to Mr. Church, of Tiverton, are characterized by the presence of well-marked dark bars, something like those of the sheep's-head. The third run, according to the same authority, is without stripes. This comes in about ten days later, and embraces the scup weighing from one-fourth to one-half of a pound, evidently fish of the preceding year's hatching, and about twelve months old. These fish, according to Mr. Church, are not marketable, largely in consequence of their heating through and spoiling before they can be iced.

An apparently unusual occurrence in the history of the scup took place in the spring of 1871, namely, the great number of young fish of the previous year, or those of the third run. These, however, besides their unusual abundance, were more mixed up with the first and second runs than usual. They swarmed in all the pounds, and, indeed, gave a great deal of trouble in the well-meant efforts of the fishermen to turn them out without injury. It is said that as many as 10,000 barrels were taken at one time in a single pound in Narragansett Bay in the middle of May, and a similar abundance was recorded by the fishermen along the entire coast, although in many localities the maximum was not seen until the end of June. The cause of this unexpected and unusual phenomenon is one that is difficult to explain. Although many fishermen insisted that these fish were hatched in 1871, it is quite certain that if so, they were not hatched in New England waters during that year. It has even been suggested that they may have been spawned in more southern waters very early in the season, subsequently moving forward to occupy the feeding-grounds of the New England coast. This hypothesis is, however, negatived by the statement of Thomas James, (page 185,) that late in the fall of 1870 his nets were filled with immense numbers of small scup of that season.

If these fish were really, as asserted, so much smaller than the supposed yearlings as to induce the impression that they were of the same year's spawning, it may be that they belonged to a late hatching of 1870. But as far as I could judge, from many observations, they were about the average represented by one year's growth. They grew very rapidly, so that by the end of September they measured nearly 6 inches in length. They continued along the coast in great abundance, and furnished capital sport for juvenile fishermen in taking them from the wharves; and when a seine was hauled in the small bays, bushels could be readily captured, although they were too small to be of any special service as food.

As expected, the small scup, to which reference was made as being very abundant in 1871, made their appearance again in 1872, of considerably larger size, weighing from a quarter to a half pound, and were marketed in large numbers. They were sent to New York, but were not very popular among the wholesale dealers. The persistence of this increase was more marked at Newport than elsewhere, where they were more plenty, according to the statements of several parties, than they had been for quite a number of years. As many as 10,000 barrels, according to Mr. Southwick, were turned out from the pounds outside of Narragansett Bay on the 21st of May. It is, however, not certain whether they were one or two years old. At Wood's Hole a similar increase of medium-sized fish was observed, but all agreed, as well at Newport as elsewhere, that there was nothing like the show of small scup which appeared in so marked a manner in 1871. The fish were evidently spawned in 1870, and were, of course, two years old in the summer of 1872. For this reason it is possible that after the present generation has reached maturity and been caught up, a scarcity of this particular species of fish may again be experienced. Both at Newport and farther east, scup of unusually large size were taken, some of them measuring 18 or 19 inches in length, with a weight of 4 pounds. But few of these, however, were captured with the hook, and they were taken during a few weeks only by the traps.

If the traps and pounds exercise so detrimental an influence upon the spawning fish as has been asserted, we could understand the appearance of yearling scup in unusual numbers in 1872, as it is well known that, owing to their unusually early appearance in 1871, they had been on their grounds some time before the nets were set for their capture. In this way a large number would be able to discharge their spawn without any interruption, the result of which should have been seen in an increased number of young fish. This reasoning, however, would hardly explain the presence of so many young fish in 1871, since the traps were in position in 1870, before the spawning fish arrived.

According to Mr. Edwards, scup were still more scarce than usual at Wood's Hole in 1872 up to the 1st of July, a few small ones only being seen, and none of any size taken with the hook. After that date, however, the two-year fish made their appearance in considerable numbers.

In reference to the movement of the scup in Narragansett Bay, the testimony taken both by the Rhode Island commission, and by Mr. Theodore Lyman and myself, was quite contradictory, some maintaining that they enter by the west passage, and, passing round the north end, fall into the traps set for them in the eastern passage; others insisting that the fish enter both passages at the same time. The general impression, however, seemed to be that the army of old fish did not pass up into the bay, but that probably while the main body kept along the shore, from headland to headland, only those that were originally spawned up the bay turned off and proceeded up toward its head. The success of the traps at Seaconnet is probably due in large part to the peculiar funnel-shape of the river, by which the fish at flood-tide would be carried out of their course. The traps there being always set toward the north, it is likely that during the flood the fish pass up along the channel, and as the tide turns, losing their direction, they are scattered toward the shores, and in following down the ebb are taken in the traps.

According to Captain Thomas Hinckley, after passing Seaconnet Point and entering Buzzard's Bay, the scup keep along the northern shore and make almost the entire circuit of the bay before appearing at Quisset Harbor and Wood's Hole, their appearance being always later there than at the head of the bay or about New Bedford. Whether it is the fish alone that belong to Buzzard's Bay that enter it, or whether others pass directly between the Elizabeth Islands and Martha's Vineyard, is not yet satisfactorily ascertained. We know, however, that they reached Waquoit, the first pound on the north side of Vineyard Sound, in 1871 as early as April 25, but that the largest numbers were taken from the 10th to the 13th of May. This gives about a week's difference between this point and Newport.

On the south side of Vineyard Sound the fish are netted at Menemsha Bight, where there are several large and effective pounds, three days or a week earlier than at Lombard'sCove, and nearly two weeks earlier than at the Wood's Hole pound.

According to Mr. Luce, breeding-fish enter the tidal ponds on the north side of Martha's Vineyard (formerly in large numbers,) where they spawn, accomplishing this operation by the end of June, the ponds being filled with young in August. As soon as frost comes these fish leave for their winter abode.

As a general rule, in their movement along the coast the scup are not found in water shallower than a few fathoms; and it sometimes happens, in the course of heavy storms, that in consequence of the discoloration of the water near the shore, the fish move farther out to sea, and on such occasions measurably escape falling into the traps.

The scup is very largely a bottom-feeder, and depends very much upon mollusks or shell-fish for subsistence. I have been informed by the fishermen that they may frequently be seen feeding upon small bivalves of different species, rooting them out of the sand or mud. The stomachs of about two hundred $1\frac{1}{2}$-pound scup were examined at one time in the beginning of September. These almost exclusively, contained shells of various genera, with some worms, and a few amphipods.

Like all other small fish, they are devoured by their more rapacious fellows, and very largely by blue-fish, notwithstanding a general impression to the contrary. The extent to which this takes place will be considered under the head of the blue-fish. Halibut, cod, sharks, and other ground-feeders, likewise use them up in great numbers.

As already remarked, the breeding-fish do not appear to feed on their first arrival, being then too much occupied in carrying out the reproductive function. As, however, they can be taken with the hook about the 1st of June, we may infer that this is about the time they begin to feed for themselves. The younger fish probably feed as soon as they reach the shores. No remains of fish have hitherto been found in the stomachs of scup, and we may conclude that they are not piscivorous.

Although the period and the general region where the eggs are deposited has been pretty well ascertained, I regret that nothing is known of the peculiar method by which this is accomplished. I have been informed (page 47) that on hauling up of anchors of boats that have been lying over night in two fathoms of water, the rope is frequently found coated with spawn sticking upon it. The eggs are doubtless fertilized as discharged, and probably adhere to the gravel, grass, and other objects at the bottom; but as to the precise period of development, nothing is known.

The scup, like other shore-fish, not unfrequently suffer from changes of weather. Mr. Southwick informed me that he has evidence to show that in the early part of May in 1809, 1817, and 1838, after a cold spell in each of those years, large numbers were thrown on the shore. On the 29th of November, 1871, there was a fall of snow at Wood's Hole, and the next day scup and sea-bass came ashore in considerable numbers, generally, according to Mr. Edwards, about ten scup to every yard along the shore for a considerable distance. They were, however, all small fish. While scup were in greatest abundance, the other fish observed were sea-bass, butter-fish, mullet, &c. Similar facts have been observed in regard to tautog, which indeed seemed to suffer very much more than scup from this agency.

As may be inferred from what has already been said, the market at the present time is supplied with scup from the spring traps and pounds, the capture by these means having become almost entirely exclusive. Formerly, however, they could be taken with the hook from the latter end of May until the end of October, and in any desired abundance. There is no fish on the American coast that bites so freely when abundant, and which can be captured with so much ease.

I am informed by Mr. Dunham that in the deep holes of the pond at Nantucket, where he has been with his boat, he has sometimes thrown a stone overboard so as to give the scup a start toward the shore, and then following and throwing his dog overboard, he has driven the fish clear out of the water upon the beach, and has taken as many as five hundred in this way at one time. A similar mode of capture was reported to me as having taken place in the pond at Menemsha Bight.

The value of the scup as a marketable fish varies, of course, with the supply; and while they have been sold in early times as low as from 10 to 25 cents a barrel, and were used as a manure, they are now too scarce for any such purpose. They were worth in 1871 from 6 to 8 cents a pound at Newport and about 2 cents at Hyannis. At New Bedford they generally brought 10 cents as a maximum price.

On the coast of Carolina they are said to prefer deep, clear water, with rocky bottom, although they may be taken in almost any locality in the region of their occurrence.

The scupremain along the northern coast until about the middle of October, when the larger ones at least, begin to leave the shores and moves out into deeper water. Mr. Vinal Edwards has, however, taken young fish at Wood's Hole as late as the 10th of December, and Captain John Rogers, of Noank, states that, in fishing for cod on Nantucket Shoals late in November, their stomachs are occasionally filled with small scup, which drop out of their mouths when hauled on deck, found to be to the extent of five or six at a time. It is quite possible that they, as well as other fish, seek in winter that portion of the Gulf Stream that corresponds in temperature to that of their summer abode; and as the mean summer temperature of the waters of Southern Massachusetts and Rhode Island amounts to about 63° Fahrenheit, they must go nearly to the latitude of Norfolk, Virginia, before they can find that same temperature in the winter season.

The European analogue of our American scup or porgy is the *Pagrus vulgaris*, the braize or becker, sometimes bream, of the fishermen. These come on to the European coast in the summer time, and are said to have much the same habits as the American species.

II.—THE BLUE-FISH.

Pomatomus saltatrix, (Linn.,) Gill.

Common names: Blue-fish; horse-mackerel; skip-jack; snap-mackerel; green-fish; white-fish.

Among the various species of marine fishes belonging to the eastern coast of the United States there is no one more conspicuous, wherever found, than the blue-fish. This prominence is due not alone to its value as an article of food, and to the sport which it furnishes to its captors, but it has a very important bearing upon the condition of our coast-fishes generally, and one worthy, perhaps, of much more attention than it has hitherto received.

The blue-fish, like most of our other fishes, has received a great variety of names. From New York northward the adults generally bear the name of blue-fish; except at Newport, where as on part of the Jersey coast, it is called horse-mackerel. It is the skip-jack of South Carolina, the green-fish of Virginia, and the tailor of Maryland, &c. They oung bear the name of skip-mackerel about New York, and white-fish higher up the Hudson River.

Its geographical distribution, if we may rely upon the accounts of writers, is very extensive. Prince Maximilian gives it as found on the coast of Brazil and Schomburg or British Guana; Webb and Berthelot record it at the Canaries; and others mention it as found in the Mediterranean Sea, off Madagascar, about Amboyna, and on the shores of New Holland.[1] Professor Poey, however, has not met with it in the vicinity of Cuba, and I find no positive evidence of its occurrence in the West Indies. On our own coastit is known from Georgia, and probably Florida, as far north as New Hampshire and Maine, although it appears to diminish in numbers to the north of Cape Ann. I have been unable to detect

[1] Castlenau, (Proceedings of the Zoological and Acclimatisation Society of Victoria, I, 1872, p. 118,) says it is one of the most common market fish in Melbourne, where it is generally of small size, although he has seen a specimen 30 inches long. He adds, that at the Cape of Good Hope, it is very common and of large dimensions. Guichenot says it is abundant and esteemed at Algiers.

any evidence of its occurrence in the Bay of Fundy, although I have been informed that it has been taken well over toward the coast of Nova Scotia.

The blue-fish is pre-eminently a pelagic or wandering fish, and like many others, especially of the *Scombridæ*, is apparently capricious in its movements, varying in numbers at particular localities with the year, and sometimes disappearing from certain regions for a large fraction of a century, again to return as before. The cause of this variation it is impossible to explain, being due in some instances, probably, to the disappearance of its favorite food in consequence of its own voracity, or for other undetermined reasons.

They occur during the summer throughout the entire range indicated for the United States, but arə much larger in size and in greatest abundance from the coast of New Jersey northward. From New Jersey osuthward, in the season mentioned, with the exception of an occasional wandering school, they are generally only about 8 to 12 inches in length, representing, therefore, in all probability, individuals of the second year's growth.

They appear to have a regular migration along our coast, presenting themselves later and later in the spring the farther they are found to the north, and disappearing in the inverse order from the same regions in the autumn. First noticed on the Carolina coast as early as March and April, immense schools of them, bound eastward, are seen off the coast of the Middle States, from the middle of May to the middle of June; and in October similar bodies, perhaps embracing fewer individuals, pass to the southward. It is possible, however, that in the autumn some schools move well out to sea, and are, therefore, less likely to be observed. They leave the northern coast about the middle of October, and about the middle of November appear in vast numbers off the coast of North Carolina, where, from Nag's Head, in Currituck County, to Cape Lookout, there is a very extensive fishery prosecuted, which furnishes blue-fish for the northern markets. It is estimated that at least one hundred and fifty crews are engaged in this fall fishing, which lasts generally until late in December. At this time individuals may be taken weighing 15 to 18 pounds, although their average size is about 10.

Their occurrence in autumn, off the coast of North Carolina, is preceded and first indicated by the vast schools of menhaden, which they follow in, several miles from the sea, and by the usual accompaniment of flocks of gulls attending them to take a share in the feast. Of the particular mode of fishing in this neighborhood we shall take occasion to speak hereafter.

According to Dr. Yarrow, the blue-fish are first seen in spring on the North Carolina coast, (the smaller ones first,) in March or April, when, however, they are much less in size than the specimens referred to as occurring in the fall. The precise time of their appearance at most of the points farther north has not yet been ascertained. Whether they actually migrate from south to north, and *vice versa*, or merely come in from the outer seas in regular order, as is believed to be the case with the shad, &c., has not been settled, although the former supposition appears the more probable. They reach the New Jersey coast some time in the early part of May, and usually appear at Newport and in Vineyard Sound (the time varying with the season) from the middle of May to the first week in June. They are expected at Edgartown from the 25th to the 30th of May; but I am informed that, on their first arrival, they feed at the bottom, and sometimes for a while are not seen at the surface at all, seldom being taken with the hook, but caught in large numbers in pounds and with the gill-net, usually along the lower edge of the net. According to Dr. Yarrow, they are not taken with the hook about Beaufort until about the 1st of July. They do not bite, however, in Vineyard Sound until from the 10th to the 15th of June, when they appear on the surface and are caught in large numbers, in the usual manner.

Great interest attaches to this fish in consequence of the changes that have taken place in its abundance, and even its actual occurrence on our coast, within the historic period. The precise nature and extent of this variation has not been established, nor whether it extended along the entire coast or not. Its earliest mention for our waters is in the work of Josselyn, ("New England Rarities Displayed," 1672,) where, on page 96, he mentions the "blew-fish, or horse," as being common in New England, (his residence was on the New Hampshire coast, or near by in Maine,) and "esteemed the best sort of fish next to rock-cod." He says: "It is usually as big as the Salmon, and a better meat by far." He also, on page 24, catalogues two kinds of "Blew-fish" or "Houndfish;" the "Speckled Houndfish" and the "Blew Houndfish, called Horsefish." There appears to be no species to which this reference could apply, excepting the subject of our present article, this being the opinion of Mr. J. Hammond Trumbull, who has devoted much research to determining the modern equivalents of ancient Indian names of animals, and to whom I am indebted for the hint. Mr. Trumbull also remarks that in a manuscript vocabulary obtained by President Stiles, in 1762, from a Pequod Indian at Groton, Connecticut, there is mentioned the "Aquaundunt or blue-fish," clearly the same as what now bears that name, which shows that this fish was found in Fisher's Island Sound in 1762.

Again, according to Zaccheus Macy,[1] the blue-fish were very abundant about Nantucket, from the first settlement of the English on the island, in 1659 to 1763, and were taken in immense numbers from the 1st of June to the middle of September. They all disappeared, however, in 1764, a period of great mortality among the Indians of that island. (See page —.) It has been suggested that the disease which attacked the Indians may have been in consequence of an epidemic in the fish upon which they fed, or else that it invaded both fish and Indians simultaneously, resulting in almost their entire extermination.

According to Dr. Mitchell, this fish was entirely unknown about New York prior to 1810; but they began to be taken in small numbers about the wharves in 1817, and were abundant in 1825. Immense numbers were caught at the Highlands in 1841. The doctor remarks, as has been done repeatedly by others, that as the blue-fish increased, the squeteague or weak-fish diminished in about the same ratio.

According to Mr. Smith, of Newport, (page 20 of testimony,) his father used to catch blue-fish some time about the year 1800, when they were very abundant and of large size, weighing from 16 to 18 pounds.

Captain Francis Pease, of Edgartown, also testified that his father spoke of large blue-fish at the end of the preceding century, some of them weighing 40 pounds. This leaves an interval between 1764 and toward the end of the century, in which no mention is made of the blue-fish, and which may probably indicate its absence, as during that time there were many works published relating to the local history and domestic economy of New England, and which would doubtless have taken note of so conspicuous a fish had it been present.

Whether they existed uninterruptedly during the century intervening

[1] Collections Massachusetts Historical Society for 1794, vol. iii, 1810.

between Josselyn's time, 1672, (or even 1659, according to Macy,) and 1764, I am at present unable to say. According to Captain Pease, they were known about Edgartown at the end of the last century. As already stated, Dr. Mitchell speaks of their first making their appearance about New York in 1810. They are noted as having been seen in Vineyard Sound again as early as 1820. It would therefore appear that they were in such small numbers about New York in 1810 that the young only were noticed flocking about the wharves, and that in ten years they were observed as far east as Nantucket, where the specimens seen, from 1824 to 1826, were very small, not over 4 inches. The next year they measured 7, and the third year 10 inches, according to the testimony of one witness, although this does not represent, in all probability, the rate of growth.

According to Captain Burgess, of Monument, Massachusetts, they were caught about Nantucket in 1825, and were very abundant in 1830. Dr. Storer states the first blue-fish recorded as having been noticed in the present century, north of Cape Cod, was captured on the 25th of October, 1837. Captain Atwood remarks that in 1838 he saw blue-fish for the first time about Provincetown. These were very small, the largest weighing only 2 pounds. In a few years, however, they became larger and more numerous, and finally increased to such an extent as to exercise a very marked influence upon the fisheries. According to the captain, (Proceedings of Boston Society of Natural History, 1863, p. 189,) they arrive in Massachusetts Bay in a body, coming at once, so as to almost fill the harbor at Provincetown. On one year they came in on the 22d of June, and although the day before eight thousand mackerel were taken, the day after not one was seen or captured. He says that they leave about the last of September, with the first cold northeasterly storm, although stragglers are taken as late as December at Provincetown.

According to Messrs. Marchant and Peter Sinclair, of Gloucester, (October, 1872,) blue-fish made their first appearance in numbers about Cape Ann twenty-five years ago, coming in great force and driving out all other fish. They are now much scarcer than twenty years ago; about the same as tautog; some seasons scarcely noticed.

Mr. J. C. Parker, an aged gentleman of Falmouth, says the first blue-fish seen at Wood's Hole in this century was taken in July, 1831; but his father informed him that they were abundant in the preceding century, about 1780 or 1790, at which time they disappeared; and that when the blue-fish left, the scup first made their appearance.

They are also noted as having shown themselves at the head of Buzzard's Bay in 1830 and 1831, and although numerous, were of small size, measuring about a foot in length.

To sum up the evidence, therefore, in regard to the periodical appearance of the blue-fish, we find notice of its occurrence in 1672, or even 1659, and up to 1764. How long it existed in the waters prior to that date cannot now be determined. The oral testimony of Mr. Parker refers to its occurrence at Wood's Hole in 1780 or 1790; and it is mentioned as being at Newport in 1800, (Mr. Smith, p. 20,) and at Edgartown, Massachusetts, about the same time, (Captain Pease, p. 39), Mitchell testifies to its occurrence in New York, of very small size, in 1810; and it is recorded as existing again at Nantucket in 1820, and about Wood's Hole and Buzzard's Bay in 1830 to 1831; and a little later at Hyannis. In 1830 it had become abundant about Nantucket, and in the fall of 1837 it was first noticed in Massachusetts Bay; and then year by year it became more and more numerous, until now it is very abundant. Several accounts agree in reference to the very large size (even to 40 or 50 pounds) of those taken in the last century.

Further research into ancient records may tend to throw more light on the early history of the blue-fish, and even materially to change the conclusions already reached. It will be observed that the references to its occurrence, from 1780 to 1800, are on the testimony of aged persons who have heard their fathers speak of it, although I find no printed records anywhere in reference to it between 1764 and 1810. The rate of progression to the north of Cape Cod I have at present no means of indicating, although they probably gradually extended farther and farther north, and may possibly occur much farther east than we have any mention of at present.

During the present century the maximum of abundance of these fish off the middle coast of the United States appears to have been reached from 1850 to 1860. The testimony elicited from various parties, as well as from printed records, indicates a decrease since that period much greater in some localities than others. About New York they are said to have been unusually plenty in the summer of 1871, but farther east the diminution which had been observed in previous years appeared to continue. The testimony taken at Newport varied somewhat, some persons thinking the fish were decidedly scarcer than in previous years, others finding no appreciable difference. (See pp. 8, 11, 18.) Mr. Harmon, of Pasque Island, Vineyard Sound, stated that the blue-fish, within a very few years, had diminished to such an extent that, when fishing from the stands, not more than two or three could be taken in a day.

At Nantucket, those fishing with gill-nets considered the blue-fish as plenty as before, and even more abundant; but the unanimous testimony of a large number of line-fishermen was to the effect that there had been a very decided reduction. This expression of opinion was also shared by the line-fishermen at Edgartown as well as at Hyannis. Indeed it was asserted that while the reduction, up to 1870, had been gradual, it became abruptly much greater in 1871. If this be true, it may have been caused by a more limited range of the fish; perhaps in consequence of remaining off the coast of New York and New Jersey, where the number is believed to have been greater than in previous years.

All parties, however, agreed that there were fewer fish on the north side of Nantucket than usual.

The testimony at Hyannis was very emphatic in reference to a positive and abrupt decrease, although this was less in the case of the blue-fish than had been observed in regard to the scup, sea-bass, and tautog.

According to some persons, the number taken in 1871 was not half that of 1870; thus, while a year or two before 1870 five hundred pounds a day was a fair average for a single fisherman, one hundred pounds was a liberal allowance for 1871. (Page 50.) Ten or fifteen years ago, eighteen men at Hyannis could load a vessel with blue-fish in a day, to do this requiring fifteen hundred fish weighing five or six pounds each. This is now said to be entirely impossible, even with twice the number of men.

According to Captain Edwards, the blue-fish in 1871 were not more than half or one-fourth as plenty as they were a few years ago; this either in consequence of their extending their cruising-grounds farther to the east, or the diminution of their food.

Captain Thomas Hinckley, also of Wood's Hole, believes the decrease to be very decided, and states that it commenced four or five years ago.

On the other hand, Dr. Yarrow learns that blue-fish have increased on the Carolina coast, as compared with their abundance before the war.

I have been unable to learn whether any appreciable difference has presented itself on the north side of Cape Cod, corresponding to that on the south side. Of the fact of the decrease in 1871, along the entire coast from Newport to Monomoy Point, there can, I think, be no question, as, although the number captured was perhaps absolutely greater than in the previous year, these were taken mainly in a greatly increased number of traps, pounds, and gill-nets, while the line-fishermen, as already stated, on ground where formerly they could readily capture from one hundred to one hundred and fifty fish in a day, now found twenty or thirty a very large allowance for the average catch. I have myself been able to appreciate a very great difference in the abundance of blue-fish in the vicinity of Wood's Hole from 1863 to 1871.

In 1872 a continued decrease in the number of blue-fish was again apparent, the number being much less everywhere than before. At Hyannis, Wood's Hole, and Edgartown, the estimated decrease compared with 1871, varied from one-half to three-fourths; and they the fish were also said to be smaller than usual. These statements are corroborated by parties in New Bedford. According to the wholesale dealers in Fulton Market, they were less plenty than heretofore. At Edgartown and Nantucket, and in Vineyard Sound, comparatively few were taken with the line, the gill-nets being depended upon for a supply.

The decrease at Hyannis is noticeably shown by the statements on page 178, where it will be seen that with nearly twice the number of boats in 1872, as compared with 1871, fewer fish were landed at Baxter's wharf. Captain Handy took less than half as many fish as in the previous year, and Timothy Crocker and J. G. Loring both referred to a corresponding decrease.

The question now arises as to the causes of this decrease in abundance on the part of the blue-fish on the south side of New England, while they appear to be as plentiful as ever off the coast of New Jersey and Long Island. It is of importance in this inquiry that this variation in the number of blue-fish has been accompanied by a similar change in the other fishes, and especially in the scup and menhaden. As, however, there is no marked indication of decrease elsewhere than from Watch Hill to Monomoy, we are entitled to look for some local cause as affecting the number; and it is a curious coincidence at least, if not a relation of cause and effect, that it is precisely in this area of diminished abundance of particular kinds of fish that we find the summer-fishing, by means of traps, pounds, and gill-nets, to have received its highest and most rapid development.

Although fixed apparatus for the capture of fish have been in use in Narragansett Bay for a considerable number of years, the introduction of such engines into more eastern waters has been comparatively slow, and usually limited to a short season in the spring of the year. Within the last five or ten years, however, the pounds have not only increased in number, but have greatly extended the time of their operation, so that instead of being taken up in June, they are now kept down much later, many of them even into October. It is, however, not to any direct action of the pounds upon the blue-fish that I attribute their scarcity. That the blue-fish themselves destroy other fish in immense numbers, there can be no question; and a reduction of their food, whether caused by themselves or supplemented by other influences, will tend to induce them to seek other fields of supply. That this latter is the case, seems to be shown by their temporary increase at least off the coast of New York and New Jersey. Indeed, in reference to the question of the fish-supply, it may be considered as established that the fecundity of fishes is so great that any ordinary influences acting upon them will exercise no particular effect, but that while the capture of fish, in ordinary seasons, by the usual human agencies, will be of comparatively little account, any disturbance of such fish, while on their spawning-grounds, must have some influence, however slight. This will be exhibited not only in the number of breeding-fish actually destroyed before their reproductive function can be accomplished, but in the breaking up of the schools, and thus keeping them from suitable spawning-grounds, causing them to waste the spawn in the waters, where, for one cause or another, a proper combination of the sexes cannot be effected, or where the eggs do not find a suitable *nidus* for development; or, again, where the young fish cannot be properly protected from the destructive agencies surrounding them. If, now, in addition to these influences, which would act perhaps very slowly and almost unappreciably for a great number of years, we introduce a new disturbance, in the form of immense numbers of the most voracious fish on record, which, from its earliest age to its maximum development is in the habit of destroying its own weight or more in fish every day, we can easily imagine what an effect must be produced.

As far as I can learn, there is no parallel in point of destructiveness to the blue-fish among the marine species on our coast, whatever may be the case among some of the carnivorous fish of the South American waters. The blue-fish has been well likened to an animated chopping-machine, the business of which is to cut to pieces and otherwise destroy as many fish as possible in a given space of time. All writers are unanimous in regard to the destructiveness of the blue-fish. Going in large schools, in pursuit of fish not much inferior to themselves in size, they move along like a pack of hungry wolves, destroying everything before them. Their trail is marked by fragments of fish and by the stain of blood in the sea, as, where the fish is too large to be swallowed entire, the hinder portion will be bitten off and the anterior part allowed to float away or sink. It is even maintained, with great earnestness, that such is the gluttony of the fish, that when the stomach becomes full, the contents are disgorged, and then again filled. It is certain that it kills many more fish than it requires for its own support.

The youngest fish, equally with the older, perform this function of destruction, and although they occasionally devour crabs, worms, &c., the bulk of their sustenance throughout the greater part of the year is derived from other fish. Nothing is more common than to find a small blue-fish of 6 or 8 inches in length, under a school of minnows or of making continual dashes and captures among them. The stomachs of the blue-fish of all sizes, with rare exceptions, are found loaded with the other fish, sometimes to the number of thirty or forty, either entire or in fragments.

As already referred to, it must also be borne in mind that it is not merely the small fry that are thus devoured, and which it is expected will fall a prey to other animals, but that the food of the blue-fish consists very largely of individuals which have already passed a large percentage of the chances against their attaining maturity, many of them, indeed, having arrived at the period of spawning. To make the case more clear, let us realize for a moment the numbers of blue-fish that exist on our coast in the summer season. As far as I can ascertain by the statistics obtained at the fishing-stations on the New England coast, as also from the records of the New York markets, kindly furnished by Middleton & Carman, of the Fulton Market, the capture of blue-fish, from New Jersey to Monomoy, during the season, amounts to not less than one million individuals, averaging 5 or 6 pounds each. Those, however, who have seen the blue-fish in its native waters, and realized the immense number there existing, will be quite willing to admit that probably not one fish in a thousand is ever taken by man. If, therefore, we have an actual capture of one million, we may allow one thousand millions as occurring in the extent of our coasts referred to, even neglecting the smaller ones, which, perhaps, should also be taken into the account.

An allowance of ten fish per day to each blue-fish is not excessive, according to the testimony elicited from the fishermen and substantiated by the stomachs of those examined; this gives ten thousand millions of fish destroyed per day. And as the period of the stay of the blue-fish on the New England coast is at least one hundred and twenty days, we have in round numbers twelve hundred million millions of fish devoured in the course of a season. Again, if each blue-fish, averaging 5 pounds, devours or destroys even half its own weight of other fish per day, (and I am not sure that the estimate of some witnesses of twice this weight is not more nearly correct,) we will have, during the same period, a daily loss of twenty-five hundred million pounds, equal to three hundred thousand millions for the season.

This estimate applies to three or four year-old fish, of at least three to five pounds in weight. We must, however, allow for those of smaller size, and a hundred fold or more in number, all engaged simultaneously in the butchery referred to.

We can scarcely conceive of a number so vast; and however much we may diminish, within reason, the estimate of the number of blue-fish and the average of their captures, there still remains an appalling aggregate of destruction. While the smallest blue-fish feed upon the diminutive fry, those of which we have taken account capture fish of large size, many of them, if not capable of reproduction, being within at least one or two years of that period.

It is estimated by very good authority, that of the spawn deposited by any fish at a given time, not more than 30 per cent. are hatched, and that less than 10 per cent. attain an age when they are able to take care of themselves. As their age increases, the chances of reaching maturity become greater and greater. It is among the small residuum of this class that the agency of the blue-fish is exercised, and whatever reasonable reduction may be made in our estimate, we cannot doubt that they exert a material influence.

The rate of growth of the blue-fish is also an evidence of the immense amount of food they must consume. The young fish, which first appear along the shores of Vineyard Sound, about the middle of August, are about five inches in length. By the beginning of September, however, they have reached six or seven inches, and on their re appearance in the second year, they measure about twelve or fifteen inches.[1]

After this they increase in a still more rapid ratio. A fish which passes eastward from Vineyard Sound in the spring, weighing 5 pounds, is represented, according to the general impression, by the 10 to 15 pound fish of the autumn. If this be the fact, the fish of 3 or 4 pounds, which pass along the coast of North Carolina in March, return to it in October, weighing 10 to 15 pounds. The only parallel to the voracity and rapacity of the blue-fish in our waters is, perhaps, to be met with in the case of the common pickerel; and an experiment quoted by Mr. Theodore

[1] According to Genio C. Scott, the blue-fish weighs 2 pounds when it appears on the coast in its second year, (aged twelve months,) and by autumn, or at eighteen months, they weigh from 3 to 5 pounds.

Lyman may serve as a measure for both, and their resulting rate of growth. He states that a friend of his, Dr. Sturtevant, introduced two young pickerel, about 5 inches long, into a horse-trough, minnows of about an inch in length being supplied to them daily. On the first day they devoured one hundred and twenty-eight; the second, one hundred and thirty-two; and the third, one hundred and fifty; and they themselves increased one inch in length in forty-eight hours, consuming an average of about sixty-six fishes each per day, a weight much greater than their own.

In view of this fact, and bearing in mind that the blue-fish, by its pertinacity and its strength and vigorous motions, can find no difficulty in overtaking the prey that it attacks, the estimate of ten fish per day is probably much below the mark.

We now proceed to consider the respective action of the pounds and the blue-fish upon the fish supply. No one will deny that most of the shore fishes are taken, as already explained, while on their way to their spawning-beds, the erection of traps and pounds, in the line of their regular migration, being especially adapted to their capture. It will also be admitted by every unprejudiced person that, in addition to the large percentage actually captured by the pounds, a decided influence is produced by their interference with the course of the remaining fish, and causing them to spawn at improper times or in unsuitable localities. Supposing, however, that the percentage already mentioned escape the perils to which they are exposed, and perform their appropriate functions in due season, their eggs will, of course, be greedily devoured by the small fry attracted by them. Apart from fish attaining a considerable size, the water abounds in various diminutive species of *cyprinodonts*, *atherinas*, &c., which are never taken in the pounds, and which, of course, hold their own year by year, and, indeed, may multiply in consequence of a diminution of the number of larger fish that would otherwise devour them. These act both upon the spawn and the young fish, as also do the other marine animals, the various crustaceans, some of the radiates, &c. As all of these are on the spot, they doubtless devour as many eggs and young one year as another, and what is left by them while growing up has finally to run the gauntlet of capture by man in various ways, and by the blue-fish and other species that devour them after they reach a considerable size.

Should it be a matter of astonishment, then, in view of this combination of agencies of destruction, if the supply of fish were to decrease appreciably on those portions of the coast where all are acting in concert, even though their number may not have diminished perceptibly, where only one or the other occurs.

In this connection, I have confined my examination to the blue-fish; but it may be stated that the squeteague is almost equally destructive, devouring as it does immense numbers of fish of considerable size. There is this difference, however, that the squeteague, from the weakness of its teeth, appears unable to mangle its prey, and confines itself to satifying its appetite by swallowing the fishes whole. Nor is there any evidence that the squeteague empties its stomach when once filled, for the purpose of loading it again. For this reason the effect produced upon other fishes by an equal number of these two kinds of fish, of the same weight, would be very dissimilar, although that of both is doubtless quite appreciable.

As already remarked, the size of this fish varies considerably with season and locality, those spending the summer on the southern coast, according to good authority, rarely exceeding two or three pounds in weight, and being generally considerably less. The largest summer specimens are those found farther to the eastward, where they are not unfrequently met with weighing from ten to fifteen pounds, although this latter weight is quite unusual. Mr. Snow, however, (page 44,) mentions having seen one of twenty-two pounds, and others give, as their maximum, from fourteen to twenty. The average size of the schools in Vineyard Sound, during the early season, is from 5 to 7 pounds. The schools, however, that make their appearance in October, embrace many individuals of from 10 to 15 pounds. It is therefore not improbable that the difference between the first-mentioned average and the last represents the increase by their summer feeding. As already remarked, blue-fish in the last century sometimes attained a weight of 40 or 50 pounds in Vineyard Sound; according to Zaccheus Macy, thirty of them would fill a barrel.

On getting back to the Carolina coast in the early part of November, according to Dr. Yarrow's statement, they are from 3 to 5 feet in length and weigh from 10 to 20 pounds. What becomes of these large fish, that so few of them are seen in the early spring, it is impossible to say. If it be really true that they are much scarcer than in the fall, we may infer that their increased size makes them a more ready prey to the larger fish and cetaceans, or that they have accomplished their ordinary period of life; possibly that they have broken up into smaller parties, less conspicuous to observation, or that they have materially changed their locality. The average length of the fish that appear in the spring off the coast of Virginia and the southern part of New Jersey, according to Dr. Coues, Dr. Yarrow, and my own observations, is about one foot, being probably about one year old. As a general rule, those of the smaller size keep close to the shore, and canal ways be met with, while the larger ones go in schools, and remain farther outside.

I was unable to obtain any very young fish about Wood's Hole in 1871, the smallest found making their appearance quite suddenly along the coast, especially in the little bays, about the middle of August, and then measuring about 5 inches by 1.20. By the end of September, however, these had reached a length of 7 or 8 inches, and at the age of about a year they probably constitute the 12 or 14 inch fish referred to as occurring along the southern coast. The fish of the third year, or those two years old, are possibly the 3-pound fish, while the 5 to 7 pound fish may be considered a year older still. Accurate observations are wanting, however, to determine these facts; as also whether they require two years, or three or more, to attain sufficient maturity for breeding. As far as I know, there is no appreciable difference between the sexes in their rate of growth or weight, excepting that the female is likely to be a little deeper in the body.

I have already referred to the principal facts connected with the migrations and movements of the blue-fish, and especially their arrival and departure. As already suggested, they appear to start along the southern coast in April, and move northward, parallel with the coast, in very large bodies, and extending sometimes several miles outside of the shore-line. Their presence at the surface is usually indicated by their "breaking," apparently in pursuit of their prey, and by the flocks of gulls and terns which hover over them. The birds become exceedingly eager on the occasion, and may be seen crowding together and darting continually at their food upon the surface of the water. No surer evidence of the presence of a school of blue-fish or Spanish mackerel, off the middle coast of the United States, can be given, in the summer-time, than the sight of gulls and terns so occupied.

The blue-fish sometimes make their way up the rivers to a considerable distance, the adults, however, apparently never entering the perfectly fresh water. They are found in the Potomac as far north as Acquia Creek, and also far up the Hudson; indeed, the young of the year are taken as high as Sing Sing on the Hudson and other tidal rivers, where the water is entirely fresh.

As already explained, the relationship of these fish to the other inhabitants of the sea is that of an unmitigated butcher; and it is able to contend successfully with any other species not superior to itself in size. It is not known whether an entire school ever unite in an attack upon a particular object of prey, as is said to be the case with the ferocious fishes of the South American rivers; should they do so, no animal, however large, could withstand their onslaught.

They appear to eat anything that swims of suitable size, fish of all kinds, but perhaps more especially the menhaden, which they seem to follow along the coast, and which they attack with such ferocity as to drive them on the shore, where they are sometimes piled up in windrows to the depth of a foot or more.

The amount of food they destroy, even if the whole of it be not actually consumed, is almost incredible. Mr. Westgate (page 33) estimates it at twice the weight of the fish in a day, and this is perhaps quite reasonable. Captain Spindel goes so far as to say that it will destroy a thousand fish in a day. This gentleman is also of the opinion that they do much more harm to the fishes of the coast than is caused by the pounds. They will generally swallow a fish of a very large size in proportion to their own, sometimes taking it down bodily; at others, only the posterior half. The peculiar armor of certain fish prevents their being taken entire; and it is not uncommon to find the head of a sculpin or other fish, whose body has evidently been cut off by the blue-fish. In the summer-time the young are quite apt to establish themselves singly in a favorite locality, and, indeed, to accompany the fry of other fishes, usually playing below them, and every now and then darting upward and capturing an unlucky individual, while the rest dash away in every direction. In this manner they attend upon the young mullet, atherinas, &c. They are very fond of squid, which may very frequently be detected in their stomachs. In August, 1870, about Fire Island, Mr. S. J. Smith, found their stomachs filled with marine worms, a species of *Heteronereis*, which, though usually burrowing in the mud, at that season swims freely toward the surface, in connection with the operation of reproduction. This, like the squid, is a favorite bait for the blue-fish; and they appear to care for little else when these are to be had. This fact probably explains the reason why, at certain seasons, no matter how abundant the fish may be, they cannot be taken with the drail.

Their influence upon other marine animals is not always injurious. Thus, according to Captain Atwood, the lobsters have multiplied fourfold in Massachusetts Bay since the blue-fish have appeared there, in consequence of their driving away the mackerel, which were the greatest enemy of the young lobsters. *Per contra*, however, he remarks that the blue-fish actually destroy great numbers of mackerel of all sizes, and they have almost entirely broken up the mackerel fishery in the vicinity of Provincetown, making it necessary for the fishermen to resort to far distant waters, to which blue-fish have not yet penetrated. According to Dr. Storer, the mackerel fisheries of Massachusetts Bay have been entirely ruined since 1847.

The fondness of the blue-fish for squid, Captain Atwood thinks, has had a material influence upon the abundance of flounders, which have a similar proclivity, and appear to depend upon these animals in greater part for food. Flounders have, therefore, greatly diminished in Massachusetts Bay, either from being starved out or obliged to resort to other localities.

The blue-fish are not unfrequently found with crabs and shell-fish in their stomachs, (page 42,) as also eels, (page 44,) which probably they obtain at night, as it is understood they feed at the bottom at that time, coming to the surface by day. This is proved by the fact that blue-fish taken in gill-nets are taken at night near the middle line; but if taken by day, then near the upper edge.

In the discussion of the question as to whether the decrease of fish on the south coast of New England has arisen from the multiplication of traps and pounds, it has been denied that scup form any part of the food of the blue-fish, it being asserted that the spinous nature of the fins effectually prevents such a performance. Apart, however, from the positive testimony of a great number of persons on this point, I am able to state in the most emphatic manner that of the large number of blue-fish examined at Wood's Hole during the summer of 1871,[1] nine-tenths of them had their stomachs filled with scup in greater or less number. Most of these fish were taken in pounds, in which scup were also caught; and it would be but the exercise of a natural instinct for the one to prey upon the other under these circumstances; and, nevertheless, it is very clear that the natural defenses of the scup did not prevent their being swallowed. Furthermore, however, the examination of many blue-fish taken in gill-nets also resulted in finding scup in their stomachs. We may, therefore, readily infer that, while, perhaps, preferring menhaden and mackerel, as being either more savory or more easily taken from their swimming near the surface of the water, blue-fish will feed upon any animal life to be found in the sea, going nearer the bottom at night, and coming to the surface by day, and that whatever fish the sea affords in greatest abundance at the time will suffer most severely from their ravages.

As already stated, the first blue-fish of the season are caught at the bottom, while fishing for scup; and the evidence shows that they are first taken in gill-nets sunk to the bottom, before they are taken with the line at the top, this being the evidence of their presence, and before any indication is seen by their "breaking" at the surface.

According to Dr. Yarrow, this fish, on the southern coast, comes in from the sea into the inlets on the flood tide, the larger ones returning on the ebb, feeding in preference in water of 4 to 5 feet in depth.

As already explained, they seem to know no particular time for taking their food, being equally voracious day and night.

I regret to say that but little definite is known in regard to the reproduction of the blue-fish. Dr. Yarrow does not give any facts in regard to this subject, at Fort Macon, except that spawn was seen to run out of a small female caught July 14. Dr. Holbrook is also silent on this head. Mr. Genio C. Scott says the spawning-beds are visited by the parent in June, and consist of quiet nooks or bays. Mr. R. B. Roosevelt states that very diminutive young occur in immense numbers

[1] Of seven hundred blue-fish the stomachs of which were examined by my assistant, Dr. Palmer, at Wood's Hole, between the 2d of August and the middle of September, six hundred and fifty-five contained scup, in numbers varying from two to ten or more, the average being four or five. Next in number to the scup came the butterfish, the squid, small mackerel, and the sand-smelt. Even young blue-fish of the season had entire scup of the year within them.

along the coast at the end of September or beginning of October. (Game Fish of America, 1862, 159.) I found the young fish at Carson's Inlet, Beasley's Point, New Jersey, in July, 1854, two or three inches in length, and more compressed than the adult; but farther east, on Vineyard Sound, although diligent search was conducted, between the middle of June and the first of October, with most efficient apparatus in the way of fine meshed nets, I met with nothing excepting fish that made their appearance all at once along the edge of the bay and harbor.

According to Captain Edwards, of Wood's Hole, a very accurate observer, they have no spawn in them when in Vineyard Sound. This statement is corroborated by Captain Hinckley; and Captain Hallett, of Hyannis, (page 48,) "does not know where they spawn." The only positive evidence on this subject is that of Captain Pease, (page 38,) who states it as the general impression about Edgartown, that they spawn about the last of July or the first of August. He has seen them when he thought they were spawning on the sand, having caught them a short time before, full of spawn, and finding them afterward for a time thin and weak. He thinks their spawning-ground is on the white sandy bottom to the eastward of Martha's Vineyard, toward Muskeeget. While not discrediting the statement of Mr. Pease, it seems a little remarkable that so few persons on the eastern coast have noticed the spawning in summer of the blue-fish; and although there may be exceptions to the fact, it is not impossible that the spawning-ground is in very early spring or even in winter off New Jersey and Long Island or farther south. It is not impossible that, at a suitable period after spawning the young, in obedience to their migratory instinct, many move northward along the coast, growing rapidly as they proceed. This explains the almost sudden appearance of fish of five inches about Wood's Hole.

We have the statement of Dr. Yarrow that vast schools of small blue-fish were met with in Beaufort Harbor during the last week in December, 1871. These were in company with small schools of young menhaden and yellow-tailed shad, and were apparently working their way toward the sea by the route of the inlet. When observed, they were coming from the southward through the sound, moving very slowly, at times nearly leaving it, and then returning. The largest were about 4 inches in length, and others were much smaller; and as many as twenty schools were observed from the wharf at Fort Macon, each of them occupying an area of from 60 to 80 feet square, and apparently from 4 to 6 feet in depth. I would not be much surprised if these fish should prove to have been spawned late in the year off the southern coast.

The mode of taking these fish varies with the locality, the more productive method being either with weirs, or pounds, or by means of the gill-net. In Massachusetts Bay immense numbers are sometimes taken in the brush-weirs, which are very common in that region. During the night of the 14th of September, 1870, I happened to be anchored off Billingsgate Shoal, where one weir took a school of blue-fish estimated at 20,000 in number, weighing probably six pounds each. Fifteen carts were occupied the entire morning in hauling these fish up from the beach.

At Hyannis, Nantucket, and Edgartown they are taken principally by the line, although a large number are caught about Nantucket in gill-nets. In 1872, owing to the increasing scarcity, comparatively few were taken at these places with the line, the supply being furnished mainly by net.

Farther west, in Vineyard Sound and in Buzzard's Bay, they are taken principally in the pounds; while still farther to the west and in

Long Island Sound, they are taken very largely in gill-nets as well as with the line. Wherever they occur, of course large numbers are taken with the hook and line by sportsmen and amateurs.

The fish taken on the south side of New England, and off the coast of New York and New Jersey, are for the most part shipped to New York for consumption as fresh fish. They are packed in ice, if near a railway communicating with the cities, and put up in sugar-boxes, about 300 pounds in a box. The fish taken at Nantucket, however, and to some extent those at Edgartown, are salted and packed in barrels for winter use. These contain about 200 pounds each, and are worth $10 per barrel in good seasons.

According to Captain Atwood, (Proceedings Boston Society of Natural History, IX, 1863, p. 189,) in addition to their capture in Massachusetts Bay in weirs, they are taken very largely outside by gilling. For this purpose two boats, each with 450 yards of netting meet, and unite the ends of their respective nets, and then, moving in opposite directions, pay out the nets, and then nearly meet with the outer ends, the net forming a semi-circle. Just before coming together, they turn inward so as to form a helicoid-curve toward the net. Then, moving outside, they endeavor to drive the schools of fish into the concavity of the net, and thereby cause them to become gilled.

Formerly, when they first appeared they were taken only in the bay, but of later years, according to Captain Atwood, they have become hardy, stay later in the season, and are more frequently found on the outer edge of the cape.

About Nantucket the gill-nets are usually set in a nearly straight line parallel with the shore; and the fish, according to Mr. Snow, are captured on the ebb tide. The nets are 25 to 50 fathoms long, and from 30 to 50 meshes wide, the meshes varying from $4\frac{1}{4}$ to $4\frac{1}{2}$ inches, No. 15 or 16 thread. The gill-nets sometimes float at the surface of the water; sometimes are sunk nearly to the bottom, as already stated, the season, the time of day, and time of tide all requiring to be taken into account.

At Newport, according to Mr. Taylor, (page 27,) the nets used in that vicinity are 76 meshes deep, the mesh $4\frac{1}{2}$ inches. In these they are taken about midway, the weight of the fish varying from $2\frac{1}{2}$ pounds to 7 or 8.

The usual method of taking them with the line is by drailing or trolling, this consisting in fastening a hook to from 20 to 50 fathoms of line, the bait consisting simply of a bit of polished metal, which may be cast around the base of the hook, or of a bit of bone or ivory similarly placed. This is dragged rapidly through the water, under full sail. Sometimes the weighted hook is covered by a piece of inverted eel-skin, one end of which is tied down over the leaded portion, and extending nearly to the barb of the hook, with a small piece generally playing just beyond; the whole resembling a small shining fish, as it moves rapidly through the water. They are sometimes, indeed, taken with a bait of red flannel, or even a white rag; as, when ravenously inclined, they will snap at anything they see thus in rapid motion, especially if it has any resemblance to a moving fish. Menhaden or other shining fish may also be used to advantage; but it is seldom thought necessary to take this trouble. The shank of the hook, or metal fastening, must be sufficiently long to prevent the blue-fish, in their eager haste to seize their prey, from cutting the cord, as they would bite through it almost with the precision of a pair of nippers. Indeed, the end of the line is sometimes connected with the hook by means of a small chain, or else coated with wire. This mode of taking the blue-fish is very exciting, as, when abundant, they usually bite at the drailing hook as rapidly as it is thrown out, several fish often being seen jumping at the same time to seize the coveted but delusive prize.

A mode recently introduced off the coast of New York and New Jersey consists in baiting certain fishing-grounds with chopped menhaden, and then anchoring the smack. Lines, with pewter squids, are then dropped overboard and hauled rapidly up. This proves to be very successful, much more so than trolling.

Although the sight of a school of fish playing in the water is generally the sign to thrown out the lines, it often happens that stragglers are picked up when their presence is not suspected, so that in regions where blue-fish are generally found, it is customary for fishermen to keep a line out at the stern while making their trips from point to point. Great care must be taken to keep the hook free from floating seaweed, which is very apt to become fastened around it, as this invariably prevents any further success.

Not unfrequently blue-fish are taken when fishing with deep-sea lines for scup or tautog, especially at night; although the surface fishing is most customary and most productive.

The fishermen of Edgartown and of some other localities on Vineyard Sound, keep their line, when fishing, well out by means of a stick of wood projecting from the side, although generally the line is held in the hand directly over the stern or side of the boat. By the use of a moderate degree of skill, at least three lines if not more can be managed well from a sail-boat, one from the stern and the others from either side.

Another method of taking them is in the surf, when they are near the shore, coming in either after menhaden or to lie in wait for the schools of young alewives, as they pass out from the ponds in which they have been bred. In this case the usual method consists in swinging a weighted hook several times around the head; then, by a dexterous fling, throwing it off as far as possible into the water, and then immediately hauling hand over hand very rapidly. If no fish is hooked, the same experiment is repeated. In this way many large fish are taken.

Sometimes also the fisherman turns, as soon as he sees the splash of the hook, and runs as rapidly as possible up the bank and from the shore; again to return and repeat the operation. Under favorable circumstances, this method of fishing is very productive, resulting in the capture of large numbers in a short time.

For fuller details of everything connected with the capture of blue-fish by means of lines, I must refer to the excellent works of Genio C. Scott, Mr. R. B. Roosevelt, Mr. Thaddeus Norris, and others, who have made such subjects a specialty.

Whether the numbers of the blue-fish can be considered as at all diminished by any or all these methods of fishing, it is impossible to state, although I am inclined to the opinion that, if any, it is very slight. As the fish are not taken when exclusively engaged in the operation of reproduction, there is no special interference with their spawning, and although there has been a variation in abundance, as already explained, this may be ascribed as well to some peculiar caprice on their part, or to their finding less food than they require; and consequently their going elsewhere in search of it.

The average catch with the hook of course varies with the abundance of the fish and their readiness to bite. According to Captain Pease, (page 40,) one man, a few years ago, could take about 1,500 pounds a day; while, as an illustration of their decrease in number, the largest catch in one day in 1871 was 500 pounds, and the average at Edgartown and Hyannis not more than 100 pounds.

On the Carolina coast the best season for fishing is about at slack water, including the last of the ebb and young flood. At full tide the success is much less.

Reference has already been made to the number of blue-fish taken in Vineyard Sound during the season of 1871, these amounting to not far from a million of fish. At Hyannis alone, notwithstanding the decided diminution in number, as many as 100,000 fish, representing a weight of half a million pounds, were taken up to the 18th of September, and shipped by the cars to New York.

Of the winter fishing for blue-fish on the coast of North Carolina, the principal range, according to Dr. Yarrow, United States Army, extends from Nag's Head to Cape Lookout, the north bank near Nag's Head being a favorite locality. The fishing season there lasts about five or six weeks, from about the middle of November to the end of December; and in 1871 there were one hundred and fifty crews engaged. At this time the fish appear to come in direct from the sea, and, after spending some time there, they pass out again to sea in a southerly direction, this being possibly the time at which they come in to spawn, although Dr. Yarrow was unable to detect the presence of any spawn.

These fish are all large, some of them weighing 18 to 20 pounds, although their average, as already remarked, is about 10. They are captured by gill-nets made of No. 6 cotton-twine, 200 yards long and about 50 meshes deep, the mesh itself being 3 inches.

They are also captured, in less number, however, by means of the hook baited and thrown in the usual manner. Their first appearance is indicated by schools of menhaden, in pursuit of which they display so great eagerness as sometimes to run themselves upon the shore. When a school is seen to approach, the nets are let off from the boats about half a mile from the shore, so that the fish are gilled as they come in. The fish are generally of about the same size, and large, no young ones being found in their company.

A full outfit costs from seventy-five to one hundred dollars, and the boat's crew share the profits, which are sometimes very large; as in a good season the fish will bring about six cents per pound. As many as 4,000 fish have been taken out at a single haul, but this is unusual. A fair average is about 3,000 fish to a crew for a season. Allowing 2,000 as an average for the 150 crews, and we have 300,000 fish, which, at an average of ten pounds each, will give 3,000,000 pounds, amounting, at 5 cents per pound, to $150,000. These figures are believed to be fully within the mark.

Dr. Yarrow further states, in this connection, that no fish will swim in their company, large sharks even sometimes losing their fins by them. The only fish of the southern waters able to protect itself against them is the largest sized drum. They are, however, devoured in large numbers by the porpoises, which follow them to their grounds and make sad havoc among them. The same is the case farther north. Sharks, too, doubtless kill considerable numbers.

The economical value of the blue-fish as a food-fish is very great, constituting, as it does, a very large percentage of the food supply, during the summer, of the people of the coast from New Jersey to Massachusetts. It is to be met with in its season in all the markets, and is the principal reliance of summer boarding-places near the sea-coast, especially since the diminution in the number of the scup and other shore fishes. This is in strong contrast to the contempt manifested for them in the earlier part of their occurrence during the present century. In one instance (page 183) a fisherman who caught two hundred could not induce people to steal them, although he left them out all night on a wharf for the express purpose. According to Dr. Storer, (Pr. Boston Soc. Nat. Hist., 1852, 289,) a bounty for its extermination was proposed, especially in view of its injury to the mackerel-fishing. The blue-fish is, however, very sweet and savory, but does not keep very well; and the difference in taste between a fish fresh from the water and one that has been out a few days, even though the latter be perfectly sweet, is very great. A great improvement in the flavor of the fish, as well as in the firmness and whiteness of its color, is effected by killing it as soon as caught and bleeding it, this operation being best performed by slashing the gills and cutting through the throat between them. The fish is well supplied with blood, as shown by its great muscular vigor, and bleeds very profusely; and persons accustomed to its taste when cooked, after being thus treated, are very unwilling to eat such as have been allowed to die in the ordinary manner.

As far as I could ascertain, very few blue-fish are used for the manufacture of manures or for oil, coming, as they do, when other kinds of food-fish are scarce. It is probable, however, that on the sea-coast, when a very large catch is made, the surplus is applied directly to the land, as is customary with the menhaden.

The wholesale value of the fresh blue-fish varies also with the season and the locality. At Edgartown the fish were sold in 1871 for about 1 cent a pound; and at Hyannis, Wood's Hole, and the pounds along the coast, at from 1½ to 2 cents a pound, the price varying with the immediate demand. At Beaufort, North Carolina, which is the principal market for the Carolina blue-fish, the wholesale value is 60 cents to $1 per hundred. The salted fish bring about $8 or $10 per barrel of 200 pounds. The retail price varies perhaps less than the wholesale, being generally, in the markets near the coast, about 8 cents a pound.

There appears to be no foreign commerce in this fish, the consumption being almost exclusively when fresh, and but to a limited extent when salted in barrels.

I have not learned whether the experiment has ever been made of salting and drying this fish, as is done with the cod family.

There appears to be no fish on the European coast presenting the same relationship to the other fishes as the blue-fish, which, as already remarked, exercises a terrorizing influence over other species, either destroying them bodily, or driving them away from their accustomed abode.

Captain Atwood refers to the influence they exert upon the shore-mackerel fisheries of New England. A similar effect is produced in Massachusetts Bay during the summer upon the fish of the cod family, the tautog, and other fish, it being understood that when the blue-fish appear all other fishing ceases for the time. Although such a result of the return of the blue-fish is not so marked on the south coast of New England, its exterminating qualities are evident, and need to be taken very seriously into account in considering the question as to the causes of the diminution of the food-fishes.

As already remarked, I feel quite assured that this combination of blue-fish, with the use of traps and pounds, has reduced the scup and tautog, sea-bass, &c., to their present scanty number on the south coast of New England. The two causes must be considered as working together, and deserving the accusations that have been brought against them. And possibly the effect is about equal, as, although the blue-fish destroy the vastly greater number, yet these are the fish swimming in the open sea and taken after the operation of spawning has been accomplished, while the pounds secure particularly the spawning fish, and that, too, during the few weeks when they school near the shore for the purpose of depositing their eggs. Whether the British committee, which prosecuted the inquiry as to the influence of nets and traps upon the fishing, would have decided as they did, to the effect that they could observe no evil result therefrom, had the blue-fish been an inhabitant of their coast, is a very serious question.

XV.—DESCRIPTION OF APPARATUS USED IN CAPTURING FISH ON THE SEA-COAST AND LAKES OF THE UNITED STATES.

MODES OF CAPTURE.

The methods by which fish are captured in the United States are very varied, and in some of their modifications may be considered as superior to those in use in other countries.

The usual apparatus may be divided into: lines armed with hooks, nets and weirs, although other methods are in less extensive use, of which it is scarcely necessary to make extended mention here, these consisting in the main of spears, harpoons, the bow and arrow, poisoning, and explosive compounds.

PROJECTILES, EXPLOSIVES, AND POISON.

The *spear* is used more especially by the Indians in different parts of the country for taking salmon, and is not so well adapted to other fish.

The *bow and arrow* are extensively employed among the Esquimaux and the Indians of the northwest coast of America.

For *poisoning* fish, berries of the *Cocculus indicus*, or some other stupefying drug, are intimately mixed with bait and thrown into the water. The fish eating this became narcotized and floated to the surface, where they are taken. This method is of course available only in still localities, like mill-ponds, &c.

The *explosives* used consist of cartridges or torpedoes of gunpowder, dynamite, nitro-glycerine, &c., and sometimes, when set off in the vicinity of a large school of fish, destroy great numbers.

The *harpoon* is largely employed in the capture of the sword-fish off the New England coast. This consists of a barb with jointed ears, and fastened to one end of a rope of several hundred feet in length, to the other end of which is attached an empty, well-bunged barrel, to serve as a buoy. The end of a long handle carries a pointed iron stem, over which the socket of the harpoon-head referred to, usually called the lily-iron, is slipped. The fisherman stations himself at the end of the bowsprit of a small sloop or schooner, supported by a sort of iron frame, and when a sword-fish is seen resting idly upon the water the boat is steered directly toward it so as, if possible, to bring the harpooner immeditely over the fish, when the weapon is driven down with great force into the back of the neck; and if the lily-iron is fastened in the flesh, it slips off from the stem of the handle, which is pulled out as the fish darts away, and the rope and buoy are thrown overboard. The fish, of course, swims off with great velocity, diving to the bottom; but after a time, fatigued by the drag of the buoy, comes again to the surface. One of the fishermen then follows in a small boat, and, taking hold of the rope, draws the fish close up to him and kills it by means of a lance.

A harpoon of a somewhat similar character is sometimes fired from a shoulder-gun, either with or without a torpedo (bomb-lance) attachment. This method is rarely used on our coast for the true fishes, so far as I know being confined to the capture of whale.

The explosion of torpedoes under the water has only lately come into vogue, and it is said has been employed with much success on our southern coast. This method is used by poachers in England and Scotland for taking salmon and trout surreptitiously, the torpedo being fired, when sunk to the bottom, by means of a portable battery or otherwise. It is said that many fish are killed in this way, and that it is extremely difficult, if not impossible, to detect the poacher. A similar practice is said to have been recently introduced into New Jersey among the trout-ponds.

The Indians of Maine and New Brunswick are accustomed to kill porpoises in the bays and off the coast, and about the islands of Campobello and Grand Manan, with muskets loaded with buckshot. In this pursuit two Indians go out together in a canoe, when the sea is calm, and hunt for the porpoises as for other wild game, and when one is seen anywhere in the distance, they row with all their skill and might directly toward the object, and, when sufficiently near, fire at the head of the porpoise as it comes above the surface. Being good marksmen, they almost invariably wound and stun the fish; but as it would quickly sink beyond reach if killed, a lance with a long handle is made use of to fasten to and hold the game, which is soon deposited in the bottom of the canoe. About the northern head of Grand Manan, and in other favorable localities, the canoes of the Indians may be seen scattered over the water by dozens, upon a favorable day, watching for porpoises, the summer season being spent in temporary encampments on the shore by Indians from various parts of the northeast coast of Maine and New Brunswick.

These different methods, however, are of little moment compared with the use of the hook and line, nets, and weirs.

LINES.

Line fishing varies in its character, from the coarse, heavy cord used in taking fish at great depths in the sea, to the delicate apparatus of the trout, salmon, and striped-bass fishermen, the first-mentioned being the most important in an economical point of view. It may consist either of the hand-line or the set-line. In the case of the *hand-line* we have a single line and one or two hooks baited and sunk to or near the bottom, or thrown to any desired distance by means of a weight, and managed from the shore, or from a boat anchored or moving slowly; or the line may be drawn rapidly over the surface of the water behind a sail-boat, as in the capture of blue-fish, Spanish mackerel, striped bass, black bass, &c., either with or without a bait, other than some shining substance to attract the attention of the fish in question. This is known as trawling or trolling.

The more effective line apparatus, however, consists in the use of what is called in the United States the "*trawl-line*" or "trot-line;" in England known as "long-line," "spillans," "spillar," or "bultow." This consists essentially of a long line from forty fathoms to several miles in length, which is anchored at each end to the bottom, the position of the ends being shown by buoys, and short lines of about three feet attached at intervals of about seven or eight feet, with a hook at the other end. In some cases the hooks on a single line number as many as five thousand, although on the coast of Maine and Massachusetts there are usually from four hundred to eight hundred. Bait of the proper kinds is placed upon these, and the lines allowed to remain down through a part of a tide. If set at half-tide, they are sometimes overhauled at intervals of half an hour or an hour. When taken up for examination, the fisherman, commencing at one end close to the buoy, lifts the main line to the surface and carries it along over the boat upon one side, which is hauled along under the line toward the other end. The fish found upon the hooks are dropped into the boat by the man who pulls up the line, while a companion, as the line passes over the boat, puts new bait, if necessary, upon the hooks and drops them again into the water. In this way the trawl is traversed from one end to the other, and, under favorable circumstances, as soon as the operation has been performed it can be again repeated, the line being taken up in an opposite direction. The principal fish taken in this way on our coast are the cod, hake, haddock, and skate, the pollock swimming too near the surface to be attracted by the bait.

In England a single trawl-line is usually forty fathoms in length, with twenty-six hooks attached by snoods. As many of these lines are united as is thought expedient, and these are shot across the tide as the vessel sails along, so that the snoods may hang clear. There is usually an anchor at each end, at intervals of forty fathoms, to keep the line in position at the bottom, as well as the buoys already referred to.

The same process is used very largely on the Banks of Newfoundland for taking cod, first introduced, I believe, by the French, and afterward imitated by men of other nationalities..

Much complaint has been made by fishermen in Massachusetts Bay and elsewhere of this mode of fishing, chiefly, however, on account of the large catch; but there seems no good reason for believing that it can exercise an injurious influence upon the supply of fishes, as none appear to be taken by it during the spawning season.

NETS.

Next to the lines come the nets, moveble or fixed. The simplest form of these is the *seine*, which, as is well known, consists of a webbing of net-work, provided with corks or floats at the upper edge, and with leads of greater or less weight at the lower, and used to inclose a certain area of water, and by bringing the ends together either to a boat or on the shore, to secure the fish that may happen to be in the inclosure, unable or unwilling to escape. The seine varies in length from one sufficient to take a few minnows to the shad-seine of a mile in length, hauled in by a windlass worked by the power of horses or oxen, or by a steam-engine.

Another equally simple form of net is the *gill-net*, which is generally fastened at one or both ends, and so arranged, by varying the weight upon the lower edge, so that it shall float near the surface of the water, at any intermediate depth, or near the bottom. When a net of this character is allowed to float with the tide, it becomes a drift-net. Both forms are used very extensively on our coast, the drift-net perhaps more frequently for taking salmon, mackerel, and herring. Shad are also taken very largely in nets of this construction; blue-fish and Spanish mackerel are more frequently captured in the fixed apparatus.

The gill-net used on Lake Michigan, (Fig. 1,) according to Mr. Milner, to whom I am indebted for the figure and descriptive account, is made of imported linen gilling-twine or thread, from No. 35 to as fine as No. 60. Its width is from fifty to eighty-one inches when stretched taut, having from twelve to eighteen meshes in the width. Each net is usually from one hundred and eighty to two hundred and seventy feet long. A light line, from "20 to 40 thread seine-twine," is seized on along the outer edges of the net—the seaming.

Another slightly heavier line—the meter—from "40 to 120 thread seine-twine," is stretched along the seaming and secured with seizings at intervals of a yard. The meter and seaming on one side of a net are usually together, about equal to from "60 to 140 thread" line, according to the exposure to storms at different fishing-grounds, and the depth of the water in which the nets are set.

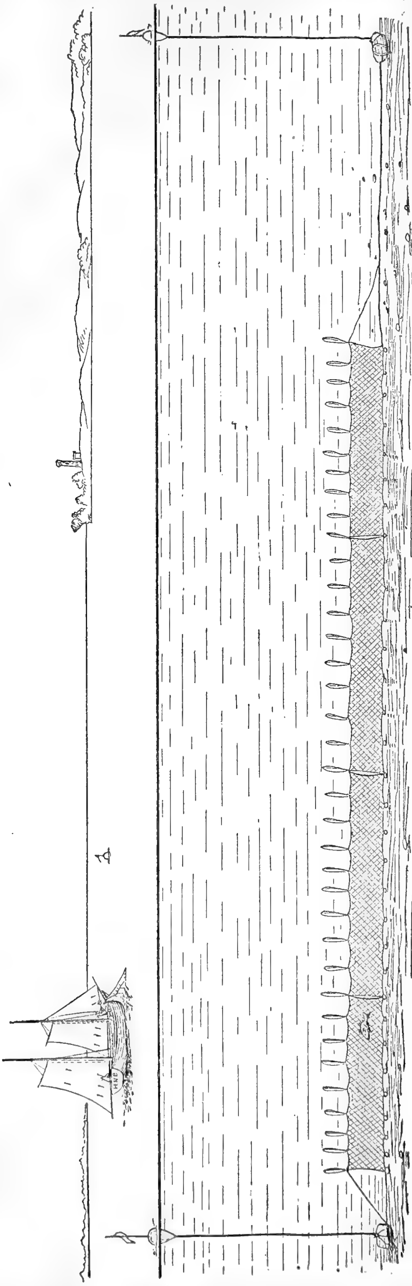


Fig. 1.

Gill Net of Lake Michigan.

Set at bottom of water, kept vertical by cedar floats,—only a few lenghts of net represented.

The seaming is for the purpose of stretching the net, the meter for strength, and the attachment on one side of the stones, on the other the floats.

The floats are splinters of cedar, thirty inches long and about one and a fourth inches wide, and three-eighths of an inch thick. The stone is a small cobble-stone, weighing about one and a fourth pounds, notched on its edges to secure a string.

Both floats and stones are taken off, when the nets are drawn up from the lake. A few fishermen use gill-nets with permanent corks and leads, similar to those used on seines.

The mesh measured in its length, or when stretched so as to form two parallel lines, is barely from four and one-fourth to five inches. The commonest size, formerly, was four and one-half inches, but within a few years nets with four and one-fourth inches mesh have been on the increase. The gill-net captures a fish by entangling it in its meshes.

In setting the nets, the stones and floats are tied on in the shanty, and the nets, with the floats, are folded into bales on a tray, with the stones in another tray drawn up to the first. A "gang" of from eight to thirty-six nets are put in the boat, with three lines and two buoys. After reaching the fishing-ground, in from eighteen to seventy fathoms of water, a stone, weighing from fifty to seventy-five pounds, is tied on the ends of two lines, one a buoy line and the other a stretcher. The stone is lowered to the bottom, when a buoy is tied to the end of one line, and the end of a net to the stretcher. The boat is moved slowly ahead, while the gang of nets is paid out, one man throwing the stones and another the floats. The weights are so closely balanced to the buoyancy of the floats, that their points are seen standing above water in a long line astern, while they slowly sink. When they come to the last net, a line, with a stone attached, is tied on and lowered to the bottom, and to the upper end a buoy is fastened. These buoys have a flag-staff, with the flag six or seven feet above the surface. They guide the fishermen to the ends of the gang, and the two are often a mile apart.

Taking up the nets.—The nets are taken up by hauling in the line until the end of the net is reached, when they are drawn over a roller fixed in the bow of the boat—nets, fish, floats, and stone, passing inboard over the roller. The stones and floats are removed and piled in racks and trays, the fish taken out and thrown into the box, and the nets doubled into bundles. Picking out sticks and leaves, rinsing the nets and drying them on stakes set in a long row for the purpose, complete the work up to tying on floats and stones again.

The cork and lead nets are dried on a large reel. At intervals of a few weeks the nets are boiled in soap-suds or lye, to rid them of fish-slime and confervæ, as otherwise the twine rots rapidly.

From two to four gangs are left in the lake at once, taking up each gang in from two to four days from the time it was set.

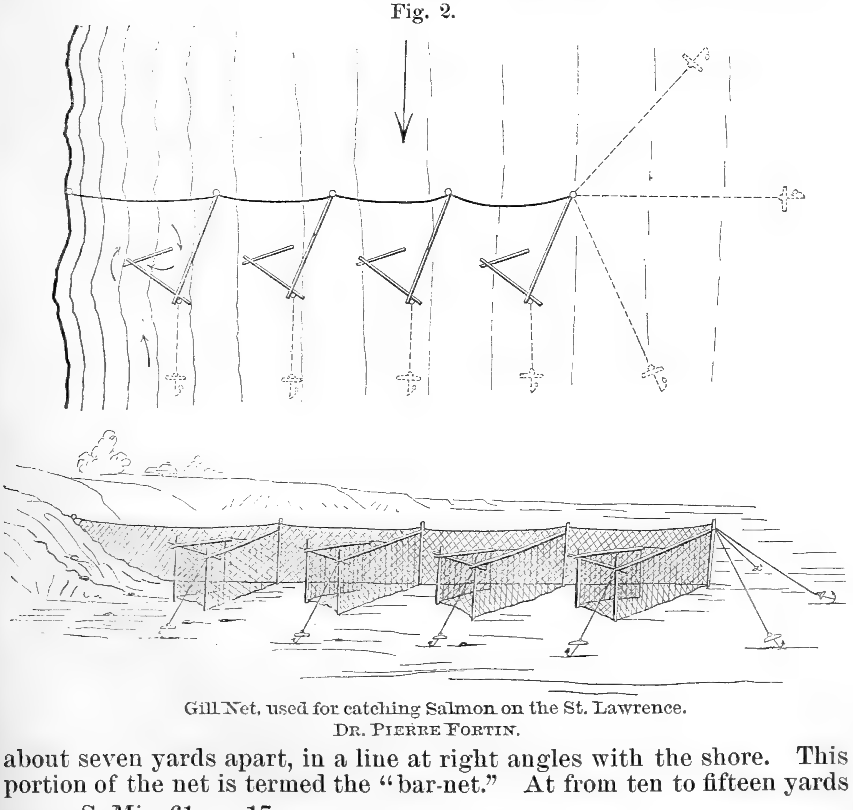
In the southern half of Lake Michigan the fishermen use a large boat, with five and six gangs to the boat, each gang having from twenty-five to thirty-six nets, and employing five men to the boat.

In the northern half of the lake light Mackinaw boats are used, two or three men to the boat, and from two to four gangs of nets, with eight to twenty nets to the gang.

When anchored, gill-nets are not unfrequently brought into a curve, one end being bent so as to form an acute and very narrow V; and the fish striking against the longer limb of the V and moving into the angle, gradually become entangled and are meshed. At other times both ends are brought around and fastened, so as to form a shape somewhat similar to that of the heart of a regular pound.

The fishery-acts of Canada, respecting the capture of salmon in their passage up the rivers at the spawning-season, provide that no net or other device shall be so used as to entirely obstruct the passage of fish, and that the main channel or course of any stream shall not be obstructed. While prohibiting the use of bag-nets, trap-nets, and fish-pounds, in the capture of salmon, it allows the use of a gill-net, (Figure 2,) known as the "stake-net," which is a net fence hung on stakes set

Fig. 2.



Gill Net, used for catching Salmon on the St. Lawrence.
DR. PIERRE FORTIN.

about seven yards apart, in a line at right angles with the shore. This portion of the net is termed the "bar-net." At from ten to fifteen yards down the stream another row of stakes is set, each opposite a stake in the bar-net, and between these stakes a wing-net is stretched, having several yards of netting more than suffices for the distance. This end is carried round in the form of a triangle and held in position by poles lashed together at their ends. The free end of one pole is secured to the stake, and of the other to the seaming of the wing-net, and thus secured they float at the surface of the stream.

The triangular portion of the wing, or "hook" as it is called, is arranged so as to allow an opening between the end of the hook and the wing through which the salmon enter the triangle.

The netting is made of strong gilling-twine, the minimum mesh allowed being five inches.

The salmon swimming up the current come in contact with the bar-net, and turning to pass around it, find themselves opposed by the wing; they turn again up stream, and are pretty certain to enter the hook, the netting of which hangs slack. In their efforts to escape they become gilled.

Another kind of net, not unfrequently used in Europe, but less in this country, is what is called the "*trammel-net*." This consists of three seines of similar outline, fastened together at their edges. The central net is very loose and full, and is of fine thread and small mesh. The two outer ones measure from three to six inches along the side of the mesh, and of coarser thread. The fish, in moving along on either side, especially if suddenly startled, pass readily through the first or coarser meshes and strike against the inner net, which is forced through on the opposite side, the fullness of the net readily permitting this protrusion. The fish is then held in a kind of pocket, and, in endeavoring to escape, is quite as likely to carry the bag the net has made across into another mesh, which, of course, holds it with perfect security. This net is much used in mill-ponds and other localities filled with brush or other obstructions preventing dragging-apparatus. Here, by muddying the vicinity of the net and then stirring around and making a great noise, the startled fish shoot in every direction, and frequently strike the net and are captured.

Next to the seine-nets of various forms, and far more productive than the gill-net, is the apparatus called "*trawl*" in England. This is simply a huge bag of netting, with an open mouth, drawn behind a vessel and dragging on the bottom of the sea, sweeping into itself the ground-fish, surface-shells, sea-weed, &c. Quite commonly this is about seventy feet long, with a semi-elliptical opening at the mouth of forty feet in breadth, diminishing gradually to the posterior end, where, however, there is a portion, of about ten feet in length, of a uniform diameter of four or five feet. The upper part of the mouth of the net is fastened to a beam of wood about forty feet long, supported at each end by two iron frames three feet high, and known as the trawl-heads or irons, the upper part of which has a socket into which the beam passes, and the lower side having a runner, turned up forward, on which the trawl rests. The trawl-net is fastened to the beam above, and to a leaded rope below, which extends from one runner to the other, exhibiting a considerable amount of slack. Ropes are fastened to each runner, which are brought together, after passing a certain distance, and to them the line itself is attached by which the apparatus is dragged along. Thus rigged, the apparatus is lowered over to the bottom, and is held behind a vessel of thirty-five to sixty tons, or even more, in moderate motion. The runners glide over the bottom, dragging the lead-line between them. The fish, as they are imbedded in the sand or concealed in the mud or weeds, if not previously startled, are frightened from their hiding-places by the lead-line, and generally shoot upward to escape. They, however, meet the upper side of the net, and in the progress of the trawl are carried back toward the posterior extremity. Here pockets have been made, or *cul-de-sacs*, into which the fish make their way and find themselves unable to escape.

After a certain time the trawl is lifted and the fish removed, and the trawl thrown over again. As may be readily imagined, this trawl-net can be used only on smooth bottom, sandy bottom being preferred. If, however, the lead-line catch upon a rock or other obstacle, it is so arranged that it will break before the drag-rope parts, so that no damage will be done other than that of tearing the net, which, of course, is preferable to losing the entire apparatus.

Trawling is generally carried on in the direction of the tide, sometimes across, but never against it, as the trawl cannot be kept down against the tide. The rate of progress is usually from half a mile to two miles an hour, depending upon the kind of fish set for, the object being to keep the trawl steadily working on the ground.

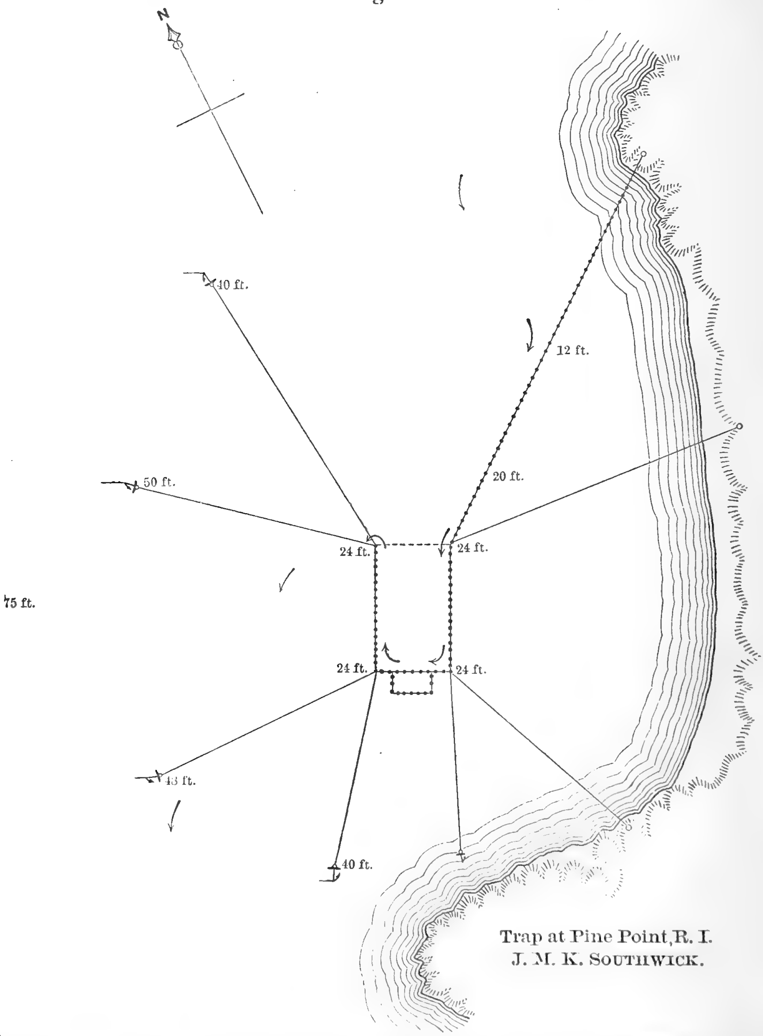
It is not a little remarkable that this method of fishing should be entirely unknown in the United States, while in England nearly all the fishes of a certain class, such as the turbot, the sole, the plaice, &c., are captured by its means. I have used a net of this character of smaller size than that described, for several seasons, to great advantage in collecting specimens for investigation; but, with the exception of one constructed for my use and one used by Dr. Stimpson and Mr. Blatchford in Florida, I am unaware of others having been placed in American waters. It is possible that the unpopularity of the flat-fish in America may be the cause of this state of things, as the flounders and skates that are taken in so great quantity by this means are not marketable, or in very small numbers only.

A net known as the "casting-net" is in extensive use in the West Indies, Florida, and elsewhere on the southern coast. This consists of a circle of netting, varying in diameter from four feet to fifteen or more, to the circumference of which are attached, at short intervals, leaden weights. There is a central opening in the net, usually constituted by a ferrule of bone or metal. One end of a long rope passes through this ferrule, and to it are attached numerous cords extending to the lead-rope. The net is used by gathering up the casting-rope in a coil on one arm, and taking the net itself on the other. By a dexterous fling of the arm containing the net, this is thrown in such a way as to spread out completely, and it is sometimes hurled to a distance of many feet, so as to fall perfectly flat on the surface of the water. The leads sink immediately, forming a circular inclosure, and imprisoning any fish that happen to be under it at the time. The rope is then hauled in from the other end, causing the entire circumference to pucker inwardly, and the leads and puckered portion come together in a compact mass, in which the fish are entangled. Much skill is of course required for success in the use of this net; but it is very efficient in taking such fish as the mullet, which, when captured with the common seine, will leap over the cork-line with the greatest ease and escape.

TRAPS, WEIRS, POUNDS, AND FYKES.

In the United States by far the greatest weight of summer market-fish, with the exception, perhaps, of the cod, shad, and menhaden, is taken in the more elaborate constructions, variously known as traps, pounds, heart nets, weirs, &c. These may consist entirely of netting, of brush or of laths, or a combination of two or more of these materials, the construction, in form and material, varying in different parts of our sea-coast or of the great lakes. The apparatus constructed of nets is used principally on the south side of New England and on the lakes, and in its simplest form, is as described by Mr. Southwick on page 10, accompanied by a diagram. The trap-net proper (Fig. 3) is peculiar to the waters of Rhode Island, especially the Seaconnet River, and is illustrated in the accompanying figure, as well as by that on page 10. The following account of this trap, and the mode of using it, I owe to Mr. Southwick.

Fig. 3.

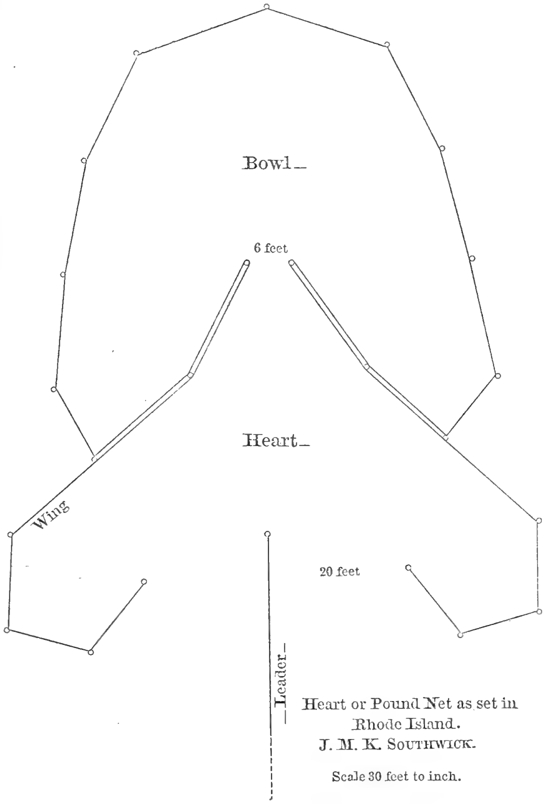


NEWPORT, *November* 20, 1871.

DEAR SIR: A trap, or "square trap" as sometimes called, is simply an oblong square box of netting, open at the inshore and above ends, to one edge of which is attached a leader running toward or on the shore, where it is fastened by an anchor or to some object. The lower edge of the leader is kept on the bottom by a chain or stones lashed to it, and the upper edge of both leader and trap is floated by corks, and all kept in place by anchors attached by cables to the upper corners. There are no poles driven into the sea-bottom, as in the heart-seine. The netting, therefore, has a certain amount of swing with the tide.

The mouth of the trap (or upper end) is kept for the time on the bottom by leads strung on a line and seized to the line run through the meshes that passes across the bottom, up the end of the side opposite the leader, and thence away around the trap, to which is seized the cork-line. This line also runs across the top of the open end to prevent the trap from spreading. And here are two buoys of corks, with lines running to the bottom and attached to the lead-line, one of which is caught by each boat, and the bottom of the trap pulled up to the gunwale, when the setting is caught by the men and distributed among them, each holding as much as he can handle, and keeping a sharp lookout that no opening be left for the fish to pass by them. The netting is now overhauled, and passes under the boats and to the bottom while the fish are being bunted into the corner where the pound is attached. When they are crowded hard, and a good bunch of them, they will sink the corks, otherwise an oar is used to sink the corks, and they pass over into the pound or pocket. Any remaining seine is thrown from the boats, and by sinking the corks at the most convenient spot, with a scoop-net or oar, the boats go out of the trap, and are ready to try the same thing over again, and so on until the tide is too strong for them; when they go ashore to eat and sleep, or wait for another tide, that must be fished in the same way, come when it will, midnight or daylight. When fish are running, the traps are bunted five or six times each tide. It takes six good men to bunt, and another good man to cook for them. These traps are set the 1st of May and taken up about the 25th. They catch almost wholly scup and sea-bass, but comparatively few other fish.

Fig. 4.



Heart or Pound Net as set in Rhode Island.
J. M. K. SOUTHWICK.
Scale 30 feet to inch.

To give some idea of the proportion, I will give the following rough estimate of the catch to one trap: Scup, 1,500 barrels; sea-bass, 2,500 barrels; flat-fish, 1,000 barrels; tautog, 500 barrels; bass, 700 barrels; mackerel, 200 barrels; menhaden, sea-robins, bellows-fish, 200 barrels.

Nineteen-twentieths of the fish are caught during the great run in five or ten days, from the 10th to the 20th of May. We have known two-thirds of the season's catch to be taken in forty-eight hours.

These traps vary from twenty to thirty fathoms in length, from five to ten in depth, and ten to fifteen in width.

Yours, truly,

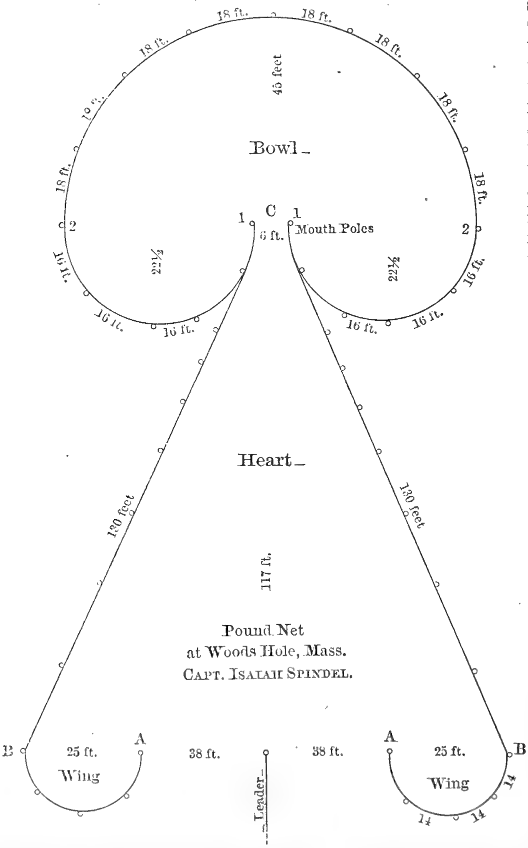
J. M. K. SOUTHWICK.

Professor BAIRD.

It will be seen that this net requires the constant supervision of the fishermen, as there is nothing to prevent the fish from swimming out after they have gone around the circuit of the inclosure. It is therefore necessary to be on the watch, so as to raise the forward part of the net in time to prevent the escape of the fish. By this precaution the fish are gradually driven back and forced into the pocket, where they are kept until needed.

The *heart-net* or *pound* consists of three parts, the *leader*, *heart*, and *bowl*, and is variously constructed, according to the fancy of the fishermen or the special conditions of the locality. Fig. 4 shows in more detail the Rhode Island pound, figured and described by Mr. Southwick on page 10. In Fig. 5 will be seen a working plan of the very efficient pound commanded by Captain Spindel at Wood's Hole, the construction and management of which will be readily comprehended from the following directions supplied by him. This class of net does not require the constant watchfulness of the managers, as the fish, once in, usually remain until taken out. This is done once or even twice a day.

Fig. 5.



First set mouth-poles, 1 and 1, six feet apart; then from center, C, run a line forty-five feet long to 2 and set stake or pole, and the same to 3 and set pole, which will bring those four poles in range; then from center, C, sweep around the circle with this forty-five-feet line and set the poles about eighteen feet apart, until you come to 2; then from center of 1 and 2 fasten line twenty-two and a half feet long, and sweep the quarter circle, setting the poles about sixteen feet apart. A little judgment must be used in setting these poles, as it is not a true circle. Finish the other quarter circle in same way, and you will have the bowl poles set.

We set the bowl poles in circle, five feet larger than the bowl, and anchor each pole.

To set heart pieces, fasten line to mouth of bowl at C, and run straight line one hundred and seventeen feet and set a pole for leader; fasten line now to this pole, and measure off thirty-eight feet and set heart pole, A; then measure, say twenty-five feet, to B, and set pole; and from this pole set a straight line of poles, about twenty-five feet apart, to mouth-pole 1. Have the wing about twenty-seven feet deep, with three poles.

We have only one row of poles to bowl, and are set five feet larger than the bowl, so that the netting can be drawn out taut, both at the bottom and top, but not necessarily close to the poles. Each pole is guyed with anchor. Our leader is two hundred and sixty-five yards long, the poles being set about twenty feet apart.

ISAIAH SPINDEL.

The next figure represents another form of this pound, as erected at Quissett Harbor by Captain Rogers, of Noank, Connecticut, and party, consisting of four brothers. This is somewhat smaller than the other, and is more easily taken off or put on the poles. We are indebted to the captain for the following account of his apparatus. We may premise, however, that the length of the leader varies with the locality, the object generally being to carry the bowl into water of from three to five fathoms in depth. This, in some cases, will be accomplished with a leader of one hundred and fifty yards, while, again, five hundred will be needed.

NOANK, CONNECTICUT, *December* 4, 1871.

DEAR SIR: I do not know whether I can give you a satisfactory account of the construction of my pound, but I will, at any rate, try to do so. The leaders are fastened upon the poles, beginning at the off-shore pole, stretching the top rope from one pole to the other, drawing it tight, fastening or seizing to every pole. The bottom rope of the leader is hauled down by ropes that are rove through every pole, close to the bottom, keeping the leader down without the use of chains, and the same throughout the whole gear, as you see by the drawing.

A center line runs round the bowl, marked on the net half way from the top to bottom, and is fastened to rings which slip up and down the poles when we haul and set the pounds, which keeps the net close to the poles, giving room inside the bowl.

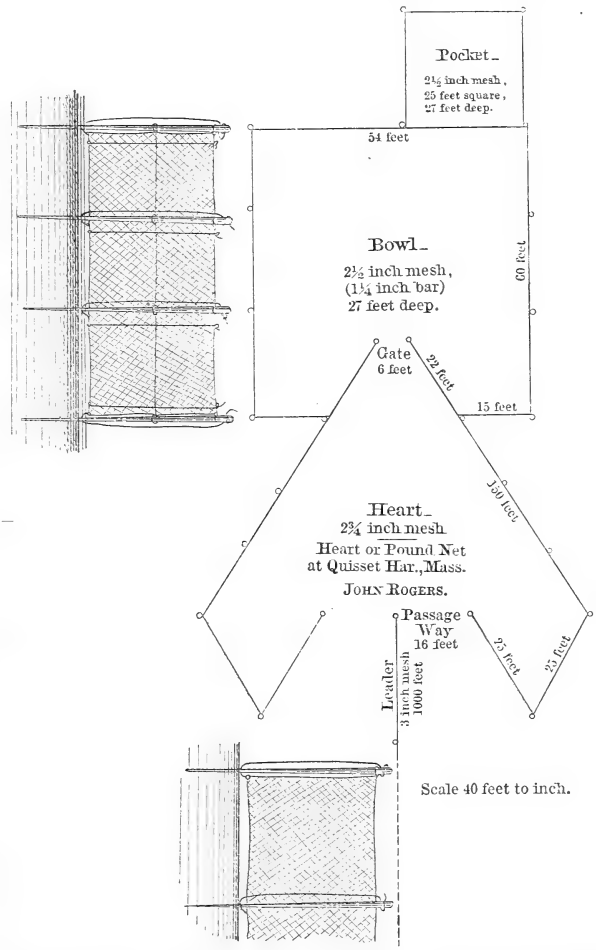
The door that opens from the "heart" into the pound is six feet wide, extending from the top rope of the bowl to the very bottom, like a gate-way.

The passage-way that runs from the leader into the heart, is sixteen feet wide on each side of the leader, extending from top to bottom.

The poles on the leader are driven at different distances, beginning at the off-shore end twenty-six feet, and varying up to forty feet apart. Poles on the heart and bowl are also driven at different distances apart, according to the shape of the net.

When we lift the pound we begin at the door, untying the ropes that hold the bowl to the bottom, pulling on the ropes that lift the bowl, following from one pole to the other round to the back, there being a haul-down rope and a lift-up rope to every pole that is attached to the bowl, which raises the whole bottom to the surface, the fish swimming ahead into the back of the bowl, and one or more boats going inside of the bowl and pursing up that part of the net, bring the fish into close compact.

Fig. 6.



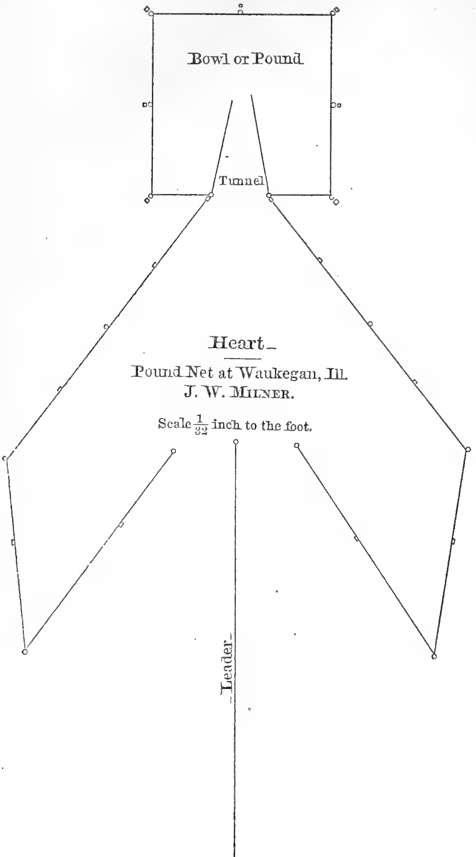
Yours, truly,

JOHN ROGERS.

Professor BAIRD.

A still more complicated arrangement of a heart-pound is that in use in Lake Michigan, and elsewhere in the great lakes, and preferred as by far the most efficient of all, as there is much less chance of the escape of the fish when once in the bowl. For the description and illustrations of this (Figs. 7 to 12) I am indebted to Mr. James W. Milner.

Fig. 7.



The pound-nets are commonly made of 20-thread soft laid seine-twine, netted by hand or woven by machinery, and well saturated with tar. They have several parts, termed the "leader," the "heart," the "pot," "bowl," or "crib," and the "tunnel."

The Leader, (Fig. 7.)—The leader is merely a net fence that guides the fishes, in their attempt to get around it, into the heart.

Small piles, of six or seven inches diameter, are driven into the lake-bottom, until about two feet only stand above the surface. The piles

Fig. 8.

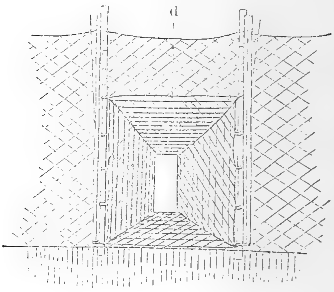


Fig. 9.

extend in a row, four rods apart, for a length of from sixty to two hundred rods, generally beginning near the shore, and extending directly out into the lake, but often started where there are favorable shoals, as far as four, and once even six miles from the shore. Upon these piles a net is stretched, extending from the top of the water to the bottom. The leader is made in pieces, ten rods in length. The top of the net is secured to the pile by a short rope, and weights are attached to the bottom, stones weighing from fifty to seventy-five pounds, every two rods. The mesh of the leader is $4\frac{1}{2}$ inches.

The Heart, (Figure 7.)—The shape of its outline gives this part of the net its name. Each side of the heart is a net, eight rods in length, set close to the lake-bottom, and reaching above the water two feet. The shore ends are secured to piles, driven each ten feet from the last pile of the leader, leaving an opening or entrance ten feet wide, on each side of the leader, through which the fish pass. The net is carried round inside of piles, arranged in the outline of the sides of a heart, until the outer ends approach each other to within ten feet, the width of the tunnel. These ends are tied fast to scantling, (*b*, fig. 11) and the scantlings are fastened snugly to the piles on each side of the tunnel-opening. The lower end of each scantling has attached an iron ring, which is put over the upper end of the pile and slid down to the bottom, while the upper end of the scantling is lashed to the head of the pile. There are three other piles on each side, besides those at the ends. The net is secured at the top by guys, three feet long, and the bottom is weighted with stones, the same as the leader, opposite and between the piles. The mesh of the heart is usually $3\frac{1}{2}$ to 4 inches, extension measure.

The Pot, Bowl, or Crib, (Fig. 7.)—The pot is in the shape of a room, having four walls and a floor. It is thirty feet square, and, in height, extends from the bottom to three feet above the surface. In the middle of the side next the heart is an opening ten feet wide and sixteen feet high, beginning at the bottom, in which is placed the tunnel. A pile is driven on the outside, at each corner, and one in the middle, on three sides, while on the heart side there are two, ten feet apart and ten feet from the corners. To all the piles, but the two mentioned, the net is made fast at the top by three-feet guys; at the bottom of each pile is sunk a stone of from seventy-five to eighty pounds' weight, and on the top of the stone is lashed a bull's-eye, (Fig. 10, *f.*) A rope tied to the bottom of the net, opposite the stone, is rove through the bull's-eye and passes upward to the top of the pile, where the end is made fast, leaving plenty of slack. When the net is set, the ropes are hauled taut and secured by half-hitches to a pin driven into the top of the pile, which serves also to coil up the slack. The mesh of the pot is from one and a half to three and one-quarter inches.

Fig. 11.

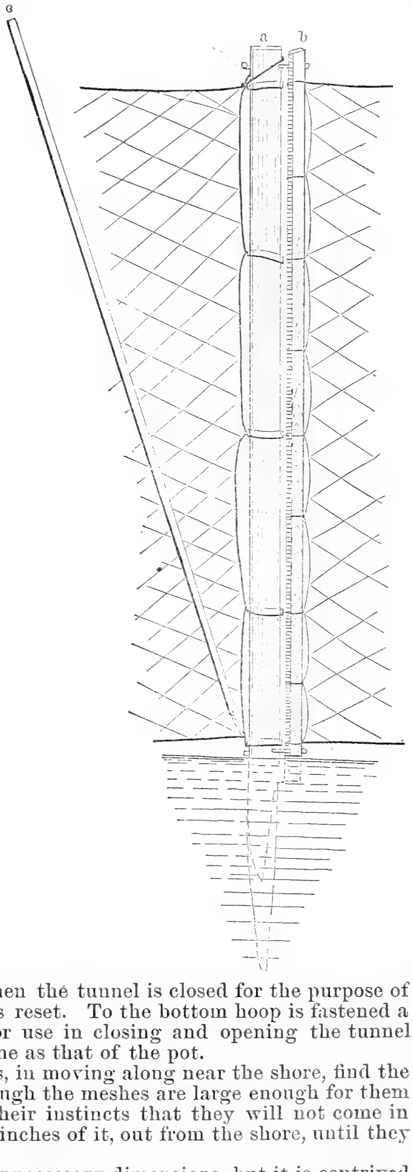
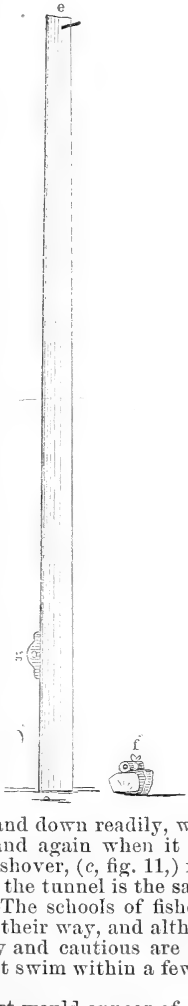


Fig. 10.



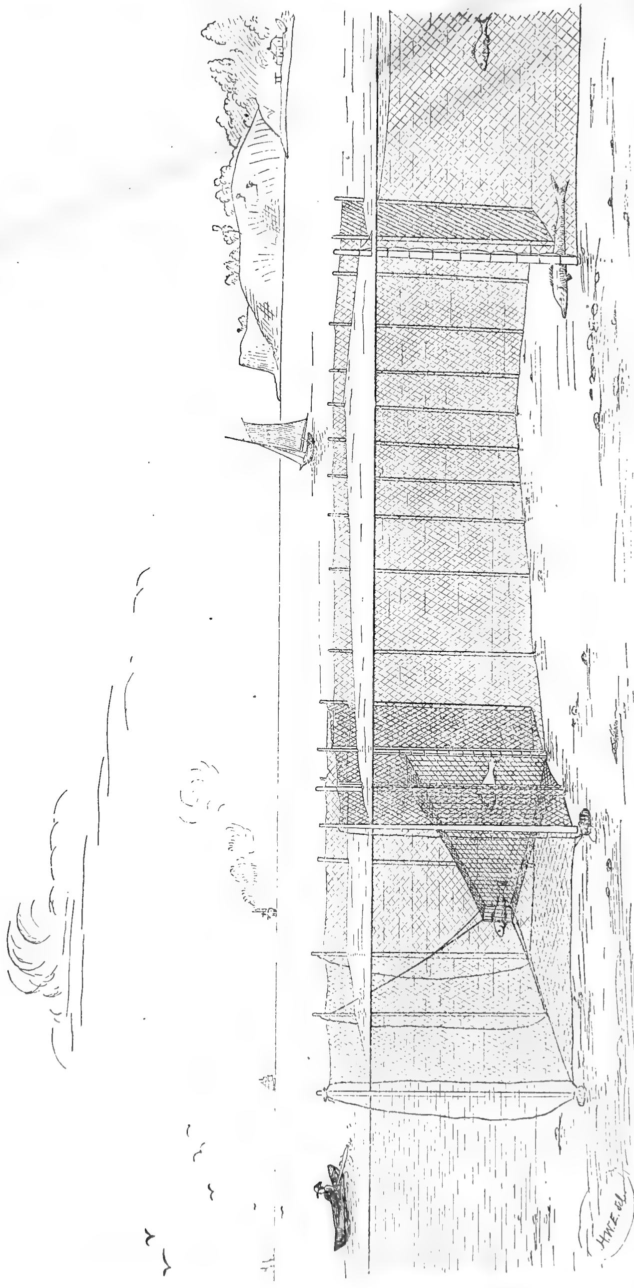
The Tunnel, (Figs. 7, 8.)—The tunnel is a netting, shaped something like a truncated cone. Its longer end is fitted and laced into the sides of the opening (*d*, fig. 8) in the heart side of the pot. The smaller end projects into the pot about sixteen feet and narrows to its outlet, an opening two and one-half feet by six, (*h*, fig. 9.) Short sticks are attached to the upper and lower sides of the outlet, having small bridles to which lines are made fast. The lower one is rove through a hole in a cleat (*g*, fig. 10) nailed to the side of the middle pile, opposite the tunnel outlet, and at five feet from the bottom, and from there passes upward to the top of the pile, where the end is made fast, leaving plenty of slack. The upper line passes directly to the top of the pile. When hauled taut they keep the tunnel standing open, for the free passage of the fish.

In the sides of the tunnel entrance are fastened hoops, five on each side. These hoops are put over the top of the adjacent piles, and allow the net to slide up and down readily, when the tunnel is closed for the purpose of taking out the fishes, and again when it is reset. To the bottom hoop is fastened a slender pole, called the shover, (*c*, fig. 11,) for use in closing and opening the tunnel entrance. The mesh of the tunnel is the same as that of the pot.

How the fishes get in.—The schools of fishes, in moving along near the shore, find the long leader obstructing their way, and although the meshes are large enough for them to pass through, so wary and cautious are their instincts that they will not come in contact with the net, but swim within a few inches of it, out from the shore, until they enter the heart.

At first sight the heart would appear of unnecessary dimensions, but it is contrived in accordance with a knowledge of the habits of the fish, which are not inclined to turn at short angles, but prefer a course of straight lines or long curves. If the passage to the tunnel is narrow and contracted, a fish becoming alarmed is much more apt to turn short round and pass out at the opening it has just entered. In the large heart they are quite as apt to dart through the tunnel as to escape through the shoreward openings.

Fig. 12.



Like many other gregarious animals, the white-fish and lake herring will flock in behind a leader, just as sheep will through a gate. Once in the pot, they are not apt to find the small opening at the outlet of the tunnel, but swim around the sides, and, after a time, becoming familiar with the net, or crowded against the sides by the numbers within the pot, many attempt to pass through the meshes, the smaller ones escaping, and a few larger, becoming gilled, die. Still, no frantic effort at escape is made until the net is lifted.

Taking out the fishes.—In taking them out a boat is sent round, and the ropes staying the bottom of the pound, and the tunnel-guys, are all cast loose. The boat is now brought inside of the pot, the "shovers" are drawn up, closing the entrance to the tunnel, and the end of the tunnel is pulled up and thrown back over the side of the pot. The bottom of the net is raised by pulling up the tunnel side, until it is reached; it is then tripped along under the boat until the fishes are gathered into a corner, like shaking wheat into the middle of a sheet, when they are thrown into the boat with a scoop-net.

The stakes on which pound netting is fastened are usually driven into place by means of a pile-driver, and are never left down throughout the winter on account of their almost certain destruction by storms and floating ice. They are piled up in the autumn and stored for use in the coming season. Sometimes they are set in large stones, about four feet square, and simply set on the bottom. This method is used on Prince Edward's Island, as in the pound of Mr. J. C. Hall of Charlottetown.

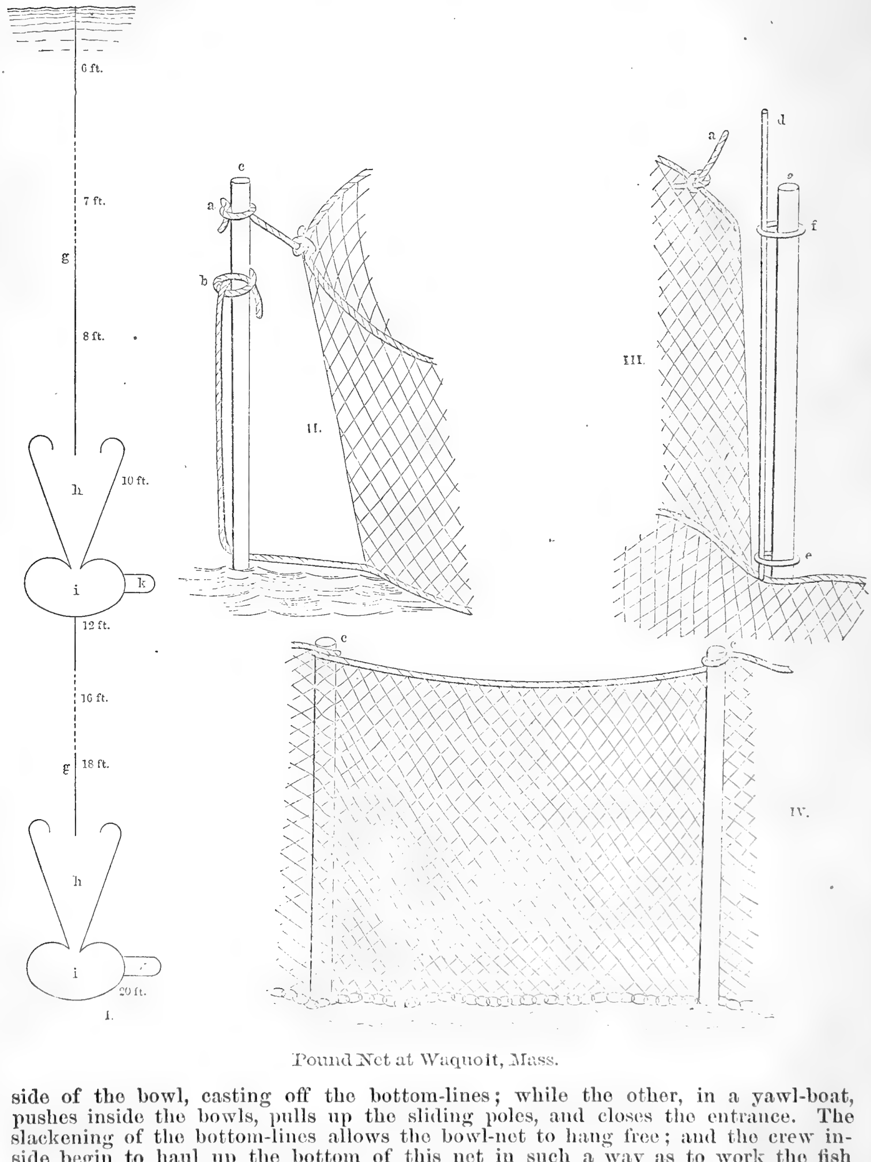
Not unfrequently the heart-pounds are so arranged that a second leader is started in a line with the first, running out from the outer side of the bowl to a given distance, and another heart and bowl attached, so as to cover a much larger portion of the channel-way. This is seen in the pound at Waquoit, Massachusetts, for a lucid description of which, with accompanying illustrations, I am indebted to the report of Theodore Lyman.

A pound or weir is an old and singular contrivance, whose success depends upon the fatal principle of fishes never to turn a sharp corner. A place is chosen where it is known that large schools are accustomed to coast along, parallel with the shore, and there a barrier is run out in a straight line. This barrier is called the "leader," and may be a stone wall, a fence of laths or of brush, or a net stretched on poles. At the end of this leader, and like a spear-head on its handle, is constructed a heart-shaped inclosure or "pound" (or "heart") having a narrow opening, on either side, next the point of the leader. On its off-shore end this heart again opens into a circular inclosure called the "bowl." A school coasting along shore is suddenly stopped by the leader, and immediately the fish turn toward deep water, and, swimming parallel with the barrier, pass into the heart, whence there is no escape save by a sharp backward turn, which, as before stated, is against their principle. Therefore they swim round and round and pass into the bowl, where they are left by the tide, or, if the bowl be in deep water, they are hauled up by a net-bottom.

The Waquoit weir is made like many of the same sort. About the middle of March, if the weather permits, the men begin to set the poles which are to support the "lint" as the netting is called. First a row of stout poles, or rather posts, running straight out, is firmly set by a floating pile-driver. The poles stand fifteen feet apart, and run directly seaward for seven hundred and fifty feet, to make the first "leader," (Fig. 13, I, *g*,) which here stops short at the mouth of the "heart," *h*, whose outline is marked out by the same kind of poles set nearer together, or about ten feet apart. The entrance to the heart is twenty-five feet wide on each side of the leader, or fifty wide in the whole; but it converges strongly toward its outer apex, so that the entrance to the "bowl" is only seven feet wide. This bowl, *i*, is marked out, like the heart, with poles set somewhat close together. Moreover, from its east side projects a sort of lobe, eighteen feet wide and thirty-six long, *k*, indicated by the five poles which are to support this "pocket" wherein fish may be kept alive. From the outer point of the bowl another row of leader-poles is driven, running seaward four hundred and fifty feet; and, at its extremity, posts are driven for the second heart, bowl and pocket, like the first. Then the lint is carried out in boats and hung on the leader-posts. It is composed of a pretty strong net, with a mesh of two and a half to three inches. Along its foot, where are placed the leads of a seine, there is made fast a chain; while along its upper edge runs an inch rope, (*i. e.*, an inch in circumference.) As the net is passed on alternate sides of the succeeding poles, a round turn is taken with the rope to hold it in place, while the chain, sinking to the bottom, maintains the lint in an upright position and closes the spaces between the poles, (13, IV.) The heart is hung with lint in the same way, but the bowl must be differently treated, for the bowl-net has a bottom as well as sides. It is in fact a great bag, forty feet long, eighty wide, and fifteen or twenty deep, and is hung in an oval of poles, fifty feet long and one hundred wide. For this purpose a one and a quarter inch rope runs, like a binding, entirely around the upper edge of the bowl-net, (Fig. II,) and opposite each pole there is made fast to this rope a head-line (13, II, *a*) whose other end is attached to the pole. These head-lines suspend the bowl-net, which cannot, however, be held down by chains or weights, because these would make it too heavy to handle when the weir is "hauled." Therefore there are bottom-lines (13. II, *b*) corresponding to the head-lines, except that they are attached to the lower edge of the bowl-net, whence they pass through a hole in the pole, are brought to the surface of the water, and are there made fast. When, now, the head-lines and bottom-lines are hauled taut and made fast, the bowl-net must be firmly set in position, namely, projecting about five feet above the water, and extending thence nearly or quite to the bottom. It remains only to show how the fish are admitted to the bowl and how the fatal door is closed on them. On either side of the entrance to the bowl stands a post, (13, III, *c*,) and, beside it, a long, slender pole (13, III, *d*) attached by rings (13, III, *f e*) to the post, but free to run up and down. The lower end of the pole is tied to the lower part of the bowl-net, and by pushing the pole down till it touches bottom, the net is held firmly down; and a gap being left in the side of the net at this point, a free entrance is made for the fish. This entrance is closed by pulling up the sliding poles till they bring the net to the surface of the water.

The weir is "hauled" once a day, and always at slack water, because with a strong tide, running east or west, it is impossible to handle the bottom-lines. The men pull out in two parties; of which one, in a large scow, passes round the out-

Fig. 13.



Pound Net at Waquoit, Mass.

side of the bowl, casting off the bottom-lines; while the other, in a yawl-boat, pushes inside the bowls, pulls up the sliding poles, and closes the entrance. The slackening of the bottom-lines allows the bowl-net to hang free; and the crew inside begin to haul up the bottom of this net in such a way as to work the fish toward one corner, letting the net, as it comes to the surface, pass under their boat, which is thus slowly drawn across the bowl toward the corner where the capture is to take place, and where the scow is already waiting outside.

An arrangement, different in construction, but on the same general principle, largely in use from New York to New London, consists of what is called a fyke-net, as shown in the accompanying sketch, (Fig. 14:)

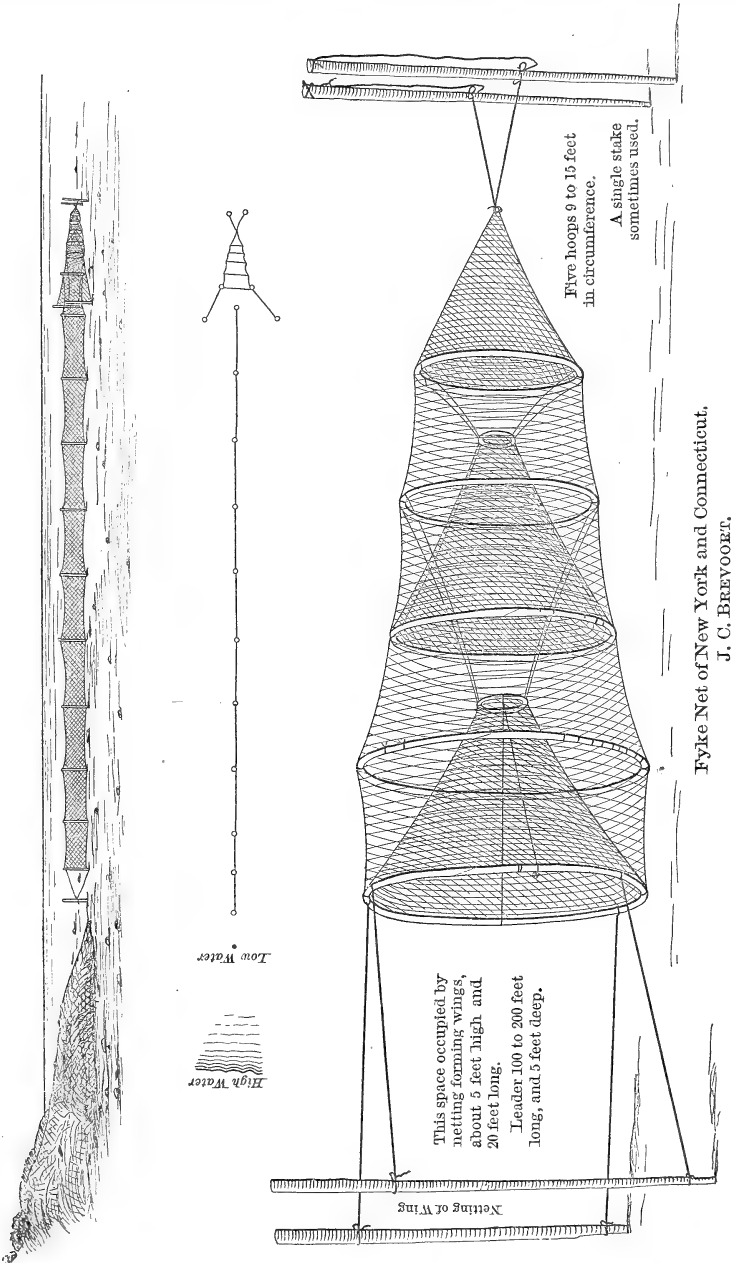


Fig. 14.

Fyke Net of New York and Connecticut.
J. C. BREVOORT.

This is essentially a leader, of any length, ending between the extended arms of a fyke-net, which is nothing more than the ordinary set-net of the rivers. The fish, in their movements, strike against the leader, are led unconsciously to this net and trapped, from which they cannot escape.

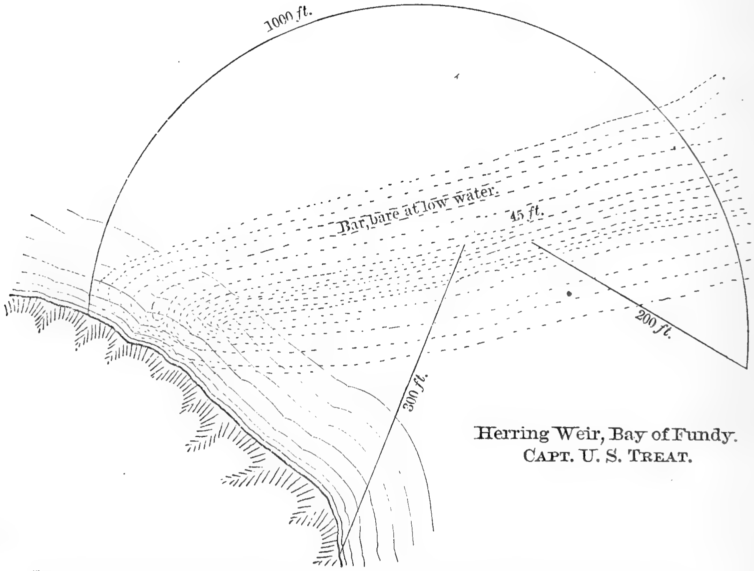
All these various forms of heart-pounds are so arranged as to take fish from either side, whether with the ebb or the flood, although it is perhaps more common for the fish to run along the shores in the ebb of the tide rather than the flood.

As we pass to the north of Cape Cod a different form of fixed apparatus comes into use, these generally the weir proper, which is commonly constructed of brush, and usually takes the fish at low tide, either leaving them inclosed in a small basin, from which they are seined, or causing them to be stranded on the bottom, where they are picked up.

The simplest form of a brush-weir consists of a mere fence of brush driven into the sand or mud, to prevent its floating away, and forming a curve concave to the ebb of the tide. As the water runs off, becoming more and more shallow, the fish which happen to be inside of the inclosure of this brush fence are detained, and left, when the water has run off, to be captured at leisure. For this arrangement no leader is required.

The ordinary construction of weirs for taking herring is seen in Fig. 15, illustrating one now in successful use by Captain U. S. Treat of Eastport.

Fig. 15.



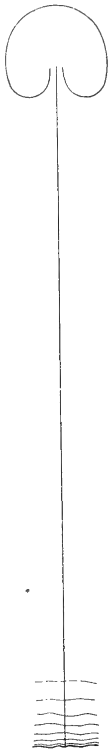
Built of piling and brush up to low water mark, netting of cotton twine above. At low water the fish are seined and dipped into boats. At low water there is 18 ft. of water between the bar and the weir.

Into this the fish enter at high tide, through a narrow opening, and if the number of fish noticed as having come in is considerable, a gate of netting, suspended over the narrow entrance, is dropped, and the escape of the fish is cut off. As the tide falls the fish are gathered into the basin in the weir, from which they are drawn into a narrower space by means of the seine, and either hauled out to the shore or dipped out into boats by means of large dip-nets. As many as from one hundred and fifty to two hundred and fifty hogsheads of herring are frequently captured in this way in a single tide.

The fish usually enter in high water, either late in the evening or early in the morning, and when low water occurs between these periods few or no fish are taken.

At Eastport the weirs on the Campobello shore, as well as those at Grand Manan, take most fish when high water occurs in the evening, rendering it necessary to take out the herring about midnight, or a little later. At Captain Treat's weir and others adjacent to it, however, the best time for taking out the fish is usually from five or six o'clock in the morning until ten, a much more convenient arrangement.

Fig. 16.



South side lower St. Lawrence. Herring Weir. J. C. BREVOORT.

The variety of weirs in use in the vicinity of Eastport, and about Campobello and the island of Grand Manan, is very great, and the number in use, as well as the quantity of herring captured in them, is almost incredible.

This form of weir does not involve the use of a leader, and can be used to advantage only where the tide is very high and the shores especially adapted to them. Weirs with leaders are used more frequently where there is a long extent of shallow water, which is bare at low tide. A simple form of this leader is given in Fig. 16, kindly furnished by Mr. J. C. Brevoort, as used on the south side of the St. Lawrence River, from Quebec to near its mouth. Here the leader may be of indefinite length, (sometimes one thousand feet and over,) ending in either a bowl or a circle. The whole is constructed of stakes or osiers, or both. Sometimes a second leader, with its second bowl, is placed exterior to and in continuation of the first. This form of leader of a weir is the simplest of all, and the one more generally used in England, where our more complicated and more efficient arrangements appear not to be known.

This fact must be borne in mind in considering the decision of the British commission in reference to the amount of influence that such apparatus could exercise upon the fish supply, of which commission Professor Huxley was a member, to the effect that such apparatus exercised very little influence upon the persistence of the fish supply.

Weirs as used in Cape Cod are somewhat differently constructed, as they consist in large part of slats or boards. The figure and following description have been furnished by Captain Prince Crowell:

EAST DENNIS, MASSACHUSETTS, *December* 2, 1871.

DEAR SIR: The weirs on the north side of the cape are what are called dry weirs; they are set on the flats where the tide ebbs off and leaves them dry, at which time the fish are taken out. The flats extend from one-half to one mile from high-water mark; from six to eight feet water over them at high water.

The leaders and heart are constructed by nailing laths upon small poles worked into the sand, with a peg through the pole (when worked down) just under the surface of the sand, on which boards are placed, then stone ballast to keep them from working up, and the first and second pound-seines are usually used, the poles being fixed down the same as the heart and leader, although some are made of all laths. Some have only one pound instead of two. There are about fifteen of these weirs between Yarmouth and Provincetown. I know of no other kind. I inclose a little diagram, (Fig. 17,) without being drawn to any particular scale, and hope it will be intelligible.

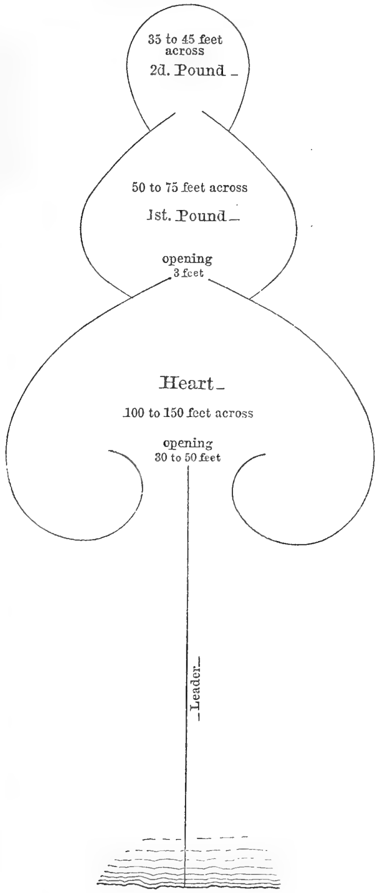
Yours, truly,

P. S. CROWELL.

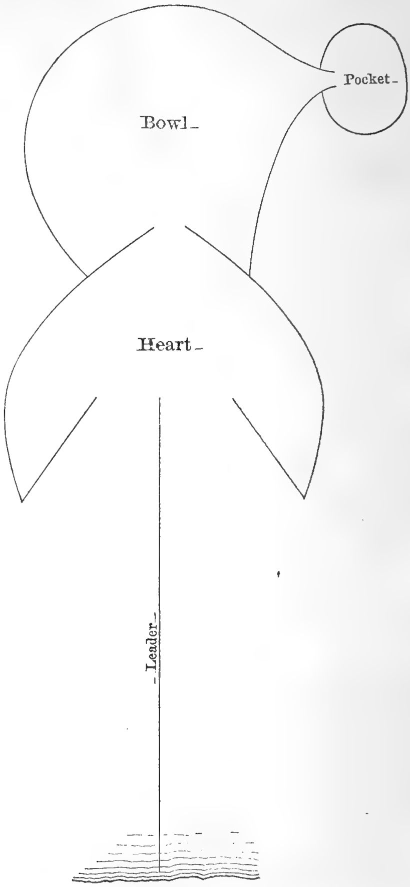
A modification of the heart-pound is largely used in the bays and mouths of the rivers of Maine and the provinces, for the capture of salmon, as illustrated in Fig. 18.

Here the leader is generally made of brush, up to the height of half-tide, and of netting the rest of the way. The heart is made of either brush or netting, and sometimes of slats. The bowl, instead of being placed at the outside of the heart, in a line with the leader, is placed either in the upper or lower side,

Fig. 17.



Slat Weir East Dennis, Mass. Bay.
CAPT. PRINCE CROWELL.



Brush Weir.
Deep Water Weir for taking Salmon, Shad &c: built into 18 to 20 feet of water. The pocket has a board floor, laid so that it is dry at low water for convenience of taking the fish.

according to the nature of the coast, in some localities the efficiency being greater in the one case, while it is reversed in the other. The bowl may consist of netting or of slats, and the two forms are illustrated in the accompanying figures.

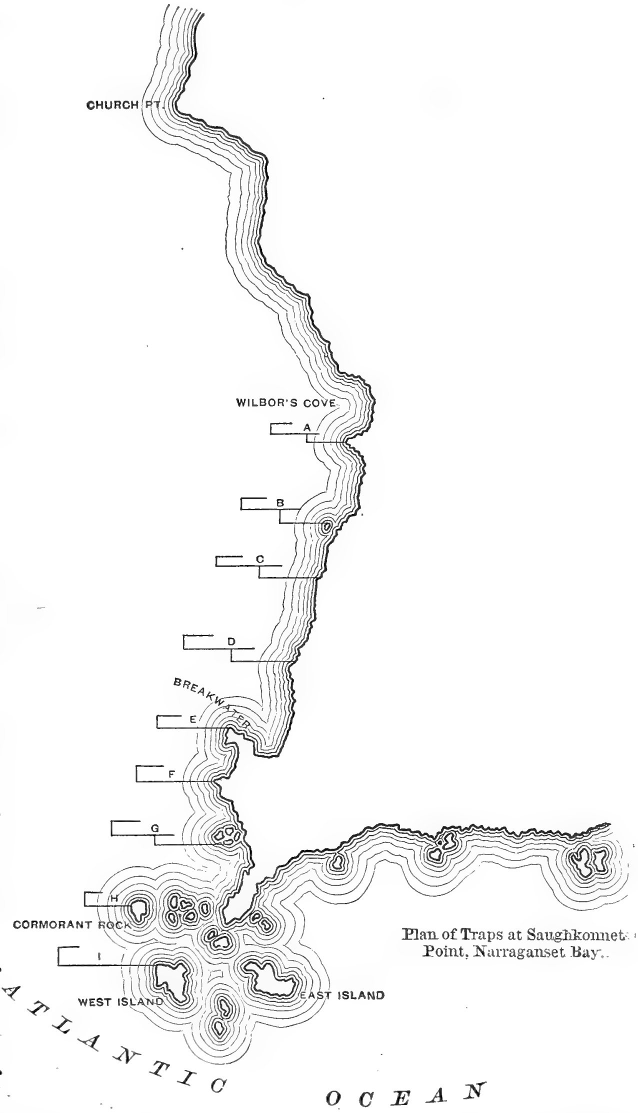
An ingenious apparatus, according to Perley, called the "spring-weir," is made use of in certain parts of the bay, where there is a very narrow entrance to a harbor, easily capable of being closed. This is so arranged as to drop flat to the bottom at low water, and allow the fish to pass over it with the incoming tide. At high water this is lifted up and worked from the shore by means of powerful capstans and ropes, forming an impassable barrier to the fish, which are retained as the tide passes out, and taken in large numbers, including shad, herring, salmon, &c.

LOCATION OF TRAPS, WEIRS, AND POUNDS, IN THE UNITED STATES.

I have thus indicated briefly the principal devices by which fishes are captured in the United States,[1] without attempting to represent all the individual modifications. The variety in the construction of traps, weirs, and pounds, is almost endless, depending very much upon the exposure, the nature of the bottom, the depth of water, the currents, the kind of fish to be taken, &c. I have given enough to illustrate the extent to which the simpler devices of the spear, the bow and arrow, and the hook, have been replaced by apparatus for a more wholesale destruction.

As already remarked, the sea-coast weirs or pounds are used almost exclusively east of Connecticut, although fixed nets are in operation in or near the rivers of that State as well as of New York, principally for the capture of shad. The accompanying diagram (Fig. 19) is a plan of the traps at Seaconnet Point, on the eastern side of Narraganset Bay, as furnished by Mr. Southwick, and the details of which are given on page 260. In the large map of the south side of New England, accom-

Fig. 19.



Plan of Traps at Saughkonnet Point, Narraganset Bay.

[1] I am indebted to Dr. H. C. Yarrow for the account of an ingenious method employed in New York Harbor for trapping the *Morrhua pruinosa*, ("Tom-cod,") and which does not come under any of the classes of fishing referred to in the preceding pages.

A sufficient quantity of good rye or wheat straw is gathered into a sheaf and firmly panying this report, the location of the principal traps and pounds in 1871 is indicated. The weirs of Cape Cod Bay are represented on a separate diagram, forming Plate XXXIX of the accompanying illustrations.

Finally, for the purpose of illustrating the subject of fish-pounds in the lakes, I give on the following page (Fig. 20) a diagram of the pound-nets erected and worked in 1871 in Lake Michigan, the nets being indicated by the short lines drawn perpendicular to the shore-line, in the water surface. A full account of the lake fisheries will be given in the report for 1872.

---

tied in the middle; after being weighted with bricks or iron the ends of the sheaf are loosely tied; a rope is attached and the bundle lowered to the bottom of the water, where it is allowed to remain for a few days, until the fish become accustomed to its presence, after which it may be examined once or twice daily. In good localities the straw in the interstices will be literally crammed with fish. Whether they enter the straw for its warmth or for the friction received in their efforts I am unable to state.

The most suitable localities for setting the trap are near wharves or rafts of timber.

XVI.—LIST OF PATENTS GRANTED BY THE UNITED STATES TO THE END OF 1872, FOR INVENTIONS CONNECTED WITH THE CAPTURE, UTILIZATION, OR CULTIVATION OF FISHES AND MARINE INVERTEBRATES.

1. HOOKS.

Date of patent.	Number.	Inventor.	Subject of invention.
July 28, 1846	....	Englebrecht & Skiff	Spring-hook. When fish pulls on bearded hook, a catch slips holding the spring-hook, which, being let loose, strikes the fish and holds him until taken off by the angler.
Aug. 21, 1847	....	Staunton Pendleton	Spring-hook.
Aug. 21, 1847	....	Job Johnson	Spring-hook.
Aug. 15, 1848	....	Ellis & Gritty	Spring-hook. When fish pulls on the bearded hook, it slips the spring-hook, which strikes and holds the fish fast.
Aug. 15, 1848	....	W. P. Blake	Spring-hook. When fish pulls on bait, it springs open, holding the jaws of the fish apart.
Sept. 5, 1848	....	W. Jenks	Spring-hook.
Mar. 20, 1849	6,207	Job Johnson	Spring-hook; twenty-one different kinds of hook and method of attachment.
Oct. 8, 1850	7,709	Warner & Gaylord	Spring-hook.
April 6, 1852	8,853	Julio T. Buels	Trolling-hook.
April 11, 1854	10,771	......do	Spring-hook.
April 11, 1854	10,761	Henry Siglers	Combination spring-hook.
Jan. 19, 1855	13,081	Richard F. Cook	Spring-hook.
Jan. 19, 1855	13,068	Charles De Saxe	Trolling-hook. Has a spring shield that covers the point of the hook when fishing among weeds.
Oct. 9, 1855	13,649	Job Johnson	Spring-hook.
April 22, 1856	14,706	Julio T. Buels	Fly or trolling hook.
July 14, 1857	17,803	Donald McLean	Self-setting trap-hook.
Sept. 20, 1859	25,507	Riley Haskels	Trolling-hook.
Feb. 12, 1861	31,396	W. L. Morris	Spring-hook. When the line is pulled, a catch slips off the ends or levers of the hook, and a spring draws the bearded points together into the fish.
Sept. 20, 1864	44,368	N. A. Gardner	Spring-hook. Two bearded hooks, forming part of a coil-wire spring with eyes, and rod heaving a line-eye for setting and releasing the hooks.
Nov. 7, 1865	50,799	Germond Crandell	Combination double-lever hook.
Dec. 19, 1865	51,651	Davis & Johnson	Spring-hook.
Nov. 20, 1866	59,844	Jacob King, jr	Spring-hook.
Nov. 20, 1866	59,893	C. O. Crosby	Fish-hook, (flattened in bend.)
Jan. 9, 1866	51,951	B. B. Livermore	Plain hook, with wire loop, to prevent fish from stealing the bait.
April 24, 1866	54,251	Johnson & Howarth	Spring or spear hook.
May 15, 1866	54,684	W. D. Chapman	Trolling-hook, with spring and fly, the latter easily removed.
Oct. 2, 1866	58,404	W. C. Goodwin	Plain hook; spiral spring around the hook to press the bait down to point.
Jan. 1, 1867	60,786	E. R. & J. W. Rhodes	Spring-hook.
Feb. 12, 1867	62,042	B. Lee, jr	Hook; the shank made in form of spiral spring.
Aug. 27, 1867	68,027	F. Angilard	Lever-hook, so arranged that when fish pulls at bait another hook strikes it and makes fast.
Nov. 12, 1867	70,868	A. J. Leinhart	Spring-hook.
Nov. 12, 1867	70,913	Elisha Sterling	Extension or trap hook, with two or more hooks; one on swivel to hold bait, the other to grapple the fish while pulling from the water.
Sept. 24, 1867	69,221	D. Kidders	Spring-hook. Two hooks, one on either end of piece of wire or shank; when baited they are pressed together, but will separate when the fish bites.
April 28, 1868	77,365	R. A. Fish	Hook.
June 30, 1868	79,446	J. B. Christian	Trolling-hook, with artificial bait.
July 21, 1868	80,151	A. A. Dennett	Spring-hook.
Jan. 26, 1869	86,154	Martin Heltz	Hook, with an eye to attach hook.
Sept. 14, 1869	94,893	Francis Kemlo	Lock-hook.
Sept. 14, 1869	94,894	......do	Lock-hook.
Sept. 14, 1869	94,895	......do	Grapple-hook, with guard to prevent fish from getting loose from barb.

List of patents granted by the United States, &c.—Continued.

HOOKS—Continued.

Date of patent.	Number.	Inventor.	Subject of invention.
Oct. 12, 1869	95, 755	F. T. Angers	Spring-hook. When set, the three hooks are close together; but when the line which is attached to the middle hook is pulled, it loosens the outer hooks, which expand in the mouth of the fish.
July 5, 1870	104, 930	W. D. Chapman	Propeller or trolling hook.
Feb. 21, 1871	111, 898	L. Arnold	Mode of attaching hook to line.
May 30, 1871	115, 434	W. D. Chapman	Propeller or trolling hook.
Aug. 8, 1871	117, 719	L. Arnold	Mode of attaching hooks to lines.
Nov. 21, 1871	121, 182	J. H. Mann	Trolling spoon-hook.
Feb. 20, 1872	123, 844	G. Sinclair	Trolling-hook.
July 16, 1872	129, 053	E. Pitcher	Hook, with double spear, to thrust down into fish when caught by hook.

2. LINES, GRAPPLES, TRAPS, &c.

Mar. 3, 1868	75, 075	D. C. Talbots	Fishing-tackle for anglers.
April 7, 1868	76, 489	T. B. McCaughans	Fish-trap.
May 12, 1868	77, 893	Joseph Koehlers	Fishing-apparatus.
Dec. 22, 1868	85, 199	E. B. Beach	Fish-trap.
Nov. 4, 1856	16, 014	Elmore Horton	Spear and grapple.
Dec. 9, 1856	16, 217	Levi Van Hossen	Fish-trap.
May 25, 1858	20, 343	Jacob Gail	Grapple.
Jan. 18, 1859	22, 644	Robert Gray	Fish-trap.
Mar. 8, 1859	23, 154	Daniel Bowmans	Fish-trap.
Aug. 2, 1864	43, 694	A. J. Leinharts	Fishing-tackle.
June 3, 1862	35, 476	T. W. Roys	Method of raising whales.
Jan. 30, 1872	123, 164	O. M. Faller	Fishing-apparatus.
Sept. 7, 1872	131, 439	Harcourt & Cottingham.	Fish and animal trap, made of wire, each wire of gate made movable.
Oct. 22, 1872	132, 476	C. Lirandais	Trap-net, used in shallow water, umbrella fashion, to lie on bottom, and having springs to close by trigger.

3. REELS.

May 26, 1838	....	Arrmah Tiffaney	Reel, for anglers' use.
July 26, 1838	....	......do	Reel or mackerel-latch, used in fishing from vessel.
Aug. 5, 1856	15, 466	John A. Baileys	Reel.
Feb. 10, 1857	16, 626	Edward Deacons	Reel.
Aug. 9, 1859	24, 987	Edward Billinghurst	Reel.
Feb. 28, 1860	27, 305	Mark S. Palmer	Reel, with guard to line to prevent it from clogging the reel.
Feb. 9, 1864	41, 494	Andrew Dougherty	Reel, with brake.
July 5, 1864	43, 460	W. H. Van Geison	Reel, with stop-attachment.
July 12, 1864	43, 485	Darwin Ellis	Reel, with stop.
July 12, 1864	43, 546	T. W. Cummings	Reel, (mode of attachment to pole,) by spring.
Aug. 29, 1865	49, 663	W. M. Stewart	Reel, set inside of rod.
June 19, 1866	55, 653	Anson Hatch	Reel, skeleton, similar to Billinghurst.
Aug. 7, 1866	56, 937	A. B. Hartils	Reel.
Nov. 26, 1867	71, 344	Julius Von Hofe	Reel.
Sept. 22, 1868	82, 377	W. H. Bradley	Reel, with two concaved disks.
Nov. 3, 1868	83, 740	J. Stetson	Clamp or reel, used for hand-line fishing.
Feb. 23, 1869	87, 188	Francis Xavier	Reel, pivoted and made to screw into rod, bridge, or stick in ground, with bell attachment.
Mar. 23, 1869	88, 026	C. S. H. Foster	Mackerel-latch.
Oct. 12, 1869	95, 839	James J. Ross	Reel.
Nov. 9, 1869	96, 652	P. A. Allmaires	Reel, set into rod.
May 31, 1870	103, 668	G. C. Sheldons	Reel, more of a kite-string holder.
Mar. 7, 1871	112, 326	E. L. Decker	Mackerel-latch.
Nov. 14, 1871	121, 020	Silas B. Terry	Reel, with friction device.
June 18, 1872	128, 137	A. H. Fowler	Reel, made of rubber skeleton.
June 14, 1873	134, 917	George Mooney	Reel, manner of attaching to rod.
June 28, 1873	135, 283	Charles L. Noe	Reel, similar to Billinghurst patent.

4. RODS.

Apr. 10, 1854	10, 795	C. Desaxe	Rod, made hollow, to contain float, lines, &c.; peculiar float.
May 20, 1862	35, 339	Julius Von Hofe	Rod; tip has a sheave or pulley on the end.
Oct. 16, 1866	58, 833	R. N. Isaacs	Tips of rods enameled to prevent wear of line.
May 18, 1858	20, 309	Underwood & Bargis	Rod, with pulley set in tip.
Oct. 4, 1859	25, 693	Henry Pritchard	Guides for lines on rods.
Dec. 24, 1867	72, 667	J. H. Montrose	Rod, hinged like parasol-handle.

List of patents granted by the United States, &c.—Continued.

RODS—Continued.

Date of patent.	Number.	Inventor.	Subject of invention.
Mar. 17, 1870	100, 895	W. J. Hubbard	Jointed rod, screwed together, to prevent slipping apart, by male and female screws.
Sept. 26, 1871	119, 251	Thomas Tout	Rod, principally of wood, with lameneal of whalebone running longitudinally.

5. FLOATS, SINKERS, AND SWIVELS.

Date of patent.	Number.	Inventor.	Subject of invention.
Dec. 12, 1854	12, 060	J. W. Heard	Sinker, made hollow to contain shot, so that it may be adjusted to required weight.
Feb. 2, 1869	86, 609	J. A. Terrell	Float, made of glass.
Feb. 8, 1870	99, 572	James Ingram	Float, with ring and plugs in ends of it, so that it may be adjusted to line without slipping over ends of line.
May 26, 1872	127, 218	Brown & Jarvis	Float, made of vulcanized rubber, for seines.
July 9, 1872	128, 885	E. Jewell	Float, for ready attachment to line, to avoid slipping over ends of line; spiral wire in either end.
Apr. 1, 1856	14, 587	Wooster Smith	Fish-hook and sinkers, used for cod-fishing.
July 7, 1863	39, 192	William Woodbury	Sinker, with spring inside for deep-sea fishing.
July 21, 1865	46, 453	E. F. Decker	Sinker, with guard-ring and swivel.
Sept. 25, 1866	58, 211	L. A. Burnham	Sinker, with lever, &c.
July 31, 1866	56, 857	J. A. Martin	Sinker, with lever, &c.
July 29, 1867	61, 625	J. A. Martin	Sinker, with lever, &c.
Dec. 10, 1867	71, 879	Martin Hiltz	Swivel, for anglers' use.
May 5, 1868	77, 628	L. D. Lothrop	Swivel, for anglers' use.
May 12, 1868	77, 774	W. H. Smith	Sinker, made in several pieces, to increase or decrease weight.
June 2, 1868	78, 546	E. F. Stacey	Nipper, or latch, to hold line.
Nov. 3, 1868	83, 681	Sewall Albee	Jig, or sinker, three pieces, and method of attaching to hook.
Dec. 15, 1868	84, 885	Leach & Hutchins	Mode of attaching hook to sinker.
Feb. 9, 1869	86, 786	F. Telgmanns	Sinker, sectional.
Aug. 3, 1869	93, 220	R. T. Osgood	Sinker, with spring and swivel, egg-shape.
Sept. 5, 1871	118, 772	H. Camp	Metallic line, with loops and reel.

6. PROJECTILES.

Date of patent.	Number.	Inventor.	Subject of invention.
July 29, 1841	2, 195	William Carseley	Spear.
Mar. 16, 1844	3, 490	Albert Moon	Harpoon; harpoon contains bottle of explosive material, which operates to throw the flukes out when it strikes.
Sept. 19, 1846	4, 764	Oliver Allen	Lance.
Nov. 24, 1846	4, 865	Holmes & West	Lance or harpoon, moveable flukes.
Dec. 3, 1846	4, 873	Charles Randall	Harpoon, moveable flukes.
Dec. 5, 1848	5, 949	Oliver Allen	Gun-harpoon.
June 4, 1850	7, 410	Robert Brown	Harpoon, mode of attaching line, } Gun-lances.
Aug. 20, 1850	7, 572	do	Harpoon lance, mode of attaching line } Gun-lances.
Sept. 3, 1850	7, 610	C. F. Brown	Harpoon.
Nov. 19, 1850	7, 777	William Albertson	Harpoon.
May 6, 1851	8, 073	Charles Burt	Exploding harpoon.
Mar. 30, 1852	8, 843	Sonnenburg & Richten	Electric whaling-apparatus.
Apr. 6, 1852	8, 862	J. D. B. Stillman	Harpoon, moveable flukes and pulleys.
June 22, 1852	9, 044	C. C. Brand	Lance for killing whales. Re-issued August, 1856.
Aug. 19, 1856	15, 577	Nathan Schofield	Expanding spiral-winged projectile.
Mar. 10, 1857	16, 819	do	Bomb-lance, with springs. Re-issued July 7, 1857.
Apr. 28, 1857	17, 173	Rufus Sibley	Bomb-lance, with moveable flukes.
May 26, 1857	17, 370	Grudehos & Eggers	Bomb-lance, with springs and moveable flukes.
May 26, 1857	17, 407	Rufus Sibley	Projectile.
May 19, 1857	17, 312	C. C. Brand	Projectile.
Oct. 20, 1857	18, 458	J. Q. Kelly	Harpoon.
Nov. 10, 1857	18, 568	H. Bates	Bomb.
Dec. 9, 1857	18, 824	N. Schofield	Projectile.
Feb. 16, 1858	19, 363	H. W. Harkness	Harpoon and lance.
Aug. 17, 1858	21, 219	Rufus Sibley	Bomb-lance.
Aug. 24, 1858	21, 278	N. Schofield	Harpoon-lance.
Nov. 2, 1858	21, 949	George Doyle	Harpoon.
Nov. 16, 1858	22, 054	A. F. & J. H. Andrews	Bomb-lance.
May 3, 1859	23, 827	P. B. Comins	Bomb-lance.
June 14, 1859	24, 371	Robert Brown	Harpoon-bomb.
Aug. 9, 1859	25, 080	Isaac Goodspeed	Projectile.
Dec. 11, 1860	30, 869	Theodore Briggs	Harpoon-lance.
Jan. 22, 1861	31, 190	Thomas W. Roys	Shoulder-gun, for harpoons, lances, &c.
July 16, 1861	32, 830	Goodspeed & Crawley	Guide for bomb-lance.
June 3, 1862	35, 474	Thomas W. Roys	Rocket-harpoon.

List of patents granted by the United States, &c.—Continued.

PROJECTILES—Continued.

Date of patent.	Number.	Inventor.	Subject of invention.
Apr. 21, 1863	38, 207	M. Adams	Harpoon, with semi-revolving head.
Oct. 27, 1863	40, 387	Oliver Allen	Bomb-lance, with perforated fire-proof diaphragm.
Feb. 21, 1865	46, 437	Silas Barker	Exploding-harpoon.
Aug. 22, 1865	49, 548	Ebenezer Pierce	Apparatus for killing whales.
Apr. 24, 1866	54, 211	Roys & Lieliendahl	Rocket-harpoon.
Apr. 23, 1867	64, 045	Robert E. Smith	Shooting-harpoon, grooved head, to receive the pivoted barb.
Dec. 3, 1867	71, 763	Z. Kelley	Harpoon, with stops, springs, and catches.
June 9, 1868	78, 675	......do	Bomb-lance.
June 1, 1869	90, 368	E. Pierce	Bomb-lance.
Dec. 7, 1869	97, 693	J. P. Rechtens	Gun-harpoon.
May 7, 1872	126, 388	Charles Freeman	Bomb-harpoons.

7. NETS AND POUNDS.

Mar. 21, 1838	....	Russell Evarts	Seine for deep-water fishing.
June 4, 1838	....	B. W. Hale	Seine for deep-water mackerel fishing.
Sept. 19, 1838	....	Cyrus Tracey	Seine.
Mar. 17, 1843	....	Harris Cook	Gill-net.
Apr. 25, 1843	....	John Downs	Form for making nets for taking eels.
Sept. 14, 1844	....	Carr, Shannon & Co.	Net or trap; place for bait similar to eel-pot.
Apr. 18, 1854	10, 794	Charles De Saxe	Landing-net.
Apr. 27, 1858	20, 125	Thomas Hall	Seine or net.
June 29, 1858	20, 725	Benjamin Merritt	Seine for sea-fishing.
Apr. 8, 1862	34, 887	F. Goodwin	Net or trap.
Apr. 25, 1863	39, 676	W. Randolph	Net, to be anchored and used as trap.
June 19, 1866	55, 635	Edw. A. Field	Net.
Aug. 7, 1866	56, 917	Ferl & Larkin	Vertical deep-water fishing-net.
Nov. 6, 1866	59, 429	William Maxwell	Net, double, with rigid mouth; can be anchored at any depth by floats and sinkers.
Feb. 26, 1867	62, 481	C. C. Crossman	Net, attached to side of boat, so as to be lowered or raised.
Dec. 17, 1867	72, 177	C. Drexel	Securing and feeding crabs.
Mar. 31, 1868	76, 284	Daniel Will	Gill-net.
Apr. 7, 1868	76, 387	Thomas Bell	Net-attachment for boats, with gauge to mast, to hoist or lower.
June 9, 1868	78, 716	B. Arnold	Mode of making nets.
July 28, 1868	80, 274	John Collins	Brace-seine.
Sept. 28, 1868	82, 490	T. Cartwright	Set-net, to be anchored; the boat is attached about midway of the net, and a line is attached to small end of bag, and can be raised into boat and the fish taken out without disturbing the rest of the net.
Oct. 13, 1868	82, 913	George D. Allen	Eel-pot.
Oct. 27, 1868	83, 493	Smith Harper	Net.
Oct. 27, 1868	83, 429	W. S. Wilcox	Pound net or trap.
Mar. 9, 1869	87, 740	F. A. Wardmiller	Dip-net.
Feb. 8, 1870	99, 713	P. C. Sabin	Purse-net, with bait-box, the net stretched on wires similar to umbrella, and, when ready to hoist, it is closed like a purse.
Apr. 4, 1871	113, 292	J. E. Hammond	Fish-trap net.
Apr. 4, 1871	113, 572	Benjamin Rider	Net-supporter.
Apr. 18, 1871	113, 817	P. E. Tierman	Pound-net.
Aug. 15, 1871	117, 957	L. H. Alexander	Net.
Nov. 14, 1871	120, 974	R. Jeffrey	Seine.
Mar. 12, 1872	124, 635	H. Smith	Seine, arranged so that portion of mouth may be below the surface.

8. OYSTER CULTURE AND GATHERING.

Mar. 2, 1858	19, 516	Thomas Sheehan	Oyster rake or tongs.
Oct. 4, 1859	25, 680	Thomas P. Sink	Reel or windlass, for hoisting oyster-dredges.
Oct. 11, 1864	44, 634	George Jury	Reel for hoisting oyster tongs or dredges.
Oct. 2, 1866	58, 426	Job Johnson	Oyster-rake.
Nov. 20, 1866	59, 812	W. Belbin	Mode of hoisting oyster-dredge.
Mar. 17, 1868	75, 550	Job Johnson	Oyster-tongs.
Apr. 14, 1868	76, 697	Asa Barrett	Oyster-rake.
July 19, 1870	105, 495	J. W. Sands	Grappling-tongs, (oyster.)
Sept. 27, 1870	107, 740	E. Ward	Oyster-tongs.
Feb. 21, 1860	27, 213	W. L. Force	Oyster-dredge.
May 20, 1862	35, 324	J. H. Newcomb	Oyster-dredge.
May 5, 1863	38, 436	Joseph Whitecars	Oyster-dredge.
Jan. 17, 1865	45, 904	W. Belbin	Oyster-dredge.
June 5, 1866	55, 228	Charles T. Belbin	Oyster-dredge.

List of patents granted by the United States, &c.—Continued.

OYSTER CULTURE AND GATHERING—Continued.

Date of patent.	Number.	Inventor.	Subject of invention.
Nov. 20, 1866	59, 812	W. Belbin	Oyster-dredge.
Jan. 4, 1867	65, 442	T. P. Sinks	Oyster-dredge.
Feb. 25, 1868	74, 857	......do	Oyster-dredge.
Apr. 7, 1868	77, 110	S. S. Shaw	Reel for oyster-dredge.
June 2, 1868	78, 509	C. T. Belbin	Oyster-dredge.
Aug. 18, 1868	81, 304	T. P. Sinks	Oyster-dredges.
June 19, 1869	85, 936	Daniel Kellers	Oyster-dredge chuck.
Apr. 27, 1869	89, 323	Thomas F. Mayhew	Oyster-dredge.
Nov. 30, 1869	97, 420	......do	Oyster-dredge.
Feb. 15, 1870	99, 900	R. O. & W. T. Howard	Reel for oyster-dredges.
Oct. 1, 1871	120, 463	T. P. Sinks	Oyster-dredge.
Nov. 28, 1871	121, 227	W. C. Baker	Oyster-dredge.
Nov. 28, 1871	121, 249	E. B. Lake	Oyster-dredge.
Jan, 2, 1872	122, 423	N. A. Williams	Oyster-dredge.
Jan. 16, 1872	122, 843	T. F. Mayhew	Reel or windlass for oyster-dredge.
Apr. 23, 1872	125, 964	T. W. Laudon	Oyster-dredge.
June 11, 1872	127, 903	Benjamin F. Leyford	Oyster nurseries.
Aug. 20, 1872	130, 631	E. H. Frazier	Shell-oyster bucket.
Oct. 29, 1872	132, 668	J. A. Ketcham	Oyster-dredge.
Jan. 21, 1873	135, 167	Isaac Smith	Oyster-tongs.

9. PRESERVATION AND UTILIZATION OF FISH.

Mar. 19, 1861	31, 736	Enock Piper	Preserving fish and meat.
Dec. 15, 1864	1, 618	James B. Herreshoff	Mode of treating fish-water for use in dyeing, &c. (Reissued December 15, 1864.)
Nov. 5, 1867	70, 435	George H. Herron	Improved mode of preparing fish for food. (Reissued January 16, 1872.)
May 19, 1868	78, 016	Benjamin Robinson	Improved process of obtaining gelatine from fish-heads.
Sept. 8, 1868	81, 987	William D Cutler	Improved method of preparing, desiccating, and preserving fish.
Oct. 27, 1868	83, 533	P. Nunan	Improvement in apparatus for preserving and freezing fish and meats, &c. (Drawing.)
Nov. 10, 1868	83, 836	William D. Cutler	Articles of food prepared from fish and potatoes.
Dec. 8, 1868	84, 801	Elisha Crowell	Improved article of prepared codfish.
Jan. 19, 1869	85, 913	William Davis	Improvement in freezing-box for fish. (Drawing.)
Jan. 19, 1869	86, 040	Thomas Sim	Improved compound for preserving fish.
Mar. 16, 1869	87, 986	Benj. F. Stephens	Improvement in putting up codfish.
Mar. 23, 1869	88, 064	J. Nicherson	Improved process of preparing fish for food.
May 25, 1869	90, 334	John Atwood, jr	Improved process of curing and putting up codfish.
June 8, 1869	90, 944	Havard & Harmony	Improved process of preserving meat, fowls, fish, &c.
Dec. 6, 1870	109, 820	D. Y. Howell	Device for freezing fish, meats, &c. (Drawing.)
Feb. 28, 1871	112, 129	Samuel H. Davis	Improvement in preserving fish by freezing.
May 21, 1872	127, 115	Isaac L. Stanley	Improved process of preparing fish for food.
Oct. 15, 1872	132, 316	Edward A. Pharo	Improvement in putting up salt mackerel and similar fish.
Dec. 15, 1868	84, 855	Edward E. Burnham	Preservation and improvement in fish or bait used in catching fish.
Feb. 11, 1868	74, 378	T. D. Kellogg	Improved method of preserving bait for fishing. (Drawing.)
Sept. 28, 1869	95, 179	R. A. Adams	Improvement in preserving fish.
Oct. 26, 1869	96, 288	George T. Thorp	Improved fish-bait.
Nov. 23, 1869	97, 145	R. A. Adams	Improvement in curing and preserving fish.
Mar. 29, 1870	101, 260	Silvanus Hamblin	Improved bait-mill for fishermen. (Drawing.)
Jan. 21, 1873	135, 113	Samuel A. Goodman, jr	Bait, composed of vegetable and animal matter; is mixed with ordinary bait.

10. FISH-CULTURE.

Sept. 17, 1867	68, 871	Seth Green	Spawn-hatching mackerel.
Jan. 16, 1868	78, 952	W. H. Furman	Fish-breeding.
Mar. 16, 1868	78, 952	W. H. Tierman	Fish-breeding device.
Aug. —, 1868	80, 775	A. J. Smith	Transporting live fish.
June 11, 1872	127, 903	Benjamin F. Leyford	Oyster-nurseries.
July 11, 1871	116, 995	R. E. Sabin	Fish-nursery.
July 12, 1872	105, 176	A. S. Collins	Fish-spawning screen.
Oct. 22, 1872	132, 349	G. A. Brackett	Fishway.

List of patents granted by the United States, &c.—Continued.

11. PATENTS GRANTED PRIOR TO 1834.

[The order shows that patents were granted to these persons, but the drawings and applications were destroyed by fire in 1836.]

Date of patent.	Number.	Inventor.	Subject of invention.
1795	....	Joseph Ellicott, Pa......	Catching fish.
1802	....	Nathaniel Robbins, N. J.	Mode of carrying fish in warm weather.
1809	....	Philip Groff, Pa.........	Seine.
1812	....	Samuel May, Pa	Seine.
1814	....	James Wells, jr., N. J...	Vessels and nets for fishing.
1818	....	James Drummond	Net.
1824	....	Daniel Gordon, Pa	Catching fish.

XVII.—LIST OF THE SEA-WEEDS OR MARINE ALGÆ OF THE SOUTH COAST OF NEW ENGLAND.

BY W. G. FARLOW, M. D.

The following list of algæ has been arranged from collections made in the summer of 1870 and spring of 1871, at Greenport and Orient, Long Island, but more especially at Wood's Hole and vicinity in the summer of 1871. I am indebted to Professor S. F. Baird for opportunities for collecting at the last-named station such as no American algologist has ever before enjoyed. Mr. S. T. Olney, of Providence, Rhode Island, has been so kind as to place at my disposal his extensive collections of Rhode Island algæ, made during the years 1846–'47–'48. The collections of 1846 and 1847, examined and named by Harvey, contained the types of *Polysiphonia Olneyi* and other species. The collection of 1848 contained some novelties, which are mentioned in the following list. Since my own list was prepared, Mr. Olney has published a complete list of Rhode Island algæ, entitled *Algæ Rhodiaceæ.* For specimens from New Haven and Watch Hill I am indebted to Professor D. C. Eaton, of Yale College; and the albums of Miss Fisher and Miss Pease, of Edgartown, have furnished choice specimens from that region.

As long ago as 1852, when the first volume of the Nereis Boreali-Americana appeared, it was understood, in a general way, that Cape Cod was the dividing line between the northern and the southern marine ora. The question has since been raised whether Cape C od is as strictly the dividing line as Harvey had supposed; whether northern species do not occur at exposed southern points, as Gay Head and Mon oeuk, and southern species wander northward to Cape Ann. Most decidedly, I think, such is not the case. In the first place, none of the characteristic algæ of the north, with a solitary exception, are found south of Cape Cod. The characteristic algæ of our northern coast are *Alaria esculenta*, GREV.; *Laminaria longicruris*, DE LA PYL.; *Agarum Turneri*, P. & R.; *Halosaccion ramentaceum*, J. AG.; *Euthora cristata* J. AG.; *P tilota serrata*, KÜTZ.; *Delesseria alata*, LAM., and *D. sinuosa* LAM. These are all common as far south as Nahant, except *Halosaccion* which is common on the coast of Maine, but does not occur south of Rye Beach, New Hampshire. From Boston Harbor to Cape Cod is a desert, as far as marine vegetation is concerned, except for a short interval at Hingham, where rocks afford a foot-hold for fucoids and chondrus, which are there gathered for the market in large quantities. Not one of the algæ above mentioned, except *Delesseria sinuosa*, is found south of

Cape Cod. *Agarum Turneri* is exclusively American, eastern and western and northern. *Alaria esculenta*, *Laminaria longicruris*, and *Euthora cristata*, are found in Europe on the northern shores of Scotland and Norway. *Euthora cristata* is rare as far south as Edinburgh, 56° N., and *Alaria esculenta* is rare in the south of England. *Ptilota serrata* and *Halosaccion ramentaceum* occur on the coast of Norway. Both *Delesseriæ* occur farther south, *D. sinuosa* in particular, which grows with subtropical sea-weeds on the southern coast of England and on the opposite shore of France. It will be seen, then, that the flora, as far south as Boston, 42½° N., resemble most strongly that of the north of Scotland and Norway, which, at its southernmost point, reaches only 58° N.

The characteristic algæ of Southern Massachusetts and Long Island Sound are *Sargassum vulgare*, AG., and *S. Montagnei*, BAIL., (an American variety of the last;) *Chordaria divaricata; Grinnellia Americana*, HARV.; *Dasya elegans*, AG.; *Chylocladia Baileyana*, HARV.; *Solieria chordalis*, AG.; *Gracilaria multipartita*, AG.; *Ptilota elegans*, BONNEM.; *Chondria Baileyana*, MONT., and *Champia parvula*, HARV. Of these, excepting one extremely doubtful case of *Grinnellia*, none have ever been found north of Cape Cod, except *Ptilota elegans*, which occurs at Beverly, Massachusetts, and *Chylocladia Baileyana*, found at Quincy, Massachusetts, by Dr. Durkee. Of *Ptilota elegans* it may be remarked, that this plant, although abundant south of Cape Cod, is local, occurring only in the more exposed places, as Gay Head, No Mans Land, and Newport. *Chylocladia Baileyana* and *Grinnellia Americana* are exclusively American, the former found as far south as Charleston, the latter on the coast of North Carolina. *Dasya elegans* is Mediterranean, and extends to the Canaries. *Solieria chordalis*, first found at Cadiz, and *Chondria Baileyana*, on the supposition that it is identical with *Chondriopsis striolata*, J. AG., are Mediterranean. *Sargassum vulgare* and *Gracilaria multipartita* are rare as far north as the south of England, where many subtropical algæ flourish. *Chordaria divaricata* is an anomaly, being local in Great Britain and common in the Baltic, while it has not been found north of Cape Cod in America. The flora of Southern New England is much like that of the Mediterranean.

But it may be asked why the appearance of the vegetation at Gay Head and Wood's Hole is so different. It is not because we have at Gay Head an offshoot of the northern flora. The false resemblance is caused by the immense quantities of *Laminaria*, composed almost entirely of *L. saccharina*, common throughout the Sound; *L. longicruris*, the distinguishing northern species, being entirely absent. *L. digitata*, a northern species, is also found, but I have hesitated to count it as northern, because I have information from New Haven, not very definite to be sure, that it is found there also. The reason is, because at Wood's Hole, Greenport, and Peconic Bay, we have an extremely southern flora, which in fact, botanically, does not belong to Long Island Sound. Gay Head does not produce northern species, but the last-mentioned localities are more favorable to the growth of warm-water species than any other parts of Long Island Sound, and at those points we meet a vegetation which we must go as far south as the Carolinas to find normally. *Sargassum vulgare*, pre-eminently a southern species, abounds at Wood's Hole and Greenport; at the latter place almost takes the place of *Fucus*. *Hypnea musciformis*, a very common West Indian species, is found near Wood's Hole and New Bedford, again at Charleston Harbor and on the coast of North Carolina. This state of things seems to be owing to the shallowness of the water in Vineyard Sound and Peconic Bay, and the southern exposure of the shore, thus allowing the water of the smaller bays to become quite warm, so that the spores of the southern algæ might pass through the colder waters of Gay Head and Montauk without germinating till they reached a more congenial home in Wood's Hole and Peconic Bay.

In examining the following list one cannot fail to notice the very small number of species added to the flora since Harvey's Nereis was published. This is in striking contrast to the experience of the zoologists, who seldom allowed a day of this summer to pass without additions to the fauna. Of the species added, seven are common to Europe; three forms, found by Harvey, only at Key West, were found at Wood's Hole. The actual number of species on the eastern coast is, probably, not greater than Harvey estimated, since recent additions are counterbalanced by the union of some of Harvey's species with older ones. No facts were obtained as to the greatest depth at which algæ will grow, as the dredgings were carried on in comparatively shallow water, but the depth at which several grow was found to be greater than Harvey had supposed, as in the case of *Chrysymenia rosea*, described as growing in tide-pools, which I have only found in six or eight fathoms of water, on shells, in company with *Scinaia furcellata*.

The following table has been prepared from Harvey's Nereis and Agardh's Species Algarum, and represents, as far as is known, the number of species found on different parts of our coast:

	From Key West north.	From Cape Cod north.	From Cape Cod to Charleston.	From Charleston to Key West.	Common to Europe.	Common to west coast.
Melanospermeæ	72	56	28	13	50	4
Rhodospermeæ	150	63	72	91	92	19
Chlorospermeæ	85	30	35	47	49	9
Total	307	149	135	151	191	32

From this table it will be seen that over sixty-two per cent. of our algæ are common to Europe. This refers to our whole eastern coast. The table, however, does not show the fact that the number of common species gradually diminishes as you proceed southward. At Nahant, out of eighty-six species, seventy-nine are common to Europe. The last column includes only those common species that are actually known to occur on the west coast; in reality, there are probably many more. The diminution of species between Cape Cod and Charleston is owing to the extent of sandy shore, on which very few algæ grow. Harvey estimated that there were about three hundred conspicuous sea-weeds in Great Britain, and counting the minute, not far from four hundred. Even allowing that our coast has not been as thoroughly explored as the British, it will be seen that, considering its great extent, it is not so rich in species as the latter coast. This is, in part, owing to the sandy shore of the Middle and Southern States. Compared with the western coast of Europe, the localization of our floræ will be noticed. They do not gradually pass into one another, but are much more sharply limited, particularly near Cape Cod.

From our coast, between Maine and Key West, little is to be expected hereafter in the way of new species, and the attention of algologists will be turned to a search for the smaller European species, and to a more accurate study of the difficult genera *Callithamnion* and *Cladophora*, and the order *Oscillatoriaceæ*. There is a lack of information about the winter state of our algæ, and this can only be supplied by residents on the shore. At present I know of no winter collections except those made by ladies of Edgartown, Massachusetts. On the coast of the extreme eastern part of Maine and the shore of the British provinces much more of novelty may be expected. Many species have been described from single or very few specimens from the Gulf of St. Lawrence, and more extensive suites than have yet been obtained are necessary for the complete establishment of the species.

MELANOSPERMEÆ.

FUCACEÆ.

1. *Sargassum vulgare*, AG. Common at Wood's Hole in warm, shallow coves. Very variable in the length and breadth of leaves, and in the ramification of the fruit-bearing branchlets, characters on which Harvey relies in separating this from the next species.

2. *S. Montagnei.* Greenport, Long Island. Probably only a variety of the last, although my Greenport specimens have narrower leaflets than any *Sargassum* gathered by me at Wood's Hole.

   S. bacciferum I have never found washed ashore, and during the summer months it is undoubtedly rare, if found at all. Said to be found in great patches off Nantucket, but I have never seen specimens.

3. *Fucus vesiculosus*, LINN.
4. *F. nodosus*, LINN.

   Both species common as far as New York, but by no means as luxuriant as north of Cape Cod.

SPOROCHNACEÆ.

5. *Desmarestia aculeata*, LAM. Common at Gay Head, Nantucket, (Miss Mitchell.)

6. *D. viridis*, LAM. Orient Point, Long Island. June, 1871.

LAMINARIACEÆ.

7. *Laminaria saccharina*, LAM. Very common at Gay Head and Montauk, Long Island; Wood's Hole, Orient Point, Newport.

8. *L. digitata*, LAM. Gay Head, Montauk. Probably the southernmost habitat of this species.

L. trilaminata, OLNEY. In August, 1870, I picked up on the north beach, Orient Point, a fragment much decayed, which, at the time, I thought belonged to this species. Professor Gray having mentioned that he had seen, several years ago, at Gay Head, a plant which might possibly have been this species, I visited that spot several times, but found no trace of *L. trilaminata*, although there was abundance of *L. saccharina*. The specimens, supposed to have been *L. trilaminata*, were probably nothing more than a monstrous form of *L. saccharina*. This view is strengthened by the fact that I have seen, at Mount Desert, *Agarum Turneri* with three alæ; and I have seen two specimens of *L. saccharina*, in which one edge of the frond had become thickened like a cord, and at the apex the cord was beginning to split into two layers, at right angles to the frond itself.

9. *Chorda filum*, STACK. Very common in shallow water.

10. *C. lomentaria*, LYNGB. Orient Point. June, 1871.

DICTYOTACEÆ.

11. *Stilophora rhizodes*, J. AG. Waquoit. A few specimens floating near Wood's Hole, in July; near Providence, (S. T. Olney.) Nowhere common. I have lately seen a specimen sent from Lenormand to Dr. Hillebrand, marked *Stilophora Lyngbyei*, AG. New York Bay. By some this species is considered a variety of the last named.

12. *Dictyosiphon fœniculaceus*, GREV. A few specimens floating off Naushon.

13. *Punctaria tenuissima*, GREV. Dredged in three or four fathoms. Wood's Hole. Common at Orient Point. June, 1871.

14. *P. plantaginea*, GREV. With the latter, and equally common at Orient Point.

CHORDARIACEÆ.

15. *Chordaria flagelliformis*, AG. Nobska, Gay Head. Not so abundant as farther north.

16. *C. divaricata*, AG. Wood's Hole, Orient, Greenport. Very common all summer in warm, shallow bays. To the eye this would appear to include two species. The young and growing parts are solid and very tortuous, and resemble, when dried, a *Mesogloia*. As the plant grows older the stem often becomes hollow, and many of the branches fall off, giving the plant a coarse appearance.

17. *Leathesia tuberiformis*, S. F. GRAY. Washed ashore on Buzzard's Bay and Orient Point, but not seen growing.

18. *Elachista fucicola*, FRIES. Wood's Hole. Parasitic on *Fuci*.

ECTOCARPACEÆ.

19. *Cladostephus verticillatus*, AG. Orient, Gay Head. Very common toward No Mans Land.

20. *C. spongiosus*, AG. Newport.

21. *Sphacelaria cirrhosa*, AG. Common at Wood's Hole and Weepecket Islands, Greenport, Orient.

22. *Myriotrichia filiformis*, GRIFF. On *Chorda lomentaria*. Point Judith, (S. T. Olney.) The only recorded case of this plant being found in America is that of Mr. Hooper, mentioned in the appendix to Harvey's Nereis, who found it in Penobscot Bay on *Dictyosiphon*. In Europe it is almost always found on *Chorda lomentaria*.

23. *Ectocarpus littoralis*, LYNGB. Everywhere common on *Fucus*.

24. *E. fasciculatus*, HARV. Gay Head and Nobska.

25. *E. Durkeei*, HARV. Gay Head.

25.* *E. viridis*, HARV. Wood's Hole, (*fide* D. C. Eaton.)

RHODOSPERMEÆ.

RHODOMELACEÆ.

26. *Chondria* (*Chondriopsis*, AG.;) *dosyphylla*, AG. Common on stones and the larger algæ at low-water mark. Wood's Hole, Orient.

C. dasyphylla, var. *sedifolia*. Not noticed by Harvey north of Key West, but not uncommon at Wood's Hole.

27. *C. Baileyana*, HARV. Very common, and with the last. Agardh refers this with a query to his *Chondriopsis striolata* of the Adriatic. I have compared my specimens with one of *C. striolata* from Agardh in the herbarium at Cambridge, and it seems to be the same, but further comparison is needed.

28. *C. littoralis*, AG. Wood's Hole. Not at all common; a species easily recognized when seen, but difficult to describe. Not noticed by Harvey north of Key West.

29. *Rhodomela subfusca*, AG. Gay Head, Vineyard Sound.

30. *Polysiphonia urceolata*, GREV. Government Wharf, Wood's Hole, Orient Point. Var. *formosa*. Orient, Nantucket.

31. *P. Olneyi*, HARV. Wood's Hole, (common,) Waquoit.

32. *P. Harveyi*, BAIL. Very common on eel-grass; the bottom of the small harbor at Wood's Hole sometimes covered with this plant after a southerly wind; washed up so abundantly at Southold, Long Island, in the autumn, as to be used for manure. It must be confessed that this species is not well defined, passing, on the one hand, into *P. Olneyi*, and, on the other, into *P. Harveyi* var. *arietina*, HARV., which seems to me to be full as clearly a distinct species as *P. Harveyi* itself. Bailey so regarded it. This plant is called on Long Island "nigger-hair;" at Wood's Hole, "dough-balls." I have fine specimens a foot in diameter, whereas in var. *arietina* the tufts are seldom over two inches in diameter. This variety is very common on the south side of Lynn Beach on eel-grass.

33. *P. subtilissima*, MONT. Seekonk River, (S. T. Olney.)

34. *P. elongata*, GREV. Common at Gay Head, and floating near Menimshi Bight. I did not collect this species until August, when many of the terminal fibrils had fallen off, leaving the ramuli rather bare. Also at Lynn Beach, but neither so luxuriant nor abundant.

35. *P. fibrillosa*, GREV. Greenport.

36. *P. violacea*, GREV. Orient Point, Gay Head, and Menimshi. Not uncommon.

37. *P. variegata*, AG. Very common in all warm, shallow water, on piers, in company with *Solieria chordalis*. Wood's Hole, Weepecket Islands, Greenport, Orient, New Haven, (Professor Eaton.)

38. *P. atrorubescens*, GREV. Gay Head and Menimshi Bight, floating with *P. elongata* and *violacea*. Not very common. Some specimens collected in July are a foot long, and the branches are covered with subulate ramuli, while others, gathered in September, are not more than two or three inches long, nearly destitute of lateral ramuli, and look like black horse-hair.

39. *P. nigrescens*, GREV. Wood's Hole, Gay Head, Orient. Var. *fucoides* common on fucus at low-water mark at Weepecket Islands, New Haven, (Professor Eaton,) Gay Head. Dredged in ten fathoms near No Mans Land.

40. *P. fastigiata*, GREV. Notwithstanding the common occurrence of *Fucus nodosus*, on which this is generally parasitic, I have found at Wood's Hole only a few specimens of this species, and those faded and greenish. New Haven, (Professor Eaton.)

41. *Dasya elegans*, AG. Very common from New York to Nantucket, being one of the most striking and abundant rhodosperms during the latter part of August and September. Washed ashore at Gay Head.

LAURENCIACEÆ.

42. *Champia* (*Lomentaria*, AG.) *parvula*, HARV. Very common on eel-grass and the larger algæ throughout Long Island Sound. When dredged in fine to ten fathoms it is flatter and more gelatinous than in shoaler water. I have a specimen from Watch Hill, collected by Professor Eaton, which seems to me to be the same as Harvey's Key West species, *C. salicornioides*, and I have numerous specimens connecting the two species, which are probably forms of the same.

CORALLINACEÆ.

43. *Corallina officinalis*, L. Common. Wood's Hole, Gay Head. The classification of this order is indeed wretched, when the fruits characteristic of three different genera are all found on a single specimen, as is the case with one from Gay Head.

44. *Melobesia membranacea*, LAM. Common along the coast on zostera.

45. *M. farinosa*, LAM. on *Sargassum vulgare*. Cuba, (C. Wright.)

46. *M. pustulata*, LAM. On *Fuci* and *Chondrus*. Cape Ann, Gay Head, Wood's Hole, Weepecket.

SPHÆROCOCCOIDEÆ.

47. *Grinnellia Americana*, HARV. On sheltered piers, below low-water mark, and on stones and sponges as low as six fathoms. Wood's Hole, Orient, Greenport, Watch Hill, (Professor Eaton,) Edgartown, Buzzard's Bay. Washed ashore at Gay Head and Nantucket. This, perhaps the most beautiful rhodosperm south of Cape Cod, is a very rapid grower, two or three crops being produced during the summer in favorable localities. It is supposed to require warm water for its perfection, but the ladies of Edgartown collect this plant in midwinter, as it is only at that time that it grows high up on the piers. I am informed by Miss Fisher that, after high tides in winter, the flats in the vicinity of Edgartown are covered with this sea-weed. Harvey described the harbor of Greenport as carpeted with *Grinnellia*. In August, 1870, I dredged that harbor in every direction, but found no trace of it, though there were a few specimens on the north beach. It is possible that the numerous fish-oil factories may have driven it away. I have never seen but one specimen of *Grinnellia* purporting to have been found north of Cape Cod; that was a water-worn fragment, supposed to have been collected at Pigeon Cove, Cape Ann. But, as the lady who showed me the specimen was not sure of the locality, and had other specimens from Long Island Sound, I think there must have been some mistake. The southernmost locality from which I have received specimens is Norfolk, Virginia.

48. *Delesseria sinuosa*, LAM. Gay Head and No Mans Land; abundant in company with *Ptilota elegans*. Watch Hill, (Professor Eaton,) Newport. Although identified by Harvey with the European plant, it seems to differ in several respects from the descriptions of that plant. The conceptacles are described as being on the midrib, or lateral nerves, in the European plant. In ours, although sometimes found in a similar position, they are more frequently scattered, and the tetraspores are frequently dispersed instead of being confined to the marginal leaflets. It generally fruits in winter and early spring, but I have one specimen fruiting in September. I have no specimen of *D. quercifolia* of the southern hemisphere with which to compare mine.

49. *Gracilaria multipartita*, J. AG. Wood's Hole, Hadley Harbor. On small stones and gravel, just below low-water mark. Our broadest specimens are considerably narrower than the European; some are so narrow as to resemble *Solieria chordalis*, and are var. B. HARV. In September, 1870, I found large masses of a *Gracilaria*, which I picked up by the armful at East Marion, Long Island. I think likely it was *G. confervoides*, GREV., but have misplaced my specimens.

GELIDIACEÆ.

50. *Gelidium corneum*, LAMOUR. This alga, so common throughout Europe, is only occasionally seen on our coasts, and then only in a very insignificant form. My specimens are not more than two inches high, and seem to belong to the variety *crinalis*, AG.

51. *Solieria chordalis*, J. AG. Very common and characteristic. Wood's Hole, Greenport, Orient, in company with *Polysiphonia variegata* and *Gracilaria multipartita*, the narrow forms of which it much resembles. Is not *Rhabdonia tenera*, J. AG., the same as this plant? There is in the herbarium at Cambridge, a specimen from Lenormand, marked *R. tenera*, J. AG., New York Harbor. It is without fruit, and the structure of the stem is that common to both *Solieria* and *Rhabdonia*. As I have never seen American specimens of *R. tenera* in fruit, while *Solieria* is very common, I think it is probable that what has been described as *Rhabdonia* is merely a sterile plant of *Solieria*.

Hypnea musciformis, LAM. Fine specimens and not uncommon at Nobska and the adjoining Falmouth shore. A common plant of the Mediterranean and the West Indias. There are, however, in the herbarium at Cambridge, no specimens from either of those localities as luxuriant as those from Nobska, some of which are a foot long.

SPONGIOCARPEÆ.

52. *Polyides rotundus*, GREV. Common at Gay Head, Newport, Orient, and Greenport, also on the rocky shores of Massachusetts Bay, though not so luxuriant there as south of the cape.

SQUAMARIÆ.

53. *Hildenbrandtia rubra*, MENEG. In fruit at Wood's Hole. Common between tide-marks and below, at Wood's Hole, Nahant, Rockport, Massachusetts, New Haven, (Professor Eaton.) This species, I believe, has never before been recognized in America, where it will probably be found to be as common as in Europe.

HELMINTHOCLADEÆ.

54. *Nemalion multifidum*, J. AG. One specimen bearing tetraspores picked up at Gay Head. It was of larger diameter and more beautiful rose color than usual.

55. *Scinaia furcellata*, BIVON. Fruiting, and not uncommon at Gay Head. Washed ashore, and also dredged in six or eight fathoms.

RHODYMENIACEÆ.

56. *Rhodymenia palmata*, GREV. Common at Gay Head, Wood's Hole, Newport, Orient, and Greenport.

CRYPTONEMIACEÆ.

57. *Phyllophora membranifolia*. Dredged at Gay Head, Newport, Orient.

58. *P. Brodiæi*, J. AG. Fine specimens, a foot long, dredged in ten fathoms off Sheep Pen Cove. Common at Gay Head, Newport, and Orient.

59. *Ahnfeltia plicata*, FRIES. Common at Gay Head, Newport, Orient.

60. *Cystoclonium purpurascens*, KÜTZ. Extremely common, in summer, in pools, and washed ashore. Gay Head, Wood's Hole, Newport, Orient, Watch Hill, (Professor Eaton.) Var β. HARV. equally common.

61. *Chondrus crispus*, LYNGB. Very common and with the last.

62. *Chylocladia Baileyana*, HARV. This plant was placed by Harvey conditionally in the genus *Chylocladia*, he having seen only the tetrasporic plant. I believe I was the first who saw the conceptacular plant, which I found growing on the Government Wharf, Wood's Hole, in July. The fruit is external and contained in a cellular pericarp. The nucleus, surrounded by a hyaline mucous envelope, consists of a mass of spores grouped without order. The plant varies very much in color, according to locality and season, and the three varieties described by Harvey run constantly into each other. Common at Wood's Hole, Buzzard's Bay, Orient, Greenport, Weepecket, New Haven, (Professor Eaton.)

63. *C. rosea*, (*Chrysimenia, Phyc. Britt.*,) HARV. This rare and beautiful alga I have found only by dredging in the region of the Devil's Back, Gay Head, in eight or ten fathoms. The tetraspores only were found.

SPYRIDIACEÆ.

64. *Spyridia filamentosa*, HARV. Common on eel-grass at Wood's Hole, Waquoit, Weepecket, and Greenport.

CERAMIACEÆ.

65. *Ceramium rubrum*, AG. Common everywhere.

66. *C. diaphanum*, ROTH. Common and luxuriant on eel-grass. Wood's Hole, Weepecket, Edgartown.

67. *C. fastigiatum*, HARV. Common on eel-grass in August and September at Wood's Hole, Weepecket, Newport, Orient, and Greenport.

68. *C. arachnoideum*, (?) AG. Wood's Hole, Orient Point. There grows in abundance on fuci, at Wood's Hole, a *Ceramium* without fruit of either kind in September. It grows in long patches on the stems of fuci near low-water mark. The filaments are rather robust, not more than an inch long, scarcely branching and forcipate at the tip. The internodes are diaphanous, and I am not certain that it is not a young state of *C. diaphanum*. At any rate I will not confuse an already sufficiently subdivided genus by adding a doubtful species.

69. *Ptilota elegans*, BONNEM. Common between Gay Head and No Mans Land, Newport. Wherever found, abundant.

70. *Griffithsia corallina*, AG. This charming plant is not uncommon during July in Buzzard's Bay, Wood's Hole, and Weepecket Islands; at the latter station I have seen the water full of it. Var. *globifera* I have found only on the Government Wharf, Wood's Hole, and once or twice in Buzzard's Bay. It is coarser in color and texture, and is not so easily dried on paper as the ordinary form. If merely a variety, it seems to owe its form to its exposed place of growth.

71. *Callithamnion tetragonum*, AG. Wood's Hole, Martha's Vineyard, Newport. Common on the larger algæ and wood-work just below low-water mark.

72. *C. Baileyi*, HARV. Not to be distinguished, in my opinion, from *C. tetragonum*, except by being less robust and somewhat more compoundly branched. It seems to me to be merely a variety grown early in the season while the water is warm.

73. *C. Borreri*, AG. Greenport, Wood's Hole. My specimens are softer than European, and seem too near *C. polyspermum*.

74. *C. byssoideum*, ARN. Orient Point, (not uncommon,) Wood's Hole, Weepecket. Specimens from the latter place are fastigiate and belong to Harvey's third variety.

75. *C. corymbosum*, AG. Wood's Hole, Gay Head, Edgartown, (Miss Pease,) Weepecket.

76. *C. seirospermum*, GRIFF. The commonest of the subgenus *Rosea*. Orient, Menimshi, Gay Head.

77. *C. Plumula*, LYNGB. Rare. Dredged near Devil's Back, Gay Head, in company with *Chylocladia rosea*, July; Orient, June; one specimen.

78. *C. cruciatum*, AG. Wood's Hole, Vineyard Sound, Weepecket. Not uncommon, but generally overlooked from its being parasitic on other species of *Callithamnion*.

79. *C. Turneri*, AG. One of the commonest species of the genus south of Cape Cod, growing in dense tufts on other algæ at low-water mark and below. Throughout Vineyard Sound, Watch-Hill, (Professor Eaton,) Orient, Siasconsett, where in July the water was completely filled with it. Beautiful while in the water, but not making handsome specimens.

80. *C. luxurians*, J. AG. On zostera. Edgartown, Massachusetts, (Miss Fisher.)

CHLOROSPERMEÆ.

SIPHONACEAÆ.

81. *Bryopsis plumosa*, LAM. Greenport, Wood's Hole, Edgartown. Common on wharves and stones between tide-marks.

ULVACEÆ.

82. *Porphyra vulgaris*, AG. Common. Wood's Hole, Newport, Greenport, New Haven, (Professor Eaton.)

83. *Bangia fuscopurpurea*, LYNGB. Wood's Hole, Newport. On piers and rocks.

84. *Enteromorpha intestinalis*, LINK. Common along the whole shore.

85. *E. compressa*, GREV. With the last, and equally common.

86. *E. clathrata*, GREV. Wood's Hole. Common.

87. *E. Hopkirkii*, MCCALLA. Edgartown, (Miss Pease.)

88. *Ulva Linza*, L. Orient. Probably along the whole coast.

89. *U. latissima*, L. Everywhere.

CONFERVACEÆ.

90. *Cladophora rupestris*, L. Gay Head, Vineyard Sound. A condensed depauperate form.

91. *C. uncialis*, FL. DAN. Orient Point, June, 1871.

92. *C. Rudolphiana*, AG. Wood's Hole.

93. *C. fracta*, FL. DAN. Wood's Hole, in Eel Pond.

94. *C. flexuosa*, GRIFF. Wood's Hole, Government Wharf.

95. *Chætomorpha Piquotiana*, MONT. Gay Head, Montauk.

96. *C. ærea*, DILLW. Gay Head.

97. *C. sutoria*, BERK. Gay Head.

98. *C. litorea*, HARV. Gay Head.

98. *C. tortuosa*, DILLW. Wood's Hole.

OSCILLATORIACEÆ.

100. *Lyngbya majuscula*, HARV. Wood's Hole, Naushon, Edgartown, called by lady collectors mermaid's hair.

101. *Calothrix confervicola*, AG. Wood's Hole.

102. *C. scopulorum*, AG. Very common everywhere on rocks.

RIVULARIACEÆ.

103. *Rivularia atra*, ———. Though not noticed before in America, I found it not uncommon on shells and stones at Wood's Hole.

Besides the list above given there remain a number of *Callithamnia* and *Cladophoræ* of doubtful species, not an uncommon occurrence with collectors. It is also probable that there are other species of *Lyngbya* and *Calothrix* to be found at Wood's Hole.

Localities of algæ, either rare or new to American localities, not included in the preceding list.

Ralfsia verrucosa, AG., (*R. deusta*, BERK.) For the first time in America found by me at Little Nahant, October, 1871. Insignificant looking, but probably not uncommon.

Calliblepharis ciliata, KÜTZ. Collected by Professor Eaton, Mr. Whitney, and myself, at Straightsmouth Island, off Cape Ann, Massachusetts, September, 1871; not very abundant. Conceptacular fruit forming on some of the specimens.

Sphacelaria radicans, AG. Doubtfully located by Harvey at Beverly. In fruit at Little Nahant, October, 1871.

Gymnogongrus Norvegicus, GREV. Lynn Beach, November, 1871. A single specimen covered with conceptacles. Narrower than most European specimens, which was also the fact in the specimen sent to Harvey from Penobscot Bay, by Mr. J. Hooper.

Ceramium Hooperi, HARV. Straightsmouth Island.

Fucus distichus, L. An alga, which I regard as undoubtedly this species, I found growing in patches near high-water mark, at Marblehead, Massachusetts, in May, 1871. I have seen growing, in considerable abundance at various stations of our coast, a *Fucus* which I supposed at first to be an unripe state of *F. vesiculosus*, but now think must be *F. furcatus*, AG. This is well marked by the flat receptacle which, according to Agardh, is repeatedly forked, rarely simple. In the plant of our coast the receptacle is quite frequently simple. I have not yet been able to see a dried specimen of *F. furcatus*, or the figure of Agardh. Should my view of this plant be correct the supposed poverty of our coast in species of *Fucus*, as compared with the English, will prove to be not so very striking after all.

Melobesia polymorpha, L. Dredged at Robbinstown, Maine, by Mr. Howe. Not before noticed in America.

Nostoc sphæroides, KÜTZ. Sent by Professor Eaton from a pond near New Haven. Not before noticed in America.

XVIII.—REPORT UPON THE INVERTEBRATE ANIMALS OF VINEYARD SOUND AND THE ADJACENT WATERS, WITH AN ACCOUNT OF THE PHYSICAL CHARACTERS OF THE REGION.

By A. E. Verrill.

A.—HABITS AND DISTRIBUTION OF THE INVERTEBRATE ANIMALS.

I.—General remarks.

The investigation of the invertebrate life of these waters, undertaken at the request of the United States Commissioner of Fish and Fisheries, was actively carried forward during the entire summer of 1871, and the very extensive collections then made have been studied by Mr. S. I. Smith, Mr. O. Harger, and myself, as thoroughly as possible during the time that has been at our disposal. The work upon the collections is by no means complete, but is sufficiently advanced to serve the immediate purposes of the Fish Commission.

To Mr. Smith I am indebted for the identification of all the Crustacea referred to in this report and the accompanying lists, except the Isopods, which have been determined mostly by Mr. Harger, to whom my thanks are also due for several excellent drawings of those animals. To Professor A. Hyatt I am indebted for the identification of some of the Bryozoa, and for most of the figures of that class. I am also under obligations to Dr. A. S. Packard, Dr. G. H. Horn, and Dr. H. A. Hagen, who have identified the insects inhabiting salt water.

According to the plans adopted, these explorations had in view several distinct purposes, all more or less connected with the investigation of the fisheries. The special subjects attended to by this section of the Fish Commission party were chiefly the following:

1st. The exploration of the shores and shallow water for the purpose of making collections of all the marine animals and algæ living between tides, on every different kind of shore, including the numerous burrowing-worms and crustacea, and to ascertain as much as possible concerning their habits, relative abundance, stations, &c.

2d. The extension of similar observations by means of the dredge, trawl, tangles, and other instruments, into all depths down to the deepest waters which were accessible to us, and to make a systematic survey, as complete as possible, of all the smaller bays and harbors within our reach, both to obtain complete collections of the animals and plants and to ascertain the precise character of the bottom, special attention being paid to the localities known to be the feeding-grounds of valuable fishes, and to those animals upon which they are known to feed.

3d. The depth of the water and its temperature, both at the surface and bottom, was to be observed and recorded in as many localities as possible, and especially where dredging was to be done, and lists of the animals and plants from special localities or depths were to be prepared, so as to show the influence of temperature and other physical features upon animal and vegetable life. Many valuable observations of this kind were made.

4th. The life of the surface-waters was to be investigated by means of hand-nets and towing-nets, on every possible occasion, and at all hours. Towing-nets of different sizes, made of strong embroidery-canvas, and attached to stout brass rings, were used with excellent results, but very many interesting things were obtained by hand-nets skillfully used. The surface collections are of great interest in themselves, and of special importance practically, as they show the nature of the food of those fishes that feed at or near the surface.

5th. The collections obtained were to be preserved by the best methods: 1st, for the purpose of making a more thorough study of them than could usually be done at the time, and for the purpose of insuring accuracy in their identification and fullness in the special lists for the final report; and, 2d, in order to supply the Smithsonian Institution, Yale College museum, and a number of other public museums, both American and foreign, with sets of the specimens collected. For this last purpose large quantities of duplicates were collected and preserved, and will be distributed at an early day.

6th. Those species of animals which cannot be preserved in good condition for study were to be examined with care and minutely described while living. The colors and appearance of the soft parts of other species were to be described in the same way, and also the eggs and young of all kinds.

7th. It was regarded as of great importance to secure accurate drawings of the living animals, and especially of such as greatly change their form and appearance when preserved, such as worms, naked mollusks, ascidians, polyps, &c. Unfortunately the available funds were not sufficient to enable us to employ a special artist for this purpose during the summer, but this deficiency has been partially remedied by the figures subsequently drawn by Mr. J. H. Emerton, Mr. S. I. Smith, Mr. O. Harger, and the writer.

8th. In all these investigations the relations existing between the fishes and the lower animals which serve as food for them were to be constantly borne in mind, and all information bearing directly upon this subject that could be obtained was to be recorded. To this end large numbers of stomachs from fishes newly caught were examined, and lists of the species found in them were made. Most of those thus ascertained to be their ordinary food were traced to their natural haunts from whence the fishes obtain them.

9th. The parasites of fishes, both external and internal, were to be collected and preserved for future study.

A large collection of such parasites was made, but the internal parasites, which are very numerous, have not yet been studied. The internal parasites were collected chiefly by Dr. Edward Palmer.

The map accompanying the present report serves to show the localities explored, and the extent of the labor in dredging and sounding. The operations during the first six weeks were under the charge of Mr. S. I. Smith, who remained until July 25. He was assisted by Dr. W. G. Farlow, who also investigated the algæ. Professor J. E. Todd, of Tabor, Iowa, then took charge of the work for three weeks, until I was able to join the party, on the 16th of August. During the remainder of the season, until September 20, the operations were under my immediate superintendence; but Professor A. Hyatt, of Boston; Dr. A. S. Packard, of Salem; Dr. Farlow, of Cambridge; and Professor D. C. Eaton, of New Haven, gave very important aid in carrying out our investigations, and our thanks are due to all of these gentlemen for their assistance. Several other naturalists were present, from time to time, and coöperated with our party in various ways.

The dredging operations in the shallow waters of Vineyard Sound and Buzzard's Bay were carried on at first by means of a sail-boat, but during the greater part of the time by means of a steam-launch. The dredgings outside of these waters, and off Martha's Vineyard, were all done by means of a United States revenue-cutter, the steamer Moccasin, under command of Captain J. G. Baker. Our thanks are due to the officers of the Moccasin, who were very courteous, and gave us all the facilities within their power for carrying out our investigations successfully. Without this important assistance we should have remained in complete ignorance of the temperature and peculiar fauna of the deeper waters off this shore, for the localities were too distant to be reached by means of the steam-launch or sail-boats.

The examination of the bottom was done by means of dredges of various sizes, constructed much like those in general use for this purpose; by "rake-dredges" of novel construction, consisting of a heavy A-shaped iron frame, to the arms of which bars of iron armed with long, thin, and sharp teeth, arranged like those of a rake, are bolted, back to back; a rectangular frame of round iron, supporting a deep and fine dredge-net, follows just behind the rake to receive and retain the animals raked from the soft mud or sand by the rake; a trawl-net, with a beam about fourteen feet long, made of stout, iron gas-pipe, and having a net, fine toward the end, about forty feet deep, and provided with numerous pockets; "tangles," consisting of an A-shaped iron frame, to which frayed-out hemp-ropes are attached. The best form has several small chains of galvanized iron attached to the frame by one end, so as to drag over the bottom, and the pieces of frayed-out rope are attached along the sides of the chains.

The ordinary dredges can be used on all kinds of bottom, except where there are rough rocks and ledges, but they generally merely scrape the surface or sink into the bottom but slightly. The rake-dredges are used only on bottoms of soft mud or sand, and are intended to catch burrowing animals of all kinds, which are always numerous on such bottoms. The trawl is adapted for the capture of bottom-fishes, as well as for crabs, lobsters, large shells, and all other animals of considerable size, which creep over or rest upon the bottom. It cannot be used where the bottom is rocky or rough, and does not usually capture many animals of small size, or those that burrow. It is, however, a very important instrument when used in connection with the ordinary dredge, for it will capture those species which are too active to be caught by the dredge, and much greater quantities of the larger species than can be obtained by the dredge alone. The "tangles" are particularly useful on rough, rocky, or ledgy bottoms, where the dredge and trawl cannot be used, but they cannot be depended upon for obtaining all the small species, especially of shells and worms. They capture mainly those kinds of animals which have rough or spiny surfaces, such as star-fishes, sea-urchins, corals, bryozoa, rough crabs, &c., and those kinds which are disposed to cling to foreign objects, such as many of the small crustacea, which are often taken in countless numbers by this means. Star-fishes and sea-urchins are especially adapted to be caught by this instrument, and are often brought up in great quantities. The tangles can be used on all kinds of bottoms, wherever there are any of those kinds of animals which they are adapted to capture.

The localities where dredgings were made by these various instruments were located on Coast Survey charts as accurately as possible, and were sufficiently numerous to give a pretty satisfactory knowledge of the nature of the bottom and its inhabitants throughout the region explored. The total number of casts of the dredges made during the three months devoted to this work was about 400. A large part of these, including all the more important ones, have been located on the map accompanying this report. The more important points where the temperature of the water was observed have also been indicated on the map and the temperatures given, the figures *above* two parallel lines indicating the surface temperature, those *below* such lines indicating the bottom temperature—thus: $\frac{62°}{57}$.

In prosecuting our explorations we soon found that there are, in the waters of this region, three quite distinct assemblages of animal life, which are dependent upon and limited by definite physical conditions of the waters which they inhabit. The first of these includes all those kinds which inhabit the bottom and shores of Vineyard Sound, Buzzard's Bay, and the other similar bodies of shallow water along this coast from

Cape Cod westward and southward. These shallow waters consist of nearly pure sea-water, which has a relatively high temperature, especially in summer, for it is warmed up both by the direct heat of the sun, acting on the shallow waters spread over broad surfaces of sand, and by water coming directly from the Gulf Stream, and bringing not only its heat, but also its peculiar pelagic animals. The temperature at the surface in August was 66° to 72° Fahrenheit. Owing to this influence of the Gulf Stream these waters never become very cold in winter, for some of the small, shallow harbors never freeze over. The greater part of the animals inhabiting these bays and sounds are southern forms.

The second assemblage is a very peculiar one, which inhabits the estuaries, ponds, lagoons, harbors, and other similar places, where the water is shallow and more or less brackish, and very warm in summer, but cold in the winter. The third group inhabits the shores of the outer islands and headlands and the bottoms in moderately deep water, outside of the bays and sounds. These outer waters are comparatively cold, even in summer, and are no doubt derived from an offshoot of the arctic current, which drifts southward along our shores in deep water and always has a tendency to crowd against and up its submarine slopes, in which it is also aided in many cases by the tides. In August, the temperature of the surface was 62° to 65°, of the bottom 57° to 62° Fahrenheit. The animals inhabiting these cold waters are mostly northern in character and much like those of the coast of Maine and Bay of Fundy. The surface waters in the bays and sounds, although usually somewhat warmer in summer than those outside, differ less in temperature than the bottom waters. Consequently we find less difference in the surface animals. We have therefore found it most convenient to group all the surface animals together, as a special division of those inhabiting the bays and sounds. In each of the groups or assemblages we find that certain kinds are restricted to particular localities, depending upon the character of the bottom or shore. Thus there will be species, or even large groups of species, which inhabit only rocky shores; others which inhabit only sandy shores; others which dwell in the muddy places; and still others that prefer the clean gravelly bottoms where the water is several fathoms deep, &c.

I have found it desirable, therefore, in describing the character of the marine life of this region, to group the animals according to the localities which they inhabit, adopting the three primary divisions given above, but, for greater convenience of reference, placing all the parasitic species together in one group. The subdivisions of these groups will be given under each, in the succeeding pages.

The primary groups will stand as follows:

1. The fauna of the bays and sounds.
2. The fauna of the estuaries and other brackish waters.
3. The fauna of the cold waters of the ocean shores and outer banks and channels.

In describing the animals belonging in these different divisions and subdivisions it has not been found desirable to mention, in this part of the report, all the species found in each, but only those that appear to be the most abundant and important, and especially those that are known to serve as the food of fishes. But in the general systematic list, which accompanies this report, all the species of the region, so far as determined, will be enumerated.

II.—THE FAUNA OF THE BAYS AND SOUNDS.

In Buzzard's Bay, Vineyard Sound, Nantucket Sound, and Muskeget Channel, (see map,) the water is shallow, being generally less than 8 fathoms deep, and rarely exceeding 14 fathoms, even in the deepest spots. It will be seen by reference to the map, on which soundings have been given and contour lines drawn, representing the zones having depths below 3, 10, 14, and 20 fathoms, respectively, that the greater part of Buzzard's Bay is less than 10 fathoms deep, and that the 3-fathom curve is nearly parallel with the shore lines, and the same is true of the 6-fathom line, which has not been drawn. The 10-fathom curve is very irregular and only extends a short distance within the mouth of the bay; but an irregular area, in which the water exceeds 10 fathoms in depth, the central part over a limited area being about 15 fathoms, is situated to the west of Penikese, Nashawena, and Cuttyhunk Islands; this is inclosed on all sides by shallower water. The 14-fathom curve is situated from four to eight miles farther off and does not enter the bay at all, showing only a very slight curvature in that direction; yet it extends far up Narragansett Bay, and to a considerable distance within the mouth of Vineyard Sound, but, like the 10-fathom line, does not enter Muskeget Channel or Nantucket Sound at any point, and shows scarcely any curvature toward those waters, which are very shallow throughout their whole extent, and much obstructed by banks and broad shoals of moving sands. The 20-fathom line at nearly all points is situated far off shore, and does not conform at all to the outline of the coast. There is, however, an area of water exceeding this depth off Newport, in the mouth of Narragansett Bay.

Vineyard Sound is deeper and much more varied in its depth and in the character of its bottom than Buzzard's Bay or Nantucket Sound, and therefore its fauna is richer in species and the facilities for collecting are much greater. In Vineyard Sound the 3-fathom curve follows the outlines of the shore very closely, and the same is true of the 6-fathom curve, which has not been represented on the map. The 10-fathom line when it enters the mouth of the sound incloses the greater part of its width and is approximately parallel with its shores, but after it passes the narrowest part of the sound, between the northern end of Martha's Vineyard and Wood's Hole, it rapidly narrows and is finally interrupted by shallows and sand-bars after passing Holmes's Hole, but there are beyond this several isolated areas of water exceeding this depth and having their long axes nearly parallel with the central axis of the channel, or rather parallel with the direction of the tidal currents. One of these areas, south of Osterville, Massachusetts, is 15 fathoms deep, but of no great size. These deeper depressions are surrounded by banks and ridges of sand, some of which rise nearly to the surface and form dangerous shoals; the shoals, like the deep channels, have their longer axes parallel with the prevailing tidal currents, but as they are mostly composed of loose moving sands, they are liable to be altered in form and position by severe storms.

These moving sands are generally very barren of life, and form true submarine deserts. Included within and nearly inclosed by the 10-fathom line, there is, between Martha's Vineyard and Naushon Island, a large area of shallower water, which is connected with the shallow water of the shore at the northern end of Martha's Vineyard, off the "West Chop," near Holmes's Hole. In some places this shallow rises nearly to the surface and forms the "middle ground," and other shoals parallel with the current that sets through the channels on either side, and consequently nearly parallel with the shore of Martha's Vineyard. It is evident that this rather extensive bank is due to the action of the tidal current which sweeps around West Chop toward the mouth of the sound, following the direction of the deeper channels, the projecting point at West Chop furnishing a lee in which the movement of the water is retarded and the sediment deposited; but this action is modified by the tidal current which enters the mouth of the sound and flows in the opposite direction, for although this current is somewhat less rapid, its duration is longer, especially that branch of it which flows between the Middle Ground Shoal and Martha's Vineyard, for this flows eastward seven hours and twenty-six minutes, while the opposite current flows westward for only four hours and thirty-four minutes; the effect of the current flowing eastward would, therefore, be to keep this channel from filling up by the sediments carried along by the westward currents. The same effect would be produced in the main channel, outside of this shoal, although the difference in the duration of the flow in the two directions is there less, the eastward flow lasting six hours and fifteen minutes, while the westward tide lasts five hours and forty-five minutes.

Similar causes determine, without doubt, the position of all the other shoals and banks of sand in this region, as well as the existence of the isolated deep areas between them, but in many cases the direction of the wind-waves produced by the more violent storms must be taken into account. The 14-fathom line extends into the mouth of the sound, as far as a point opposite Nashawena Island; and beyond this there are several isolated areas which are of this depth; the most extensive of these is opposite the southern half of Naushon Island and in a line with the main channel at the mouth of the sound. Since the tides are greater in Buzzard's Bay than in Vineyard Sound, and neither the times of low water and high water, nor the relative duration of the ebb and flow are coincident, very powerful currents set through the passages, between the Elizabeth Islands, connecting these two bodies of water. This is most noticeable in the case of Wood's Hole, because there the channel is narrow and shallow, and much obstructed by rocks. These channels are, therefore, excellent collecting grounds for obtaining such animals as prefer rocky bottoms and rapidly flowing waters.

The shores of Vineyard Sound and Buzzard's Bay are quite diversified and present nearly all kind of stations usually found in corresponding latitudes elsewhere, except that ledges of solid rock are of rare occurrence, but there are numerous prominent points where the shore consists of large rocks or boulders, which have been left by the denudation of deposits of glacial drift, forming the cliffs along the shores. Sandy beaches are frequent, and gravelly and stony ones occasionally occur. Muddy shores are less common and usually of no great extent.

In Buzzard's Bay the bottom is generally muddy, except in very shallow water about some of the islands, where patches of rocky bottom occur, and opposite some of the sandy beaches where it is sandy over considerable areas. Tracts of harder bottom, of mud or sand, overgrown with algæ, occasionally occur. In Vineyard Sound the bottom is more varied. It is sandy over large districts, especially where the shoals occur, and in such places there are but few living animals, though the sand is often filled with dead and broken shells, but in other localities the sand is more compact and is inhabited by a peculiar set of animals. Other extensive areas have a bottom of gravel and small stones and broken shells; on such bottoms animal life is abundant, and the entire bottom seems to be covered in some places by several kinds of compound ascidians, which form large masses of various shapes, often as large as a man's head. In still other places, chiefly off rocky points and in the channels between the islands, rocky bottoms occur, but they are usually of small extent. Muddy bottoms are only occasionally met with. They occur in most of the deep areas which are isolated, and sometimes in the deep channels, but are more common in sheltered harbors and coves.

In Nantucket Sound and Muskeget Channel the bottom is almost everywhere composed of sand, and the same is true of an extensive area to the east and northeast of Nantucket Island, where shoals of moving sand are numerous and often of large size, but in the partially sheltered area on the north side of Nantucket, there is more or less mud mixed with the sand.

For greater convenience the following subdivisions have been adopted in describing the animals of the bays and sounds:

1. Rocky shores, between high-water and low-water marks.
2. Sandy and gravelly shores.
3. Muddy shores and flats.
4. Piles of wharves, buoys, &c.

5. Rocky bottoms below low-water mark.
6. Stony, gravelly, and shelly bottoms.
7. Sandy bottoms.
8. Muddy bottoms.
9. Free-swimming and surface animals.
10. Parasitic animals.

It must, however, be constantly borne in mind that very few kinds of animals are strictly confined to any one of these subdivisions, and that the majority are found in two, three, or more of them, and often in equal abundance in several, though each species generally *prefers* one particular kind of locality. In other cases the habits vary at different seasons of the year, or at different hours of the day and night, and such species may be found in different situations according to the times when they are sought. The more common and characteristic species are, however, pretty constant in their habits and may be easily found in their respective stations at almost any time.

Since those animals that inhabit the shores, between tides, are most frequently seen and can be most easily obtained and studied by those who are not professional naturalists, I have entered into more details concerning their habits and appearances than in the case of those obtained only by dredging. Such species as have not been previously named and described in other works will be more fully described in the systematic list, to follow this report, and references will there be given to descriptions of the others.

II.—1. ANIMALS INHABITING THE ROCKY SHORES OF THE BAYS AND SOUNDS.

The principal localities where these animals were studied and collected are at Nobska Point, just east of Wood's Hole; Parker's Point, between Great Harbor and Little Harbor, near Wood's Hole; the neck of land north of Wood's Hole Channel; several localities on Naushon and the adjacent islands; and numerous localities on the shores of Long Island Sound, as at Savin Rock and Light-House Point, near New Haven; Stony Creek; Thimble Islands, &c.

In all these places the rocks, in a zone extending from near low-water mark of ordinary tides to near half tide, are generally covered with an abundance of "rock-weeds," (*Fucus nodosus* and *F. vesiculosus*,) which hang in great olive-brown clusters from the sides of the rocks or lie flat upon their surfaces when left by the tide, but are floated up by means of their abundant air-vessels when the tide rises. Mingled with these are several other algæ, among which the green "sea-cabbage" (*Ulva latissima*) is one of the most abundant. Below this zone of *Fucus* there is a narrow zone which is only exposed during spring-tides; in this the *Ulva* and many other more delicate green and red algæ flourish. Above the Fucus-zone there is another zone of considerable width which is covered for a short time by every tide; and still higher up another zone which is ordinarily only washed by the waves and spray, but is in part occasionally covered by unusually high tides. As the tides do not rise very high in this region these zones are all much narrower and less distinctly marked than on the coast further north, and especially on the coast of Maine and in the Bay of Fundy, but yet they can always be easily recognized and distinguished by their peculiar forms of animal and vegetable life. Pools of sea-water left by the tide frequently occur in each of these zones, among the rocks, and afford excellent opportunities for studying and collecting the animals.

The animals of rocky shores are to be sought for in a variety of ways. A few occur quite exposed, clinging to the rocks or weeds, in defiance of the surf. These are chiefly univalve shells, barnacles, and such animals as grow like plants, firmly attached to solid objects, among these are the bryozoa, hydroids, and sponges. A much larger number seek shelter under the rocks, or on their lower sides, or in crevices and cavities between them; these must be sought by turning over the rocks and exploring the crevices concealed by the *Fucus*, &c. Many other species conceal themselves still more effectually by burrowing in the mud, gravel, and sand beneath and between the rocks; these are often uncovered in turning over the rocks, but must also be sought for by digging with a spade, stout trowel, or some other tool, in the dirt exposed when the rocks are removed. The number of curious species of annelids, holothurians, bivalve-shells, actiniæ, &c., which can be unearthed in this way is always very surprising to the inexperienced in this kind of collecting. Still other kinds can be found by carefully examining the pools and discovering the smaller animals by their motions, or by the shadows that they cast when the sun shines, or by noticing their burrows, or, if time will not admit of a more careful examination, by sweeping a fine hand-net through the weeds along the edges. Many small crustacea, shells, etc., may also be found clinging to the corallines and other algæ growing in such pools, or even among the algæ lying upon the rocks, and especially among masses of detached algæ, thrown up by the waves.

In the uppermost zone the animals are of comparatively few kinds, but these usually occur in great abundance. The most conspicuous is, perhaps, the common "rock-barnacle" or "acorn-shell," *Balanus balanoides*, which adheres firmly to the rocks by its base and can resist the most violent surf, even on the outer ocean shores. When left by the tide these dull white conical shells are not calculated to attract much attention, except on account of their vast numbers, for they sometimes completely whiten the rocks for long distances along the zone in which they flourish best, and even so crowd against each other that they cannot assume their normal form, but become greatly elongated. But when the tide comes in, each one lifts up the double-door which closes the aperture at the summit of the shell and puts out an organ, bearing a cluster of gracefully curved and fringed arms, which it quickly sweeps forward with a grasping motion and then quickly withdraws, as if in search of food, and this motion will be repeated with great regularity for a long time, unless the creature be disturbed, when it instantly withdraws its net and closes its doors. No one who will take the trouble to examine this little animal, when in active operation in one of the tide-pools, can fail to admire its perfect adaptation to its mode of life and the gracefulness of its motions. The movement referred to serves not only to obtain food, which, in the form of microscopic animals, is always abundant in the water, but also to supply fresh currents of water for respiration. This creature is also well worthy of mention here because it serves as food for the tautog, and probably for other fishes that can obtain it at high water.

Two species of small univalve shells (*Littorina*) are always to be found in abundance clinging to the surface of the rocks, or among the sea-weeds, or creeping about in the tide-pools. These are often found quite up to high-water mark, but the full-grown ones are more common lower down among the "rock-weeds." One of these (Plate XXIV, fig. 138) is subglobular in form, the spire being depressed and the aperture wide. This is the *Littorina palliata*. It varies much in color; the most common color is dark olive-brown, not unlike that of the *Fucus*, but orange-colored and pale yellow specimens are not uncommon, while others are mottled or banded with yellow or orange and brown. The second species is more elongated and has a more elevated and somewhat pointed spire. This is *Littorina rudis*, and it has many varieties of form, color, and sculpture; one of its varieties is represented on Plate XXIV, fig. 137. Some specimens are smooth, others are covered with revolving lines or furrows; in color it is most frequently dull gray, olive-green, or brown, but it is often prettily banded, checked, or mottled with yellow or orange, or even black, and sometimes with whitish. This species is viviparous. These shells are both vegetarians and feed upon the algæ among which they live. Another allied shell, the *Lacuna vincta*, (Plate XXIV, fig. 139,) is found clinging to the sea-weeds at low-water mark and sometimes in the tide-pools. This is usually pale reddish or purplish brown, or horn-colored, and most commonly is encircled by two or more darker, chestnut-colored bands. This also feeds upon the algæ. Associated with the last, two or three other kinds of small shells are generally found. One of the most abundant of these is the *Bittium nigrum*, (Plate XXIV, fig. 154,) which is, as its name implies, generally black, especially when young, but large specimens are often only dark brown or even yellowish brown below; it occurs in great abundance, clinging to the sea-weeds and eel-grass at and below low-water mark, and is also to be found in the tide-pools and on the under sides of rocks. Associated with the last, and resembling it in form and color as well as in habits, another much less common species occurs, which is remarkable for having its whorls reversed, or coiled to the left, in the direction opposite to that of most other shells. This is the *Triforis nigrocinctus*, (Plate

XXIV, fig. 152.) This species is more at home at the depth of a few fathoms, among algæ. Another still smaller and lighter colored species, which often occurs abundantly in similar situations, both on algæ and under stones, is the *Rissoa aculeus*, (Plate XXIV, fig. 141,) but this generally seeks more sheltered situations. All these shells feed upon the algæ. With them there can usually be found large numbers of several carnivorous species. The most abundant one is a small but pretty shell, having a smooth surface and quite variable in color, though usually reddish or purplish brown, and irregularly mottled or banded with yellowish or whitish, the light-colored spots often taking the form of crescents, and varying much in size and number. This is the *Astyris lunata*, (Plate XXI, fig. 110.) It lives among the algæ, and also among hydroids, and may be found in almost all kinds of localities, both above and below low-water mark. It is usually abundant on the under sides of rocks among hydroids, &c., and can nearly always be found in the tide-pools. Another allied species of larger size, and much less common, the *Anachis avara*, (Plate XXI, fig. 109,) often occurs with it. Clinging to the rocks, or sheltered in the crevices and on their under surfaces, a much larger, dull-white or grayish, roughly-sculptured shell can usually be found in abundance. This is the *Urosalpinx cinerea*, (Plate XXI, fig. 116,) which the oystermen call "the drill," a name very suggestive of its habits, for it gets its living, like many other similar univalve shells, by drilling a round hole, by means of the sharp, flinty teeth that cover its tongue, through the shells of oysters and other bivalves and then sucking out the contents at its leisure. It is usually very abundant on the oyster-beds, and often proves very destructive. Another shell of about the same size, somewhat resembling the last, and having similar habits, is often found associated with it on the more exposed rocky points, as at Nobska Point, the Wepecket Islands, &c. This is, however, a very northern and arctic shell, which extends also around the northern coasts of Europe, and is called *Purpura lapillus*, (Plate XXI, figs. 118 and 119;) it is here near its southernmost limits, for it is not not found in Long Island Sound or farther south; while the former is a southern shell, abundant on the whole southern coast as far as the Gulf of Mexico, and rare north of Cape Cod, except in a few special localities of sheltered and warm waters. The *Purpura* is seldom found living much below low-water mark, and prefers the exposed rocky headlands on the ocean shores, where it flourishes in defiance of the breakers. It lays its eggs in smooth, vase-shaped capsules, attached to the sides or under surfaces of stones by a short stalk, and usually arranged in groups, (Plate XXI, fig. 120.) The eggs of "the drill" are laid in similar places, but the capsules have very short stalks, or are almost sessile, and are compressed, with an ovate outline, and angular ridges pass down their sides. The "limpet," another northern and European shell, having a low conical form, is occasionally found clinging to the rocks at low-water in this region, but is far more common north of

Cape Cod. This shell is the *Acmæa testudinalis*, (Plate XXIV, figs. 159, 159*a*;) it is extremely variable in color, but is most commonly radiated, checked, or tesselated with brown, pale greenish, and white. It grows much larger on the coast of Maine than here. A peculiar narrow form of this shell, (var. *alveus*,) represented by fig. 159*b*, lives on the leaves of eel-grass. Beneath the rocks, and generally attached to their under sides, among hydroids, bryozoa, &c., several species of small, slender, pointed, and generally whitish shells occur, which belong to the genus *Odostomia*. The most common of these are *O. trifida*, (Plate XXIV, fig. 145,) *O. bisuturalis*, (Plate XXIV, fig. 146,) and *O. fusca*, (Plate XXIV, fig. 144,) but other similar species are often to be found. These all have the singular habit of spinning a thread of mucus by means of which they can suspend themselves from any surface. In confinement they will often creep along the surface of the water, using the bottom of the foot as a float, in a manner similar to that of many fresh-water shells. On the under sides of rocks are occasionally found some very beautiful and interesting naked mollusks; but this group of animals is far less abundant in this region than farther north. The largest and finest species observed here is the *Doris bifida*, (Plate XXV, fig. 176,) which grows to be about an inch long. Its body is deep purple, specked with white and bright yellow, and the beautiful wreath of gills is covered with bright golden specks; the ends of the tentacles are also bright yellow. Its eggs are contained in convoluted gelatinous ribbons, which are attached to the under sides of rocks or in crevices. Another rare and curious species, the *Doridella obscura*, (Plate xxv, fig. 173,) is occasionally found on the under side of stones. This is a small, oval, flattened species, of a dark brown or blackish color, with small, white retractile tentacles on the back, but the gills are very small and situated underneath, near the posterior end of the body, in the groove between the mantle and foot. The eggs are inclosed in a delicate gelatinous string, which is coiled up something like a watch-spring, and attached to the under side of stones.

Of bivalve shells several species are common on rocky shores, especially in the crevices and under the rocks. Three kinds of muscles are usually met with. The species which lives at high-water mark, clustering about the small upper pools and in the crevices, and having its shell ribbed with radiating ridges and furrows, is the *Modiola plicatula*, (Plate XXXI, fig. 238.) This species is far more abundant, however, along the borders of estuaries and on salt marshes and muddy shores, always preferring the upper zone, where it is covered for a very short time by the tide. The most common species among the rocks, toward low-water mark, and in the larger pools, is the *Mytilus edulis*, (Plate XXXI, fig. 234,) which is the "common muscle" all along our coast from North Carolina to the Arctic Ocean. It is perfectly identical with the common muscle of Europe, which there forms a very important article of food, and in many places, as on the coast of France, is extensively cultivated for the market. On our coast it is seldom used as food, although quite as good as on the European shores; but it is collected on some parts of our coast in vast quantities to be used for fertilizing the soil. It is most abundant in the shallow waters of bays and estuaries, where the water is a little brackish, but flourishes well in almost all kinds of situations where there is some mud, together with solid objects to which it can attach itself. Along the coasts of Long Island and New Jersey it is taken in almost incredible quantities from the shallow sheltered bays and lagoons that skirt those shores. It grows very rapidly and under favorable conditions becomes full grown in one season. Like all other kinds of true muscles, it has the power of spinning strong threads by means of the groove in its long, slender foot, and, by extending the foot, glues them firmly by one end to rocks, shells, or any other solid substances, while the other end is firmly attached to its body. When they attach their threads to their neighbors they form large clusters. Thus a very firm and secure anchorage is effected, and they are generally able to ride out the most violent storms, though, by the giving way of the rocks or shells to which they are attached, many are always stranded on the beaches after severe storms. They are not confined to the shallow waters, for very large specimens were dredged by me, several years ago, in 40 to 50 fathoms in the deep channels between Eastport, Maine, and Deer Island, where the tide runs with great force; and it has since been dredged by our parties in still deeper water in the same region, showing that it can live and prosper equally well under the most diverse conditions. The specimens from sheltered localities and sandy bottoms are, however, much more delicate in texture and more brilliant in color than those from more exposed situations. Some of the thinner and more delicate specimens, from quiet and pure waters, are translucent and very beautifully colored with brown, olive, green, yellow, and indigo-blue, alternating in radiating bands of different widths; while others are nearly uniform pale yellow, or translucent horn-color. Those from the exposed shores are generally thicker, opaque, and plain dull brown, or bluish black, and not unfrequently they are very much distorted. This species breeds early in the spring. I have found immense numbers of the young, about as large as the head of a pin, which had just attached themselves to algæ, hydroids, &c., on the 12th of April. These shells are not destined to remain forever fixed, however, for they not only swim free when first hatched, but even in after life they can, at will, let go their anchor-threads, or "byssus," and creep about by means of their slender "foot," until they find another anchorage that suits them better, and they can even climb up the perpendicular sides of rocks or piles by means of the threads of the "byssus," which they then stretch out and attach, one after another, in the direction they wish to climb, each one being fastened a little higher up than the last. Thus, little by little, the heavy shell is drawn up, much in the manner employed by some spiders when moving or suspending an unusually large victim. This common muscle is not only useful to man directly as food, and as a fertilizer, but it serves as an important article of food for many fishes, both in its young stages and when full grown. The tautog makes many a hearty meal on the full-grown shells, as do several other kinds of fishes, while the "scup" and others devour the young. The common star-fishes feed largely upon muscles, as well as oysters, and they also have many other enemies. A small parasitic crab, *Pinnotheres maculatus*, lives in their shells, between their gills, in the same manner as the common *Pinnotheres ostreum* lives in the oyster. Another larger muscle, sometimes called the "horse-muscle," which is the *Modiola modiolus*, (Plate XXXI, fig. 237,) lives at extreme low-water mark in the crevices between the rocks, and usually nearly buried in the gravel and firmly anchored in its place. Sometimes it occurs in the larger pools, well down toward low-water mark. It is, like the last, a northern species, and extends to the Arctic Ocean and Northern Europe. It is much more abundant on the northern coasts than here, and, although it is almost entirely confined to rocky shores and bottoms, it extends to considerable depths, for we dredged it abundantly in the Bay of Fundy, at various depths, down to 70 fathoms. Like the preceding, it is devoured by the tautog and other fishes. Its thick shell, covered with a glossy, chestnut epidermis, and rudely hairy toward the large end, are points by which it can easily be recognized, and its shape is also peculiar. The common "long clam," *Mya arenaria*, (Plate XXVI, fig. 179) is very often met with buried in the sand and gravel beneath stones and rocks, but it is far more abundant on sandy and muddy shores, and especially in estuaries, and will, therefore, be mentioned with more details in another place.

Another shell, somewhat resembling the "long clam," but never growing so large, and more cylindrical in form though usually much distorted, is occasionally met with under the rocks or in crevices. This is the *Saxicava arctica*, (Plate XXVII, fig. 192.) It is much more abundant farther north, and has a very extensive range, being found on most coasts, at least in the northern hemisphere. On those coasts where limestone exists it has the habit of burrowing into the limestone, after the manner of *Lithodomus* and many other shells. The only localities on our coast where I have observed this habit are at Anticosti Island, in the Gulf of Saint Lawrence, where the soft limestones are abundantly perforated in this way. On the New England coast limestones rarely occur, and they have to be content with such cracks and crannies as they can find ready made; consequently their shells, in growing to fit their places, become very much distorted. This species can also form a byssus, when needed, to hold its shell in position. The siphon-tube is long and much resembles that of *Mya*, (see fig. 179,) but is divided at the end for a short distance, and generally has a reddish color. The "bloody clams," *Scapharca transversa*, (Plate XXX, fig. 228,) and *Argina pexata*, (Plate XXX, fig. 227,) are occasionally met with at low water, under or among rocks, and generally attached by a byssus, but their proper home is in the shallow waters off shore, especially on muddy, shelly, and gravelly bottoms. The fishermen call them "bloody clams," because the gills are red, and when opened they discharge a red fluid like blood. The little shell called *Kellia planulata* (Plate XXX, fig. 226) is also sometimes found under stones at low water. Attached to the sides and surfaces of rocks and ledges along many parts of this coast, young oysters, *Ostrœa Virginiana*, often occur in vast numbers, sometimes completely covering and concealing large surfaces of rocks. But these generally live only through one season and are killed by the cold of winter, so that they seldom become more than an inch or an inch and a half in diameter. They come from the spawn of the oysters in the beds along our shores, which, during the breeding season, completely fill the waters with their free-swimming young. They are generally regarded as the young of "native" oysters, but I am unable to find any specific differences between the northern and southern oysters, such differences as do exist being due merely to the circumstances under which they grow, such as the character of the water, abundance or scarcity of food, kind of objects to which they are attached, age, crowded condition, &c. All the forms occur both among the northern and southern ones, for they vary from broad and round to very long and narrow; from very thick to very thin; and in the character of the surface, some being regularly ribbed and scolloped, others nearly smooth, and others very rough and irregular, or scaly, &c. When young and grown under favorable conditions, with plenty of room, the form is generally round at first, then quite regularly oval, with an undulated and scolloped edge and radiating ridges, corresponding to the scollops, and often extending out into spine-like projections on the lower valve. The upper valve is flatter, smooth at first, then with regular lamellæ or scales, scolloped at the edges, showing the stages of growth. Later in life, especially after the first winter, the growth becomes more irregular, and the form less symmetrical; and the irregularity increases with the age. Very old specimens, in crowded beds, usually become very much elongated, being often more than a foot long, and perhaps two inches wide. In the natural order of things this was probably the normal form attained by the adult individuals, for nearly all the oyster-shells composing the ancient Indian shell-heaps along our coast are of this much-elongated kind. Nowadays the oysters seldom have a chance to grow to such a good old age as to take this form, though such are occasionally met with in deep water. The young specimens on the rocks are generally mottled or irregularly radiated with brown. They were not often met with on the shores of Vineyard Sound, for oysters do not flourish well in that sandy region, though there are extensive beds in some parts of Buzzard's Bay, and a few near Holmes's Hole, in a sheltered pond. The oysters prefer quiet waters, somewhat brackish, with a bottom of soft mud containing an abundance of minute living animal and vegetable organisms. In such places they grow very rapidly, and become fat and fine-flavored, if not interfered with by their numerous enemies. I shall have occasion to speak of the oyster again, when discussing the fauna of the estuaries, &c.

Another shell, related to the oyster and like it attached by one valve to some solid object, is common, adhering to the under sides and edges of rocks near low-water mark. This is the *Anomia glabra*, (Plate XXXII, figs. 241, 242,) and it is often called "silver-shell" or "gold-shell" on account of its golden or silvery color and shining luster; and sometimes "jingle-shell" from its metallic sound when rattling about on the beach with pebbles, &c. This shell, however, does not grow firmly to the rock like an oyster, but is attached by a sort of stem or peduncle, which goes out through an opening in the side of the lower valve; this is soft and fleshy at first, but late in life often becomes ossified, or rather calcified, and then forms a solid plug.

Of the lower classes of Mollusca, several Ascidians and Bryozoa occur under and among the rocks. Among the former the *Molgula Manhattensis* (Plate XXXIII, fig. 250) is the most common. This usually has a subglobular form, especially when its tubes are contracted, and is almost always completely covered over with foreign matters of all sorts, such as bits of eel-grass and sea-weeds, grains of sand, &c. When these are removed its color is dark or pale olive-green, and the surface is a little rough. This species is often attached to the underside of rocks, but is still more frequently attached to sea-weeds and eel-grass, and is sometimes so crowded as to form large clusters. Another species, having some resemblance to the last when contracted, is the *Cynthia partita*, (Plate XXXIII, fig. 246,) but besides the great difference in the tubes and apertures, this has a rougher and wrinkled surface and a rusty color. The specimens that grow on the undersides of stones are often much flattened, as in the figure, but it grows more abundantly attached to the piles of wharves and on shelly bottoms in shallow waters, off shore, and in such places assumes its more normal erect position, and a somewhat cylindrical form. Each aperture is marked with four alternating triangles of flake-white and purplish red. This and the preceding are eaten by the tautog. Most of the other ascidians are much more at home on the bottom, off shore, although some of them sometimes occur at low-water on rocks or in pools.

A delicate and elegantly branched bryozoan, the *Bugula turrita*, (Plate XXXIV, figs. 258, 259,) is often found attached to sea-weeds in the pools, and it is also frequently thrown up in large quantities by the waves, after storms. A smaller kind, with slender, ivory-white, and stellate branches, the *Crisia eburnea*, (Plate XXXIV, figs. 260, 261,) also occurs on the sea-weeds in pools. And with this is a coarser species, which forms calcareous crusts and tubercles, having the surface covered with the prominent tips of the tubes; this is the *Cellepora ramulosa*, and like the *Crisia* it is a northern species, which inhabits also the shores of northern Europe. Still other species of bryozoa occur in these situations. One of the most abundant is *Alcyonidium hispidum*, which forms soft gelatinous incrustations around the stems of *Fucus*. On the under sides of the stones several additional kinds occur, the most common of which is the *Escharella variabilis*, (Plate XXXIII, fig. 256,) which forms broad calcareous crusts, often several inches across, and of some thickness, composed of small perforated cells. While living this species is dark-red or brick-red, but it turns green when dried, and then fades to yellow, and finally to white. It is far more abundant on shelly bottoms, off shore, in 3 to 10 fathoms of water, and in such places often covers every stone, pebble, and shell, over wide areas, and in some cases forms rounded coral-like masses two or three inches in diameter and more than an inch thick.

Crustacea in considerable numbers may also be found upon the rocky shores. Of crabs four or five species are common, concealed under the rocks and in crevices. The "green crab," *Carcinus granulatus*, occurs quite frequently well up toward high-water mark, hiding under the loose stones, and nimbly running away when disturbed. It may also be found, at times, in the larger tidal pools. Its bright green color, varied with spots and blotches of yellow, makes this species quite conspicuous. The common "rock-crab," *Cancer irroratus*, is generally common under the large rocks near low-water mark and often lies nearly buried in the sand and gravel beneath them. This species is usually larger than the preceding, often becoming three or four inches across the shell, and though less active it uses its large claws freely and with force. It can be easily distinguished by having nine blunt teeth along each side of the front edge of its shell or carapax, and by its reddish color sprinkled over with darker brownish dots. This crab also occurs in the pools, where the comical combats of the males may sometimes be witnessed. It is not confined to rocky shores, but is common also on sandy shores, as well as on rocky and gravelly bottoms off shore. It is widely diffused along our coast, extending both north and south, and is common even on the coast of Labrador. Like all the other species of crabs this is greedily devoured by many of the larger fishes, such as cod, haddock, tautog, black-bass, and especially by sharks and sting-rays. Two smaller kinds of crabs are also very abundant under the stones, especially where there is some mud. These are dark olive-brown and have the large claws broadly tipped with black. They are often called mud-crabs on account of their fondness for muddy places. One of these, the *Panopeus depressus*, (Plate I, fig. 3,) is decidedly flattened above, and is usually a little smaller than the second, the *Panopeus Sayi*, which is somewhat convex above. They are usually found together and have similar habits. A third small species of the same genus is occasionally met with under stones, but lives rather higher up toward high-water mark, and is comparatively rare. This is the *Panopeus Harrisii.* It can be easily distinguished, for it lacks the black on the ends of the big claws and has a groove along the edge of the front of the carapax, between the eyes. This last species is also found in the salt marshes, and was originally discovered on the marshes of the Charles River, near Boston. All the species of *Panopeus* are southern forms, extending to Florida, or to the gulf-coast of the Southern States, but they are rare north of Cape Cod, and not found at all on the coast of Maine. They contribute largely to the food of the tautog and other fishes. The lobster, *Homarus Americanus*, is sometimes found lurking under large rocks at low-water, but less commonly here than farther north, as, for instance, about the Bay of Fundy. In this region it lives also on sandy and gravelly bottoms, off shore, but in rather shallow water. It is an article of food for many fishes, as well as for man. Active and interesting little "hermit-crabs," *Eupagurus longicarpus*, are generally abundant in the pools near low-water, and concealed in wet places beneath rocks. In the pools they may be seen actively running about, carrying upon their backs the dead shell of some small gastropod, most commonly *Anachis avara* or *Ilyanassa obsoleta*, though all the small spiral shells are used in this way. They are very pugnacious and nearly always ready for a fight when two happen to meet, but they are also great cowards, and very likely each, after the first onset, will instantly retreat into his shell, closing the aperture closely with the large claws. They use their long slender antennæ very efficiently as organs of feeling, and show great wariness in all their actions. The hinder part of the body is soft, with a thin skin, and one-sided in structure, so as to fit into the borrowed shells, while near the end there are appendages which are formed into hook-like organs by which they hold themselves securely in their houses, for these spiral shells serve them both for shields and dwellings. This species also occurs in vast numbers among the eel-grass, both in the estuaries and in the sounds and bays, and is also frequent on nearly all other kinds of bottoms in the sounds. It is a favorite article of food for many of the fishes, for they swallow it shell and all. A much larger species, belonging to the same genus, but having much shorter and thicker claws, (*Eupagurus pollicaris*,) is also found occasionally under the rocks at low-water, but it is much more common on rocky and shelly bottoms in the sounds and bays. Its habits are otherwise similar to the small one, but it occupies much larger shells, such as those of *Lunatia heros*, *Fulgur carica*, &c. This large species is devoured by the sharks and sting-rays.

The Amphipods are also well represented on the rocky shores by a considerable number of species, some of which usually occur in vast numbers. These small crustacea are of great importance in connection with our fisheries, for we have found that they, together with the shrimps, constitute *a very large part of the food of most of our more valu-*

able edible fishes, both of the fresh and salt waters. The Amphipods, though mostly of small size, occur in such immense numbers in their favorite localities that they can nearly always be easily obtained by the fishes that eat them, and no doubt they furnish excellent and nutritious food, for even the smallest of them are by no means despised or overlooked even by large and powerful fishes, that could easily capture larger game. Even the voracious blue-fish will feed upon these small crustacea, where they can be easily obtained, even when menhaden and other fishes are plenty in the same localities. They are also the favorite food of trout, lake white-fish, shad, flounders, scup, &c., as will be seen from the lists of the animals found in the stomachs of fishes. One species, which occurs in countless numbers beneath the masses of decaying sea-weeds, thrown up at high-water mark on all the shores by the waves, is the *Orchestia agilis* SMITH, (Plate IV, fig. 14,) which has received this name in allusion to the extreme agility which it displays in leaping, when disturbed. The common name given to it is "beach-flea," which refers to the same habit. Its color is dark olive-green or brown, and much resembles that of the decaying weeds among which it lives, and upon which it probably feeds. It also constructs burrows in the sand beneath the vegetable debris. It leaps by means of the appendages at the posterior end of the body.

A much larger species, and one of the largest of all the amphipods, is the *Gammarus ornatus*, (Plate IV, fig. 15,) which occurs in great numbers beneath the stones and among the rock-weed near low-water mark. The males are much larger than the females, and sometimes become nearly an inch and a half long. They cannot leap like their cousins that live at high-water mark, but skip actively about on their sides among the stones and gravel, until they reach some shelter, or enter the water, when they swim rapidly in a gyrating manner back downward, or sideways. But although they can swim they are seldom met with away from the shore or much below low-water mark. The zone of *Fucus* is their true home. This species is abundant on all our shores, wherever rocks and *Fucus* occur, from Great Egg Harbor, New Jersey, to Labrador. Its color is generally olive-brown or reddish-brown, much like that of the *Fucus* among which it lives. The only good English name that I have ever heard for these creatures is that of "scuds" given by a small boy, in reference to their rapid and peculiar motions.

Another smaller species, *Gammarus annulatus* SMITH, frequently occurs under stones in similar places, but usually a little higher up. This is a pale species, having darker bands, with red spots on the sides of the abdomen. Still higher up, *G. marinus* often occurs.

With the *Gammarus ornatus* another, much smaller, light slate-colored amphipod is generally to be found. This is the *Melita nitida* SMITH. Its habits appear to be similar to those of the *Gammari*. Another small species, found in the same situations, is the *Mœra levis* SMITH; this is whitish in color, with black eyes.

Two species of the genus *Amphithoë* also live under rocks at low water, but these, like the other species of this genus, construct tubes in which they dwell. The *Amphithoë maculata* (Plate IV, fig. 16) is much the larger, and constructs large, coarse tubes of gravel, bits of sea-weed, &c., and attaches them in clusters to the under sides of stones. They often leave their tubes, however, and may be found free among the weed or under stones. The color is generally dark green, though sometimes reddish, and there is often a series of light spots along the back, and the whole surface is covered with minute blackish specks; the eyes are red. The second species, *Amphithoë valida* SMITH, is much smaller, being generally less than half an inch long. It is usually bright green in color, and has black eyes. It often lives among the bright green fronds of *Ulva latissima*, and its color is nearly that of the *Ulva*.

Another amphipod, resembling a small *Gammarus*, about half an inch long, and light olive-brown or yellowish brown in color, is sometimes found in large numbers swimming actively about in the larger tidal pools, and occasionally darting into the growing sea-weeds for rest or concealment. This is the *Calliopius læviusculus*. It also often occurs in vast numbers swimming at the surface, far from land, not only in the sounds and bays, but out at sea, as for instance in the vicinity of St. George's Bank and in the Gulf of St. Lawrence, where it is equally abundant. It is devoured in large quantities by numerous fishes. The *Hyale littoralis* occurs near high-water, among algæ, and in pools.

The Isopods are also well represented on the rocky shores. One of the most common is the *Sphæroma quadridentata*, (Plate V, fig. 21,) which bears some resemblance, both in form and habits, to the "pill-bugs,' which live upon the land. This species is found in abundance under stones and rocks, or creeping slowly about among the branches and roots of sea-weeds, on their sides and upper surfaces, from low-water mark nearly up to high-water mark. In color it is exceedingly variable, for no two can be found that are alike; but the colors, consisting of irregular blotches and dashes of dark gray, light gray, slate, greenish, and white, are so blended as to imitate very closely the colors of the barnacles and gray surfaces of the rocks where they live, and no doubt they derive considerable protection from their enemies by these imitative colors. When disturbed they curl themselves up in a ball and fall to the bottom.

Another smaller and much more active species, which has a more slender form, is found in vast numbers creeping actively about over the rocks and barnacles, and especially beneath rocks and drift-wood. This is the *Jæra copiosa*. It is also excessively variable in color, but shades of green, gray, and brown predominate, and cause it to imitate very effectively the surfaces of the rocks covered with small green algæ, where it loves to dwell. It is found nearly up to high-water mark, and has a wide range both northward and southward along the coast.

Another very common and much larger isopod is the *Idotea irrorata*, (Plate V, fig. 23,) which grows to be nearly an inch long. Its colors are extremely varied. Often the general color is dark gray, light gray, dull green, or brownish, thickly specked and blotched with darker, but the colors are often brighter and the markings more definite; not unfrequently a band of white, or yellowish, or greenish, runs along the middle of the back, with perhaps another along each lateral border. This species occurs creeping among the "rock-weeds" and other algæ at low water, in the pools, creeping on the under sides of stones, adhering to eel-grass, and also among floating sea-weeds, away from the shore, and in many other situations. Its colors are generally well adapted for its concealment, by imitating, more or less perfectly, the rocks and weeds among which it lives. Even those with bright green markings are thus protected when living on eel-grass or *Ulva;* the dark, obscurely marked ones when on dead eel-grass or dark *Fucus;* the grays and browns when on stones and among barnacles, &c. This protection is not perfect, however, for they often fall victims to hungry fishes of many kinds.

The *Idotea phosphorea* HARGER, is a closely allied species, which grows even larger. It can easily be distinguished by the tail-piece, which is acute in this, but tridentate in the last, and by its rougher surface and more incised lateral borders. Its colors are similar and equally variable, though they are frequently in larger and more definite spots and blotches, and the light spots are often bright yellow. It is, as its name indicates, decidedly phosphorescent. It lives under the same circumstances as the preceding species, but is much less common in this region, though it is abundant in the Bay of Fundy. It often occurs among the crowded stems of *Corallina officinalis* in the larger tide-pools.

Another related species, the *Erichsonia filiformis* HARGER, (Plate VI, fig. 26,) also occurs among the *Corallina* and other algæ in the tide-pools. This is a smaller species than the two preceding, but is somewhat similar in its colors, which are equally variable and equally adapted for its concealment; in this the colors are more commonly various tints of brown, or dull reddish, or light red, which are well adapted to blend with the colors of the *Corallines*. Quite a different looking creature is the *Epelys montosus*, which is occasionally found concealed beneath stones where there is more or less mud. This species also frequents muddy bottoms, and is pretty effectually concealed by its rough-looking back and the coating of mud and dirt that always adheres to it.

Clinging to the hydroids and delicate algæ on the under sides of stones, and in tide-pools, curious slender-bodied crustacea belonging to the genus *Caprella* (similar to fig. 20, Plate V) may often be found in considerable numbers, but they are still more abundant on rocky bottoms off shore. They have the habit of holding on firmly by the posterior legs, and extending the body out at an angle, with the long, rough front legs stretched out in various directions. While in these attitudes and at rest they often closely resemble the branches of the hydroids and algæ among which they live, especially as they also imitate them in colors, for all these species are variable in color, being generally gray, with darker specks, when living among hydroids, but often bright red when living among red algæ. This habit of holding themselves stiffly in such peculiar positions recalls the similar habits of many insects, especially some of the Orthoptera and the larvæ of the geometrid moths, and they also recall the larvæ, just named, by their singular mode of climbing actively about among the branches of the hydroids and algæ, for they bend the slender body into a loop, bring the hind legs up to the front ones, and taking hold with them stretch the body forward again, just like those larvæ, though their legs are long and slender and differ widely in structure. These little creatures are very pugnacious and are always ready to fight each other when they meet, or to repel any intruder similar in size to themselves. Their large claws are well adapted for such purposes.

The marine worms or Annelids are very numerous under the rocks between tides, and concealed beneath the surface of the gravel and mud that accumulates between and beneath the stones and in crevices. Many kinds also live in the pools, lurking among the roots of the algæ, burrowing in the bottom, or building tubes of their own in more exposed situations. Many of these annelids are very beautiful in form and brilliant in color when living, while most of them have curious habits and marvelous structures. Several species are of large size, growing to the length of one or two feet. Some are carnivorous, devouring other worms and any other small creatures that they can kill by their powerful weapons; others are vegetarians; but many are mud-eaters, swallowing the mud and fine sand in great quantities, for the sake of the animal and vegetable organisms that always exist in it, as is the case with clams and most of the bivalve shells, and many other kinds of marine animals.

All these Annelids are greedily devoured by most kinds of marine fishes, whenever they can get at them, and, since many of the annelids leave their burrows in the night to swim at the surface, or do this constantly at the breeding season, they make an important element in the diet of many fishes besides those that constantly root for them in the mud and gravel, like the tautog, scup, haddock, &c. The young of nearly all the annelids also swim free in the water for a considerable time, and in this state are doubtless devoured in immense numbers by all sorts of young and small fishes.

One of the largest and most common Annelids found under rocks, burrowing in the sand and gravel, is the *Nereis virens*, (Plate XI, figs. 47–50.) It lives both at low-water mark and at a considerable distance farther up. It grows to the length of eighteen inches or more, and is also quite stout in its proportions. The color is dull greenish, or bluish green, more or less tinged with red, and the surface reflects bright iridescent hues; the large lamellæ or gills (fig. 50) along the sides are greenish anteriorly, but farther back often become bright red, owing to the numerous blood-vessels that they contain. It is a very active and voracious worm, and has a large, retractile proboscis, armed with two strong, black, hook-like jaws at the end, and many smaller teeth on the sides, (figs. 48, 49.) It feeds on other worms and various kinds of marine animals. It captures its prey by suddenly thrusting out its proboscis and seizing hold with the two terminal jaws; then withdrawing the proboscis, the food is torn and masticated at leisure, the proboscis, when withdrawn, acting somewhat like a gizzard. These large worms are dug out of their burrows and devoured eagerly by the tautog, scup, and other fishes. But at certain times, especially at night, they leave their own burrows and, coming to the surface, swim about like eels or snakes, in vast numbers, and at such times fall an easy prey to many kinds of fishes. This habit appears to be connected with the season of reproduction. They were observed thus swimming at the surface in the daytime, near Newport, in April, 1872, by Messrs. T. M. Prudden and T. H. Russell, and I have often observed them in the evening, later in the season. At Watch Hill, Rhode Island, April 12, I found great numbers of the *males* swimming in the pools among the rocks at low-water, and discharging their milt. This worm also occurs in many other situations, and is abundant in most places along the sandy and muddy shores, both of the sounds and estuaries, burrowing near low-water mark. It occurs all along the coast from New York to the Arctic Ocean, and is also common on the northern coasts of Europe.

With the last, in this region and southward, another similar species, but of smaller size, is usually met with in large numbers. This is the *Nereis limbata*, (Plate XI, fig. 51, male.) It grows to the length of five or six inches, and can easily be distinguished by its slender, sharp, light amber-colored jaws, and by the lateral lamellæ, which are small anteriorly and narrow or ligulate posteriorly. Its color, when full grown, is usually dull brown, or smoky brown or bronze-color anteriorly, with oblique light lines on the sides, and often with a whitish border to each ring, which form narrow, pale bands at the articulations; posteriorly the body and lateral appendages are pale red, and the longitudinal dorsal blood-vessel is conspicuous. The male, of which the anterior part is represented in fig. 51, differs greatly from the female in the structure of the middle region of the body, which is brighter red in color, and has the side appendages more complicated and better adapted for swimming. The females agree with the males very well in the form and structure of the head and anterior part of the body, but the middle region does not become different from the anterior, as in the male. Both sexes are often dug out of their burrows, under stones or in the sand, but in such places there are few males in proportion to the females. The males, however, sometimes occur swimming free at the surface in vast numbers. They swim with an undulating motion, and are quite conspicuous on account of the bright red color of the middle region of their bodies. Mr. S. I. Smith observed them swimming in this way, in the daytime, in August, at Fire Island, on the southern side of Long Island, where they occurred in incredible numbers and were eagerly pursued by the blue-fish, which at such times would not take bait. We often caught them in Vineyard Sound, in the evening, at the surface, with towing-nets. These worms must, therefore, contribute largely to the food of many fishes. It is very common on our sandy shores as far south as South Carolina. A third species, *Nereis pelagica*, (Plate XI, figs. 52–55,) is abundant under stones farther north, but in this region is chiefly found on shelly bottoms, in the deeper waters of the sounds. These three species of *Nereis* are called "clam-worms" by the fishermen. Two large species of worms belonging to the genus *Rhynchobolus* (formerly *Glycera*) are often met with in burrows, in the mud beneath stones. These are pale reddish, deep flesh-colored, or dull purplish red, and rather smooth-looking worms, thickest in the middle, and tapering to both ends. They have a large proboscis, armed at the ends with four black, hook-like jaws, and are remarkable for their rapid spiral gyrations. They belong more properly to the muddy and sandy shores, and will, therefore, be mentioned more particularly in another place. They are represented on Plate X, figs. 43–46. *Ophelia simplex* occurs under stones at half-tide, and below.

The *Marphysa Leidyi* (Plate XII, fig. 64) is a large and handsome worm, occasionally met with under stones at low-water mark, but is more common on shelly bottoms in shallow water off shore. It grows to the length of six inches or more, and its body is flattened, except toward the head, where it becomes much narrowed and nearly cylindrical. It is yellowish or brownish red, and brilliantly iridescent. The branchiæ are bright red, and commence at about the sixteenth segment; the first ones have only one or two branches, but farther back they become beautifully pectinated. There are six unequal caudal cirri, the lower lateral ones longest. It is furnished with powerful jaws, and is carnivorous in its habits.

A small but very active worm, *Podarke obscura* V., (Plate XII, fig. 61,) is often found in large numbers beneath stones. These are dark brown or blackish in color, sometimes with lighter bands. They come out at night and swim at the surface in vast numbers. They are also often met with at the surface among eel-grass, in the daytime, in large numbers. A large and very singular worm, which burrows and constructs tubes in the mud and gravel beneath stones, is the *Cirratulus grandis* V., (Plate XV, figs. 80, 81.) This is usually yellowish brown, dull orange, or ocher-colored, and is remarkable for the numerous long, flexible, reddish or orange cirri that arise all along the sides. Another very large and interesting worm, often associated with the last, both among and under rocks, and on muddy shores, is the *Amphitrite ornata*, (Plate XVI, fig. 82.) This worm constructs rather firm tubes out of the consolidated mud and sand in which it resides, casting cylinders of mud out of the orifice. It grows to be twelve to fifteen inches in length. Its color is flesh-color, reddish, and orange-brown to dark brown, and it has three pairs of large plumose or arborescent gills, which are blood-red. The tentacles are flesh-colored, very numerous, and capable of great extension, even to the length of eight or ten inches, and are kept in constant motion in gathering up the materials with which it constructs its tube. Two species of worms, remarkable for their soft bodies filled with bright red blood, which is not contained in special blood-vessels, are also found under stones where there is mud in which they can burrow. The smaller of these is *Polycirrus eximius*, (Plate XVI, fig. 85.) Its tentacles are very numerous, and are extended in every direction by forcing the blood into them, which can be seen flowing along in the form of irregular drops, distending the tubular tentacles as it passes along. The second species is a much larger and undescribed species, remarkable for its very elongated body and for having very singular branching gills on the sides along the middle region; the first and last of these gills are simple or merely forked, but those in the middle are divided into numerous branches; and in either case each branch is tipped by a cluster of setæ. In allusion to this remarkable feature I have called it *Chætobranchus sanguineus*. Its tentacles are like those of the last species, but longer and more numerous; in full-grown specimens they can be extended twelve to fifteen inches or more. Its color is blood-red anteriorly, but more or less yellowish at the slender posterior part. It is very fragile and it is seldom that a large specimen can be obtained entire. It grows to be twelve to fifteen inches long. This, like the three species last mentioned, feeds upon the minute organisms contained in the mud, which it swallows in large quantities. Two species of *Lumbriconereis* are, also, frequently found burrowing in the mud and sand beneath stones, but they belong more properly to the muddy shores. They are long, slender, reddish, and brilliantly iridescent worms, readily distinguished by having a smooth, blunt-conical head, without tentacles. They are carnivorous and have complicated jaws. The head and anterior part of the body of the larger species (*L. opalina* V.) is represented in Plate XIII, figs. 69, 70. The other (*L. tenuis* V.) is very slender, thread-like, nearly a foot long, and has no eyes.

There are several kinds of highly organized annelids which may be found adhering to the under side of stones or concealing themselves in crevices. Among these are three species, which have the back covered with two rows of large scales. One of these, having twelve pairs of nearly smooth scales, is the *Lepidonotus sublevis* V., (Plate X, fig. 42;) the color is variable, but usually brown or grayish, with darker specks, thus imitating the color of the stones. Another more common species is the *Lepidonotus squamatus*, (Plate X, figs. 40, 41,) which also has twelve pairs of scales, but they are rough, and covered with small rounded or hemispherical tubercles; this is usually dark brown. The third species has sixteen pairs of smooth scales, and belongs to another genus. This is *Harmothoë imbricata;* it varies exceedingly in color, but is usually grayish or brownish, more or less specked, blotched, or striped with blackish; sometimes there is a black stripe along the middle of the back; sometimes the general color is dark reddish. These three species of scaly worms all have a large proboscis with four powerful jaws at the end, and a circle of papillæ, as in figs. 40 and 41; they are carnivorous in their habits and rather sluggish in their movements. When disturbed they curl themselves up into a ball. They are very complicated in their appendages, and the spines and setæ of these appendages are very curious in structure, when examined with a microscope. Notwithstanding their numerous sharp spines they are often devoured by fishes, and they frequently also fall victims to their more powerful companions belonging to the Nereis tribe, and are sometimes destroyed even by the apparently inoffensive Nemerteans. Adhering to the under sides of the rocks and stones there are several kinds of tubes constructed by annelids. One of the most common and abundant kinds of these tube-dwelling worms is the *Sabellaria vulgaris* V., (Plate XVII, figs. 88, 88*a*.) This worm constructs firm and hard tubes out of fine sand and a cement secreted by special glands. These tubes are bent and twisted in various directions and are generally united together into masses or colonies, sometimes forming aggregations of considerable thickness and perhaps several inches or a foot across. The tubes of this worm are also common on the shells of oysters. Another very curious and beautiful worm, the *Scionopsis palmata* V., constructs much larger and coarser tubes out of bits of sea-weeds and shells, sand, small pebbles, and other similar materials; these tubes are long and crooked and attached for their whole length to the under side of rocks. The worm that constructs them has some general resemblance to the *Amphitrite ornata*, but is seldom more than three or four inches long and is usually darker colored, the color being generally reddish brown or dark brown, more or less speckled with white. There are only seventeen fascicles of setæ on each side. The gills are only three in number, viz: an odd median one, much larger than the others, placed just behind the tentacles; and a pair of smaller ones, but similar in form and just back of the first; all three gills have a stalk or peduncle, and branch toward the end in a palmate or digitate manner, each of the divisions again subdividing. The gills can be retracted beneath a sort of collar which arises just behind them; their color is greenish, specked with white. The gills of this worm are very elegant in form, and quite unlike those of any other known species, both in position and form. Therefore it is necessary to establish a new genus for this species. It has been found from Vineyard Sound to New Jersey; both among eel-grass in shallow water, and under stones. The *Nicolea simplex* is a related species, with similar habits.

The crooked, round, calcareous tubes made by *Serpula dianthus* V., are often to be found adhering to the under surfaces and sides of stones near low-water mark, and also in the pools in more exposed situations; sometimes they are even aggregated together into masses. When disturbed the worm suddenly withdraws its beautiful wreath of gills into its tube and closes the aperture closely by means of a curious plug or operculum. This is placed at the end of a rather long pedicle, and is funnel-shaped, the outside longitudinally striated and the edge bordered by about thirty sharp denticles; from the middle of the upper side another smaller, short, funnel-shaped process arises, the edge of which is divided into twelve or thirteen, long, rather slender, rigid processes, which are usually a little curved inward at the top, but may be spread apart in a stellate form. A small, rudimentary, club-shaped operculum exists on the other side. When these tubes are placed in sea-water and left undisturbed for a short time, the occupant will cautiously push out its operculum and display its elegant wreath of branchiæ, which varies much in color in different specimens, but often recalls the varied hues and forms of different kinds of pinks, (*Dianthus*.) The name which I have given to it alludes to this resemblance. Fine specimens of this *Serpula* may often be found, also, in the pools near low-water mark, attached to the upper surfaces or sides of rocks, and in such situation they display their charms to great advantage. The wreath of branchiæ is nearly circular, consisting of two symmetrical parts, each of which is made up of about eighteen pectinate branchiæ; these are covered on their inner surfaces with slender filaments which extend nearly to the ends, but leave the tips naked. Young specimens have fewer branchiæ. In the more common varieties these branchiæ are purple at base, with narrow bands of light red or pale yellowish green; above this they are transversely banded or annulated with purplish brown, alternating with yellowish green, or with purple and white; the pinnæ usually correspond in color to the part from which they arise, but are sometimes all purple. In other specimens the branchiæ are yellowish white, or greenish white, banded with brown. In one variety (*citrina*) they are bright lemon-yellow, or orange-colored, throughout. The operculum, in all the varieties, is usually brownish green above, with the sides purplish brown, lined with whitish near the edge, and with a greenish white band at the base; the pedicle is usually purplish, with two or more bands of white. The body is usually deep greenish yellow, with the back lemon-yellow; the collar is broad with an undulated border, and is pale green, veined with darker green blood-vessels. This species is also often met with in dredging on shelly bottoms.

The *Potamilla oculifera* (Plate XVII, fig. 86) is another beautiful annelid, related somewhat to the *Serpula*, but its tubes are tough and flexible; they are constructed out of fine sand and other foreign matters, glued firmly together with the special secretions of the animal. These tubes are often found attached to the under sides of stones, but, passing around to the sides, open upward by a free extremity; they also frequently occur in sheltered nooks in the tide-pools. The worm, when undisturbed, puts out a beautiful wreath of branchiæ somewhat resembling that of the *Serpula*, but there is no operculum. The branchiæ are always beautifully colored, though the colors are quite variable. In one of the commonest styles of coloration, the branchiæ are surrounded at base with reddish brown; above this with a ring of white; next by a band of reddish brown; then for the terminal half the color is yellowish gray, with indistinct blotches of brown; on the outer sides of the branchiæ there are one to three dark red eyes. There are ten or more branchiæ in each half of the wreath, and they are longer on one side than on the other.

Another related species, the *Sabella microphthalma* V., also occasionally occurs in the pools and on the under sides of stones, constructing tubes very much like those of the last species. This is a much shorter and stouter worm, with the branchial wreath relatively much larger and nearly half as long as the body. The branchiæ are pale yellowish, greenish, or flesh-color, with numerous transverse bands of darker green extending to the pinnæ; on the outer side of the branchiæ there are numerous minute eye-like spots of dark brown, arranged in two rows on each. The body is usually dull olive-green. The *Fabricia Leidyi* V., is another member of this group of worms, but is of very minute size. It constructs delicate, flexible tubes, free toward the end, which usually stands upright. Its tubes may be found in the pools and on the under side of stones. The worm itself is very small, slender, and when undisturbed protrudes a wreath, composed of six branchiæ, to a considerable distance above the mouth of the tube. The branchiæ have five to seven pinnæ on each side, the lowest much the longest, so that when expanded they all reach nearly to one level. At the base of the branchiæ there are two pulsating vesicles, alternating in their beats; and just back of these there are two minute brown eye-specks; two similar eyes exist at the posterior end. Eleven segments of the body bear fascicles of setæ. Color yellowish white, the blood-vessels red.

Two or more species of the minute but beautiful worms belonging to the genus *Spirorbis* are found attached to the fronds of sea-weeds, to shells, stones, &c., especially in the pools. These are related to the *Serpula*, and like it form solid calcareous tubes, but these are always coiled up in a close spiral, and the coil is attached by one side. The little worms put out an elegant wreath of branchiæ, and are furnished with an operculum. Another very interesting and beautifully colored worm, sometimes found under and among the stones, where there is mud, is the *Cistenides Gouldii* V., (Plate XVII, figs. 87, 87*a*.) This constructs very remarkable, conical, free tubes, of grains of sand arranged in a single layer, like miniature masonry, and bound together by a water-proof cement. This worm belongs more properly to the muddy and sandy shores and will be mentioned again.

Under stones and decaying sea-weeds, near high-water mark, two or more kinds of small slender worms are usually found in great numbers; these differ widely from all those before mentioned, and are more nearly related to the common earth-worms of the garden. One of these is white, slender, and about an inch long, tapering to both ends. This is *Halodillus littoralis* V., apparently forming a new genus allied to *Enchytræus*. Another is of about the same size, but rather longer and more slender, and light red in color. It has a moniliform intestine, with a red blood-vessel attached to it above and below. It belongs apparently to the genus *Clitellio*, (*C. irroratus* V.)

In addition to all these setigerous *Annelids* which have been enumerated, there are quite a number of worms to be found on the rocky shores which are destitute of all these external appendages, and have the surface of the body smooth and ciliated. There are two tribes of such worms: in one of them the body is much elongated, and either roundish, or flattened, and usually very changeable in form and capable of great extension and contraction. These are known as *Nemerteans*; most of them have a proboscis which they can dart out to a great length. In the other group, known as *Planarians*, the body is broad, short, and depressed, and often quite flat, and their internal structure is quite different.

One of the largest of the Nemerteans, the *Meckelia ingens*, (Plate XIX, figs. 96, 96*a*,) is met with under stones where there is sand, but it belongs properly to the sandy shores. It is an enormous, smooth, flat worm, yellowish, flesh-colored, or whitish, and sometimes grows to be ten or twelve feet long and over an inch wide. The *Meckelia rosea* also occurs occasionally in similar places. This is similar in form, but is smaller, less flattened, and decidedly red in color. It is often covered by adhering sand. Another species, belonging to the Nemerteans, is often found in great abundance under stones from mid-tide to near high-water mark. Many of them are often found coiled together in large clusters. This is the *Nemertes socialis*; it is very slender or filiform, and often five or six inches long when extended. Its color is dark ash-brown or blackish, a little lighter beneath, and it has three or four eyes in a longitudinal group on each side of the head. Another larger species, apparently belonging to the genus *Cerebratulus*, but not sufficiently studied while living, is also abundant under stones. It is much stouter and is usually dark olive-green, brownish-green, or greenish-black in color, but a little lighter below and at the borders of the head. Several other small Nemerteans occur under similar circumstances. In the pools, creeping over and among the algæ and hydroids, a yellowish or light orange-colored species, one or two inches long, is often met with. This species secretes an unusual amount of mucus, which is, perhaps, connected with its climbing habits, and I have on this account named it *Polinia glutinosa* V., (Plate XIX, fig. 97.) It varies in the number of its eyes, according to its age, but they are always grouped in oblique clusters as in the figure.

The color is sometimess bright orange anteriorly, but lighter posteriorly, with a faint dusky or greenish line along the middle.

Another species, closely resembling the last in form, color, and size, is quite common under stones, and especially in dead tubes of *Serpula*, near low-water mark. This is the *Cosmocephala ochracea* V., (Plate XIX, figs. 95, 95*a*;) it has numerous eyes on the sides of the head, three or four on each side forming an anterior row parallel with the margin; the others forming two parallel oblique groups, usually with two or three eyes in each, farther back. On the lower side of the head there is, on each side, an obliquely transverse groove. The color is usually dull yellowish-white or grayish; the anterior part is often tinged with orange and the posterior with ash-gray; there is generally a distinct paler median line, most distinct anteriorly. It grows to be two or three inches long, when extended.

Of the Planarians several species are also found creeping over the under side of stones and in the tide-pools. One of the most abundant is *Procerodes frequens*, which is a very small but lively species, found creeping on the under side of stones near high-water. It is usually about an eighth of an inch long, dark brown or blackish above and gray below, and it has two reniform eyes. The *Monocelis agilis* is still smaller, elliptical, with only one median eye; its color is dark brown or blackish. By some writers this genus is placed among the Nemerteans. Two larger species of this group are also occasionally found on the under side of stones. One of these, the *Planocera nebulosa*, (Plate XIX, fig. 100,) is usually about half an inch wide and three-fourths long, but may become nearly circular, or may extend into a long elliptical form. It is flat and thin, with flexuous edges. Its color is olive-green above, with a lighter median stripe behind, and yellowish green below. The tentacles on the back are whitish and retractile.

The *Stylochopsis littoralis* V., (Plate XIX, fig. 99,) is also frequently found on the under side of stones. It is remakable for having a cluster of eyes on each tentacle, other clusters in front of them, and two or more rows of eye-spots around the margin, especially in front. Its color is variable, but usually greenish, greenish yellow, or brownish yellow, often reticulated with flesh-color; there is generally a pale median streak posteriorly. The eggs were laid July 12th in large clusters, composed of many small white eggs closely crowded together, side by side, and attached to the surface of the glass jar in which they were kept.

There are also representatives of the "round worms," or Nematodes, to be found beneath the stones and among the roots of algæ, hydroids, &c. The commonest of these is, perhaps, the *Pontonema marinum* (Plate XVIII, fig. 94.) This is a small, very slender, smooth, white, round worm, tapering to both ends, and very active in its movements, constantly coiling itself into a spiral and again uncoiling itself. Its head is furnished with about six minute cirri; in the male the tail is short, narrow, nearly straight, but one-sided, rapidly tapering. and subacute; in the female the body is much longer, and the tail is long, slightly tapered, straight, and obtuse. The *Pontonema vacillatum* also occurs in similar places in abundance. In this species the male has a short, obtuse, incurved tail; the female a straight, tapering, narrow, obtuse one. Both species are oviparous, and the female genital orifice is near the middle of the body. These worms are from a quarter to half an inch or more in length. Their complete history is not known; they are closely allied to many of the parasitic worms, and it is possible that in some stages of their development these are also parasites.

Of the Radiates there are also numerous species to be found on these rocky shores.

Although the purple "sea-urchin," *Arbacia punctulata*, and the green "sea-urchin," *Strongylocentrotus Dröbachiensis*, (Plate XXXV, fig. 268,) are sometimes met with, their occurrence is irregular and uncertain at low-water in this region. The former occurs in abundance on rocky and shelly bottoms in the sounds; while the latter occurs chiefly on similar bottoms in the cold area, and at low-water on the outer rocky shores, and still more abundantly farther north.

The green star-fish, *Asterias arenicola*, (Plate XXXV, fig. 269,) is found in large numbers at low-water among the rocks at certain times, but at other times is seldom met with, though a few young specimens can almost always be found by careful search beneath the stones. The adults were very abundant on the shore at Parker's Point, in the latter part of June; but by the middle of July very few could be found there. Their habit of coming up to the shore may be connected with their reproductive season. They are always abundant on shelly bottoms in the bays and sounds, especially where there are beds of muscles or oysters, upon which they feed. They often prove exceedingly destructive of oysters planted in waters that are not too brackish for their comfort. They manage to eat oysters that are far too large for them to swallow whole, by grasping the shell with their numerous adhesive feet, and then, after bending their five flexible rays around the shell so as partly to inclose it, they protrude the lobes and folds of their enormous saccular stomach from the distended mouth, and surrounding the oyster-shell more or less completely with the everted stomach they proceed to digest the contents at leisure, and when the meal is finished they quietly withdraw the stomach and stow it away in its proper place. In this way a large "school" of star-fishes will, in a short time, destroy all the oysters on beds many acres in extent, unless their operation be interfered with by the watchful owners. In one instance, within a few years, at Westport, Connecticut, they thus destroyed about 2,000 bushels of oysters, occupying beds about 20 acres in extent, in a few weeks, during the absence of the proprietor.

In order to stop their operations it is necessary to dredge over the oyster-grounds and destroy all the star-fishes thus brought up, by leaving them on shore above high-water mark; for if simply torn in pieces and thrown overboard, as is sometimes done, each ray has the power of reproducing all the lost parts, so that each fragment may, after a time, become a perfect star-fish.

The color of this species is generally dark green or brownish green, with the madreporic plate bright orange; the males are more inclined to brown, and sometimes have a reddish tint. It is found all along the coast from Massachusetts Bay to Florida.

The eggs of this species, like those of most other star-fishes, produce peculiar larvæ, entirely unlike the parents, and provided with vibrating cilia by means of which they swim about in the water, or at the surface, for a considerable time. The young star-fish develops within the larva and gradually absorbs the substance of the larva into its own organization.

The development of this and our other common species has been very fully described and illustrated by Mr. A. Agassiz.

Of the Hydroids many species occur in the pools, or attached to the lower sides of overhanging rocks, or of stones that have an open space beneath them, or growing upon the *Fucus* and other sea-weeds at low-water mark. The most abundant of all is the *Sertularia pumila*, (Plate XXXVII, fig. 279,) which grows in small tufts of delicate branches on the stems and fronds of all the larger sea-weeds, and on the sides and lower surfaces of stones. Another beautiful species, the *Obelia commissuralis*, (Plate XXXVII, fig. 281,) occurs at low-water mark and in tide-pools, attached to stones and sea-weeds. It is very delicate and much branched, and sometimes grows five or six inches high, though usually smaller. At certain times it produces small medusæ in its urn-shaped reproductive capsules; these are discharged and swim free for some time, having sixteen tentacles when they become free. Several other species of this genus also occur attached to the sea-weeds at low-water. The most common of these is *O. diaphana*, which grows about an inch high, attached to the stems of *Fucus*. The *Campanularia flexuosa* is another similar hydroid, remarkable for its large reproductive capsules, in which medusæ are developed that never become free. This species occurs in the pools at low-water, on weeds and stones, and also on the lower sides of overhanging rocks or the timbers of wharves. It is much more abundant farther north, as at Eastport, Maine, where it grows in profusion on the timbers of the wharves, hanging down from their lower sides, collapsed and dripping, while the tide is low. The *Pennaria tiarella* (Plate XXXVII, figs. 277, 278) is a very conspicuous and beautiful species on account of its much-divided black branches and numerous bright red flower-like hydroids. It occurs occasionally in the pools, and just below low-water mark, attached to stones, corallines, &c., but is more common in somewhat deeper water on rocky and shelly bottoms. The "file-fish" feeds on this species, and probably on other allied hydroids, for its stomach was found full of the stems and branches, cut up in fine pieces. Its broad, sharp-edged jaws are admirably adapted for browsing on hydroids, but yet this may not be its principal food, for our observations were very few on this fish, owing to its rarity. One of the most interesting of the hydroids, found in the rocky pools at low-water, or in other shaded places, is the *Hybocodon prolifer*, (Plate XXXVIII, fig. 282.) This is one of the largest and most beautiful of the tubularians, and is very conspicuous on account of its deep orange-red color. It is by no means common, and grows only in those pools where the water is pure and cool, or under the shade of overhanging rocks. It usually grows singly or in groups of two or three clustered together. The delicate hydrarium of *Bougainvillia superciliaris* (Plate XXXVII, fig. 276) is also occasionally met with in the larger tide-pools near low-water mark, and the small, free medusæ, which are produced by budding from the hydrarium, are frequently found swimming in the waters in spring. The *Clava leptostyla* is a beautiful and apparently soft and tender species, but it grows in clusters on the fronds of *Fucus* at low-water mark, on the most exposed shores, and withstands the most powerful surf, unharmed. The colonies are bright light red in color and consist of numerous hydroids arising from creeping stolon-like tubes, which interlace to form the base of the colony. Each of the hydroids consists of a cylindrical stem, slender at base and about a quarter of an inch high, at the end of which there is a thicker, club-shaped or fusiform "head," covered with about fifteen to thirty, long, slender tentacles, but the form both of the heads and tentacles is constantly changing, owing to their contractions. The small medusa-buds are grouped in clusters below the tentacles and do not become free. This species is also to be found in the pools and on the under sides of large stones close to low-water mark.

The *Hydractinia polyclina* is often met with covering the dead shells inhabited by the hermit-crabs, whether in the pools or in deeper water off shore, with a soft, velvet-like, reddish coating, which is made up of hundreds of hydroids united together by their bases into a rather firm, continuous layer, covered with conical points. This basal layer sometimes not only entirely covers the shell, but extends out considerably beyond the borders of the aperture, so as to increase the capacity of the interior. This is no doubt a great gain to the crab, because he will not be so soon compelled to exchange his shell for a larger one. Each colony of these hydroids is either male or female; the sexes differ in depth of color, the male colonies being palest. But in each colony there are also many sterile individuals, who have to do the eating and digesting for the whole community, while the sexual individuals attend to the reproduction of the race. Farther north, as at Nahant, Massachusetts, this species often incrusts broad surfaces of the rocks in the pools, but I have not observed it growing in this way south of Cape Cod; yet in one instance we dredged it growing on a rock.

The *Halecium gracile* V. is frequently found growing in profusion on the under side of stones, in tide-pools, and attached to oysters, dead shells, &c., in shallow waters, both of the sounds and estuaries. It forms rather dense, pale, flexible tufts, three or four inches high, with very numerous slender branches.

Of Polyps there are several species belonging to the actinians, or "sea-anemones," and one species of genuine coral, (*Astrangia*,) but the latter is seldom found at low-water, though common in shallow water, on rocky bottoms. The most common of the actinians is the "fringed sea-anemone," *Metridium marginatum.* This may almost always be found on the under sides of large stones that have sufficient space beneath, in sheltered crevices near low-water mark, and adhering to the rocks along the borders of the larger tide-pools, where they are shaded and protected by the overhanging sea-weeds. In full expansion this species has a very graceful form. From the expanded base the body rises in the form of a tall, smooth column, sometimes cylindrical, sometimes tapering slightly to the middle, and then enlarging to the summit. Toward the top the column is surrounded by a circular thickened fold, above which the character of the surface suddenly changes, the skin becoming thinner and translucent, so that the internal radiating partitions are visible through it. This part expands upward and outward to the margin, which is folded into numerous deep undulations or frills, and everywhere covered with very numerous, fine, short, crowded tentacles. The tentacles also cover the upper side of the disk, half way to the mouth, but are larger and less crowded in proportion to the distance from the margin. The mouth is oval and the lips divided into numerous folds. The largest specimens are sometimes five or six inches high and three or four inches across the disk. The colors are extremely variable. Most frequently the sides of the body are yellowish brown or orange-brown, but it may be of any shade from white, flesh-color, pink, salmon, chestnut, orange, yellow, light brown, to dark umber-brown; or it may be mottled and streaked with two or more of these colors. The upper part of the body and tentacles are translucent, and have lighter colors, generally either white, pink, flesh-color, or pale salmon; the tentacles are also frequently banded with flake-white, and often have dark tips. This species, when much irritated, throws out from minute loop-holes along the sides large numbers of long, slender, white threads, which are covered with microscopic stinging-organs, powerful enough to defend them from the attacks of fishes and other enemies; but they do not penetrate the human skin.

Another species, the "white-armed anemone," *Sagartia leucolena*, (Plate XXXVIII, fig. 284,) is also common at low-water, especially on the under side of large stones, and sometimes nearly buried in sand and gravel. This is more elongated and slender than the last, and has a smaller, simple and plain disk, with the tentacles much longer and more slender, and crowded together near the margin; the surface of the body is smooth and uniform, without any thickened fold. The color is usually pale salmon or flesh-color, and the skin is translucent, so as to show the internal lamellæ; the tentacles are paler and more translucent, and usually whitish, but sometimes pale salmon. The tentacles, in full expansion, are over an inch long. A second elongated species of *Sagartia* (*S. modesta*) occurs buried up to its tentacles in the gravel and sand among rocks. This species is quite rare, and has a much thicker and firmer skin, which is nearly opaque and dull yellowish in color; the tentacles are shorter, with dark greenish markings at the base.

The *Halocampa producta* (Plate XXXVIII, fig. 285) also occurs under the same circumstances with the last, though it may also be found on sandy shores, slightly attached to a shell or pebble, perhaps a foot beneath the surface, but in expansion it stretches its body so as to expand its tentacles at the surface, above its burrow, into which it quickly withdraws when disturbed. This species is remarkable for the great length and slenderness of its body in full extension; for having only twenty tentacles, with swollen tips; and for the rows of suckers along the sides, to which it fastens grains of sand, &c. It has no distinct disk at the base, which is bulbous and adapted for burrowing Its color is whitish, flesh-color, or pale salmon, with the suckers whitish. The tentacles usually have darker brown tips, but sometimes the tips are flake-white. In full expansion the length of large specimens is about a foot, and the diameter about a third of an inch, but in contraction the body becomes much shorter and more swollen.

The *Astrangia Danæ*, which is the only true coral yet discovered on the coast of New England, is occasionally found on the under side of overhanging rocks, or in pools where it is seldom or never left dry. The coral forms incrusting patches, usually two or three inches across, and less than half an inch thick, composed of numerous crowded corallets, having stellate cells about an eighth of an inch in diameter. The living animals are white, and in expansion rise high above the cells and expand a circle of long, slender, minutely warted tentacles, which have enlarged tips. These coral-polyps, when expanded, resemble clusters of small, white sea-anemones, and like them they will seize their prey with their tentacles and transfer it to their mouths. They feed readily, in confinement, upon fragments of mollusca or crustacea.

Several species of sponges also occur in the rocky pools and on the under sides of stones. The most conspicuous one is a bright red species, which forms irregular crusts, and rises up in the middle into many small, irregular, lobe-like branches. Another species forms broad, thin incrustations, of a sulphur-yellow color, on the under side of stones. These species have not been identified. A small, urn-shaped or oval species, with a large aperture at the summit, surrounded by a circle of slender, projecting spicula, occurs in the pools, and is probably the same as the *Grantia ciliata* of Europe.

In addition to the numerous species already enumerated, most of which belong to groups that are essentially marine animals, there are a few species of marine insects that are frequently met with under stones, or among the small green algæ. Among these a small lead-colored insect belonging to the family of "spring-tails," *Anurida maritima*, is the most abundant. With it a spider, *Bdella*, and several species of mites (*Trombidium*) are often found. Several specimens of a "false scorpion," *Chernes oblongus*, were also found by Mr. Smith near low-water mark under stones. In the pools and on the rocks, among the green confervæ and other sea-weeds, the active green larvæ of a two-winged fly, *Chironomus oceanicus*, is often found in abundance. This larva we have detected in the stomach of the "tom-cod," mixed with small crustacea.

List of species inhabiting the rocky shores of the sounds and bays.

In the following list the species living in these situations are brought together systematically, whether mentioned in the preceding pages or not. The lists are not to be regarded as complete, but include most of the species ordinarily met with. The references are to the pages of this report, where remarks upon the species may be found:

ARTICULATA.

Insects.

	Page.
Chironomus oceanicus	331
Anurida maritima	331
Chernes oblongus	331
Bdella marina	331
Trombidium, several species	331

Crustacea.

	Page.
Cancer irroratus	312
Panopeus depressus	312
P. Sayi	312
P. Harrisii	313
Carcinus granulatus	312
Eupagurus pollicaris	313
E. longicarpus	313
Homarus Americanus	313
Orchestia agilis	314
Hyale littoralis	315
Calliopius læviusculus	315
Gammarus ornatus	314
G. annulatus	314
G. Marinus	314
Mœra levis	315
Melita nitida	314
Amphithoë maculata	315
A. valida	315
Caprella, sp	316
Sphæroma quadridentata	315
Idotea irrorata	316
I. phosphorea	316
Erichsonia filiformis	316
Epelys montosus	
Jæra copiosa	315
Balanus balanoides	304
Numerous small Entomostraca.	

Annelids, (Chætopods.)

Oligochæta.

Nemerteans.

Planarians.

Nematodes.

MOLLUSCA.

Gastropods, (Univalves.)

Lamellibranchs, (*Bivalves.*)

Ascidians.

Bryozoa, (*or Polyzoa.*)

RADIATA.

Echinoderms.

Acalephs.

Polyps.

PROTOZOA.

Sponges.

II.—2. FAUNA OF THE SANDY SHORES OF THE BAYS AND SOUNDS.

These sandy shores vary considerably in character according to their situations and composition. In the more exposed positions the beaches of fine loose sand differ but little in character from those that prevail so extensively on the ocean shores, from Cape Cod to North Florida. In more sheltered situations there is generally more or less mud mixed with the sand, which often forms shores with a very gentle slope, running down to broad flats, bare at low-water; such flats of sandy mud are the favorite homes of large numbers of burrowing creatures; but even on the exposed beaches of loose siliceous sand, which are completely torn up and remodeled by every storm, there are still to be found many kinds of animals perfectly adapted to such conditions, finding there their proper homes. In other cases there is more or less gravel and pebbles mixed with the sand, which, under some conditions of exposure, produce a firm and compact deposit, admirably adapted to the tastes and habits of certain tube-dwelling and burrowing creatures. In other places, especially in sandy coves or other sheltered situations, the sandy flats are partly covered by tufts and patches of eel-grass, and there are many animals that find congenial resorts on such flats. Then there will sometimes be pools or rivulets of sea-water on the sandy flats, in which certain creatures often spend the short time while thus imprisoned by the tide.

The special localities where the sand-dwelling species of this region were chiefly studied, are the beaches on Naushon and adjacent islands; Nobska Beach and several other beaches near Wood's Hole; the extensive sand-beach between Falmouth and Waquoit; the beach at Menemsha Bight, on Martha's Vineyard; several beaches on the shores of Buzzard's Bay; the beaches at South End, Savin Rock, and other localities near New Haven; the beaches on Great South Bay, Long Island; the beaches at the mouth of Great Egg Harbor, New Jersey, &c., besides the outer beaches at various other points.

Along the upper part of the sand-beaches there is generally an almost continuous belt of dead sea-weeds, broken shells, fragments of crabs, lobsters, and various other débris cast up by the waves. Although many of the dead shells, &c., which occur in this way, belong really to the sandy shores near low-water, others have come, perhaps, from deeper water and other kinds of bottom. Therefore, although such rubbish-heaps may afford good collecting grounds for those who frequent the shores after storms, it would be useless to enumerate the species that more or less frequently occur in them. Beneath such masses of decaying materials many insects and crustacea occur, together with certain genuine worms. Part of these are truly marine forms, and are never found away from the sea-shores, but many, especially of the insects, are in no sense marine, being found anywhere in the interior where decaying matters abound. The two-winged flies (*Diptera*,) of many kinds, are especially abundant, and their larvæ occur in immense numbers in the decaying sea-weed. Some of these flies are, however, true marine species, and live in the larval state in situations where they are submerged for a considerable time by the tide. I have often dug such larvæ from the sand near low-water mark, and have also dredged them at the depth of four or five fathoms off shore. During unusually high tides immense quantities of the fly-larvæ will be carried away by the encroachment of the waters, and thus become food for fishes of many kinds, and especially for the young ones, which frequent the shallow waters along the shores. There are also many species of beetles (*Coleoptera*) which frequent these places, and several of them are genuine marine insects, living both in the larval and adult conditions in burrows between tides. Among these are two or three species of *Bledius*, belonging to the *Staphylinidæ*; several tiger-beetles (*Cicindela*,) and representatives of other families. The "tiger-beetles" are very active, carnivorous insects and frequent the dry sands just above high-water mark; when disturbed they rise quickly and fly away to the distance of several yards before alighting. They are so wary that it is difficult to catch them without a net. Most of the species reflect bright, metallic, bronzy or green colors, and many of them have the elytra more or less marked with white. Mr. S. I. Smith found the larva of our largest species (*C. generosa*) at Fire Island, living in holes in the sand below high-water mark, associated with the species of *Talorchestia*.

Beneath the decaying sea-weeds on the sandy shores immense numbers of the lively little crustacean, *Orchestia agilis*, (p. 314, Plate IV, fig. 14,) may always be found. Two other related species, of larger size and paler colors, but having the same habit of leaping, though not in such a high degree, occur among the weeds, or burrowing in the sand, or beneath drift-wood, &c., a little below high-water mark. In fact the sand is sometimes completely filled with their holes, of various sizes. Both these species are stout in form, and become about an inch long when mature. One of them, *Talorchestia longicornis*, can be easily distinguished by its very long antennæ ; the other, *T. megalophthalma*, by its shorter antennæ and very large eyes. Both these species are pale grayish, and imitate the color of the sand very perfectly. When driven from their burrows by unusually high tides or storms they are capable of swimming actively in the water. They make dainty morsels for fishes and many shore birds, as well as for certain crabs, especially *Ocypoda arenaria*.

On sandy beaches near high-water mark, especially where the sand is rather compact and somewhat sheltered, one of the "fiddler-crabs," *Gelasimus pugilator*, is frequently found in great numbers, either running actively about over the sand, or peering cautiously from their holes, which are often thickly scattered over considerable areas. These holes are mostly from half an inch to an inch in diameter, and a foot or more in depth, the upper part nearly perpendicular, becoming horizontal below, with a chamber at the end. Mr. Smith, by lying perfectly still for some time on the sand, succeeded in witnessing their mode of digging. In doing this they drag up pellets of moist sand, which they carry under the three anterior ambulatory legs that are on the rear side, climbing out of their burrows by means of the legs of the side in front, aided by the posterior leg of the other side. After arriving at the mouth of their burrows and taking a cautious survey of the landscape, they run quickly to the distance often of four or five feet from the burrow before dropping their load, using the same legs as before and carrying the dirt in the same manner. They then take another careful survey of the surroundings, run nimbly back to the hole, and after again turning their pedunculated eyes in every direction, suddenly disappear, soon to reappear with another load. They work in this way both in the night and in the brightest sunshine, whenever the tide is out and the weather is suitable. In coming out or going into their burrows either side may go in advance, but the male more commonly comes out with the large claw forward. According to Mr. Smith's observations this species is a vegetarian, feeding upon the minute algæ which grow upon the moist sand. In feeding the males use only the small claw with which they pick up the bits of algæ very daintily; the females use indifferently either of their small claws for this purpose. They always swallow more or less sand with their food. Mr. Smith also saw these crabs engaged in scraping up the surface of the sand where covered with their favorite algæ, which they formed into pellets and carried into their holes, in the same way that they bring sand out, doubtless storing it until needed for food, for he often found large quantities stored in the terminal chamber. Mr. T. M. Prudden has since ascertained that one of the other species of "fiddlers" on our shores (*G. minax*) is also a vegetarian and feeds upon similar algæ, which grow on the muddy salt-marshes.

The *Ocypoda arenaria* is a crab allied to the "fiddlers" and similar in some of its habits. It is a southern species, ranging as far as Brazil, and adult specimens have not yet been observed on the coast of New England, but Mr. Smith has observed the young in abundance at Fire Island, and we have the young from Block Island; it occurs at Great Egg Harbor, New Jersey, of larger size, and therefore it may be looked for on the beaches of Nantucket and Martha's Vineyard. This crab lives on the beaches at, and even far above, high-water mark. It digs large holes like the fiddlers, often in the loose dry sand, back from the shore, yet when disturbed it will sometimes take to the water in order to escape. though it soon returns to the shore. In digging its holes, according to Mr. Smith's observations, it works in the same way as the "fiddler-crabs," except that it is quicker in its motions, and often, instead of carrying the pellets of sand to a distance from the hole, it throws it away with a sudden and powerful jerk, scattering the sand in every direction, It is even more cautious in its movements, and is always on the alert, even the slightest movement on the part of one who is watching them is sure to send them all into their holes instantly. In color this species imitates the sand very perfectly, especially while young, when they are irregularly mottled and speckled with lighter and darker shades of gray. They also have the habit of crouching down closely upon or into the sand, when suddenly frightened, and aided by their colors will often thus escape observation. At other times they will trust to their speed and scamper over the sand with such swiftness that they are not easily captured. This crab is carnivorous in its habits and, according to Mr. Smith's observations, it lives largely upon the "beach-fleas" (*Talorchestia*) which inhabit the same localities. It will lie in wait and suddenly spring upon them, very much as a cat catches mice. It also feeds upon dead fishes and other animals that are thrown on the shore by the waves.

Another inhabitant of the upper part of the sand-beaches, just below high-water mark, is the *Scyphacella arenicola* SMITH, which has, as yet, been found only on the coast of New Jersey, but probably occurs farther north. It is a small, sand-colored Isopod crustacean, which has no near relatives, so far as known, except in New Zealand. It burrows in the sand, making a little conical mound around the mouth of the holes.

The only Annelid observed high up on the sand-beaches is the slender, white *Halodrillus littoralis*, referred to on page 324, which lives under the decaying sea-weeds in great numbers.

On the lower parts of the sand-beaches, toward low-water mark, and especially on the broad flats, which are barely uncovered by the lowest tides, a much larger number of species occurs.

Among the Crustacea of these sandy shores we frequently find the common *Cancer irroratus*, (p. 312,) which is very cosmopolitan in its habits. Occasionally we meet with a specimen of *Carcinus granulatus*, but this is not its favorite abode; but the "lady-crab" or "sand-crab," *Platyonichus ocellatus*, (Plate I, fig. 4,) is perfectly at home among the loose sands at low-water mark, even on the most exposed beaches. This species is also abundant on sandy-bottoms off shore, and as it is furnished with swimming organs on its posterior legs, it can swim rapidly in the water and was taken at the surface in Vineyard Sound in several instances, and some of the specimens thus taken were of full size. When living at low-water mark on the sand-beaches it generally buries itself up to its eyes and antennæ in the sand, watching for prey, or on the lookout for enemies. If disturbed it quickly glides backward and downward into the sand and disappears instantly. This power of quickly burrowing deeply into the sand it possesses in common with all the other marine animals, of every class, which inhabit the exposed beaches of loose sand, for upon this habit their very existence depends during storms. By burying themselves sufficiently deep they are beyond the reach of the breakers. The means of effecting this rapid burrowing are very diverse in the different classes. Thus one of the fishes (*Ophidium marginatum*), which lives in these places, has a long acute tail and by its peculiar undulatory motions can instantly bury itself tail-first in the sand. Others have acute heads and go in head-first.

The "lady-crab" is predacious in its habits, feeding upon various smaller creatures, but like most of the crabs it is also fond of dead fishes or any other dead animals. In some localities they are so abundant that a dead fish or shark will in a short time be completely covered with them, but if a person should approach they will all suddenly slip off backwards and quickly disappear in every direction beneath the sand; after a short time, if everything be quiet, immense numbers of eyes and antennæ will be gradually and cautiously protruded from beneath the sand, and after their owners have satisfied themselves that all is well, the army of crabs will soon appear above the sand again and continue their operations. The color of this crab is quite bright and does not imitate the sand, probably owing to its mode of concealment. The ground-color is white, but the back is covered with annular spots formed by specks of red and purple. It is devoured in great numbers by many of the larger fishes.

Another curious burrowing creature, living under the same circumstances as the last, is the *Hippa talpoida*, (Pate II, fig. 5.) But this species burrows like a mole, head-first, instead of backward. It can also swim quite actively and is sometimes found swimming about in the pools left on the flats at low-water. It is occasionally dug out of the sand at low-water mark, and is often thrown up by the waves, on sand-beaches, but it seems to live in shallow water on sandy bottoms in great numbers, for in seining on one of the sand-beaches near Wood's Hole for small fishes, a large quantity of this species was taken. Its color is yellowish white, tinged with purple on the back. It is one of the favorite articles of food of many fishes. Mr. Smith found the young abundant at Fire Island, near high-water, burrowing in the sand. This species is still more abundant farther south.

The curious long-legged "spider-crab," *Libinia canaliculata*, is frequently met with at or just below low-water mark on sandy shores, but its proper home is on muddy bottoms.

Creeping, or rapidly running, over the bottom in shallow water, or in the tide-pools on the flats, the smaller "hermit-crab," *Eupagurus longicarpus*, (p. 313,) may almost always be observed ensconced in some dead univalve shell, most commonly that of *Ilyanassa obsoleta*. This species is still more abundant among eel-grass, and on muddy shores.

The common "sand-shrimp," *Crangon vulgaris*, (Plate III, fig. 10,) always occurs in great numbers on the sandy flats and in the tide-pools and rivulets, as well as on the sandy bottoms in deeper water off shore. This species is more or less specked irregularly with gray, and imitates the color of the sand very closely. When resting quietly on the bottom, or when it buries itself partially and sometimes almost entirely, except the eyes and long slender antennæ, it cannot easily be distinguished by its enemies, and, therefore, gains great protection by its colors. When left by the tide it buries itself to a considerable depth in moist sand. It needs all its powers of concealment, however, for it is eagerly hunted and captured by nearly all the larger fishes which frequent the same waters, and it constitutes the principal food of many of them, such as the weak-fish, king-fish, white perch, blue-fish, flounders, striped bass, &c. Fortunately it is a very prolific species and is abundant along the entire coast, from North Carolina to Labrador, wherever sandy shores occur. The young swim free for a considerable time after hatching, and were taken at the surface in the evening, in large numbers. The common prawn, *Palæmonetes vulgaris*, (Plate II, fig. 9,) often occurs, associated with the *Crangon*, but it is much more abundant among the eel-grass, and especially in the estuaries where it has its proper home. As this is one of the most abundant species and of great importance as an article of fish-food, it will be mentioned again, with more details, in connection with the fauna of the estuaries.

Several species of smaller crustacea also burrow in the sand at low-water mark. One of the most remarkable of these is an Amphipod, the *Lepidactylis dytiscus*, which by its external form reminds one of *Hippa*, with which it agrees in habits, for it burrows in the sand like a mole.

It is also occasionally found under stones in sandy places. Its color is pale yellowish white. The *Unciola irrorata* (Plate IV, fig. 19) often lives in tubes in the sand in abundance, but is by no means confined to such localities, for it occurs on all kinds of bottoms and at all depths down to at least 430 fathoms (off St. George's Bank,) and is abundant all along the coast, from New Jersey to Labrador. It is particularly abundant on shelly and rocky bottoms, and although it habitually lives in tubes, it does not always construct its own tube, but is ready and willing to take possession of any empty worm-tube into which it can get, and having once taken possession it seems to be perfectly at home, for it remains near the end of the tube protruding its stout claw-like antennæ, and looking out for its prey, in the most independent manner. It will also frequently leave its tube and swim actively about for a time, and then return to its former tube, or hunt up a new one. It seems, however, to be capable of constructing a tube for itself, when it cannot find suitable ones ready-made. Its color is somewhat variable, but it is generally irregularly specked with red and flake-white, and the antennæ are banded with red. It contributes very largely to the food of many fishes, such as scup, pollock, striped bass, &c.

On the moist sand-flats curious crooked trails made by the *Idotea cæca* (Plate V, fig. 22) may generally be seen. This little Isopod burrows like a mole just beneath the surface of the sand, raising it up into a little ridge as it goes along, and making a little mound at the end of the burrow, where the creature can usually be found. This species is whitish, irregularly specked with dark gray, so as to imitate the color of the sand very perfectly. It is also capable of swimming quite rapidly. The *Idotea Tuftsii* is another allied species, having the same habits and living in similar places, but it is much more rare in this region. It has also been dredged on sandy bottoms off shore. It is a smaller species and darker colored, with dark brown markings. The *Idotea irrorata* (p. 316, Plate V, fig. 23) also occurs on sandy shores wherever there is eel-grass, among which it loves to dwell.

The well known "horseshoe-crab" or "king-crab," *Limulus Polyphemus*, is also an inhabitant of sandy shores, just below low-water mark, but it is more abundant on muddy bottoms and in estuaries, where it burrows just beneath the surface and feeds upon various small animals. At the breeding season, however, it comes up on the sandy shores to deposit the eggs, near high-water mark. According to the statements of Rev. S. Lockwood, (in American Naturalist, vol. iv, p. 257,) the spawning is done at the time of high tides, during May, June, and July; they come up in pairs, the males, which are smallest, riding on the backs of the females and holding themselves in that position by the short feet, provided with nippers, which are peculiar to the males. The female excavates a depression in the sand and deposits the eggs in it, and the male casts the milt over them, when they again return to deeper water, leaving the eggs to be buried by the action of the waves.

In aquaria, under favorable circumstances, the eggs hatch in about six weeks, but in their natural conditions they probably hatch sooner than this; under unfavorable conditions the hatching may be delayed for a whole year. The eggs are very numerous. In addition to the interesting observations of Mr. Lockwood, Dr. A. S. Packard has since given more detailed accounts of the development of the embryos and young of *Limulus* in the proceedings of the American Association for the Advancement of Science, 1870, p. 247, and in the Memoirs of the Boston Society of Natural History, vol. ii, p. 155, 1872.

Annelids are quite numerous on the sandy shores where the conditions are favorable. It is evident that these soft-bodied creatures would be quickly destroyed by the force of the waves and the agitation of the sand, were they not provided with suitable means for protecting themselves. This is effected mainly in two ways: the sand-dwelling species either have the power of burrowing deeply into the sand with great rapidity, or else they construct long durable tubes, which descend deeply into the sand and afford a safe retreat. Many of the active burrowing species also construct tubes, but they usually have but little coherence and are not very permanent, nor do they appear to be much relied on by the owners. There is, however, great diversity both in the structure and composition of the tubes of different species, and in the modes by which the rapid burrowing is effected.

The large green *Nereis* (*N. virens*, p. 317) is found on the sandy shores in places that are somewhat sheltered, especially if there be an admixture of mud or gravel with the sand to give it firmness and solidity. This species burrows deeply beneath the surface and lines the interior of its large irregular burrows with an abundant mucus-like secretion, which gives smoothness and some coherency to the walls, but does not form a solid tube. With this, and in greater numbers, the smaller species, *Nereis limbata*, (p. 318,) is also found, and its habits appear to be essentially the same. Both this and the preceding can burrow rapidly, but much less so than some other worms, and consequently they are not well adapted to live on exposed beaches of moving sands, but prefer coves and harbors. The two large species of *Rhynchobolus* are much better adapted for rapid burrowing. Their heads are very small and acute, and destitute of all appendages, except four minute tentacles at the end; the body is long, smooth, and tapers gradually to both ends, and the muscular system is very powerful, and so arranged as to enable these worms to coil themselves up into the shape of an open spiral, like a corkscrew, and then to rapidly rotate themselves on the axis of the spiral. When the sharp head is inserted into the loose mud or sand and the body is thus rotated, it penetrates with great rapidity and disappears almost instantly. Both these species are found on sandy as well as on muddy shores and flats near low-water mark, and also in deeper water. The one usually most abundant is *R. dibranchiatus*, (Plate X, figs. 43, 44;) this is readily distinguished by having a simple gill both on the upper and lower sides of the lateral appendages. The other, *R. Americanus*, (Plate X, figs. 45, 46,) has gills that are more or less branched on the upper side of the appendages, as shown in fig. 46, but none on the lower side; the appendages are also longer, especially posteriorly, and differently shaped. The proboscis is remarkably long and large, and when full y protruded it shows four large, black, sharp, fang-like jaws or hooks. Both these worms are destitute of true blood-vessels, such as most of the allied worms possess, but have the general cavity of the body filled, between the various organs, with bright red blood, which shows through the skin, giving a more or less red or purple color to the whole body and proboscis.

The two species of *Lumbriconereis* already referred to (p. 320,) occur in similar localities, and are usually associated with the two preceding species, but they are less rapid burrowers and require for their safety localities where the sand is compact and mixed more or less with mud, or where it is somewhat sheltered from the force of the waves. In sandy coves, and especially on the flats of sandy mud, close to low-water mark, the smaller species, *L. tenuis*, is generally very abundant, penetrating the sand, beneath the surface, in every direction. It is often a foot or more in length when extended, and not much larger than coarse thread or small twine, and bright red in color. When the sand in these localities is turned up with a spade, their drawn-out, red, thread-like bodies can usually be seen in large numbers, but they are so fragile that it is difficult to obtain an entire specimen. The head is obtusely conical, a little flattened, smooth, pale red, and iridescent, without eyes. The other species, *L. opalina* V., (Plate XIII, fig. 69,) is much larger, growing to the length of eighteen inches or more, and about .10 to .12 of an inch in diameter. Its color is dark bronze, or reddish brown, or pale red, the surface reflecting the most brilliant opal-like colors. It is easily distinguished from the *L. tenuis* by its four eyes in a row across the back part of the head. Both these species, when removed from their burrows, coil themselves in a long spiral. They burrow readily and deeply, but not so rapidly as many other worms, and do not seem to have permanent tubes. Another worm, found in similar places and readily mistaken for *L. tenuis* on account of its long, slender, almost thread-like body and red color, is the *Notomastus filiformis* V.; but in this species the head is very acute, the lateral appendages and setæ are very different, and the color is paler red, with bands or rings of bright red. This species has, moreover, a smooth, subglobular proboscis, without jaws, while the former has a powerful set of complicated jaws, without a distinct proboscis, and they are widely different in internal anatomy. The latter feeds upon the organic matter contained in the mud that it swallows, while the species of *Lumbriconereis* are carnivorous, feeding upon other worms, &c. A second and much larger species of *Notomastus* occurs in similar places, though apparently preferring a greater proportion of mud. This species, *N. luridus* V., grows to be about ten inches long and .10 in diameter. Its color is a dark purplish or lurid brown, specked with white, and sometimes inclined to red. Its head is very acute, and it has a smooth, swollen, dark blood-red proboscis. It is a rapid burrower, penetrating deeply into the fine mud and sand. The *Maldane elongata* V. is another worm allied to the last, and usually associated with it, but this species constructs rather firm, round tubes out of the fine sand and mud, which are very long and descend deeply into the soil, and are often .20 to .25 of an inch in diameter. This worm is six or eight inches long, with a round body of nearly uniform diameter, which looks as if obliquely truncated at both ends, but the obliquely-placed upper surface of the head is bordered by a slight ridge or fold on each side and behind. The color is dark umber-brown, or reddish brown, the swollen part of each ring often lighter grayish or yellowish brown, but usually bright red, owing to the blood-vessels showing through. The intestine is large and filled with sand. Another worm, belonging to the same family with the last and, like it, constructing long, round tubes of agglutinated sand, is the *Clymenella torquata*, (Plate XIV, figs. 71, 72, 73,) but this species often lives where the sand is more free from mud, or even in nearly pure, siliceous sand, and sometimes considerably above low-water mark, though it is also found in deep water. It generally constructs its long and nearly straight tubes very neatly, of fine white sand, without mud. It loves, however, to dwell in sheltered spots, in coves, or in the lee of rocks and ledges, and is also partial to those spots on the sandy shores where eel-grass grows, building its tubes among the roots. It is a rather handsomely colored species, being usually pale red, with bright red bands around the swollen parts of the rings, but it is sometimes brownish red or dull brown. It can always be recognized by the peculiar collar on the fifth ring, and by the peculiar funnel-shaped caudal appendage, surrounded by small papillæ, and preceded by three segments or rings that are destitute of setæ.

The large and singular worm, *Anthostoma robustum* V., (Plate XIV fig. 76,) lives like the last, with which it often occurs, in nearly pure sand, where it is somewhat sheltered from the violence of the waves, but is also fond of places where there is more or less gravel mixed with the sand. It sometimes occurs some distance above low-water mark, and constructs a large, thick, somewhat firm tube by consolidating and cementing the sand around its burrow. These tubes descend nearly perpendicularly to a great depth, and can usually be distinguished by a slightly elevated mound of dirt around the opening, which is usually different in color from the surrounding sand; and sometimes there are recently-ejected cylindrical masses of such earth on the summit of the little hillocks. The worm itself, when full grown, is fifteen inches or more in length, and nearly half an inch in diameter. The head is very acute and the front part of the body is firm and muscular, with very small lateral appendages, and fascicles of setæ in four rows; but back of the twenty-fourth body-segment an appendage develops below the lower fascicles of setæ, and farther back becomes broad, foliaceous, and divided into several lobes; back of the twenty-eighth segment the branchiæ appear in a row on each side of the back, and soon become long and ligulate; at the same time other ligulate appendages develop from the upper lateral appendages, which become dorsal, and these, with the gills, form four rows of processes along the back, outside of which are the elongated setæ and other appendages. The posterior part of the body is more slender and much more delicate than the anterior part, and so fragile that an entire specimen can rarely be obtained, and those that are obtained, when in confinement very soon detach fragment after fragment, until only the anterior part is left. In their natural habitations they would undoubtedly be able to reproduce their lost parts, like many other annelids. The color of this worm is ocher-yellow, tinged with orange, or dark orange; there are usually two rows of dark-brown spots along the back; the branchiæ are blood-red; and posteriorly there is a brownish red median dorsal line. The proboscis is very singular, for it is divided into several long, flat, digitate processes, separate nearly to the base, and somewhat enlarged at the end.

Another species of this genus, of smaller size, *A. fragile* V., often occurs in the sandy flats in great numbers, its small holes sometimes completely filling the sand over considerable areas and extending nearly up to half-tide mark. This species grows to the length of four inches or more, with a diameter of about .10. Its head is even more acute than in the last species, with a very slender, translucent apex. The body has the same form, but is more slender. The processes above and below the fascicles of setæ begin to appear at the fourteenth segment, and the setæ begin to be decidedly elongated at the fifteenth. The dorsal branchiæ begin on the sixteenth segment, and become long and ligulate at the twentieth. The color is yellowish orange to orange-brown; the dorsal surface, posteriorly, and the branchiæ are red. The body posteriorly is very slender and extremely fragile. The last or caudal segment is smooth, oblong, with two long filiform cirri at the end. The proboscis is large and broad, consisting of numerous, often convoluted, lobes or folds, united by a thinner membrane or broad web.

The *Aricia ornata* V. is another related species, living in similar places with the last and having similar habits. The head is acute in this species, but the dorsal branchiæ and lateral appendages commence much nearer the head, and the side appendages are developed into crest-like, transverse series of papillæ, which cover the lateral and ventral surfaces of the body anteriorly.

Two species of *Spio* also occur in similar situations inhabiting small round tubes or holes made in the sand near low-water, often occuring in great numbers in certain spots. They prefer localities that are not exposed to the full force of the storms. One of these, *S. setosa* V. (Plate XIV, fig. 77,) is remarkable for the length of the setæ in the dorsal bundles; the two large tentacles (of which only one is drawn in the figure) are usually folded backward between the red dorsal branchiæ, which form a row along the back on each side. The other, *S. robusta* V., is a stouter species, which has much shorter setæ in the dorsal fascicles; the middle lobe of the head is emarginate in front and the lateral lobes are convex. Both species have four small eyes on the top of the head, those of the posterior pair nearest together. In similar places, and often associated with the two preceding species, another allied worm often occurs in great abundance, completely filling the sand, in its chosen abodes, with its round vertical holes, and throwing out cylinders of mud. It is so gregarious that in certain spots hundreds may be found within a square foot, but yet a few yards away, on the same kind of ground, none whatever may be found. This is *Scolecolepis viridis* V. This species, like the two preceeding, has a pair of large tentacles on the back part of the head, which are usually recurved over the back between the rows of ligulate branchiæ, and four eyes on the top of the head; the central lobe of the head is slightly bilobed in front, the lateral ones convex; the branchiæ are long, slender, ligulate, meeting over the back, and exist only on about one hundred segments, or on about the anterior third part of the body. The body is rather slender, depressed, and about three inches long when full grown. The color is usually dark green, or olive-green, but sometimes light green, or tinged with reddish anteriorly; the branchiæ are bright red; the large tentacles are light green, usually with a row of black dots, and often crossed by narrow flake-white lines or rings. This species has been found abundantly on Naushon Island, and other localities in that region; at New Haven; and at Somer's Point and Beesley's Point, New Jersey. With the last species at Great Egg Harbor, New Jersey, another more slender species of the same genus occurred, *Scolecolepis tenuis* V. This was three or four inches long and very slender; the body was pale green; the tentacles longer and more slender than in the last, whitish, with a red central line; the branchiæ red, often tinged with green, shorter than in the last. The head is relatively broad, with the central lobe rounded in front. The branchiæ are confined to the anterior part of the body. The setæ in the upper fascicles are much longer than in the last species, those of the three anterior segments longer than the others and forming fan-shaped fascicles, directed upward and somewhat forward.

Another singular Annelid, belonging to the same tribe and having nearly the same habits, is represented in Plate XIV, fig. 78, this has been found by Mr. A. Agassiz burrowing in sandy mud at about half-tide, both at Naushon Island and at Nahant, Massachusetts, and he has also described its development and metamorphoses, but I have not met with the adult myself in this region, although the young were frequently taken in the towing-nets in the evening. Mr. Agassiz regards it as perhaps identical with *Polydora ciliatum* of Europe. It occurred in large colonies, closely crowded together, building upright tubes in the mud. The presence of a large group of peculiar stout setæ on each side of the fifth segment will distinguish this from all the preceding species. The young of this, like those of most of the annelids, swim free at the surface for some time, and are often taken in great numbers in the towing-nets.

The *Nerine agilis* V., is still another representative of the group to which the last five species belong, and like them it has two long and large tentacles on its head, but it is a far more active and hardy species than any of them, and much better adapted for rapid burrowing. It accordingly lives on exposed beaches even where the sand is loose, and can also maintain itself on the exposed sandy beaches of the outer ocean-shores, exposed to the full force of the surf, its extremely quick burrowing affording it the means of protecting itself against the action of the sea. It lives in small round holes near low-water mark; unlike the related species, already mentioned, it has a very sharp conical head. The two large tentacles are about half an inch long, and originate close together on the upper side of the back of the head, and are usually recurved over the back when the worm is swimming in the water, as it is capable of doing, but when it is wriggling about on the sand they are twisted about in all directions and variously coiled; and when in their holes the tentacles are protruded from the opening. The eyes are four, small, black, placed close together in front of the base of the tentacles. The upper lobe of the lateral appendages is large and foliaceous and connected with the branchiæ along the anterior part of the body, but partially free farther back. The body is two or three inches long and rather slender; the color is reddish or brownish anteriorly, greenish white on the sides, except on the anterior third; the branchiæ, which extend the whole length of the body, are light red; tentacles greenish white.

One of the largest and most beautiful Annelids of this region is the *Diopatra cuprea*, (Plate XIII, figs. 67 and 68.) This species grows to be more than a foot long, with the body depressed and often nearly half an inch broad. It constructs a very curious permanent tube in which it dwells very securely. The part of these tubes beneath the surface of the sand is composed of a tough parchment-like material, and often descends obliquely to the depth of two or three feet or more; the upper end of the tube projects two or three inches from the surface of the sand or mud, and is thickly covered with bits of eel-grass and sea-weeds, fragments of shells, and other similar things, all of which are firmly attached to the tube, but project externally in all directions, giving this part of the tube a very rough and ragged appearance externally, but it is very smooth within, and often it has an opening half an inch in diameter, or large enough so that the worm can turn around, end for end, inside of it. When undisturbed the occupant thrusts its head and the anterior part of the body out of the tube to the distance of several inches in search of food, or materials to add to its tube, exposing the curious bright red gills, which are shaped something like miniature fir trees. The central stem is long and tapering, with a blood-vessel winding spirally up to its summit, and another winding in the opposite direction down to its base; the basal part is naked, but above this slender branches are given off, forming spirals all along the stem and gradually decreasing in length to the tip; each of the branches contains two slender blood-vessels. These branchiæ commence at the fifth segment and do not extend to the end of the body, the last ones being much smaller, with few branches. The first four setigerous segments have an acute, conical, papilliform ventral cirrus at the base of the lateral appendages; on the fifth and following segments these become low, broad, rounded, whitish tubercles, with longitudinal wrinkles or grooves, and with a dark spot in the middle; these appear to contain the glands which secrete the cement used in constructing the lining of the tube, for when attaching any additional object at the end, after adjusting it in the desired position the worm constantly rubs this part of the lower surface backward and forward over the edge of the tube and the object to be cemented to it, until a perfect adherence is effected, and a smooth coating of firm mucus is deposited, and this operation is repeated for every piece added to the tube. It is very interesting to watch these worms, when in confinement in an aquarium, while engaged in constructing their tubes. By placing bits of bright colored shells, tinsel, cloth, or even pieces of bright colored feathers, near the tubes, they can be induced to use them, and thus some very curious looking tubes will be produced; but they evidently prefer the more rough and homely materials to which they are accustomed, when they can be had. The iridescent, opaline colors of this species are usually very brilliant and beautiful, especially on the back, head, and bases of the antennæ. The general color of the body is reddish brown, or deep brown, thickly specked with gray; the antennæ are paler brown; the lateral appendages yellowish brown, finely specked with white and dark brown; the gills usually blood-red, but varying from light red to dark brown. There are two, small, black eyes between the bases of the odd median and upper lateral antennæ. This species is often quite abundant on the sand-flats near low-water mark, especially where there is more or less mud mixed with the sand, but it is still more abundant in the shallow or moderately deep waters off shore, on muddy and shelly bottoms. It is difficult, however, to obtain entire specimens with the dredge, for it usually merely cuts off the upper end of the tube, while the occupant retreats below; occasionally the head of the worm is cut off in this way. On the shore, also, it is not easy to obtain entire specimens unless the tubes be cautiously approached and the retreat of the worm prevented by a sudden and deep thrust of the spade below it, so as to cut off the tube. This species is carnivorous and has a very powerful set of black jaws, which are unequal on the two sides of the mouth, (fig. 68.)

The *Marphysa Leidyi* (p. 319, Plate XII, fig. 64) is allied to the preceding species, and has somewhat similar habits, but does not construct such perf ct tubes. It is occasionally dug out of the sand at low-water, but is much more common in deeper water.

The *Staurocephalus pallidus* V. is also an inhabitant of these sandy shores, burrowing in the sand at low-water. It is a slender species, about two inches long and one-tenth broad. It is peculiar in having four long, slender antennæ or tentacles on the front of the head, arranged in a cross-like manner, to which the generic name alludes. There are also four, small, dark red eyes on the upper side of the head. The color is pale yellowish, the red blood-vessels showing through anteriorly. This worm is allied to the two preceding, and to *Lumbriconereis*, and like them it is predacious in its habits and has a very complicated set of jaws, consisting of numerous sharp, fang-like pieces of various shapes, arranged in several rows on both sides.

The *Sthenelais picta* V. is another curious Annelid, which is sometimes found burrowing in the sand at low-water mark, but it also occurs on shelly and muddy bottoms in deep water. It has a long, slender body, six inches or more in length, and the back is covered with two rows of thin, smooth scales, which are very numerous. The head is usually brownish, with a whitish spot on each side; there is generally a dark brown band along the back; the scales are translucent, and vary in their color-markings, but more commonly there is a border of dark brown or blackish along the inner edge, which is usually connected with a similar border along the anterior edge, or with an anterior angular spot, and often with a dark border along the posterior edge, leaving more or less of the central part of each scale white and translucent.

The *Nephthys picta* (Plate XII, fig. 57) is also sometimes found burrowing in sandy mud at low-water mark, but it is much more frequent in the deeper waters of the sounds. It can be distinguished at once from all the other species of *Nephthys* found in this region by its greater slenderness, and by having the body whitish and variously marked or mottled on the back, toward the head, with dark brown; it sometimes has a dark brown median dorsal-line. The shape of the head and position of the tentacles are also peculiar.

In sheltered situations, where there is some mud with the sand, the *Cirratulus grandis* V., (p. 319, Plate XV, figs. 80, 81,) is often met with burrowing beneath the surface. In similar places, and also in nearly pure, compact sand, and in sand mixed with gravel, the large tubes of *Amphitrite ornata* (p. 320, Plate XVI, fig. 82) are often to be seen; these show a round opening, a quarter of an inch or more in diameter, surrounded by a slightly raised mound of sand, often different in color from that of the surface, and sometimes there are cylinders of such sand around the opening. These tubes are scarcely to be distinguished from those of *Anthostoma robustum*, described above, and are found in similar places. But the worms are very unlike in appearance and structure.

Several species of slender, greenish worms, belonging to the genera, *Phyllodoce*, *Eumidia*, *Eulalia*, and *Eteone*, are occasionally dug out of the sand. In all these the head is well-developed and provided with four *antennæ* at the end, and in the three last with an odd median one on its upper side, and they all have two well-developed eyes, and oval or lanceolate, leaf-like branchiæ along the sides of the back. They are very active species, and most of them belong properly to the shelly and rocky bottoms in deeper water, where they are often very abundant. In sheltered coves, where there is mud with the sand, *Cistenides Gouldii* V., (p. 323, Plate XVII, figs. 87, 87*a*,) often occurs, but it is more partial to the muddy shores. On various dead shells, as well as on certain living ones, and on the back of *Limulus*, &c., the masses of hard, sandy tubes, built and occupied by the *Sabellaria vulgaris* V., (p. 321, Plate XVII, figs. 88, 88*a*,) often occur.

Of the Nemerteans the largest and most conspicuous is the *Meckelia ingens* (p. 324, Plate XIX, figs. 96, 96*a*.) This species lives in the clear sand, near low-water mark, as well as in places that are more or less muddy, and notwithstanding its softness and fragility, by its means of burrowing rapidly, it can maintain itself even on exposed shores, where the sands are loose and constantly moved by the waves. The young, several inches or even a foot in length, are quite common, but the full-grown ones are only occasionally met with. The largest that I have found were at least 15 feet long, when extended, and over an inch broad, being quite flat; but they could contract to two or three feet in length, and then became nearly cylindrical and about three-quarters of an inch in diameter; the body was largest anteriorly, tapering very gradually to the posterior end, which was flat and thin, terminated by a central, small, slender, acute, contractile process one-quarter of an inch or less in length. The proboscis of the largest one, when protruded, was fifteen inches long, and about one-fifth of an inch in diameter where thickest. This proboscis, which is forcibly protruded from a terminal opening in the head, appears to be an organ of locomotion, at least to a certain extent, for when it penetrates the loose sand in any direction it makes an opening into which the head can be thrust, and then, by enlarging the opening, it can easily penetrate. But the proboscis is probably used, also, as an instrument for exploring the sand in various directions, either in search of food or to test its hardness or fitness for burrowing, thus economizing time and labor. At any rate, the ways in which this remarkable instrument is used by these worms, when kept in confinement with sand, suggest both these uses. But the proboscis is by no means the principal organ of locomotion, for the head itself is used for this purpose, urged forward by the undulatory movements of the muscular body, and aided by the constantly changing bulbous expansions, both of the head and body, which both crowd the sand aside, making the burrow larger, and furnish points of resistance toward which the parts behind can be drawn, or against which the head and anterior parts can push in continuing the burrow. The head, moreover, is extremely changeable in form, at one time being spear-shaped, with a pointed tip and thin edges, and constricted at the neck; in the next minute broadly rounded; then perhaps truncate or even deeply emarginate at the end; then gradually losing its distinctness and blending its outlines continuously with those of the body; or perhaps shrinking down to a small oval form, not more than one-third as wide as the body just back of it. All these and many other changes can often be witnessed within a very few minutes, and are so effected as greatly to aid the creature in burrowing This worm can also leave the bottom and swim rapidly in the water, the body being usually kept up edgewise and impelled forward by the undulations of the body, which thus become horizontal. When swimming in this way the motion reminds one of the swimming of a snake or an eel. In addition to the terminal pore, for the proboscis, there is a deep lateral slit or fossa on each side of the head, and a large ventral orifice beneath. The latter is very changeable in form, changing from elliptical, long oval, oblong, or hour glass-shape, to circular in rapid succession. There are no eyes. Along each side of the greater part or the length of the body, the voluminous, transversely-banded lateral organs can be imperfectly distinguished through the translucent integument, as well as the median cavity, in which a dark pulsating tube can sometimes be seen. The lateral organs commence at about the anterior fourth in small specimens, but in the larger ones relatively nearer the head, for in the largest they originate only six or eight inches back of it. The portion in front of the lateral organs is thicker and more cylindrical than the rest of the body.

The color of the largest specimens is generally light red or flesh-color, with the lateral edges and central band translucent grayish white, the lateral organs showing through as dull yellowish transverse branches, with diverticula between them; head yellowish. But one large specimen was dull brownish yellow; others are yellowish white, with the lateral organs deep chestnut-brown, crossed by white lines. The small specimens are generally paler, usually pale flesh-color or yellowish white and often milk-white. Some of the diversity in color may be due to sexual differences. This species has also been dredged on sandy and shelly bottoms in six to eight fathoms in the sounds.

Dr. Leidy has also described another similar species, from Great Egg Harbor, under the name of *Meckelia lactea*, which I have not been able to distinguish, unless it be what I have regarded as the light-colored young of *M. ingens;* the white color seems to have been the principal character by which it was distinguished from the latter.

The *Meckelia rosea* is, however, a very distinct species, but it lives in similar places and is often associated with the *M. ingens*. It has very similar habits, but does not grow to a very large size. The largest specimens observed are only six or eight inches long, and about a fifth of an inch broad. The body is also more cylindrical, the flattened part being relatively thicker and narrower, and not thin at the edges; in contraction it becomes nearly cylindrical. The lateral fossæ of the head are long and deep; the ventral opening is relatively much smaller than in *M. ingens* and usually round. The proboscis is very long, slender; color, light purplish red or rose-color. The integument is rather firm and secretes a tenacious mucus to which a thin coating of sand often adheres when the worms are taken from their burrows. This species seems to construct an imperfect tube by slightly cementing the sand with its mucus. All these species of *Meckelia* when caught and when kept in confinement generally break off portions from the posterior part of the body, one after another, until nothing but the head and a lot of short segments remain. Under favorable conditions they would doubtless be able to restore the lost parts, for other Nemerteans, having the same habit, are known to do so, and in some cases even the small fragments from the central parts have been known to again become entire worms. Various fishes feed upon these *Meckeliæ*, and it is probable that the habit of dismembering, or rather disarticulating themselves, may serve an important purpose, by enabling them to escape, in part at least, when seized by fishes or crabs, for if even half the body should be lost the remaining half would be much better than nothing, for it could soon restore either a head or a tail.

Another Nemertean, which lives in sand at low water, is the *Tetrastemma arenicola* V., (Plate XIX, fig. 98.) This is slender, subcylindrical, and four or five inches long when extended. The head is versatile in form, usually lanceolate or subconical, and has four eyes on the upper side. There is a deep fossa on each side of the head. The ventra opening, which is behind the lateral fossæ, is small, triangular. The color is deep flesh-color or light purplish.

The *Balanoglossus aurantiacus* is a very remarkable worm, related to the Nemerteans, which lives in the clear, siliceous sand near low-water mark. It is gregarious in its habits and occurs abundantly in certain spots, although not to be found in other similar places near by. It makes tubes or holes in the sand, twelve or fourteen inches deep, and lined with a thick and smooth layer of mucus. It throws out of the orifice peculiar elliptical coils of sand, by which the nature of the occupant may be known. This species was found by our party on the shore of Naushon Island, but Mr. A. Agassiz has found it abundantly at Newport, and on the beach just beyond Nobska Light, and also at Beverly, Massachusetts. Dr. Packard informs me that he has collected it at Beaufort, North Carolina, and I have received specimens found at Fort Macon, from Dr. Yarrow. The specimens first discovered were found at Charleston, South Carolina, by Dr. William Stimpson, twenty years ago, but they were only briefly and imperfectly described by Mr. Girard, at that time, under the name of *Stimpsonia aurantiaca*. Mr. A. Agassiz has recently described and illustrated this worm, very fully, under the new name, *B. Kowalevskii*, in the Memoirs of the American Academy of Arts and Sciences, vol. ix, p. 421, and he has also given an account of its remarkable development and metamorphoses, proving that the larva is a free-swimming form, long known as *Tornaria*, and generally supposed to be the larva of a star-fish. This worm, when full grown, attains a length of six inches or more and a diameter of about a quarter of an inch. The body is elongated, tapering gradually, with a long, slender posterior portion. The body is somewhat flattened dorsally throughout most of its length. At the anterior end it is furnished with a broad thickened collar, in which large numbers of mucus-secreting glands are situated; the anterior border of the collar is undulated, and from within the concavity, on the dorsal side arises a large muscular proboscis, which has a distinct peduncle, or narrower basal stem, above which it swells out into a somewhat flattened, long, pyriform, or elongated and subconical form, the shape constantly changing during life. The proboscis is somewhat wrinkled longitudinally, and more strongly horizontally, being furnished with muscles running in both these directions, and its surface contains mucus-secreting glands. According to Mr. Agassiz the cavity of the proboscis is not connected with the alimentary canal, but opens externally by a pore at the end, and by a narrow slit on the ventral side near the base, in advance of the mouth. The mouth is large and situated at the base of the proboscis on the ventral side. For some distance along each side of the back, behind the collar, is a row of complex gills; these are remarkable on account of their structure and position; they are formed from diverticula of the œsophagus and finally communicate with a row of external orifices situated along each side of the median dorsal-vessel. The gills are supported by a system of solid supports, constituting a sort of internal skeleton; the base of the proboscis is also connected with a firm internal frame-work. The color of this species is somewhat variable; in young specimens the body was brownish yellow with lighter mottlings, the collar red, and the proboscis white; in large specimens the proboscis is pale reddish yellow, the collar darker colored, the body purplish or brownish, the sides mottled with greenish and whitish, owing to the lateral organs or liver showing through. The proboscis of this worm, according to the observations of Mr. Agassiz, is the principal organ of locomotion, but the collar also aids in the movements. The proboscis appears to be used much as certain bivalve mollusks, such as *Solen*, *Petricola*, &c., use their foot in burrowing; the end being contracted to a point, is thrust forward into the sand; water being then forced into it, by the muscles farther back, the end expands into a bulb, enlarging the hole and giving a point of resistance toward which the rest of the body can be drawn; the front part of the proboscis being again contracted and the water expelled, the point can be again thrust forward and the movements repeated.

Two species of Sipunculoid worms are also found living in the sand at low-water. The largest and most common of these is the *Phascolosoma Gouldii*, (Plate XVIII, fig. 93.) This species grows to the length of a foot or more, and is often nearly half an inch in diameter, though more commonly about a quarter of an inch. The body is round and constantly changing in size and shape, owing to its contractions and expansions; the surface is smoothish, but longitudinally lined with muscular fibers anteriorly, and transversely wrinkled posteriorly. The integument is firm and parchment-like. The mouth is surrounded by numerous short tentacles, which are partially connected together by a thin web, and crowded together in several circles. The color is yellowish white, grayish white, or yellowish brown. It burrows deeply in the sand and gravel, using its body for this purpose very much as the *Balanoglossus*, just described, uses its proboscis.

Another much smaller species of the same genus occurs in sand at low-water, and has similar habits, but it appears to be rather uncommon and has not been satisfactorily identified.

Comparatively few species of Mollusks naturally inhabit sandy shores, though the shells of many species may be found on the beaches. On the more exposed beaches of loose siliceous sand none but those which have the power of burrowing quickly and deeply beneath the surface can exist. We find, however, that quite a number of our species, both of gastropods and bivalves, possess this power in a high degree and do habitually live on the exposed beaches of loose sand.

Among the Gastropods one of the largest and most conspicuous is the *Lunatia heros*, (Plate XXIII, figs. 133–136.) This species occurs all along our coast, from the Gulf of St. Lawrence to Cape Hatteras or beyond, wherever sandy shores and pure waters are to be found, and it even seems to prefer the outer ocean beaches, where the waves break with full force, for it is abundant and of very large size on the outer beaches of the coast of New Jersey. When in motion (Fig. 134) the white soft parts are protruded from the shell to a remarkable extent and spread out broadly on all sides, so as to nearly conceal the shell; the foot is large, flat, and broadly expanded, with thin edges, and by means of it the animal is able to burrow, like a mole, beneath the surface of the sand, both for protection and in search of the bivalve shells upon which it preys. The foot when well expanded is concave below and lubricated by a very abundant secretion of mucus, and therefore, when extended beneath the surface of the moist sand, it acts like a great sucker, holding the animal in place pretty firmly by the atmospheric pressure, thus serving as a sort of anchor in the sand. But nevertheless large numbers of these mollusks are uncovered, overturned, and thrown high up on the beaches by the storms, especially in winter and early spring. This species, like many others of its tribe, drills round holes through the sides of various bivalve shells by means of the small flinty teeth on its lingual ribbon, which acts like a rasp, and having thus made an opening it inserts its proboscis and sucks out the contents. All sorts of burrowing bivalves in this way fall victims to this and the following species, nor do they confine themselves to bivalves, for they will also drill any unfortunate gastropods that they may happen to meet, not even sparing their own young.

A variety of this species (var. *triseriata*, Plate XXIII, figs. 135, 136) has three revolving rows of chestnut or purplish spots, and has been regarded by most writers as a distinct species, and sometimes as the young; but both the plain and spotted shells occur of all sizes, from the the youngest to the oldest, and they are nearly always found together. In some cases, however, a shell that has the spots well defined until half grown, afterwards loses its spots and becomes perfectly plain, showing that the difference is only a variation in the color, but each style varies considerably in form.

Another allied shell, growing nearly as large and generally much more abundant, except on the outer beaches, is the *Neverita duplicata*, (Plate XXIII, fig. 130.) This species has the same habits as the preceding and in this region they are often found together; but this is a more southern species, extending to the Gulf of Mexico and even to Texas, but it is not very common north of Cape Cod and does not extend to the eastern coast of Maine and Bay of Fundy.

The curious egg-cases of this and the last species are often met with on the sandy and muddy flats at low-water. They consist of a broad, thin ribbon of sand, coiled up into a circle and shaped something like a saucer, but without a bottom; the ribbon is composed of innumerable little cells, each containing one or more eggs and surrounded with grains of fine sand cemented together by mucus. The cells can easily be seen by holding one of these ribbons up to the light and looking through it. The peculiar form of these egg-masses is due to the fact that they are molded into shape by being pressed against the body of the shell when they are being extruded, and while they are still soft and gelatinous; they thus take the form and spiral curvature of that part of the shell, and when laid in the sand the fine grains at once adhere to and become imbedded in the tenacious mucus, which soon hardens.

The *Tritia trivittata* (Plate XXI, fig. 112) is also frequently found on sandy shores and flats. When left by the tide it creeps along the surface of the sand, leaving long crooked trails, and sometimes burrows beneath the surface, and when burrowing it moves with the aperture downward and the spire pointing obliquely upward, but when at rest in its burrow it reverses its position and rests with the spire downward and the aperture toward the surface.

The *Ilyanassa obsoleta* (Plate XXI, fig. 113) is also generally to be found in considerable numbers creeping over the flats, and making trails and burrows like the last, but this species has its proper home on the muddy shores and in estuaries, and will, therefore, be mentioned again.

At certain times, especially in the spring, multitudes of the young shells of *Bittium nigrum* (p. 305, Plate XXIV, fig. 154) are found creeping on the surface of the moist sand in sheltered places, at low-water, and generally associated with large numbers of the *Astyris lunata*, (p. 306, Plate XXII, fig. 110.) But this is not the proper habitat of either of these species; the reason of this habit is not obvious, unless they may have been accidentally transported to such places. They may be found, however, on the eel-grass growing on sandy shores. The *Lacuna vincta* (p. 305, Plate XXIV, fig. 139) also frequently occurs on eel-grass and sea-weeds in such places.

The *Crepidula fornicata* (Plate XXIII, figs. 129, 129*a*) and *C. unguiformis* (Plate XXIII, fig. 127) occur on shells inhabited by the hermit crabs as well as on the living shells of *oysters*, *Pecten*, *Limulus*, &c; and the smaller and darker species, *C. convexa*, (Plate XXIII, fig. 128) occurs both on the eel-grass, and on the shells of *Ilyanassa obsoleta*, especially when occupied by the small hermit-crabs. Occasionally specimens of *Fulgur carica* (Plate XXII, fig. 124) and of *Sycotypus canaliculatus* are found crawling on sandy flats or in the tide pools, especially during the spawning season, but they do not ordinarily live in such situations, but in deeper water and on harder bottoms off shore. The curious egg-cases of these two species are almost always to be found thrown up by the waves on sandy beaches. They consist of a series of disk-shaped, subcircular, or reniform, yellowish capsules, parchment-like in texture, united by one edge to a stout stem of the same kind of material, often a foot and a half or two feet in length. The largest capsules, about an inch in diameter, are in the middle, the size decreasing toward each end. On the outer border is a small circular or oval spot, of thinner material, which the young ones break through when they are ready to leave the capsules, each of which, when perfect, contains twenty to thirty, or more, eggs or young shells, according to the season.

Dr. Elliott Coues, who has observed *F. carica* forming its cases at Fort Macon, North Carolina, states that the females bury themselves a few inches below the surface of the sand on the flats that are uncovered at low-water, and remain stationary during the process. The string of capsules is gradually thrust upward, as fast as formed, and finally protrudes from the surface of the sand, and when completed lies exposed on its surface. The string begins as a simple shred, two or three inches long, without well-formed cases; the first cases are small and imperfect in shape, but they rapidly increase in size and soon become perfect, the largest being in the middle; the series ends more abruptly than it begun, with a few smaller and less perfect capsules. The number of capsules varies considerably, but there are usually seventy-five to one hundred or more. At Fort Macon Dr. Coues observed this species spawning in May, but at New Haven they spawn as early as March and April. It is probable that the period of spawning extends over several months. Mr. Sanderson Smith thinks that they also spawn in autumn, on Long Island. It is not known how long a time each female requires for the formation of her string of capsules. There are two forms of these capsules, about equally abundant in this region. In one the sides of the capsules are nearly smooth, but the edge is thick or truncate along most of the circumference, and crossed by numerous sharp transverse ridges or partitions, dividing it into facets. Dr. Coues states that these belong to *F. carica*. An examination of the young shells, ready to leave the capsules, confirms this. The other kind has larger and thinner capsules, with a thin, sharp outer edge, while the sides have radiating ridges or raised lines. Sometimes the sides are unlike, one being smooth and more or less concave, the other convex and crossed by ten or twelve radiating, elevated ridges, extending to the edge. This kind was attributed to *F. carica* by Dr. G. H. Perkins, and formerly by Mr. Sanderson Smith, but a more careful examination of the young shells, within the capsules, shows that they belong to *S. canaliculata*.

Among the sand-dwelling bivalve shells we find quite a number of species that burrow rapidly and deeply, some of them living in permanent holes or perpendicular burrows, into which they can quickly descend for safety, and others burrowing in the sand in all directions, without permanent holes.

The "razor-shell," *Ensatella Americana*, (Plate XXVI, fig. 182, and Plate XXXII, fig. 245,) is a common inhabitant of sand-flats and sand-bars, where the water is pure, generally living near low-water mark or below, but sometimes found considerably above low-water mark, as on the sand-bar at Savin Rock. This curious mollusk constructs a deep, nearly round, somewhat permanent burrow, which descends nearly perpendicularly into the sand to the depth of two or three feet. These holes can generally be recognized, by their large size and somewhat elliptical form, when the tide is out. Sometimes they are very abundant in certain spots and not found elsewhere in the neighborhood. They sometimes come to the top of the burrow, when left by the tide, and project an inch or two of the end of the shell above the surface of the sand; at such times, if cautiously approached, many can easily be secured by pulling them out with a sudden jerk, but if the sand be jarred the whole colony will usually take the alarm and instantly disappear. When thus warned it is generally useless to attempt to dig them out, for they quickly descend beyond the reach of the spade. They will often hold themselves so firmly in their holes by means of the expanded end of the long muscular foot, that the body may be drawn entirely out of the shell before they will let go. When not visible at the orifice they can often be secured by cutting off their retreat with a sudden oblique thrust of the spade below them. They are obliged to come up to the upper part of the burrow on account of the shortness of their siphons, or breathingtubes, which can be protruded only about an inch in specimens of the ordinary size, and as they depend upon one of these to bring them both food and oxygen, and on the other (dorsal) one to carry off the waste water and excretions, it is essential for their happiness that the orifices of these tubes should be at or near the opening of the burrow most of the time. In this respect the common "long clam," *Mya arenaria*, (fig. 179,) and many others that have very long and extensile tubes have a great advantage. But the "razor-shell" makes up for this disadvantage by its much greater activity. Its foot, or locomotive organ, (see fig. 182,) is long and very muscular and projects directly forward from the anterior end of the shell; at the end it is obliquely beveled and pointed, and it is capable of being expanded at the end into a large bulb, or even into a broad disk, when it wishes to hold itself firmly and securely in its burrow. In excavating its burrows it contracts the end of the foot to a point and then thrusts it beneath the surface of the sand; then, by forcing water into the terminal portion, it expands it into a swollen, bulbous form, and thus crowds the sand aside and enlarges the burrow; then, by using the bulb as a hold-fast, the shell can be drawn forward by the contraction of the foot; the latter is then contracted into a pointed form and the same operations are repeated. The burrow thus started soon becomes deep enough so that the shell will maintain an upright position, when the work becomes much easier and the burrow rapidly increases in depth. The "razor-shell," like all other bivalves, depends upon the minute infusoria and other organic particles, animal and vegetable, brought in by the current of water that supplies the gills with oxygen. It is preyed upon by several fishes that seem to be able to root it out of the sand, or perhaps seize it when at the surface. In this region its principal enemies are the tautog and skates. The latter appear to eat only the *foot*, for in their stomachs there are sometimes many specimens of this organ, but no shells or other parts.

The common "long clam," *Mya arenaria*, (p. 309, Plate XXVI, fig. 179,) is also found on sandy shores from low-water nearly up to high-water mark, but it prefers localities where there is more or less gravel or mud with the sand, so as to render it compact, and it has a decided preference for sheltered localities, and especially abounds on the shores of estuaries where there is a mixture of sand, mud, and gravel. It will, therefore, be more particularly mentioned among the estuary species. Yet it is often found even on the outer ocean-beaches, in favorable localities, but not in the loose sands. It lives in permanent burrows, and on account of its extremely long siphon-tubes, which can be stretched out to the length of a foot or more, it is always buried at a considerable depth beneath the sand. The specimens of this shell that live on the outer sandy beaches are much thinner, whiter, and more regular in form than those found in the estuaries; they are often quite delicate in texture, and covered, even when full grown, with a thin, yellowish epidermis, and look so unlike the homely, rough, and mud-colored specimens usually sold in the markets, that they might readily be mistaken for another species.

The "sea-clam" or "surf-clam," *Mactra solidissima*, (Plate XXVIII, fig. 202,) is a large species which belongs properly to the sandy shores, and is seldom found elsewhere. It is common both in the sounds and on the outer ocean-beaches, but is not very often found above low-water of ordinary tides unless thrown up by the waves. Its proper home is on sandy bottoms in shallow water, just beyond low-water mark and down to the depth of four or five fathoms. It occurs all along our coast, wherever there are sandy shores, from North Carolina to Labrador. Its shells are extremely abundant and of very large size on the outer sand-beaches of New Jersey and the southern side of Long Island. This species grows very large, some of the shells being more than six inches long and four or five broad; and there is great variation in the form of the shell, some being oval, others more oblong or elliptical, and others nearly triangular; some are very swollen, others quite compressed; but all the intermediate grades occur. The siphon-tubes are quite short and the creature does not usually burrow very deeply, nor does it seem to construct any permanent burrows. But it has a very large muscular, compressed foot, with which it can quickly burrow beneath the surface of the sand. Nevertheless large numbers are always thrown on the beaches by violent storms, and once there they are very soon devoured by crows, gulls, and other large birds that frequent the shores. This species is not very largely used as food, and is seldom seen in our markets; partly because it cannot usually be so easily obtained in large quantities as the common "long clam" and "round clam," and partly because it is generally inferior to those species as an article of food, for the meat is usually tougher, especially in the largest specimens. But moderate-sized and young "surf-clams" are by no means ill-flavored or tough, and are quite equal in quality to any of the other clams, either "long" or "round," that are ordinarily sold in the markets.

The *Siliqua costata*, (Plate XXXII, fig. 244,) *Lyonsia hyalina*, (Plate XXVII, fig. 194,) and *Lævicardium Mortoni*, (Plate XXIX, fig. 208,) are usually to be found on sandy shores and beaches, often in considerable numbers, but they do not naturally live above low-water mark, and, when found higher up, have probably been carried there by the action of the waves. Their proper homes are on sandy bottoms, in shallow water off shore. They are all rapidly burrowing species, and can live, for a time at least, in the loose sand above low-water mark.

The *Angulus tener* (Plate XXVI, fig. 180, animal, and Plate XXX, fig. 223, shell) is a species that is partial to sandy bottoms and sandy shores, though it is also often found in soft mud. It frequently occurs living at low-water mark, but is more abundant in deeper water. It is a rapid burrower, and has remarkably long, slender, white siphons, which are entirely separate, from the base, and very flexible. On account of the length of these tubes it can remain buried to a considerable depth beneath the surface of the sand, merely projecting the tubes upward to the surface. It is, nevertheless, like other bivalves, often rooted out of its burrows and devoured by many fishes, especially, in this region, by the "scup" and flounders. This species is found all along the coast, from the Gulf of Saint Lawrence to South Carolina.

The *Macoma fusca* (Plate XXX, fig. 222) is a related species, also furnished with similar, very long, slender, separate tubes, and is, therefore, able to live deeply buried beneath the surface. This species is much more abundant than the preceding, between tides, but it most abounds on shores that are more or less muddy, and in estuaries. But when living on the sandy shores, and where the water is pure, it becomes much smoother and more delicate, and is often of a beautiful pink-color and much larger than the specimen figured. When living in the muddy estuaries it generally has a rough or eroded surface, more or less irregular form, and a dull white or muddy color, often stained with black, resembling in color the *Mya arenaria*, with which it is sometimes associated. It is dug up and eaten by the tautog and other fishes.

The pretty little *Tottenia gemma* (Plate XXX, fig. 220) is a species peculiar to sandy shores, both above and below low-water mark; and it often occurs in immense numbers on the sandy flats laid bare by the tides, buried just beneath the surface of the sand. Owing to its small size it is, however, liable to be overlooked, unless particularly sought for. It is an active species and burrows quickly. It is peculiar in being viviparous, as was first observed by Mr. G. H. Perkins, who found, in January, from thirty to thirty-six, well-formed young shells, of nearly uniform size, in each of the old ones. This shell has a lustrous, concentrically grooved surface; the color is yellowish white or rosy, with the beaks and posterior end usually purple or amethyst-color. It occurs all along the coast from Labrador to South Carolina. The common "round clam" or "quahog-clam," *Venus mercenaria*, (Plate XXVI, fig. 184, animal,) is also common on sandy shores, living chiefly on the sandy and muddy flats, just beyond low-water mark, but is often found on the portion laid bare at low-water of spring-tides. It also inhabits the estuaries, where it most abounds. It burrows a short distance below the surface, but is often found crawling at the surface, with the shell partly exposed. It has short siphon-tubes, united from the base to near the ends, and a large, muscular foot, with a broad, thin edge, by means of which it can easily burrow beneath the sand when necessary. The lobes of the mantle are separate all around the front and ventral edge of the shell, and their edges are thin, white, and folded into delicate frills, some of which, near the siphon-tubes, are elongated and more prominent. Owing to the broad opening in the mantle, the foot can be protruded from any part of the ventral side, and has an extensive sweep, forward and backward. The foot and mantle edges are white; the tubes are yellowish or brownish orange toward the end, more or less mottled and streaked with dark brown, and sometimes with opaque white.

This species is taken in large quantities for food, and may almost always be seen of various sizes in our markets. The small or moderate-sized ones are generally preferred to the full-grown clams. Most of those sold come from the muddy estuaries, in shallow water, and are fished up chiefly by means of long tongs and rakes, such as are often used for obtaining oysters. Sometimes they are dredged, and occasionally they can be obtained by hand at or just below low-water mark. These estuary specimens usually have rough, thick, dull-white, or mud-stained shells, but those from the sandy shores outside have thinner and more delicate shells, often with high, thin ribs, especially when young; and in some varieties the shell is handsomely marked with angular or zig-zag lines or streaks of red or brown, (var. *notata.*) These varieties often appear so different from the ordinary estuary shells that many writers have described them as distinct species, but intermediate styles also occur. This species is very abundant along the coast from Cape Cod to Florida; north of Cape Cod it is comparatively rare and local. It does not occur on the coast of Maine or in the Bay of Fundy, except in a few special localities, in small, sheltered bays, where the water is shallow and warm, as at Quahog Bay, near Portland; but in the southern parts of the Gulf of Saint Lawrence, as about Prince Edward's Island and the opposite coast of Nova Scotia, where the water is shallow and much warmer than on the coast of Maine, this species again occurs in some abundance, associated, in the same waters, with the oyster and many other southern species that are also absent from the northern coasts of New England, and constituting a genuine southern colony, surrounded on all sides, both north and south, by the boreal fauna.

The curious and delicate shell called *Solenomya velum* (Plate XXIX, fig. 210) is occasionally found burrowing in the pure, fine, siliceous sand near low-water mark, about two inches below the surface, but its proper home is in shallow water, beyond low-water mark, and it is, perhaps most abundant where there is mud mixed with sand, and it also lives in soft mud. Its shell is glossy and of a beautiful brown color, and is very thin, flexible, and almost parchment-like in texture, especially at the edges. It is a very active species, and has a very curious foot, which is protruded from the front end of the shell, and can be used in burrowing, very much as the "razor-shell," described above, uses its foot; but the *Solenomya* makes use of its foot in another way, for it can swim quite rapidly through the water, leaving the bottom entirely, by means of the same organ. The foot can be expanded into a concave disk or umbrella-like form at the end, and, by suddenly protruding the foot and expanding it at the same time, a backward motion is obtained by the reaction against the water; or, by suddenly withdrawing the foot and allowing it to remain expanded during most of the stroke, a forward motion is obtained. It is a singular sight to see this shell swim swiftly many times around a vessel of water, at the surface, until, finally, becoming exhausted by its violent exertions, it sinks to the bottom for rest.

The common "scollop," *Pecten irradians,* (Plate XXXII, fig. 243,) is also frequently found living on sandy shores and flats, or in the pools, but it belongs more properly to the sheltered waters of the ponds and estuaries, where it lives among the eel-grass. It will, therefore, be mentioned again in that connection.

The "common muscle," *Mytilus edulis,* (p. 307,) is frequently found in large patches on sandy flats, fastened together by the threads of byssus. Some of the most beautifully colored varieties, (fig. 234,) with radiating bands of blue and yellow, are often found in such places, but the species is much more abundant and larger in other situations, especially in the shallow and sheltered waters of the bays, where there is more or less mud.

Ascidians are almost entirely wanting on the sandy shores, but *Molgula Manhattensis* (p. 311, Plate XXXIII, fig. 250) is sometimes found even on sandy shores, attached to eel-grass.

Of Bryozoa only two species are usually met with, and even these do not have their true stations on the sandy shores. The delicate and gracefully branched *Bugula turrita* (p. 311, Plate XXXIV, figs. 258, 259) is occasionally found growing attached to the eel-grass, which often grows in the sandy tide-pools, or at extreme low-water. It also occurs in great abundance among the masses of sea-weeds thrown up by the waves on the sandy beaches. Such specimens are often large and luxuriant, in some cases being more than a foot in length ; these are derived from the bottom in deeper water, off shore.

The *Escharella variabilis* (p. 312, Plate XXXIII, fig. 256) is often found encrusting dead shells of various kinds, especially such as are inhabited by the larger "hermit-crabs." It is also cast up in abundance, on some beaches, from deeper water.

The Radiates are not numerous on sandy shores, yet several interesting species may be found. Among the Echinoderms we find four species of holothurians, one sea-urchin, one star-fish, and one ophiuran.

The most common holothurian is the *Leptosynapta Girardii,* (Plate XXXV, figs. 265, 266.) This is a long, slender, very delicate and fragile species, which burrows deeply in the sand or gravel near low-water mark. The holes are round and go down almost perpendicularly; they are usually not more than a quarter of an inch in diameter. The creature is not quick in its motions, and can usually be found in the upper part of its burrow when the tide is out. The skin is thin and quite translucent, so that the white muscular bands that run lengthwise of the body, on the inside, can be easily seen, as well as the large intestine, which is always quite full of sand and gives a dark appearance to the body. The tentacles are almost always in motion, and are used in burrowing as well as for other purposes. The skin is filled with minute perforated oval plates, to each of which there is attached, by the shank, a beautiful little anchor, (fig. 266,) quite invisible to the naked eye. The flukes of these anchors project from the skin and give it a rough feeling when touched; they afford the means of adhesion to various foreign substances, having a rough surface, and are doubtless useful to them when going up and down in the burrows. When kept in confinement this species will generally soon commence to constrict its body, at various points, by powerful muscular contractions, which often go so far as to break the body in two, and after a few hours there will usually be nothing left but a mass of fragments.

Another related species, *L. roseola* V., also occurs in similar places and has nearly the same habits, but this species is of a light rosy color, caused by numerous minute round or oval specks of light red pigment scattered through the skin. The anchors are similar but much more slender, with the shank much longer in proportion. The perforated plates are also much smaller in proportion to the length of the anchors.

The *Caudina arenata* is much more rare in this region. It lives at extreme low-water mark, or just below, buried in the sand. Its skin is thicker and firmer than that of the preceding species, and its body is shorter and stouter, while the posterior part narrows to a long slender caudal portion. Its skin is filled with immense numbers of small, round, wheel-like plates, with an uneven or undulated border, perforated near the rim with ten to twelve roundish openings, and usually having four quadrant-shaped openings in the middle; or they may be regarded as having a large round opening in the middle, divided by cross-bars into four parts. This species appears to be rare in this region, and was met with only by Professor H. E. Webster, at Wood's Hole, but it is quite abundant in some parts of Massachusetts Bay, as at Chelsea Beach and some of the islands in Boston Harbor. These and all other holothurians are devoured by fishes.

The *Thyone Briareus* is a large purple species, often four or five inches long and one inch or more in diameter. It is thickly covered over its whole surface with prominent papillæ, by which it may easily be distinguished from any other found in this region. It is more common in the shallow waters off shore, on shelly bottoms.

The "sand-dollar," *Echinarachnius parma*, (Plate XXXV, fig. 267,) is the only sea-urchin that is commonly met with on sandy shores in this region, and this is not often found living on the shore, except at extreme low water of spring-tides, when it may sometimes be found on flats or bars of fine siliceous sand in great numbers, buried just beneath the surface, or even partially exposed. It creeps along beneath the sand with a slow gliding motion, by means of the myriads of minute extensile suckers with which it is furnished. It is far more abundant on sandy bottoms at various depths off shore. It has a very wide range, for it is found all the way from New Jersey to Labrador, and also on the North Pacific coast; and in depth it ranges from low-water mark to 430 fathoms, off Saint George's Bank, where it was dredged by Messrs. Smith and Harger. When living its color is usually a rich purplish brown, but it soon turns green when taken from the water. It gives a dark green or blackish color to alcohol, which stains very injuriously any other specimens put in with it. The fishermen on the coast of Maine and New Brunswick sometimes prepare an indelible marking-ink from these "sand-dollars," by rubbing off the spines and skin and, after pulverizing, making the mass into a thin paste with water. A number of fishes have been found to swallow this unpromising creature for food, and the flounders consume large numbers of them.

The common green star-fish, *Asterias arenicola*, (p. 326, Plate XXXV, fig. 269,) is sometimes met with on sandy shores, but is much less abundant than on rocky shores. The curious "brittle star-fish," *Ophiura olivacea*, is sometimes found among the eel-grass on sandy shores, especially in tide-pools, in sheltered localities. It may be recognized by its nearly circular, disk-like body, about three-quarters of an inch in diameter, with five round, rather slender, tapering, stiff-looking arms, about three inches long. The color is bright green, much like that of the eel-grass among which it lives. When at home in the water it moves about over the sand quite rapidly by means of its arms. When taken from the water it does not usually break itself up into numerous fragments, as readily as most of its related species do. It is rather southern in its distribution, and Vineyard Sound is perhaps its northern limit. It extends southward at least to North Carolina.

Of acalephs there are no species known to me that properly belong to the sandy shores, but *Hydractinia polyclina* (p. 328) is often found on the shells carried about by the hermit-crabs, in such situations, and there are species of *Obelia* and other hydroids that sometimes grow on the eel-grass in the tide-pools, but they are much more frequent in other situations.

Among the Polyps we find several species proper to sandy shores and specially adapted to this mode of life. One of the most interesting of these is the *Halocampa producta*, (p. 330, Plate XXXVIII, fig. 285,) which has already been described. This often occurs in the sand at low-water mark, and makes round holes about a foot deep, which can sometimes be recognized by small cracks radiating from the hole when the tide leaves them uncovered.

The *Sagartia modesta* (p. 330) is also found buried in the sand at low-water, especially where there is also some gravel with the sand. The *Sagartia leucolena* (p. 329, Plate XXXVIII, fig. 284) is sometimes found in similar situations, but belongs properly to the rocky shores.

The *Paractis rapiformis* is a species that is still little known. It lives buried deeply in the sand at and below low-water mark. It appears to be common on the coast of North Carolina, at Fort Macon, where it is often thrown up by storms, and it has also been found at Great Egg Harbor and near New Haven light. The body is three or four inches long when extended, and an inch or more in diameter, and is very changeable in form. The surface is nearly smooth, slightly sulcated lengthwise, and the color is usually pink, or pale flesh-color, translucent. The tentacles are numerous, short, tapering, pale greenish olive, with a dark band around the base, connected with a dark line radiating from the mouth. Toward the upper part of the body the surface is somewhat wrinkled and is capable of attaching grains of sand to itself. When thrown up by the waves it contracts into a globular or pyriform shape and "somewhat resembles a boiled onion or turnip."

List of the species ordinarily inhabiting the sandy shores.

ARTICULATA.

Insects.

	Page.		Page.
Muscidæ, (larvæ)	335	Geopinus incrassatus	335
Cicindela generosa (larva)	336	Phytosus littoralis	335
C. dorsalis	335	Bledius cordatus	335
C. hirticollis	335	B. pallipennis	335
C. albohirta	335	Heterocera undatus	335

Crustacea.

	Page.		Page.
Ocypoda arenaria	337	Orchestia agilis	346
Gelasimus pugilator	336	Talorchestia longicornis	336
Cancer irroratus	338	T. megalophthalma	336
Carcinus granulatus	312	Lepidactylis dytiscus	339
Platyonichus ocellatus	338	Unciola irrorata	340
Libinia canaliculata	339	Idotea irrorata	340
Hippa talpoida	338	I. cæca	340
Eupagurus pollicaris	313	I. Tuftsii	340
E. longicarpus	339	Scyphacella arenicola	337
Crangon vulgaris	339	Limulus Polyphemus	340
Palæmonetes vulgaris	339		

Annelids, (Chætopods.)

	Page.		Page.
Sthenelais picta	348	Polydora ciliatum	345
Nephthys picta	348	Diopatra cuprea	346
Eteone, sp.	349	Marphysa Leidyi	347
Nereis virens	341	Lumbriconereis opalina	342
N. limbata	341	L. tenuis	342
Cirratulus grandis	348	Staurocephalus pallidus	348
Scolecolepis viridis	345	Rhynchobolus Americanus	342
S. tenuis	345	R. dibranchiatus	341

Bryozoa and Ascidians.

RADIATA.

Echinoderms.

Polyps.

II. 3.—FAUNA OF THE MUDDY SHORES OF THE BAYS AND SOUNDS.

The muddy shores in this region grade almost insensibly into the sandy shores; and shores that are entirely of mud, without any admixture of fine sand, rarely occur except in the estuaries and lagoons. Therefore we find, as might have been anticipated, that it is difficult to draw a very definite line between the animals living upon the sandy shores and those living upon the muddy shores and flats. Many of the species seem, also, to be equally at home, whether living in mud or sand, and many others prefer a mixture, although capable of living in either. But if we were to compare the animals living in pure sand with those living in clear mud, the two lists would be quite different, although a considerable number would be common to both lists. Moreover, the eel-grass grows in considerable quantities both upon sandy and muddy shores, in certain localities, and a large number of species which inhabit the eel-grass will, therefore, be found in both lists.

In discussing the species found on sandy shores, in the preceding pages, references have constantly been made to other stations inhabited by many of the species, and especially in the case of those that are common to the sandy and muddy shores. Therefore it will not be necessary to repeat the facts in this connection, but the species will be enumerated in the list at the end of this section.

A considerable number of species have their place in this list chiefly because they occur on beds of oysters planted on muddy shores, at and just below low-water mark. Without these artificial stations some of them would hardly be found on such shores, or at least but rarely. It is evident that the shells of oysters, when in large quantities, supply, to a certain extent, conditions similar to those of rocky shores, and consequently it is natural that certain rocky-shore species should be found in such situations. Only the more common and most important of these have been introduced into the list, however, for to include all the species to be found among oysters would uselessly extend the catalogue.

Among the Crustacea we find a considerable number of species which have their proper homes on the muddy shores. Of the true crabs there are at least eleven species that constantly occur in these situations, but several of them, viz., *Cancer irroratus*, (p. 312,) *Panopeus depressus*, (p. 312,) *P. Sayi*, (p. 312,) and *Carcinus granulatus*, (p. 312,) are found in greater numbers elsewhere, and depend largely upon the oyster-beds for their safety on these shores. The *Carcinus granulatus*, however, often resorts to the holes and cavernous places under the peaty banks of the shores, or along the small ditches and streams cutting through the peaty marshes near the shore. The marsh "fiddler-crab," *Gelasimus pugnax*, is usually very abundant in the peaty banks and along the ditches and streams at and just above high-water mark, where it excavates great numbers of deep holes, often completely riddling the soil. This species is, however, more at home along the borders of the estuaries and lagoons and will be described more fully in that connection, as well as the *Sesarma reticulata*, which often occurs with it in both situations.

The "oyster-crab," *Pinnotheres ostreum*, (Plate I, fig. 2, male,) is found wherever oysters occur. The female lives, at least when mature, within the shell of the oyster, in the gill cavity, and is well known to most consumers of oysters. The males (fig. 2) are seldom seen, and rarely, if ever, occur in the oyster. We found them, on several occasions, swimming actively at the surface of the water in the middle of Vineyard Sound. They are quite unlike the females in appearance, being smaller, with a firmer shell, and they differ widely in color, for the carapax is dark brown above, with a central dorsal stripe and two conspicuous spots of whitish, as indicated in the figure; the lower side and legs are whitish. The female has the carapax thin and translucent, whitish, tinged with pink. The *Pinnixa cylindrica* (Plate I, fig. 1) is a related species which is occasionally met with on muddy shores. It lives in the tubes of certain large *Annelids* in company with the rightful owner. The specimens hitherto met with in this region were either found free, or dug out of the mud, and it is uncertain with what worm they associate, though it is most likely to be the *Nereis virens*, but on the coast of South Carolina it lives, according to Dr. Stimpson, in the tubes of *Arenicola cristata* Stimpson. It has been found in the stomach of the ocellated flounder.

The common edible-crab or "blue-crab," *Callinectes hastatus*, is a common inhabitant of muddy shores, especially in sheltered coves and bays. It is a very active species and can swim rapidly; it is therefore often seen swimming at or near the surface. The full-grown individuals generally keep away from the shores, in shallow water, frequenting muddy bottoms, especially among the eel-grass, and are also found in large numbers in the somewhat brackish waters of estuaries and the mouths of rivers. The young specimens of all sizes, up to two or three inches in breadth, are, however, very frequent along the muddy shores, hiding in the grass and weeds or under the peaty banks at high-water, and retreating as the tide goes down; when disturbed they swim away quickly into deeper water. They also have the habit of pushing themselves backward into and beneath the mud for concealment. They are predacious in their habits, feeding upon small fishes and various other animal food. They are very pugnacious and have remarkable strength in their claws, which they use with great dexterity. When they have recently shed their shells they are caught in great numbers for the markets, and these "soft-shelled crabs" are much esteemed by many. Those with hard shells are also sold in our markets, but are not valued so highly. This crab can easily be distingushed from all the other species found in this region by the sharp spine on each side of the carapax.

The common "spider-crab," *Libinia canaliculata*, (p. 339,) is very common on muddy shores and flats. It hides beneath the surface of the mud and decaying weeds or among the eel-grass, and is very sluggish in its motions. Its whole surface is covered with hairs which entangle particles of mud and dirt of various kinds; and sometimes hydroids, algæ, and even barnacles grow upon its shell, contributing to its more ready concealment. The males are much larger than the females, and have long and stout claws. They often spread a foot or more across the extended legs. The females have much smaller and shorter legs and comparatively weak claws.

Another similar species, *Libinia dubia*, is also found on muddy shores and has nearly the same habits. It has a much longer rostrum, more deeply divided at the end.

The two common species of "hermit-crabs" are both found on muddy shores, especially among eel-grass, but the larger one, *Eupagurus pollicaris*, (p. 313,) is comparatively rare. The small one, *E. longicarpus*, (p. 313,) is very common and usually occupies the dead shells of *Ilyanassa obsoleta*, though many may be found in other species of shells.

The *Gebia affinis* (Plate II, fig. 7) is a crustacean somewhat resembling a young lobster three or four inches in length. It lives on muddy shores and digs deep burrows near low-water mark, in the tenacious mud or clay, especially where there are decaying sea-weeds buried beneath the surface. The burrows are roundish, half an inch to an inch in diameter, very smooth within, and go down obliquely for the distance of one or two feet, and then run off laterally or downward, in almost any direction, to the depth of two or three feet, and are usually quite crooked and winding. We have found them most abundant on the shore of Great Egg Harbor, New Jersey, near Beesley's Point, but they also occur at New Haven and Wood's Hole, &c. This species is quite active; it swims rapidly and jumps back energetically. It is eagerly devoured by such fishes as are able to capture it. When living the colors are quite elegant. Along the back there is a broad band of mottled, reddish brown, which is contracted on the next to the last segment; each side of this band the mottlings are fewer, and the surface somewhat hairy. The last segment and the appendages of the preceding one are thickly specked with reddish brown; their edges are fringed with gray hairs. The *Calianassa Stimpsoni* SMITH, (Plate II, fig. 8, large claw,) is also a burrowing species, but its habits are at present little known, owing to its rarity. It has been found in the stomach of fishes, and is probably more common farther south.

The *Squilla empusa* is a very interesting creature, whose habits are still imperfectly known. It is often thrown on the beaches by the waves, and probably it usually burrows in the mud below low-water mark, but in certain localities it has been found burrowing at or near low-water mark of spring-tides, forming large, irregular holes. The very curious, free-swimming young (Plate VIII, fig. 36) were often taken in the towing-nets. Large specimens are eight or ten inches long and about two broad. The body is not so stout built as that of the lobster, and the carapax or shell is much smaller and softer, while the abdomen is much larger and longer in proportion. The legs and all the other organs are quite unlike those of the lobster, and the last joint of the great claw, instead of forming a pair of pincers with the next, is armed with a row of six sharp, curved spines, which shut into corresponding sockets, arranged in a groove in the next joint, which also bears smaller spines. By means of this singular organ they can hold their prey securely, and can give a severe wound to the human hand, if handled incautiously. It also uses the stout caudal appendages, which are armed with spines, very effectively. The colors of this species are quite vivid, considering its mud-dwelling habits. The body is usually pale green or yellowish green, each segment bordered posteriorly with darker green and edged with bright yellow; the tail is tinged with rose and mottled with yellow and blackish; the outer caudal lamellæ have the base and spines white, the last joint yellow, margined with black; the inner ones are black, pale at base; the eyes are bright emerald-green; the inner antennæ are dark, with a yellow band at the base of each joint; and the flagellum is annulated with black and white.

The common shrimp, *Crangon vulgaris*, (p. 339, Plate III, fig. 10,) is frequent on muddy shores, where it has a darker color than when living on sandy shores. The common prawn, *Palæmonetes vulgaris*, (p. 339, Plate II, fig. 9,) is also common in such situations, especially where there is eel-grass, among which it finds its favorite resorts, but it is still more abundant in the estuaries. Another shrimp, the *Virbius zostericola* SMITH, also occurs among the eel-grass, in similar places. It is usually greenish in color.

Two other species of shrimp-like crustacea, belonging to the genus *Mysis*, are also found on muddy shores, especially among eel-grass.

The *Mysis stenolepis* SMITH, (Plate III, fig. 12, female,) is often very abundant in such situations. The small young ones have been taken in May, and the half-grown ones later in the season. In the early spring the adult females, with eggs, occur in great numbers among the eel-grass, in estuaries and ponds. Mr. Vinal N. Edwards caught a large number in a small pond at Wood's Hole, April 1. No males were found at this time with the females; the only adult males observed were taken in autumn. Possibly the males do not survive the winter. The adult females have not been observed in summer, and they probably die after hatching their young in the spring. The whole body is translucent; each segment of the body has a stellate black spot; and there is more or less blackish pigment on the caudal lamellæ, telson, antennal scales, and inner flagellum and peduncle of the antennulæ. This species contributes largely to the food of many fishes. The other species, *M. Americana* SMITH, also lives among eel-grass, as well as in deeper water off shore among algæ. This has been found in large numbers in the stomachs of the shad and the spotted flounder.

Of Amphipods there are comparatively few species. The *Unciola irrorata* (p. 340, Plate IV, fig. 19) is pretty common here, as elsewhere. The *Amphithoë valida* SMITH (p. 315,) is often met with among eel-grass. Another species, *A. compta* SMITH, also occurs in the same places. It differs from the preceding in many characters, but may easily be distinguished by its red eyes. A third species of the genus, *A. longimana* SMITH, is also found among eel-grass. It has black eyes. The *Corophium cylindricum* and *Gammarus mucronatus* occur among eel-grass and algæ, often in great numbers.

Of Isopods there are several species. The *Idotea irrorata* (p. 316, Plate V, fig. 23) is common wherever eel-grass is found. The *Erichsonia attenuata* HARGER, (Plate VI, fig. 27,) is also found clinging to eel-grass in muddy situations. The *Epelys trilobus* (Plate VI, fig. 28) is found creeping about over the bottom or among and beneath the decaying vegetable matter and mud usually to be found in sheltered situations. It is usually so covered up with adhering dirt as readily to escape observation. The *Epelys montosus* also occurs in similar situations.

Whenever lumber or drift-wood has been left for some time on the muddy shores it is found to be more or less eaten by the *Limnoria lignorum*, (Plate VI, fig. 25.) This small isopod gnaws its galleries in the wood to a depth of about half an inch from the surface, and after a time these galleries become so numerous that the superficial layer will be completely honey-combed, and it will then scale off and another layer will be attacked. This little creature often does great damage to the piles of wharves and other kinds of submerged wood-work in this region, and will be mentioned again in discussing the animals inhabiting piles, &c.

The "horse-shoe crab," *Limulus Polyphemus*, (p. 340,) is also common on muddy shores, burrowing beneath the surface, at or just below low-water mark.

Many of the Annelids found on muddy shores occur also on sandy shores, especially where there is a mixture of mud with the sand, and consequently they have been mentioned in the preceding pages. Among these are *Nereis virens* (p. 317, Plate XI, figs. 47–50) and *N. limbata*, (p. 318, Plate XI, fig. 51,) both of which are common on muddy shores; also *Diopatra cuprea*, (p. 320, Plate XIII, figs. 67 and 68;) *Lumbriconereis opalina*, (p. 342, Plate XIII, figs. 69, 70;) *L. tenuis*, (p. 342;) *Maldane elongata*, (p. 343;) *Notomastus luridus*, (p. 342;) *Notomastus filiformis*, (p. 342;) *Cirratulus grandis*, (p. 319, Plate XV, figs. 80, 81;) *Cistenides Gouldii*, (p. 323, Plate XVII, figs. 87, 87*a*;) all of which are found both in mud and sand, but prefer, perhaps, a mixture of the two. *Rhynchobolus Americanus* (p. 342, Plate X, figs. 45, 46) and *R. dibranchiatus* (p. 341, Plate X, figs. 43, 44) are also found in mud, though perhaps more common in fine sand, or sandy mud.

The "blood-drop," *Polycirrus eximius*, (p. 320, Plate XVI, fig. 85) is however, a species that belongs properly to muddy localities, and it delights in the softest and stickiest mud of the shores, near low-water mark. The larger blood-drop, *Chætobranchus sanguineus*, (p. 320,) is also found in similar situations, and the soft mud, filled with decaying vegetable matter, seems to be its most congenial home.

Of Mollusks there are comparatively few species that are peculiar to muddy shores, but there are many that live almost equally well in such localities and on shores or bottoms of other kinds.

Among the Gastropods, the proper mud-dwelling species are few. The *Ilyanassa obsoleta* (p. 354, Plate XXI, fig. 113) is the most abundant, for it occurs everywhere over the mud-flats in great numbers, and, in cold weather, often crowds in large numbers into the pools left on the flats. The *Nassa vibex* (Plate XXI, fig. 114) has nearly the same habits, but is comparatively rare. It is more frequently found among the eel-grass, and is more common farther south.

The *Eupleura caudata* (Plate XXI, fig. 117) is usually found rather sparingly in this region, but in one locality, at Waquoit, it occurred in considerable numbers in the small streams and ditches in the muddy marshes near the shore. It occurs occasionally at low-water, but is more often met with on muddy and shelly bottoms in the shallow water of the bays and sounds, and is much more common farther south. The *Crepidula convexa* (p. 355, Plate XXIII, fig. 128) is very common on the shells of *Ilyanassa obsoleta*, especially when they are inhabited by "hermit-crabs." It is also frequently found on the eel-grass, where, in August, it often deposits its bright yellow eggs inclosed in small, gelatinous masses, which are grouped in clusters.

The *Bulla solitaria* (Plate XXV, fig. 161) is a species restricted to muddy shores and bottoms, in sheltered situations, and is found also in muddy ponds and estuaries. The color of the animal of this species is quite peculiar, and when it is fully extended it has a singular appearance. The general color is usually orange-brown, and it is thickly speckled with darker brown. This shell is devoured in large numbers by the flounders, and doubtless by other fishes.

A number of species which habitually live clinging to eel-grass are to be found in the localities where this plant flourishes, either in the pools or at low-water mark, but they are not peculiar to or characteristic of muddy shores. Among these the most common are *Astyris lunata*, (p. 306;) *Bittium nigrum*, (p. 305;) *Triforis nigrocinctus*, (p. 305;) and *Lacuna vincta*, (p. 305.) The *Littorina irrorata* is occasionally found in sheltered situations, but this region is north of its true range, and such specimens as are found may have been introduced from farther south with oysters. It is very abundant on the southern coast. The *Urosalpinx cinerea* (p. 306) occurs wherever there are beds of oysters, upon which it feeds.

Most of the bivalve shells to be found on muddy shores have already been enumerated as living also on the sheltered sandy shores, and the majority of them flourish equally on both kinds of shores, and on those of a mixed or intermediate character. Among these are *Mya arenaria*, (p. 309;) *Macoma fusca*, (p. 358;) *Angulus tener*, (p. 358;) *Venus mercenaria*, (p. 359;) *Argina pexata*, (p. 309;) *Mytilus edulis*, (p. 307;) *Pecten irradians*, (p. 361.) There are, however, other species that are almost peculiar to muddy shores, and are highly characteristic of them. The *Pholas truncata* (Plate XXVII, fig. 200) excavates deep holes in deposits of tenacious clay at all elevations between tides, and is still more frequently found living in holes in the borders of peat-bogs, or marsh deposits, which have been encroached upon by the sea. In such places they sometimes occur nearly up to the ordinary high-water mark. Their holes are round and nearly perpendicular, and increase in size from the orifice downward. They vary in depth according to the size of the shell; the deeper ones are often a foot or a foot and a half in depth and often an inch in diameter. The shell remains near the bottom and stretches out its long siphon tubes, which are united together quite to the end, until the tips reach the external orifice of the burrow These tubes are generally yellowish white except at the end, where they are blackish or brownish; the orifices and papillæ are also variously marked with purplish brown or dark brown. The dark coloration of the end of the siphon tubes is doubtless for purposes of protection from predacious fishes, crabs, &c. Its foot is short and stout, obliquely truncated, and bevelled at the end. The *Petricola pholadiformis* (Plate XXVII, fig. 199) is generally associated with the preceding species and is more abundant. Its habits are nearly the same, but it does not make its burrows so deep; it is more active in its motions, and can easily climb up to the upper part of its hole by means of its long, thin, white foot, which is tongue-shaped and very extensible and flexible. The siphon-tubes are long and slender, tapering, and united for about a quarter of their length, beyond which they are separate and divergent. They are yellowish white, more or less spotted, especially toward the end, with orange, brownish, or blackish, which, in large specimens, forms streaks near the ends or even becomes confluent, making the tips very dark colored. The branchial orifice is surrounded by a circle of numerous bipinnate papillæ, which usually alternate with smaller and more simple ones; the papillæ of the dorsal tube are similar, but more simple.

The *Tagelus gibbus* (Plate XXVI, fig. 181, animal; Plate XXX, fig. 217, shell) is another inhabitant of muddy shores, which burrows deeply into the mud. This species is confined, on the shores, chiefly to the zone near low-water mark, but probably lives also in shallow water beyond the reach of the tides. In this species the foot is large and muscular, thick, tongue-shaped, and has a very wide range of motion, for the mantle is open along the whole length of the ventral edge of the shell. The tubes are separate, from the base, and are round, white, and capable of very great extension, for a specimen of ordinary size, kept in confinement, extended the tubes to the length of nine inches. These tubes are translucent, and at the end have small rounded lobes around the aperture, each lobe being furnished at its base, inside, with a small, orange, eye-like spot, which is probably an imperfect visual organ, and with two others on the inside lower down. The branchial tube has six of these lobes and ocelli; the dorsal one has eight. On each tube there is a row of small, white, slender, obtuse papillæ, corresponding to each terminal lobe, and running along the whole length of the tubes. The color of the animal is white throughout. This bivalve makes deep burrows in the tenacious mud, each of which has two orifices, not far apart, for the two tubes. By this peculiarity their burrows may be at once recognized, whenever seen.

The *Mulinia lateralis* (Plate XXVI, fig. 185, B, animal) is occasionally found living at extreme low-water mark, on muddy flats, but its true home is on the soft muddy bottoms in shallow water, where t is often excessively abundant. In this species the foot is relatively large and muscular, more or less pointed at the end, and capable of assuming many different forms and positions; it has a wide sweep in its motions and can be thrust forward or backward. The siphon-tubes are united nearly to the end, but the separation is indicated by a groove between them for nearly half the length. The branchial tube is the largest, and its orifice is surrounded by a circle of twelve to twenty-four, slender, elongated, simple papillæ, each of which usually has a small, black, eye-like spot at its base; a little below this terminal circle there is another, composed of smaller, very short, blunt papillæ. The dorsal tube also has a subterminal circle of similar papillæ, above which the tip forms a retractile cone, with the small, simple orifice at the tip. The animal is yellowish white, the tubes generally pale yellow. This species burrows just beneath the surface of the mud, and it is eaten in large numbers by the scup and other fishes.

The *Cumingia tellinoides* (Plate XXX, fig. 221) and *Kellia planulata* (Plate XXX, fig. 226) are sometimes found living in the mud at low-water, but are rare in such situations. They are more common at the depth of a few fathoms on muddy and shelly bottoms.

The ribbed muscle, *Modiola plicatula*, (p. 307, Plate XXXI, fig. 238, is very abundant near and even above high-water mark, along the muddy borders of the marshes and banks and among the roots of grass. The *Modiola hamatus* is occasionally met with, especially on oyster-beds, adhering to the shells, where it is sometimes very abundant. It has probably been introduced with the oysters, from the South, where it is common. It somewhat resembles the preceding species, but it is shorter, broader, with strong radiating ribs, many of which are forked. Its color is yellow or yellowish brown.

The common "scollop," *Pecten irradians*, (p. 361, Plate XXXII, fig. 243,) occurs among the eel-grass on muddy shores in great abundance, in many localities, especially in sheltered places. The young shells may be found during the whole summer, but the adult specimens come up to the shallow waters and shores in great numbers in the autumn. This species is very active and can rise from the bottom and swim through the water with great rapidity by opening and energetically closing its valves, thus expelling the water from the gill-cavity, the reaction sending the shell backward. It often remains up among the leaves of the eel-grass, resting upon them, where they are matted together, but if alarmed the creature suddenly swims away in the manner described, and takes to the bottom. It is very watchful and quickly perceives its enemies. The thickened outer edge of the mantle, both above and below, is fringed with rows of numerous tapering papillæ or tentacles, the inner ones largest, and among the bases of these there is a row of very bright silvery or bluish eyes, thirty to forty or more to each valve the number increasing with the size of the shell; a short distance within the outer fringe of tentacles there is a raised yellow or orange ridge, which bears another series of smaller papillæ, and the space between these and the outer ones is radiately striated. The central muscle which closes the valves of this shell is large and powerful. This is the portion which is sold in our markets in large quantities, and is highly esteemed by many as an article of food. Its decided sweetish taste is, however, objectionable to some persons. To some, also, it proves actually injurious, sometimes producing nausea and even worse symptoms. After storms this shell is sometimes found thrown upon the beaches in immense quantities.

The oyster, *Ostræa Virginiana*, (p. 310,) is often planted upon the muddy shores at and below low-water mark, in many parts of Long Island Sound and elsewhere, but for this purpose the muddy estuaries are preferred, where the water is more brackish and the bottom less disturbed by the storms. The mud, however, should not be too deep, and ought to have a solid substratum, a few inches beneath.

The Ascidians are generally uncommon on muddy shores, but wherever the eel-grass flourishes, and especially in sheltered situations, the *Molgula Manhattensis* (p. 311, Plate XXXIII, fig. 250) is usually to be found adhering to it. The *Botryllus Gouldii* (Plate XXXIII, figs. 252, 253) is also frequently found growing upon the eel-grass in such situations, as well as upon the piles of wharves, bottoms of boats, &c. This species was found in great profusion upon the eel-grass in Little Harbor, at Wood's Hole, and in Waquoit Pond. In both these localities the water is nearly pure and but slightly, if at all, brackish. But it has also been found by Professor D. C. Eaton on the piles at Brooklyn, New York, where the water is more brackish. This species when young forms thin, soft, circular or oval incrustations covered with stellate clusters of the minute animals, (fig. 253,) which are imbedded in it; each of these has a small circular orifice toward the outer end, opening into the gill cavity, and another orifice opening into a larger cavity in the center of the cluster, which is common to all those in the cluster; and it has a central external orifice, through which the waste water from the gills, the fæces, and the eggs are discharged. These young colonies begin to appear in June and grow very rapidly, new individuals being formed by buds that originate from the first ones in rapid succession, so that in two or three weeks the small colonies will increase from a quarter of an inch in breadth up to three or four inches, if they be situated on a flat surface and have room to spread. If upon the stem or leaf of the eel-grass they will extend entirely around it, and perhaps several inches along its length, if not opposed by other colonies. At the same time the crusts increase very much in thickness. Thus by the end of the summer, the eel-grass, algæ, stems of hydroids, &c., often become completely covered up by the luxuriant growth of this curious compound animal. The colors of this species are extremely variable and often very elegant, and it is seldom that two colonies can be found with precisely the same pattern of color. Growing upon the same leaf of eel-grass, many different colonies may often be found, each showing a different arrangement of the colors.

In one of the most common varieties the general color of the common tissue between the stellate clusters is dull olive-green, thickly specked with small flake-white spots, which are formed by the enlarged terminal portion of stolon-like processes, which bud out from the perfect individuals composing the clusters, and are arranged somewhat in circles around the clusters; the lower portion of these stolons is usually yellow or orange, and the outer part deep purple, tipped with flake-white. The individual animals, or zoöids, composing the stellate clusters, are deep purple, with the branchial orifice yellowish white, surrounded by a circle of orange; a short flake-white longitudinal line runs along the middle of the upper side, interrupted by the branchial opening, but this line is often represented only by two white spots; other flake-white spots are usually irregularly scattered over the outer end.

In another variety the deep purple zoöids have a circle of flake-white around the branchial orifice, a short white bar or spot beyond it on the outer end, a white spot on the middle between the orifices, and another white spot on the inner end near the anal orifice; the stolons colored as in the preceding.

In another common variety (var. *bicolor*) the colors are similar except that the outer half of each zoöid is almost entirely covered with flake-white, sometimes tinged with orange, while the proximal half is deep purple. Another has the purple zoöids spotted and blotched with flake-white over the whole surface; sometimes the specks are so fine and numerous as to give a uniform silvery or frosted appearance, (var. *farinacea.*)

One peculiar variety (*annulata*) has a small circle of white around the the branchial opening, surrounded by another large circle of flake-white, which incloses nearly the outer half of the zoöid. The variety *atrox* has the zoöids covered to a considerable extent with flake-white, so arranged on each as to present the appearance of a skull; the two eyes being formed by deep purple spots.

The variety *variegata* is pale yellowish olive or orange-brown; the zoöids have a white ring around the branchial orifice, inclosed by a brown ring, which is often interrupted; and the latter is surrounded more or less completely by flake-white, there is usually also a median bar of flake-white; the inner portion is deep purple, more or less mottled with white, and there is a white spot at the inner end. In the variety *albida* nearly the whole upper surface of the zoöids is flake-white.

In another very beautiful and distinct variety (var. *stella*) the common tissue is translucent, pale olive, with white-tipped stolons; the zoöids are brown or purple, marked on the upper side with two parallel longitudinal bars of flake-white, which are separated by a narrow dark line, all of which radiate from the center of the cluster, thus producing the appearance of a many-rayed star, with the rays alternately white and dark; the white bars are sometimes interrupted near the inner ends, and small specks of flake-white are sometimes scattered over the outer end. In this form there are often ten to fifteen zoöids in each cluster, and they appear longer and less swollen than in the other varieties, owing, perhaps, to the optical effect of the radiating lines. This is the most distinctly marked variety that was observed, and was at first thought to be a distinct species.

The Radiates are not abundant on muddy shores. The *Thyone Briareus* (p. 362) is sometimes found on such shores, in sheltered situations, among eel-grass. The common star-fish, *Asterias arenicola*, (p. 326, Plate XXXV, fig. 269,) is often altogether too abundant on muddy shores, on the oyster-beds, where it commits great havoc.

The *Hydractinia polyclina* (p. 328) is often found on the shells occupied by "hermit-crabs." Several species of *Obelia* grow upon the eel-grass, where the water is sufficiently clear. The *Halecium gracile* V. (p. 328,) is frequently found attached to the shells of oysters, and to other solid objects.

List of species commonly found on the muddy shores of the bays and sounds.

ARTICULATA.

Crustacea.

	Page.		Page.
Gelasimus pugnax	367	Mysis stenolepis	370
Sesarma reticulata	367	M. Americana	370
Pinnixa cylindrica	367	Squilla empusa	369
Pinnotheres ostreum	367	Gammarus mucronatus	370
Cancer irroratus	367	Amphithoë valida	370
Panopeus depressus	367	A. compta	370
P. Sayi	367	A. longimana	370
Callinectes hastatus	367	Unciola irrorata	370
Carcinus granulatus	367	Corophium cylindricum	370
Libinia canaliculata	368	Idotea irrorata	370
L. dubia	368	Erichsonia attenuata	370
Eupagurus longicarpus	368	Epelys trilobus	370
E. pollicaris	368	E. montosus	370
Callianassa Stimpsoni	369	Limnoria lignorum	370
Gebia affinis	368	Limulus Polyphemus	370
Virbius zostericola	369	Numerous small Entomostraca, of many genera.	
Crangon vulgaris	369		
Palæmonetes vulgaris	369		

Annelids, (Chætopods.)

	Page.		Page.
Nereis virens	371	Cistenides Gouldii	371
N. limbata	371	Amphitrite ornata	320
Diopatra cuprea	371	Rhynchobolus Americanus	371
Lumbriconereis opalina	371	R. dibranchiatus	371
L. tenuis	371	Cirratulus grandis	371
Maldane elongata	371	Polycirrus eximius	371
Notomastus luridus	371	Chætobranchus sanguineus	371
N. filiformis	371		

MOLLUSCA.

Gastropods.

	Page.		Page.
Ilyanassa obsoleta	371	Littorina irrorata	372
Nassa vibex	371	Lacuna vincta	372
Eupleura caudata	371	Bittium nigrum	372
Urosalpinx cinerea	372	Triforis nigrocinctus	372
Astyris lunata	372	Bulla solitaria	371
Crepidula convexa	371		

Lamellibranchs.

Ascidians.

RADIATA.

Echinoderms.

Acalephs.

II. 4.—ANIMALS INHABITING THE PILES AND TIMBERS OF WHARVES AND BRIDGES, BOTTOMS OF VESSELS, BUOYS, AND OTHER SUBMERGED WOOD-WORK.

In these situations a large number of species may be found, but the majority of them are not peculiar to such stations. There are, however, quite a number of species that are nearly always found under these circumstances, and others are directly dependent for their very existence upon submerged wood. Some of these, like the *Teredo*, for example, are of so great importance, owing to the injuries which they do to valuable property, that it seems desirable to make a special division for the animals ordinarily found in connection with wood-work of various kinds, whether injurious or not.

On the piles of wharves and bridges various kinds of sea-weeds often grow in abundance, each species having a particular zone to which it is limited; but as these plants require light, they are found almost exclusively upon the outer rows of piles and timber, and are most abundant on the outer side of the piles and on the southern exposures, where they get the most sunlight. These algæ afford congenial homes to a considerable number of animals, most of which occur also among algæ on the rocky shores and in tide-pools. Beneath the wharves, where the piles are constantly shaded, very few algæ, and those only of the smallest and simplest kinds, such as Ocillatoriæ and Diatoms, are to be found. But in these shaded situations many animals, such as Tubularians and other Hydroids, some Ascidians, Bryozoa, &c., delight to dwell. Many of these adherent animals also live in abundance on the outermost piles of the wharves, at or just below low-water mark, where they are more or less exposed to the sunlight.

The animals that are found among or attached to the seaweeds growing on the piles are, for the most part, identical with those that are to be found in similar situations among the algæ on rocks and in rocky tide-pools.

Among those that are nearly or quite peculiar to submerged wood-work are several species of "ship-worms," (*Teredo* of several species, and the *Xylotrya fimbriata*,) which are bivalve mollusks; the wood-eating *Limnoria;* several species of barnacles, which belong to the Crustacea; some of the tubularians, and other hydroids, &c.

Of the salt-water Insects two species have been observed on the piles of wharves. One of these is a small, slender, green larva, with a dark, firm head, and sharp jaws. It is the larva of a small, two-winged fly, probably identical with the *Chironomus oceanicus* of Packard.

On the piles of a wharf at Menemsha, Dr. Edward Palmer found, in October, a very interesting insect-larva. It lived in a stout tube composed of grains of sand firmly cemented together, and attached by its whole length to the piles; the single specimen is broken at both ends. The tube is flattened, and consists of a central, subcylindrical, tapering portion, or proper tube, which is covered on all sides with a single layer of small grains of sand, neatly arranged; along each side of this, and partly covering its upper surface, and to fill the angle between it and the surface to which it was attached, larger grains of sand are cemented. The preserved portion of the tube is about three-quarters of an inch long and nearly one-quarter wide, at the larger end, but not more than half as wide at the small end. The larva is about a third of an inch long, rather stout, and has a pair of long, sharp, curved jaws, and three pairs of rather long, hairy legs. It belongs to the Phryganidæ, among the Neuroptera, and somewhat resembles some of the well-known larvæ of the caddis-flies, common in fresh water, which make tubes or cases of various kinds. Dr. Hagen, who has examined this specimen, refers it to the genus *Molanna*, of which three North American species are known, but only in the adult state. All the larvæ of this genus, known in Europe, live in fresh water, and no other species of the Phryganidæ has been observed in sea-water, although some live in water that is slightly brackish.

Of Crustacea the most important species is the *Limnoria lignorum*, (p. 370, Plate VI, fig. 25.) This little creature is grayish in color, and covered with minute hairs. It has the habit of eating burrows for itself into solid wood to the depth of about half an inch. These burrows are nearly round, and of all sizes up to about a sixteenth of an inch in diameter, and they go into the wood at all angles and are usually more or less crooked. They are often so numerous as to reduce the wood to mere series of thin partitions between the holes. In this state the wood rapidly decays, or is washed away by the waves, and every new surface exposed is immediately attacked, so that layer after layer is rapidly removed, and the timber thus wastes away and is entirely destroyed in a few years. It destroys soft woods more rapidly than hard ones, but all kinds are attacked except teak. It works chiefly in the softer parts of the wood, between the hard, annual layers, and avoids the knots and lines of hard fiber connected with them, as well as rusted portions around nails that have been driven in, and, consequently, as the timbers waste away under its attacks, these harder portions stand out in bold relief. Where abundant it will destroy soft timber at the rate of half an inch or more every year, thus diminishing the effective diameter of piles about an inch annually. Generally, however, the amount is probably not more than half this, but even at that rate, the largest timbers will soon be destroyed, especially when, as often happens, the *Teredos* are aiding in this work of destruction. It lives in a pretty narrow zone, extending a short distance above and below low-water mark. It occurs all along our shores, from Long Island Sound to Nova Scotia. In the Bay of Fundy it often does great damage to the timbers and other wood-work used in constructing the brush fish-weirs, as well as to the wharves, &c. At Wood's Hole it was formerly found to be very destructive to the piles of the wharves. The piles of the new Government wharves have been protected by broad bands of tin-plate, covering the zone which it chiefly affects. North of Cape Cod, where the tides are much greater, this zone is broader, and this remedy is not so easily applied. It does great damage, also, to ship-timber floating in the docks, and great losses are sometimes caused in this way. Complaints of such ravages in the navy-yard at Portsmouth, New Hampshire, have been made, and they also occur at the Charlestown navy-yard, and in the piles of the wharves at Boston. Probably the wharves and other submerged wood-work in all our sea-ports, from New York northward, are more or less injured by this creature, and, if it could be accurately estimated, the damage would be found surprisingly great.

Unlike the *Teredo*, this creature is a vegetarian, and eats the wood which it excavates, so that its boring operations provide it with both food and shelter. The burrows are made by means of its stout mandibles or jaws. It is capable of swimming quite rapidly, and can leap backward suddenly by means of its tail. It can creep both forward and backward. Its legs are short and better adapted for moving up and down in its burrow than elsewhere, and its body is rounded, with parallel sides, and well adapted to its mode of life. When disturbed it will roll itself into a ball. The female carries seven to nine eggs or young in the incubatory pouch at one time.

The destructive habits of this species were first brought prominently to notice, in 1811, by the celebrated Robert Stephenson, who found it rapidly destroying the wood-work at the Bell Rock light-house, erected by him on the coast of Scotland. Since that time it has been investigated and its ravages have been described by numerous European writers. It is very destructive on the coasts of Great Britain, where it is known as the "gribble."

The remedies used to check its ravages are chiefly copper or other metallic sheathing; driving broad-headed iron nails, close together, into the part of the piles subject to their attacks; and applying coal-tar, creosote, or verdigris-paint, once a year or oftener.

Another singular crustacean, common on the piles at Wood's Hole, is the *Tanais filum*. This is a very slender, whitish species, almost thread-like in form, but has the first pair of legs much thickened, with very peculiar, stout claws, ovate in form; the rest of the anterior legs are very slender. The antennæ are short and thick, the inner ones directed forward; the outer ones more slender, and curved outward and backward. This species lives among the adhering ascidians and hydroids on the piles, and has also been found in deeper water, in the Bay of Fundy. Its habits are little known, but some of the allied species have been accused of boring in wood.

Two species of barnacles are very common on the piles of the wharves. The common barnacle of the rocky shores, *Balanus balanoides*, (p. 305,) is also common on the piles of wharves and bridges, between tides, and also on the bottoms of vessels, &c. It never grows very large, although it may become so crowded together as to form a continuous crust. It is easily distinguished from the other species by its membranous base, which never forms a solid plate, like that of the other species. The "ivory-barnacle," *Balanus eburneus*, is also common on all kinds of submerged wood-work, whether fixed or floating. It is usually abundant on the piles and timbers of wharves, buoys, oyster-stakes, bottoms of vessels, &c. It is chiefly found below low-water mark if on fixed objects, and is even more common in the brackish waters of estuaries than in the purer waters outside, and it is capable of living even in pure fresh water, for Professor Jeffreys Wyman has sent me specimens collected, by himself, about sixty-five miles up the Saint John's River, in Florida, where the water is not at all brackish. This species is sometimes found adhering to the carapax of crabs, the shell of *Limulus*, and various mollusks. It is easily distinguished from most species on account of its low, broad form and its smooth white exterior. It has a shelly base. The *B. crenatus*, common on shells and stones in deep water, also occurs on vessels. Other species are often found on the bottoms of vessels that have come from warmer latitudes. Some of them are of large size. One of the most frequent of these is *Balanus tintinabulum*.

Several species of "goose-barnacles," *Lepas*, are frequently found alive on the bottoms of vessels, and especially such as have recently arrived from the West Indies and other foreign countries. These resemble, in general appearance, *L. fascicularis*, (Plate VII, fig. 33,) which is a common indigenous species, usually found adhering to floating sea-weeds and other small objects in early summer, in large numbers. It is doubtful whether any of those found on the bottoms of vessels can be regarded as true natives of this region. The most common of them is *L. anatifera;* the valves of its shell are bordered with orange. The other common species are *L. anserifera* and *L. pectinata*. Species of the curious genus, *Conchoderma*, also occur on the bottoms of vessels.

Among the Crustacea that commonly occur among the ascidians, hydroids, and algæ on the piles of wharves, are *Panopeus Sayi*, (p. 312,) *P. depressus*, (p. 312, Plate I, fig. 3,) *Gammarus ornatus*, (p. 314, Plate IV, fig. 15,) *Amphithoë compta* S., (p. 370,) *Corophium cylindricum*, (p. 370,) *Melita nitida*, (p. 314,) *Caprella*, sp., (p. 316,) and various small Entomostraca. *Jæra copiosa* (p. 315) often occurs abundantly near high-water mark, on old piles and timber, living in the crevices and cracks, or under loosened bark.

Of Annelids very few if any species occur that are peculiar to these situations. The *Potamilla oculifera* (p. 322, Plate XVII, fig. 86) is quite common on the piles of wharves where the water is pure. *P. microphthalma* V. (p. 323) also occurs under the same circumstances, and also on the piles in harbors, where the water is brackish.

The *Lepræa rubra* V. was found living in tubes among the ascidians on the piles of the wharves. This is a Terebelloid worm, somewhat resembling the *Amphitrite ornata*, (Plate XVI, fig. 82,) but is much smaller, and there are fascicles of setæ on all the segments. There are three pairs of arborescently divided branchiæ, which are pedunculated, the last pair being quite small. The body is bright red, the tentacles pale flesh-color.

The *Nicolea simplex* V. (p. 321,) was also found with the last in large numbers, but mostly of small size. Both males and females of *Nereis limbata* (p. 318, Plate XI, fig. 51, male) were often found among the barnacles and ascidians on the piles of the wharves at Wood's Hole, but the males were the most abundant, while the reverse was the case with those dug out of the sand and gravel on the shores.

Numerous other Annelids were occasionally met with among the ascidians and algæ. Among these were *Polycirrus eximius*, (p. 320, Plate XVI, fig. 85;) *Podarke obscura* V., (p. 319, Plate XII, fig. 61;) a *Phyllodoce*, &c. Two Nemerteans were also common; one of these was an olive-green species, with a light dorsal stripe, belonging probably to the genus *Cerebratulus*, but it was not carefully studied; the second was *Polinia glutinosa*, (p. 324, Plate XIX, fig 97.)

Of Gastropod mollusks quite a number of species occur on the piles of wharves, and some of them in great abundance, especially the smaller kinds which live among the hydroids and confervæ. The most abundant species is generally the *Astyris lunata*, (p. 306, Plate XXI, fig. 110,) which generally occurs among the small algæ and especially on the Tubularians, in countless numbers; *Anachis avara* (p. 306, Plate XXI, fig. 109) is often found in considerable number; *Bittium nigrum* (p. 305, Plate XXIV, fig. 154) and *Triforis nigrocinctus* (p. 305, Plate XXIV, fig, 152) are usually common and the former often is very abundant; *Cerithiopsis Greenii* (Plate XXIV, fig. 153) sometimes occurs, but is rare; *Ilyanassa obsoleta* (p. 354, Plate XXI, fig. 113) and *Tritia trivittata* (p. 354, Plate XXI, fig. 112) are common, especially the former; *Urosalpinx cinerea* (p. 306, Plate XXI, fig. 116) is generally to be found at or below low-water mark on the piles and buoys; *Bela plicata* (Plate XXI, fig. 107) is sometimes met with, but is not common; *Odostomia bisuturalis* (p. 307, Plate XXIV, fig. 146) and other species of the genus are often found near low-water mark on the piles, especially where they are somewhat decayed. *Littorina palliata* (p. 305, Plate XXIV, fig. 138) and *L. rudis* (p. 305, Plate XXIV, fig. 137) nearly always occur near high-water mark, on the piles, where there are algæ. In the harbors, where the water is brackish, and less frequently in the purer waters, the *Alexia myosotis* (Plate XXV, fig. 168) may be found on timbers and piles near high-water mark, and sometimes, also, *Skenea planorbis*, (Plate XXIV, fig. 142,) *Littorinella minuta*, (Plate XXIV, fig. 140,) and *Rissoa aculeus*, (p. 306, Plate XXIV, fig. 141.) Among and feeding upon the Tubularians growing on the piles at and just below low-water mark, the beautiful *Æolidia pilata* (Plate XXV, fig. 174) may often be found, especially in the harbors where the water is more or less brackish.

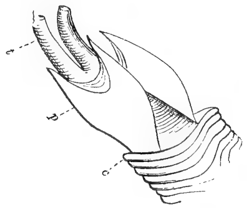
Another related species, apparently the *Cavolina gymnota*, was found by Professor Todd, on an old wreck in the Wood's Hole passage, but it differs in several points from any form that has been described. The branchiæ were arranged in six transverse simple rows, on each side, those of the second and third longest; in the anterior rows there were four to six branchiæ, the lower ones much shorter than the upper ones. In life the branchiæ were dark green or blackish.

Several other Gastropods are occasionally met with in these situations, but the species above named are about all that ordinarily occur.

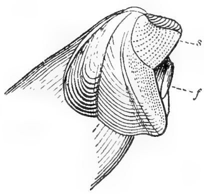
Among the Lamellibranchs, or "bivalve-shells," we find the *Teredo* tribe, nearly all of which are peculiar to submerged wood-work, either fixed or floating, and most of them are capable of doing great damage, both to ships and to the timber and piles of wharves and bridges, or other similar structures. Although popularly known as the "ship-worm," these creatures are not at all related to the worms, but are true mollusks, quite nearly allied, in many respects, to the common "long-clam" (*Mya*) and to the *Pholas*. Like those shells the *Teredo* excavates its holes or burrows merely for its own protection, and not for food; but the *Teredo* selects wood in which to form its holes, and when these have been excavated it lines them with a tube of shelly material. The holes are very small at the surface of the wood, where they were formed by the young *Teredos* but they gradually grow larger as they go deeper and deeper into the wood, until they sometimes become ten inches or more in length and a quarter of an inch in diameter, but the size is generally not more than half these dimensions. The holes penetrate the wood at first perpendicularly or obliquely, but if they enter the side of the timbers or planks across the grain, the burrows generally turn horizontally in the direction of the grain a short distance beneath the surface, unless prevented by some obstruction, or by the presence of other *Teredo* tubes, for they never cross the tubes of their companions or interfere with each other in any way, and there is always a thin layer or partition of wood left between the adjacent tubes. It is, however, not necessary that they should follow the grain of the wood, for they can and do penetrate it in every direction, and sometimes not more than half the tubes run in the direction of the grain, and they are often very crooked or even tortuous. They rapidly form their burrows in all kinds of our native woods, from the softest pine to the hardest oak, and although they usually turn aside and go around hard knots, they are also able to penetrate through even the hardest knots in oak and other hard woods. The Teredos grow very rapidly, apparently attaining maturity in one season, and therefore, when abundant, they may greatly damage or completely destroy small timber in the course of four or five months, and even the largest piles may be destroyed by them in the course of two or three years.

The most abundant species in this region is the *Teredo navalis* (cuts 1 and 2; Plate XXVI, fig. 183, animal; Plate XXVII, fig. 186, shell.)

1.



2.



EXPLANATION OF THE CUTS.

Fig. 1. Posterior or outer end of a living *Teredo navalis*, removed from its burrow; *c*, the muscular collar by which it adheres to the shelly lining of its burrow; *p*, the shelly "pallets" which close the aperture when the animal withdraws; *t*, the two retractile siphon-tubes which project from the hole when the animal is active.

Fig. 2. Anterior end and shell of the same; *s*, the front part of the shell; *f*, the foot or boring organ.

This is the same species that has attracted so much attention in Europe, during nearly two centuries, on account of the great damage that it has done, especially on the coast of Holland. Nevertheless no full description of the animal of this species has yet been published, nor any satisfactory figures of the soft parts.

When removed from its tube (see Plate XXVI, fig. 183) the animal is found to have a very long, slender, smooth, soft, whitish body, tapering somewhat toward the outer or posterior end, (fig. 1,) which has a muscular, circularly wrinkled collar, (*c*,) by which the animal is, when living, attached to the inside of the shelly lining of its tube. To the inside of this collar two shelly plates, known as the "pallets," (*p*,) are attached by their slender basal prolongations; their outer portions are broad and flat, and more or less emarginate or two-horned at the end. These are so connected with the muscles that when the animal withdraws its tubes into its hole the free ends of these pallets are made to fold together and close the opening, thus serving as an operculum to protect the soft tubes against enemies of all kinds. Between the bases of the pallets arise the siphonal tubes, (*t*,) which are soft and retractile, united together for half their length or more, but separate and divergent beyond; they are nearly equal, but the ventral or branchial tube is perhaps a little larger than the other, and is fringed with a few small papillæ at the end; the tubes are white or yellowish, sometimes specked with reddish-brown. At the anterior end of the body and farthest from the external opening of the hole, is seen the small, but elegantly sculptured, white bivalve shell, (cut 2, *s*; and Plate XXVI, fig. 183, *s*.) The shell covers the mouth and palpi, liver, foot, and other important organs. The foot (*f*) is a short, stout, muscular organ, broadly truncate or rounded at the end, and appears to be the organ by means of which the excavation of the burrow is effected. The shell is covered by a delicate epidermis, and probably does not assist in rasping off the wood, as many have supposed. The gills are long and narrow, inclosed mostly in the naked part of the body, and are reddish brown in color. The *Teredos* obtain their microscopic food in the same manner as other bivalve mollusks, viz., by means of a current of water constantly drawn into the branchial tube by the action of vibrating cilia within; the infusoria and other minute organisms are thus carried along to the mouth at the other end, while the gills are supplied with oxygen by the same current; the return current passing out of the dorsal tube removes the waste water from the gills, together with the fæces and excretions of the animal, and also the particles of wood which have been removed by the excavating process. As the animal grows larger the burrows are deepened, the lining of shelly matter increases in length and thickness, the shell itself and the pallets increase in size, and the terminal tubes grow longer. But as the orifices of the terminal tubes must necessarily be kept at the external opening of the burrow, the muscular collar at the base of the tubes constantly recedes from the entrance, and with it the pallets; at the same time imbricated layers of shelly matter are usually deposited in the upper end of the shelly tube, which are supposed to aid the pallets in closing the aperture when the tubes are withdrawn. When the animal has completed its growth, or when it has encountered the tubes of its companions and cannot pass them, or when it approaches the exterior of a thin piece of wood and cannot turn aside, it forms a rounded or cup-shaped layer of shelly matter, continuous with the lining of the tubes, and closing up the burrow in front of its shell; sometimes it retreats and forms a second partition of the same kind.

This species produces its young in May and probably through the greater part or all of the summer. The eggs are exceedingly numerous, probably amounting to millions, and they are retained in the gill-cavity, where they are fertilized and undergo the first stages of their development. The embryos pass through several curious phases during their growth. In one of the early stages they are covered with fine vibrating cilia, by means of which they can swim like ciliated infusoria; later they lose these cilia and develop a rudimentary bivalve shell, which is at first heart-shaped, and the mantle begins to appear and larger retractile cilia develop upon its edge, which serve as organs for swimming; but at this period the shell is large enough to cover the whole body when contracted. In this stage they swim actively about in the water; later the cilia become larger, a long, narrow, ligulate foot is developed, by means of which they can creep about and attach themselves temporarily to solid objects; the shells become rounder, a pair of eyes and organs of hearing are developed; after this the little animal begins to elongate, the locomotive cilia are lost, the eyes disappear, and the mature form is gradually assumed. These young *Teredos*, when they finally locate upon the surface of wood-work and begin to make their burrows, are not larger than the head of a pin, and consequently their holes are at first very minute, but owing to their rapid growth the holes quickly become larger and deeper.

This species is very abundant along the southern coast of New England, from New York to Cape Cod, wherever submerged wood-work, sunken wrecks, timber buoys, or floating pieces of drift-wood occur. It also infests the bottoms of vessels not protected by sheathing. It is not confined to pure sea-water, but occurs in the piles and timbers of our wharves in harbors that are quite brackish. I have found it abundant in the piles of Long Wharf in New Haven Harbor, where the water is not only quite brackish, but also muddy and contaminated with sewerage and other impurities. At Wood's Hole it was found to be very abundant in the cedar buoys that had been taken up from various localities and placed on the wharves to dry and be cleaned. Captain B. J. Edwards informed me that formerly, when the buoys were not taken up, they would not usually last more than two years, owing chiefly to the attacks of this *Teredo*, but under the present system there are two sets of buoys, which are alternately taken up and put down every six months. After a set has been taken up and allowed to dry thoroughly they are scraped to remove the barnacles, &c., and then receive a thorough coat of verdigris paint, each time, before they are put down. With this treatment they will last ten or twelve years, but they are more or less perforated and injured every year, until finally they become worthless. Inasmuch as the *Teredos* produce their young all through the summer, and they develop to a very large size in one season, it is evident that the best time to take up the buoys would be in midsummer, before the early crop of young have grown large, and leaving too little time for the later crop to become large, in the buoys thus put down, before winter, when most of them would probably be killed by the cold weather. In this way the damage might be materially diminished, if not inconsistent with the other duties of the officers of the vessels employed in this service. There are, as yet, no means of estimating the extent of the damage done to our wharves, shipping, &c., by this and the various other species of *Teredo* found on our coast, but judging from their abundance along the whole coast, it is much greater than is generally supposed.

The *Teredo navalis* is also abundant on the coast of Europe, from the Mediterranean and Black Seas to Christiania, and the coasts of Great Britain. Its habits have been quite thoroughly investigated by several Dutch naturalists, owing to the great damage that it has done on their coast, at times even threatening a general inundation of the country by destroying the wood-work of the dikes. This *Teredo* occupies a zone of considerable breadth, for it often lives considerably above low-water mark and extends several feet below it, even to the depth of fourteen feet, according to some writers.

The best remedies in common use to resist or prevent its attacks are copper-sheathing, used chiefly on vessels; broad-headed nails, closely driven, used for piles and timbers; creosote and coal-tar, frequently applied. The various poisonous substances that have been applied to timber for this purpose, however useful they may be in other respects, have little or no effect on the *Teredo*, for it does not depend upon the wood for its food, and even protects its body externally with a layer of shell, lining its holes. The only remedies that are likely to succeed are those calculated to prevent the lodgment and entrance of the young ones beneath the surface. Even creosote, thoroughly applied under pressure at the rate of 10 pounds per square foot, has been found insufficient to prevent their attacks, for piles thus treated at Christiania were found by Mr. Jeffreys to be filled with the *Teredo* within two years after they were put down.

Several other species of *Teredo* also occur on this coast. The *Teredo megotara* (Plate XXVII, fig. 188) has been found in floating pine wood at Newport, Rhode Island, and in cedar buoys, &c., at New Bedford, Massachusetts; as well as in Massachusetts Bay, at Provincetown and other places; it is also found as far south as South Carolina at least. This species sometimes grows to a large size, forming tubes at least eighteen inches long. It sometimes occurs, also, in the piles of wharves in this region. The *Teredo Thomsoni* (Plate XXVII, fig. 187) has been found in great numbers in the marine railway and also in cedar buoys at New Bedford. It has also been found at Provincetown in a whaling-ship that had cruised in the West Indies.

The *Xylotrya fimbriata* (Plate XXVII, fig. 189) is very similar to the common *Teredo*, except that it has long, oar-shaped pallets, with slender stalks; the blade is flattened on the inside and convex externally, and consists of ten to twelve, or more, funnel-shaped segments which set one into another; their margins project at the sides, making the edges of the blade appear serrated. This species appears to be indigenous on this coast. It has been found living in a sunken wreck in Long Island Sound, near New Haven, and I have also taken it from the oak timbers of a vessel, the Peterhoff, employed in the blockading service, during the late war, on the coast of the Southern States. It grows to a rather large size, often forming holes a foot or more in length and a quarter of an inch in diameter, though usually smaller. The pallets are sometimes half an inch long.

Among the kinds of bivalve shells that do not bore in wood, there are but few species that commonly inhabit piles of wharves. The most frequent of these is the common muscle, *Mytilus edulis*, (p. 307, Plate XXXI, fig. 234,) which sometimes adheres in large clusters. The common oyster, *Ostræa Virginiana*, (p. 310,) often attaches itself to the piles, but in such situations seldom survives the winter.

Ascidians often occur in large quantities attached to the piles, at and just below low-water mark, and also on the under side of floating timber. They often completely cover large surfaces and spread over the barnacles, hydroids, and algæ, which have previously located. They grow very rapidly, attaining their full size during a few weeks in midsummer.

The most abundant species are usually *Molgula Manhattensis* (p. 311, Plate XXXIII, fig. 250) and *Cynthia partita*, (p. 311, Plate XXXIII, fig. 246.) At Wood's Hole, on the piles of the Government wharf, in August and September, the *Perophora viridis* V. was exceedingly abundant, creeping over and covering up the other ascidians as well as the barnacles, hydroids, and algæ. This is a compound or "social" Ascidian, in which stolon-like tubular processes come out from the basal portion of the first individuals and run in every direction over the surfaces of objects to which they are attached, producing buds at intervals, which rapidly develop into little Ascidians like the old ones, and give out other stolons in their turn; thus they will very soon cover large surfaces, though each individual Ascidian is quite small. The body is compressed, broad oval, or more or less rounded in outline, with a terminal branchial, and lateral anal orifice, both slightly raised on short and broad tubes. The body is attached to the stolons by a short narrow pedicle, and is usually not more than an eighth of an inch high. The color is bright green or yellowish green, and the integument is soft and translucent.

On the piles of the same wharf, and associated with the last, was another compound Ascidian, *Amarœcium constellatum*; this forms solid gelatinous masses, with a smooth, convex surface, usually less than an inch in diameter and about half an inch high, but often larger. The zoöids, or individual animals, are quite small, long, and slender, and entirely imbedded in the gelatinous mass that unites them together. They are arranged in circular, oval, or stellate groups, with a common cloacal orifice in the center of each cluster. The masses are usually pale orange-red, varying to yellowish and pale flesh-color. The stomach of each individual is bright orange-red; the branchial sac is flesh-color, pale yellow, or orange; the tubes and upper part of the mantle bright orange or lemon-yellow.

The *Botryllus Gouldii* (p. 375, Plate XXXIII, figs. 252, 253) also frequently occurs on the piles of the wharves, creeping over the stems of Tubularians, the surfaces of other ascidians, fronds of algæ, or on the surface of the wood itself. It also frequently forms broad, soft incrustations on the bottoms of boats, floating timber, &c.

The Bryozoa are also usually quite abundant on the piles and timbers of wharves, &c.

The *Bugula turrita* (p. 311, Plate XXXIV, figs. 258, 259) is one of the most common as well as one of the most elegant of these. It occurs attached to the adhering sea-weeds, &c., forming delicate white plumes.

The *Escharella variabilis* (p. 311, Plate XXXIII, fig. 256) usually forms firm, coral-like incrustations, but when attached to hydroids and sea-weeds it spreads out into foliaceous or lichen-like, rigid, calcareous fronds, which are dull red while living.

On the piles at Wood's Hole the *Bugula flabellata* was also very abundant. This forms elegant circular or fan-shaped fronds, consisting of numerous repeatedly forked, flat, and rather narrow branches, on which the cells are arranged in about three longitudinal rows. This species, like others of the genus, bears very singular structures, known as avicularia, which, under the microscope, have the form and appearance of the stout, hooked beaks of certain birds, such as the hawk, owl, parrot, &c. These beaks are attached by flexible stems, and are provided internally with powerful muscles by means of which they are constantly opened and closed, and can bite with considerable force. In this species these are attached to the sides of the cells, along the edges of the branches. Their office seems to be to defend the colony against small parasites, and dirt of all kinds, which, unless thus removed, would soon cover up the cells and destroy the animals. In addition to these, various less conspicuous species often occur in abundance, especially *Vesicularia gracilis*; *V. dichotoma* V.; and *V. cuscuta*.

Of Radiata there are but few species in such localities, with the exception of the Hydroids, which are usually very abundant.

The green star-fish, *Asterias arenicola*, (p. 326, Plate XXXV, fig. 269,) may occasionally occur adhering to the piles just below low-water mark, but it does not have this habit to such an extent as does the *A. vulgaris*, north of Cape Cod, for the latter is almost always to be seen in abundance on the piles of the wharves of the northern seaports, as at Portland, Eastport, &c., and less abundantly at Boston.

One of the most beautiful, as well as one of the most abundant, of the Hydroids that occur on the piles of wharves, and on the under side of floating timber, is the *Parypha crocea*, (Plate XXXVI, fig. 274.) This species grows in great luxuriance upon the piles, especially in those harbors where the water is somewhat brackish. It forms large clusters of branching stems, often six inches or more in height, each of which is surmounted by a beautiful, flower-like, drooping head of a pink or bright red color. These heads are often broken off, or even voluntarily cast off, when the animals are unhealthy, but new ones are soon reproduced, and, therefore, this does not seem to be a very serious accident, though certainly a very inconvenient one, for the mouth, stomach, tentacles, and most other organs are all lost when these "heads" drop off. This species does not produce free-swimming medusæ, but the buds, corresponding to those that develop into free medusæ in many other cases, in this remain attached to the heads in drooping clusters, looking like loose clusters of light red grapes, in miniature.

The buds produced by the hydroid-heads of one colony are either all males or females, and, while attached to the hydroid-heads, eggs or spermules are developed within them; the eggs are fertilized and develop into young hydroids, which, when finally expelled, are provided with a circle of slender tentacles, and need only to attach themselves to some solid substance by the basal end of the body to become fixed, tubularian hydroids, similar to the old ones in many respects, though still very small and simple in structure. These young tubularians swim and crawl about for a time, and after attaching themselves they rapidly grow larger and produce stolons from the base, from which buds arise that develop into forms like the first one; other buds are produced from the sides of the stems, which also become like the others, and in this way the large clusters of tubularians are rapidly formed.

Several species of Campanularians are also to be found attached to the piles and timbers of wharves and bridges. At Wood's Hole the most abundant species was *Obelia pyriformis*, which grew in great profusion on the piles just below low-water mark. It is a delicate and much branched species, with elongated, pear-shaped, reproductive capsules, and is beautifully phosphorescent. On the hull of an old wreck in Wood's Hole passage, where the tide flows with great force, the *Obelia flabellata* was found in abundance, though it does not appear to have been noticed on this side of the Atlantic before. It has very elongated, slender, simple, but crooked stems, with numerous, alternate, short, forking, fan-shaped branches; these generally fork close to their origin, the divisions diverging in opposite directions. The hydroid calicles (hydrothecæ) are small, cup-shaped, or broad bell-shaped, with a smooth rim, and they are borne on slender pedicles that are of various lengths, but mostly short and composed of only four to six rings. The reproductive capsules (gonothecæ) are urn-shaped, with a short, narrow neck; they are borne on short pedicles, of few rings, arising from the axils of the branches. Some of the specimens were eight or ten inches long.

On the piles of Long Wharf, at New Haven, the *Obelia gelatinosa* of Europe was found growing in great luxuriance in September. The water at this locality was quite brackish, but it will probably be found, also, in pure sea-water, for on the coast of Europe it is common both in brackish and pure ocean-water. It is probable that this species has not been observed before on our coast, for although the name occurs in several local lists, these refer, according to Mr. A. Agassiz, to other species, and he does not include the present species in his Catalogue of North American Acalephæ. It is a large species, growing to the length of ten or twelve inches, and branches widely and very profusely. It differs from most of our other species in having a thick, compound stem, composed of many united tubes. The smaller branches are, however, profusely divided, and the branchlets are simple, very slender, white, and translucent, their delicacy contrasting strongly with the stout, dark-colored stems. The larger branches mostly arise in pairs, close together, but immediately diverge; the small branches and branchlets are alternate. The hydrothecæ are very small, deeply bell-shaped, the rim divided into ten or twelve teeth, which are squarish in form, and slightly emarginate at the end; their pedicles vary in length, and are often rather long and slender, especially the terminal ones. The gonothecæ are elongated, urn-shaped, with a narrow, short, tubular neck. I also found this species in April, growing on oysters, at Great Egg Harbor, New Jersey.

Several other species of *Obelia* occur in similar situations, together with various related genera.

The *Sertularia pumila*, (p. 327, Plate XXXVII, fig. 279) often occurs attached to the *Fucus* and other sea-weeds growing on the piles.

The *Halecium gracile* V., (p. 328,) often grows on the piles in great abundance, especially where the water is somewhat brackish, and it sometimes also occurs in great profusion on floating drift-wood.

Of Actinians the most frequent species is the *Sagartia leucolena*, (p. 329, Plate XXXVIII, fig. 284,) which can almost always be found among the adhering barnacles and ascidians; not unfrequently it attaches itself within a dead barnacle, and, in fact, seems quite partial to such a location.

The *Metridium marginatum* (p. 329) also frequently occurs on the piles, but is much less frequent, and generally of smaller size than it is farther north, as about Boston and on the coast of Maine.

Several sponges occur frequently on the piles of the wharves, but they have not been well determined. Among them the *Grantia ciliata*, or a closely allied species, is very common, and also another of the same group, which is tubular and branched, (*Leucosolenia botryoides* ?).

The common, red branching sponge (p. 330) is frequent, and also a slender branching species of *Chalina*, near *C. oculata*. Two or more species of *Tedania*, forming irregular, massive, pale-yellow sponges of a brittle texture, are common.

List of species commonly found on piles and timbers of wharves and bridges on buoys, bottoms of vessels, and other submerged wood-work.

ARTICULATA.

Insects.

	Page.		Page.
Chironomus oceanicus	379	Molanna, sp	379

Crustacea.

	Page.		Page
Panopeus Sayi	382	Jæra copiosa	382
P. depressus	382	Tanais filum	381
Hyale littoralis	315	Balanus eburneus	381
Gammarus ornatus	382	B. crenatus	381
Melita nitida	382	B. balanoides	381
Amphithoë compta	382	B. tintinabulum	381
Corophium cylindricum	382	Lepas anserifera	382
Caprella, sp	316	L. anatifera	382
Limnoria lignorum	379	L. pectinata	382
Idotea irrorata	316	Conchoderma virgata	382
I. phosphorea	316	C. aurita	382

Annelids.

	Page.		Page.
Lepidonotus squamatus	320	Nicolea simplex	382
Harmothoë imbricata	321	Lepræa rubra	382
Eulalia, sp	349	Polycirrus eximius	382
Eumidia, sp	349	Potamilla oculifera	382
Podarke obscura	382	Sabella micropthalma	382
Autolytus cornutus	397	Euchone, sp	416
Nereis limbata	382	Serpula dianthus	322
Sabellaria vulgaris	321	Spirorbis spirillum	323

Nemerteans.

	Page.		Page.
Polinia glutinosa	382	Cerebratulus, (?) sp	382
Nemertes socialis	324		

MOLLUSCA.

Gastropods.

	Page.		Page.
Bela plicata	383	Astyris lunata	383
Urosalpinx cinerea	383	Anachis avara	383
Tritia trivittata	383	Littorinella minuta	383
Ilyanassa obsoleta	383	Rissoa aculeus	383

Lamellibranchs.

Ascidians.

Bryozoa.

RADIATA.

Echinoderms.

Acalephs.

Polyps.

PROTOZOA.

Porifera, (*Sponges.*)

II. 5.—ANIMALS INHABITING THE ROCKY BOTTOMS OF THE BAYS AND SOUNDS.

In this region the proportion of rocky bottom is relatively quite small, and mostly to be found only in quite shallow water. Therefore the animal life is very similar to that of the rocky shores and tide-pools, near low-water mark.

In Vineyard Sound and vicinity the rocky bottoms examined were chiefly at the following localities, as indicated on the accompanying chart, viz.: 1st. An area south of Parker's Point and occupying a part of the bottom of the passage between Parker's Point and Nonamesset Island, on both sides of the channel, and extending somewhat south of a line drawn from Nobska Point to the southeastern end of Nonamesset Island. The dredgings made in this area are, 9, *a, b, c, d;* 2, *a, b;* 3, *a, b, c;* 4, *a, b;* 5, *c, d, e;* 8, *a, b;* 18, *a, b.* 2d. An area south and southwest of Nobska Point; dredgings, 21, *b, e;* 22, *a;* and others not recorded were made on this patch. 3d. In the Wood's Hole passage, between the north end of Nonamesset Island and the opposite shores, there are numerous rocky patches, and the tides flow with great force; dredgings, 14, *a, b, c, d, e, f, g;* 16, *a, b;* 17, *c, d, e;* 15, *a, b;* and many others were made on this bottom. 4th. A small area between Uncatena Island and Long Neck; dredgings, 11, *e, f,* and 71, *c,* were on this patch. 5th. A small area, south of the Wepecket Islands, where the dredging, 73, *d,* was made. 6th. A region of rocks and sand off West Chop, north of Martha's Vineyard; in the dredgings made here, 37, *c, d, e,* some very fine hydroids and ascidians were obtained. 7th. In Quick's Hole, the passage between Nashawena and Pasque Islands, a rocky bottom, with abundant ascidians, hydroids, and sponges, was found, where dredgings 77, *a* and *c,* were made.

In addition to these localities numerous dredgings were made on rocky bottoms off Gay Head and Devil's Bridge, and also between Martha's Vineyard and No Man's Land, but these properly belong to the cold outer region.

In the vicinity of New Haven, rocky bottoms, generally of small extent, are found off the light-house, and off South End and Branford Point, also among the Thimble Islands. All these localities have been examined by me in numerous dredging excursions made during the past eight years. Nevertheless the fauna of the rocky bottoms of this region is probably more imperfectly known than that of other kinds of bottom. This is mainly owing to the difficulties encountered in dredging upon rough rocks.

Rocky bottoms are very favorable for many kinds of Crustacea, both for those that swim free and conceal themselves among the sea-weeds that grow on rocks in shallow water, and for those that take refuge beneath the rocks. Consequently rocky bottoms are the favorite feeding-grounds for certain kinds of fish, especially tautog, striped bass, black bass, cunners, &c., in this region.

The common crab, *Cancer irroratus*, (p. 312,) *Panopeus Sayi*, (p. 312,) *P. depressus*, (p. 312,) the larger hermit-crab, *Eupagurus pollicaris*, (p. 313,) and the smaller hermit, *E. longicarpus*, (p. 313,) are common species on the rocky bottoms. A small species of spider-crab, *Pelia mutica*, occasionally occurs. The *Cancer borealis* has hitherto been a rare species, and little is known concerning its habits or distribution; it appears to frequent rocky bottoms chiefly, but most of the specimens obtained in this region were found thrown up by the waves on the shores of Cuttyhunk Island, No Man's Land, and near Gay Head.

The lobster, *Homarus Americanus*, frequents rocky bottoms, concealing itself under and among the rocks while watching for its prey, but it is much less abundant in this region than on the coast of Maine and in the Bay of Fundy, and does not usually grow to so large a size as in the northern waters. It also occurs on the sandy and gravelly bottoms of Vineyard Sound, where most of those sent to the markets from this region are obtained. The young, free-swimming larvæ of the lobster, in the stages represented in Plate IX, figs. 38, 39, were often taken at the surface in great abundance, during June and July, in the towing-nets. The young lobsters were also found swimming actively at the surface by Mr. S. I. Smith, even after they had acquired the true lobster-like form and structure, and were nearly three-quarters of an inch long. In this stage they swim and act much like shrimp. While young, therefore, the lobster must be devoured in immense numbers by many kinds of fishes, and even when of considerable size they are still preyed upon by the tautog and black bass, and especially by sharks, skates, and rays, and doubtless by other fishes. We found the lobsters very abundant off Menemsha on a sandy and weedy bottom in shallow water. At this place over one hundred were taken at a single haul, by the trawl. The lobsters caught for the market are nearly all caught in "lobster-pots," baited with refuse fish of various kinds.

In addition to the common shrimp, *Crangon vulgaris*, (p. 339, Plate III, fig. 10,) another quite different species (*Hippolyte pusiola*) was often met with on the rocky bottoms. This is a smaller species, about an inch long, of a pale gray, salmon, or flesh-color, often specked with red; there is usually a white stripe along the middle of the back, and sometimes transverse bands of red or white; the antennæ are annulated with flesh-color and light red, and the legs are sometimes specked with brown, and often annulated with brown, or with gray and white. It differs from all the other American species in having a short, acute rostrum, scarcely projecting beyond the eyes, with three or four sharp teeth on its upper edge and none below. In form and general appearance it somewhat resembles the *Virbius* represented in Plate III, fig. 11, but is stouter and quite different in color. It is a northern species, extending to Greenland and Northern Europe, and is more common on the coast of Maine, where it is usually associated with several other larger species of the same genus, all of which are remarkable for their brilliant colors, the various shades of red usually predominating. Their bright colors are no doubt directly connected with their habit of living among the bright red algæ, so abundant in the shallow waters on rocky bottoms.

A beautiful little shrimp-like Crustacean, *Mysis Americana* SMITH, sometimes occurs in immense numbers among the algæ growing on the rocks just below low-water mark, especially in spring. This is an important species, as it is one of the principal kinds of food for the shad and other fishes. The full grown specimens are only about an inch long. It is almost transparent, whitish, with conspicuous black eyes; there is a row of more or less conspicuous, dark stellate spots along the body, both above and below, and similar specks often occur on the tail; a spot of dark brown or blackish often occurs on each side of the carapax. The intestine shows through as a greenish or brownish line.

Another small, shrimp-like species belonging to an interesting new genus, the *Heteromysis formosa* SMITH, often occurred in small colonies, sometimes hid away in the dead shell of some large bivalve or gastropod. The females of this species are of a beautiful light rose color, but the males have the pale color and translucency common to most of the species of *Mysis*.

Numerous Amphipods also occur, most of which are also found in the pools or under stones at low water, and have, consequently, been mentioned on former pages. One of the most curious Amphipods was a small species, found living among the large compound ascidians, which is probably *Cerapus tubularis* SAY. This species constructs a little, slender, free tube, which it inhabits and carries about upon its back when it travels, very much as the larvæ of caddis-flies, common in fresh waters, carry about their tubes. One species of barnacle, the *Balanus crenatus*, was abundant, often completely covering small stones and shells. This has not been met with, as yet, at low-water, although it occurs on the bottoms of vessels.

Of Annelids a large number inhabit rocky bottoms, but as most of them live beneath the rocks, or in tubes attached to rocks and stones, it is difficult to obtain an accurate knowledge of them. Many of the species seem, however, to be found also in pools and beneath the stones on rocky shores, and have already been mentioned.

Perhaps the most characteristic Annelids of rocky bottoms are the scaly worms, of which three species are common in this region, viz.:

Lepidonotus squamatus, (p. 320, Plate X, figs. 40, 41;) *L. sublevis* V., (p. 320, Plate X, fig. 42;) and *Harmothoë imbricata*, all of which cling close to the rough surfaces of the stones, or hide away in the cracks and crevices, or conceal themselves in the interstices between the ascidians, barnacles, roots of algæ, or in the cavities of sponges, &c. Several long, slender, and active species, belonging to the genera *Phyllodoce*, *Eulalia*, *Eumidia*, and *Eteone*, are of frequent occurrence; most of them are bright green or yellowish green in color, and all have small, leaf-like branchiæ along the sides.

The *Nereis pelagica* (p. 319, Plate XI, figs. 52–55) is very common, living beneath the stones, and especially in the interstices between the lobes of a large, sand-covered, compound ascidian, *Amarœcium pellucidum*, in company with the species of *Phyllodoce*, &c., just named. This species of *Nereis* is remarkable for its brilliant iridescence. It is a northern species, extending to the Arctic Ocean and northern coast of Europe. It is very abundant on the coast of Maine, under stones at low-water mark.

Associated with the preceding species among the sandy compound ascidians, occurring both on rocky and gravelly bottoms, were large numbers of the *Lumbriconereis opalina*, (p. 320, Plate XIII, figs. 69, 70,) conspicuous on account of the brilliant iridescent colors. Several other Annelids also occurred among these ascidians. The *Cirrinereis fragilis*, which is a small and delicate species, furnished with conspicuous eyes, and related to the large *Cirratulus*, occurs beneath the stones. The singular *Naraganseta coralii* occurs burrowing in the coral, *Astrangia Danæ*, and in this respect is similar in its habits to the allied genus *Dodecacerea*, which excavates its galleries in the solid shells of *Cyprina Islandica*, *Pecten tenuicostatus*, &c., in the Bay of Fundy. The *Sabellaria vulgaris*, (p. 321, Plate XVII, figs. 88, 88*a*;) *Nicolea simplex*, (p. 321;) *Scionopsis palmata*, (p. 321;) *Potamilla oculifera*, (p. 322,) Plate XVII, fig. 86;) *Sabella microphthalma*, (p. 323;) *Serpula dianthus*, (p 322;) and *Fabricia Leidyi*, (p. 323,) all occur in tubes attached to the rocks and stones.

A species of *Spirorbis*, which forms a small, white, calcareous shell, coiled up in an open spiral, is commonly attached to the algæ and hydroids. The *Autolytus cornutus* (Plate XIII, figs. 65, 66) constructs cylindrical tubes, which are attached to sea-weeds and the branches of hydroids. This is a small flesh-colored species, with conspicuous brown eyes; the ends of the body are often tinged with green, and the dark, greenish intestine shows through as a median line. The males and females are widely different in appearance and structure, and there are also asexual individuals (fig. 65) very different from both. The asexual ones construct the tubes referred to, but do not remain in them constantly, for they are also often taken swimming at the surface. The males and females are also taken at the surface, especially in the evening, but they also occur creeping over and among the hydroids. This worm is particularly interesting on account of its remarkable mode of reproduction, for, like several other marine annelids, it presents the phenomena of alternate generation. Its history has been well given by Mr. A. Agassiz.* The very numerous eggs of the female (fig. 66, *e*) are at first contained in the general cavity of the body, between the intestine and the outer wall, along the whole length of the body; afterwards they pass into a pouch on the lower side of the body, extending from the twelfth to about the twenty-sixth segment; in the pouch they hatch into young worms, and soon after the sac bursts and they escape into the water. The females apparently die after discharging the young. The eggs do not develop into males and females, but into the asexual or neuter individuals, (fig. 65,) which differ widely from the others in form and in the eyes and other appendages of the head, as well as in the internal anatomy and lateral appendages. After these neuter individuals become nearly full-grown, having forty to forty-five segments, a median dorsal swelling arises at about the thirteenth or fourteenth segment, most commonly on the thirteenth, and soon after two others arise from the sides of the same segment and develop rapidly; these swellings finally become the three front tentacles of a new head, (*a*, *a*, *a*, fig. 65;) soon a pair of eyes appears on the upper side of the segment, than a pair of tentacular cirri; then the second pair of eyes; then other appendages of the head, until finally a complete head is formed, having the structure belonging to the head of a male or female, as the case may be. As the new head, with its appendages, becomes more completely organized, the segments posterior to it, which are to become the body of the new individual, become more highly developed, and the lateral appendages more complicated, those back of the fifth in the male, or the sixth in the female, acquire dorsal fascicles of long setæ, and the dorsal cirris becomes longer; at the same time some additional segments are developed; and the ova in the female, or spermatazoa in the male, are formed. Finally the new sexual individual, thus formed out of the posterior segments of the original neuter, breaks its connection and swims off by itself, and becomes a perfectly developed male or female. The head of the female is represented in fig. 66; a male individual is represented as developing from an asexual individual in fig. 65. The male can be easily distinguished from the female by the pair of large antennæ, which are forked in the male, but simple in the female. Farther details concerning this curious mode of reproduction may be found in the memoir of Mr. Agassiz, together with numerous excellent illustrations, in addition to those here copied.

Associated with the preceding species a few specimens were found which probably belong to another species of *Autolytus*. These were quite slender, light-red in color, with paler annulations, but only the asexual individuals were observed. Another species of larger size also occurs among the hydroids, near New Haven, which belongs to *Autolytus* or

* On Alternate Generation in Annelids, and the Embryology of Autolytus cornutus; Boston Journal of Natural History, Vol. VII, p. 384, 1863.

some closely allied genus, but of this only the asexual form has occurred, and it has not yet been carefully studied. This becomes nearly an inch long and quite slender. The body is white, with about fifty annulations of bright purplish red between the segments, but sometimes a red ring is absent, leaving wider white bands; the lateral appendages are simple, and each has a dot of red on the anterior side; the head is orange, with four dark red eyes.

Of Mollusks there are but few species among the higher groups which do not also occur on the rocky shores at low-water, but of the Ascidians and Bryozoa we find numerous additional species. The Gastropods are represented by the large *Fulgur carica* (p. 355, Plate XXII, fig. 124) and *Sycotypus canaliculatus*, (p. 355;) also by the "drill," *Urosalpinx cinerea*, (p. 306, Plate XXI, fig. 116,) which is usually abundant in shallow water; *Astyris lunata* (p. 106, Plate XXI, fig. 110) is abundant on the hydroids and algæ; *A. zonalis*, (Plate XXI, fig. 111,) which is an allied species, of larger size and with plainer colors, is sometimes met with, but is rare in this region. It takes its name from two narrow spiral zones of white that usually surround the whorls. The *Crucibulum striatum* (Plate XVIII, figs. 125, 126) is often met with clinging firmly to the rocks and stones.

The *Leptochiton apiculatus* (Plate XXV, fig. 167) is one of the most characteristic and common species on rocky and gravelly bottoms; this also adheres firmly to the stones and dead shells, and its grayish or dirty whitish shell, often more or less stained, blends its color with that of its surroundings in a way that might deceive the fishes themselves. The back is covered with a series of movable plates, so that when removed the animal can curl itself into a ball, like a "pill-bug," (*Oniscus*,) or like an armadillo, a habit that it shares in common with the scaly annelids, *Lepidonotus* and *Harmothoë*, which live in the same places with it. The flexibility of the shell also enables the chitons to adapt themselves more closely to the uneven surfaces of the rocks than they otherwise could. More rarely the *Leptochiton ruber* (Plate XXV, fig. 166) is met with, though farther north, as in the Bay of Fundy, this is a very common species, while the *apiculatus* is quite unknown there, being decidedly southern in its range. The *ruber* is, as its name implies, a red species, and its colors are usually bright and beautifully varied with lighter and darker. Its bright color would seem at first a fatal gift, calculated to attract the attention of passing fishes, which are always fond of such food, but when we examine its habits more closely we find that it lives almost exclusively on and among rocks that are incrusted by the curious stony algæ, known as "nullipores," (*Lithothamnion polymorphum*,) which are red in color, but of various shades, and often completely cover the rocks with irregular red incrustations, over large areas in shallow water, especially on the coasts farther north, so that this shell and a larger species, (*C. marmoreus*,) usually associated with it, are admirably adapted by their colors for living and concealing themselves on such bottoms, while many other species, frequenting the same localities, have a similar coloration, though belonging to very different groups. As examples we may mention the beautifully variegated star-fish, *Ophiopholis aculeata*, (Plate XXXV, fig. 270,) rare in this region, but very abundant in the Bay of Fundy; *Crangon boreas*, common on the same bottoms in the Bay of Fundy; several species of shrimp belonging to the genera *Hippolyte*, *Pandalus*, &c. The bright red colors of all these animals would certainly be very fatal to them were there no red algæ among which they could conceal themselves and thus escape, to a considerable extent, from the voracious fishes, which are nearly always ready to pounce upon them whenever they expose themselves. One or two handsome species of *Æolis* (similar to fig. 174) were taken, but for lack of opportunity they were not identified while living, and these soft and delicate creatures cannot be preserved in alcohol so as to be identified afterwards with certainty. The handsome little *Doto coronata* (Plate XXV, fig. 170) occurs occasionally on the hydroids, upon the animals of which it feeds. This species is generally less than half an inch in length. The body is pale yellowish, or salmon-color, or rosy, specked with pink, light red, or dark red, which often forms a median dorsal line toward the head; the curious papillose branchiæ along the back are pale orange, the lateral and terminal papillæ being tipped with bright purplish red, dark red, or carmine, with a ring of flake-white below the tip; the head and tentacles are pale and translucent. The eggs are laid upon the hydroids, in long, flattened, and convoluted gelatinous strings, at various times during the early summer.

Another curious and beautifully colored naked mollusk, the *Polycera Lessonii*, also occurs occasionally on rocky bottoms, among hydroids and bryozoa. In this species the body is pale flesh-color, or sometimes pale orange, and thickly covered with bright, deep green specks, giving the whole surface a green color; along the back is a median line of tubercles or papillæ, and there are two other rows on each side, which extend as far as the gills or a little beyond; all these tubercles are tipped with bright sulphur-yellow, except that the last ones of the lateral rows, posterior to the gills, are usually tipped with flake-white, but these have two or three irregular, lateral lobes, which are tipped with yellow; other smaller, yellow tubercles are scattered over the back, sides, head, and tail; the tentacles are also bright yellow, but sometimes specked with green and yellow, with yellow tips. The gills are three in number, in a cluster on the middle line of the back, posteriorly; each one is bipinnate and delicately plumose; they are colored similar to the back, generally more or less specked with bright yellow, and often with flake-white; the tips are usually bright yellow.

Another small but singular species, which also occurs among the hydroids, as well as among dead shells, is the *Doridella obscura*, (Plate XXV, fig. 173;) in this the colors are not conspicuous, but seem rather intended for its concealment. The back is sometimes light, yellowish brown, finely mottled with white, and specked with darker brown; dorsal tentacles white and retractile; lower surface white or light yellowish, a three-lobed yellowish or brownish internal organ showing through in the middle of the foot. Other specimens are very dark-brown or almost black above, finely mottled with whitish. The anterior angles of the head are prolonged into tentacle-like organs or palpi. The gills are situated beneath, in the groove between the edge of the foot and the mantle, on the left side, and near the posterior end of the foot; they consist of a tuft of slender filaments.

Of Lamellibranchs certain species occur on rocky bottoms, which attach themselves firmly to the rocks, either by the side of one valve, like the oyster, *Ostræa Virginiana*, (p. 310,) and the *Anomia glabra*, (p. 311, Plate XXXII, figs. 241, 242;) or by threads of byssus, which they spin and use as cables for anchoring themselves, like the common muscle, *Mytilus edulis*, (p. 307, Plate XXXI, fig. 234,) the "horse-muscle," *Modiola modiolus*, (p. 309, Plate XXXI, fig. 237,) the *Argina pexata*, (Plate XXX, fig. 227,) and *Scapharca transversa*, (Plate XXX, fig. 228,) all of which are common in this region; but certain other species occur, which burrow beneath the stones, like the *Saxicava arctica* (p. 309, Plate XXVII, fig. 192) and *Mya arenaria* (p. 463, Plate XXVI, fig. 179,) and several other less common species.

The Ascidians are usually very abundant on the rocks and stones at all depths. The *Cynthia partita* (p. 311, Plate XXXIII, fig. 246,) is very common, often forming large, rough clusters, much overgrown with hydroids, bryozoa, and algæ. The specimens mostly belong to the erect variety, and in form are quite unlike the one figured. The body is more or less cylindrical, oblong, or urn-shaped, about twice as high as broad when expanded, and with a wide base; the branchial orifice is largest, and situated at the summit of a broad, terminal tube, swollen at base; the anal orifice is smaller, on a short lateral or subterminal tube. Both orifices are usually squarish, and open widely, but, when fully expanded, they sometimes become nearly circular; they are often surrounded at the edge with a narrow circle of red, and each tube has eight longitudinal stripes of white, narrowing downward to a point at the base of the tubes, and alternating with purplish brown ones, which are usually specked with flake-white. The exterior of the test is more or less rough and wrinkled, and generally yellowish or rusty, often tinged with deep purplish brown on the upper parts or throughout. The tubes are usually roughened by small, wart-like papillæ. Unpromising as this species looks, it is devoured by the tautog. The *Molgula Manhattensis* (p. 311, Plate XXXIII, fig. 250) is generally associated with the former. The *Perophora viridis* (p. 388) is often very abundant, creeping over and covering up the two preceding, as well as other ascidians, algæ, hydroids, &c. The most conspicuous species, however, are the massive compound ascidians, which sometimes completely cover the bottom. One of the most abundant of these is the *Amarœcium pel-*

lucidum, which forms large, hemispherical or irregular masses, often six or eight inches, or even more, in diameter, with the surface more or less completely covered by adhering sand. These masses consist of a large number of lobes or basal branches, which come out from a common base as elongated, stolon-like processes, and enlarge upward to the end, which is obtusely rounded, and variable in size, but usually from a quarter to half an inch, while the length may be from one to six inches; these lobes often coalesce, more or less completely, at the upper surface, which is sometimes naked and smooth, translucent, and of a gelatinous appearance. Each of these lobes contains a central cloacal orifice, around which a colony of minute ascidians, or zoöids, are grouped, in a manner analogous to the arrangement in *Botryllus*, already described, (p. 389,) but in the present case the zoöids are very long and slender; the lower end of each, containing the ovaries, with the heart at its extremity, extends down toward the base of the lobe in which they are contained to various distances, varying according to the age and state of development of each zoöid, but the full-grown ones are often nearly an inch long. Each zoöid has its own branchial orifice opening at the surface, as in *Botryllus*, while all the anal tubes discharge the refuse water, fæces, and eggs into the common cloacal ducts.

The *Amarœcium stellatum* is another related species, which is nearly as abundant as the last, and likewise grows to a very large size. It forms large, smooth, irregular plates, or crest-like lobes and masses, which are attached by one edge to the stones and gravel. These plates are sometimes one to two feet long, six inches high, and about an inch thick, and, owing to their smooth surface and whitish color, look something like great slices of salt-pork, and in fact it is often called "sea-pork" by the fishermen. Other specimens will be four or five inches high, and only one or two inches broad at the base, and perhaps half an inch in thickness, and the summit often divides into broad, flat, blunt lobes; various other shapes also occur, some of them very irregular. The larger specimens of this species are generally of a pale-bluish or sea-green color by reflected light when first taken from the water, but pale salmon or flesh-color by transmitted light. The zoöids are much elongated and arranged in more or less regular circular groups over the whole surface, with a small cloacal orifice in the center of each circle. If kept in water, when they grow sickly the zoöids will be forced partially or wholly out of their cavities by the contraction of the tissues around them—a peculiarity seen also in other species of this genus. These zoöids have the branchial tube prominently six-lobed, and of a bright orange-color, this color also extending over the upper or outer end of the body, between the tubes, and more or less over the branchial sac, which is pale yellow or whitish below. The stomach is longitudinally sulcated, with bright orange-red ribs or glands; intestine bright orange or yellow.

This species is devoured by sharks, skates, and the tautog, although it would seem difficult for them to digest it, or get much nutriment from it. The supply is certainly sufficiently abundant.

A third species of this genus, and much more beautiful than either of the preceding, is also common on rocky bottoms. This is the *Amarœcium constellatum* V. (p. 388,) which has already been described as occurring on the piles of the wharves. In deeper water, attached to rocks, it grows to a larger size, forming thick, hemispherical or cake-shaped masses or crusts, sometimes becoming somewhat mushroom-like by the upper parts growing out beyond the central attached portion, which then becomes a short and broad peduncle. It can be easily distinguished from the last on account of its brighter colors, the general color inclining to orange, and by the more irregular and complicated clusters of zoöids. It is less abundant than either of the two preceding.

Two other species of compound Ascidians are also abundant in this region, as well as farther north. These belong to the genus *Leptoclinum;* they form thin, irregular, often broad, white, or salmon-colored incrustations over the surfaces of the rocks, shells, and other ascidians; these crusts are of a firm, coriaceous or gritty texture, and have a finely granulous surface. Under the microscope they are seen to be filled with small, nearly globular particles of carbonate of lime, from which points project in every direction. The zoöids are very minute and are scattered over the surface in large and scarcely distinct groups, which have, however, a common cloacal orifice in the middle, but the several cloacal tubes or channels leading to each central orifice are long, with many crooked branches, reminding one of miniature rivers, and the zoöids are arranged along these ducts and their branches. One of these species, the *Leptoclinum albidum*, is easily distinguished by its chalky white color; the other, *L. luteolum*, is buff or salmon-color. It is possible that the last may even prove to be only a colored variety of the former, but the very numerous specimens that I have collected and examined, in the living state, both in the Bay of Fundy and Vineyard Sound, do no not warrant their union. In these localities both forms are about equally common, but near New Haven the *L. luteolum* has not yet been met with, though the other is not uncommon.

The Bryozoa are very abundant on rocky bottoms at all depths. Some of these incrust the rocks directly, like the *Escharella variabilis*, (p. 312, Plate XXXIII, fig. 256;) *Alcyonidium hirsutum; Escharipora punctata*, &c.; but even these seem to prefer other locations, and by far the greater number occur attached to algæ, hydroids, ascidians, and dead shells. A large part of the species occur also in rocky pools at low-water mark, or attached to the *Fuci* and other sea-weeds between tides, or to the under sides of stones laid bare by low tides, and have, consequently, been previously mentioned. Others which have not yet been detected on the shore will doubtless be found there by more thorough search.

The *Alcyonidium ramosum* (Plate XXXIV, fig. 257) is one of the most conspicuous species, and is often very abundant, attached to rocks in shallow water. In such situations we have often found arborescently branched specimens, twelve to fifteen inches high, with smooth, cylindrical branches about a third of an inch in diameter.

The *Alcyonidium hispidum* (p. 312) does not appear to have been recorded as from our coast, by previous writers, but it is one of our most common species, and may almost always be found incrusting the stems of *Fucus* at low-water mark, as well as the under surfaces of rocks; below low-water mark it is less abundant, generally incrusting *Phyllophora*, and other stout, palmate algæ. It is easily distinguished by the slender, acute, reddish spines, of horn-like texture, which surround each of the cells. It forms soft crusts of moderate thickness, gradually extending over the surface of the sea-weeds to which it becomes attached.

The *A. hirsutum* has also been hitherto overlooked on our coast, but is common, living under the same circumstances as the last, and sometimes associated with it, both above and below low-water mark. I have found it in the greatest abundance in some of the large, rocky tide-pools on the outermost of the Thimble Islands, east of New Haven. It was there growing chiefly upon *Phyllophora membranifolia*, in some cases entirely covering and concealing the plant, from the base of the stem to the tips of the fronds. It also often grows on the "Irish moss," *Chondrus crispus*, on rocky bottoms in shallow water. It forms rather thin, soft crusts, which have small, soft papillæ scattered over the surface; from the summit of each of these papillæa zoöid protrudes, when they expand, and displays an elegant little wreath of tentacles, much as in *A. ramosum*, (see fig. 257.) The *A. parasiticum* is also a species hitherto neglected on our coasts. It forms thin crusts on algæ and hydroids, which generally become coated with a layer of fine sand or dirt. I have not observed it at low-water, but have found it at the depth of a few fathoms on rocky bottoms in Vineyard Sound.

The *Vesicularia dichotoma* V. is a very common species, both on rocky shores, in pools and on the under side of stones; and in shallow water on rocky and shelly bottoms. It is also capable of living in brackish water, and is frequent on the oyster-beds. It usually forms cæspitose clusters of many crowded, slender, white stems, each of which is repeatedly forked, branching in a somewhat arborescent manner. There is a little crowded cluster of small, dark-colored, oval or pear-shaped cells just below each fork, the cells being sessile and arranged in two somewhat spiral rows in each cluster. It generally grows about an inch high, but sometimes two or three inches. When expanded each of the zoöids protrudes from its cell-like body a delicate wreath of eight slender tentacles.

The *Vesicularia cuscuta* is a delicate, creeping species, which resembles, in miniature, the "dodder-plant," (*Cuscuta*,) and creeps over other bryozoa and hydroids, very much as the dodder creeps over other plants. The stem is very delicate, filiform, jointed, and at intervals gives off two very slender, opposite branches, which diverge at right angles, and in their turn branch at intervals in the same way. The cells are small and oval or elliptical, mostly arranged in clusters at or near the branchings of the stems, but some are often scattered on the branches; they are attached by a narrow base. It occurs both at low-water in pools and in shallow water among rocks. The *V. armata* is also a creeping species, but the cells are terminated by four conical prominences, each of which bears a slender spine when perfect. This also occurs both between tides and in shallow water, on hydroids and bryozoa.

With these species of *Vesicularia*, and often attached to them and creeping over them, as well as on other kinds of bryozoa, hydroids and algæ, a very curious little species often occurs, in which the cells are small, campanulate, and raised on slender pedicels, which rise from slender, white, creeping stems. This is the *Pedicellina Americana*. The zoöids, when expanded, display a wreath of twelve or more tentacles; in contraction and when young they are often clavate.

The *Ætea anguinea* has not been recorded as from our coast, but is very common on rocky and shelly bottoms, creeping over various hydroids, algæ, ascidians, broyozoa, &c.; it also frequently occurs on floating eel-grass and algæ, in company with many hydroids. It consists of delicate, white, creeping, calcareous stolons, from which arise elongated, slender, clavate, white, rigid, erect cells, with the aperture at the end; the narrower, pedicel-like portion of the cell is surrounded by fine, circular, punctate striæ.

The *Eucrate chelata* is also a slender, creeping species, and has somewhat similar habits, but is much less common, and has been met with only in the deeper parts of Vineyard Sound on ascidians and hydroids. In this species each cell arises from the back of the preceding one, near the end, and bends upward and forward obliquely, the cell expanding from a narrow, pedicel-like, basal portion to a more or less oval upper part, with the aperture oblique and subterminal. This, also, is a new addition to the fauna of our coast, although, like the last, long well known on the coast of Europe.

The *Diastopora patina* grows attached to algæ and eel-grass; it forms little circular disks, with tubular cells arising from the upper surface, those in the middle being longest.

The *Tubulipora flabellaris* frequently occurs attached to various kinds of slender-branched algæ, such as *Ahnfeltia plicata*, &c. It forms small, blunt-lobed, coral-like masses, composed of long, crooked, tubular cells, united by a porous mass at base. Toward the borders of the lobes the cells are crowded and polygonal. In the central parts they are more cylindrical and form groups or radiating rows. Associated with the preceding on the algæ, *Crisia eburnea*, (p. 311;) *Mollia hyalina*, (Plate XXXIV, fig. 264;) *Cellepora ramulosa*, (p. 312;) and other species occur. The *Membranipora pilvsa* (Plate XXXIV, figs. 262, 263) is frequent on rocky bottoms, growing chiefly upon *Phyllophora* and other algæ. It may be known by the oval cells, bordered by erect, bristle-like processes, of which the one at the proximal end of the cell is much longer than the rest.

Another species, *M. lineata*, is also common, incrusting rocks and shells in broad, thin, radiating patches. In this the cells are oblong, crowded, and separated only by the linear margins. In the most common variety there are eight or ten slender spinules on each side of the cells, which bend over so as to meet or interlock across the open cells. The cells are much smaller as well as narrower than those of the preceding species.

Of Echinoderms only a few species occur in this region, on rocky bottoms, which causes this fauna to contrast very strongly with that of the rocky bottoms farther north, as in the Bay of Fundy or on the coast of Maine, where numerous other fine species of star-fishes and several additional Holothurians are common. The common green sea-urchin, *Strongylocentrotus Dröbachiensis*, (Plate XXXV, fig. 268,) so very abundant farther north, and especially in the Bay of Fundy, where it occurs in abundance at low-water mark, and on rocky bottoms at all depths down to 110 fathoms, and off St. George's Bank even down to 450 fathoms, is comparatively rare in this region and chiefly confined to the outside colder waters, as off Gay Head and No Man's Land, where it was quite common. But a few specimens were dredged at several localities in Vineyard Sound. The largest occured on the rocky bottoms off West Chop, and off Menemsha. It has been found occasionally in Long Island Sound, as off New Haven and Stratford, Connecticut, but is there quite rare and small. It feeds partly on diatoms and other small algæ, &c., which it cuts from the rocks with the sharp points of its teeth, but it is also fond of dead fishes, which are soon devoured, bones and all, by it in the Bay of Fundy. In return it is swallowed whole in large quantities by the wolf-fish and by other large fishes. The purple sea-urchin, *Arbacia punctulata*, is much more abundant in Vineyard Sound and similar waters, in this region. This is a southern species which is here near its northern limit. It is easily distinguished by its rather stout, unusually long, purple spines; by its ambulacral pores in two simple rows; by the upper surface of the shell being partly destitute of spines; and by the anal region, at the summit of the shell, which is formed of only four rather large plates. It occurred of large size, associated with the preceding species, off West Chop and Holmes's Hole; it was quite abundant in the passage at Wood's Hole, especially on shelly and gravelly bottoms north of Naushawena Island, and it was met with at many other localities.

The common green star-fish, *Asterias arenicola*, (p. 326, Plate XXXV, fig. 269,) is very common on all the rocky bottoms in this region. A smaller and more beautiful northern star-fish was occasionally met with in Wood's Hole passage and several other localities on rocky or gravelly bottoms. This was the *Cribrella sanguinolenta;* it is much more common north of Cape Cod, and is abundant in the Bay of Fundy and northward to Greenland; it is also found on the northern coasts of Europe. It has not been found much south of Vineyard Sound on this coast. It can easily be distinguished by its five round, tapering rays, covered with small spinules, and by having only two rows of locomotive suckers in the grooves on the under side of the rays, instead of four rows, as in the common star-fishes belonging to the genus *Asterias.* Its color is quite variable. It is often orange, or purple, or rose-color, or cream-color, and sometimes mottled with red and purple, &c. Unlike the preceding, and most other species of our star-fishes, this does not have free-swimming young. Its eggs are deposited around the mouth, and retained by the mother until they develop into little star-fishes capable of taking care of themselves.

The Hydroids are very numerous on rocky bottoms. A few species, like *Hydractinia polyclina* (p. 328) and the *Thamnocnida tenella*, attach themselves directly to the rocks, but the greater number adhere to ascidians, algæ, or to other hydroids. Many of the species are also to be found on the rocky shores in tide-pools, and have already been mentioned. Among those not yet detected at low water is a delicate species of *Plumularia*, with slender, alternately pinnate branches, which was found growing upon rocks in company with *Hydractinia.* The *Thamnocnida tenella* is a Tubularian which grows in clusters, two or three inches high, consisting of long, slender, somewhat branched stems, which are more or less crooked, and usually irregularly and distantly annulated, with beautiful pink heads at the top. The general appearance is like that of the *Parypha*, (Plate XXXVI, fig. 274.) The *Obelia dichotoma* was found growing upon ascidians (*Cynthia partita*, &c.) in 8 or 10 fathoms, among rocks. It is a well-known European species, but has not hitherto been established as an inhabitant of our coast. It has dark, horn-colored, slender stems, with pretty long and rather erect, slender, alternate branches, which branch again in the same way. The hydroid cells are deeply campanulate, with the margin slightly sinuous or scolloped, the slight notches corresponding with faint angular ridges which run down on the upper parts of the cells, giving the upper half a slightly polygonal form. In this respect this species closely resembles the *Obelia commisuralis.* The reproducsive capsules are elongated, urn-shaped, with a narrow, raised, sub-conical neck.

The *Obelia geniculata* is often very abundant on the fronds of *Laminaria* and other algæ having flat fronds. Its creeping tubular stolons often thickly cover the surface with a complete net-work; from these the erect stems rise to the height of about an inch. This species may be known by the prominent geniculation at the origin of the hydroid pedicels. The *Obelia fusiformis* has a similar mode of growth, but is much less common. Its hydroid cells are comparatively small and their pedicels very short.

Several very delicate and beautiful creeping hydroids, belonging to the Campanularians, also occur attached to larger hydroids, and the algæ. Among these are *Clytia Johnstoni*, having comparatively large, bell-shaped cups, with a notched rim, each borne on a long, slender, generally simple pedicel, ringed at each end, and arising from the creeping stems. The reproductive capsules are urn-shaped and annulated. The *C. intermedia* is quite similar in its growth, but has smaller and deeper cups, with smaller notches around the rim. The *Orthopyxis caliculata* grows in the same manner; it has beautiful little bell-shaped or cup-shaped cells, with an even rim, each borne on a long, slender, annulated pedicel with one of the rings, just below the cup, very prominent. Its reproductive capsules are large, oblong, smooth, and obtuse at the end. The *Platypyxis cylindrica* has small, very deep, somewhat cylindrical cups, with the rim divided into sharp teeth or notches; each one is borne on a small, slender pedicel, generally less than an eighth of an inch high, feebly annulated at each end. The reproductive capsules are elongated, compressed, flaring slightly at the end. The *Campanularia volubilis*, is also a very small, but elegant species; it has deep cylindrical cups, which have a regularly scolloped rim, the scollops being small and evenly rounded. The pedicels are very slender, and are annulated *spirally* throughout their whole length, so as to appear as if twisted; just below the cup there is one prominent rounded annulation, or bead, the whole resembling in miniature the stem of certain wine-glasses and glass vases. The reproductive capsules are vase-shaped, attached by short pedicels, and have the neck elongated and gradually narrowed to the end, which flares slightly.

The *Lafoëa calcarata* is also a small creeping hydroid, belonging to another family. It has curved tubular cells. It nearly always grows on *Sertularia cornicina*, which is a small species, resembling *S. pumila*, (Plate XXXVII, fig. 279.) The *Sertularia argentea* (Plate XXXVII, fig. 280) is a large, profusely branched species, often growing to the length of a foot or more. It is very abundant in this region. *S. cupressina* is closely related, but much less common. The *Hydrallmania falcata* is also a large species very common on these bottoms. It can be easily distinguished by the spiral arrangement of its branches and the unilateral arrangement of its jug-shaped cells along the branches.

The *Eudendrium ramosum* and *E. dispar* are not uncommon on rocky bottoms, and are both beautiful species, somewhat resembling the *Pennaria*, (Plate XXXVII, fig. 277.)

The species of Polyps are the same as those found on rocky shores at low-water mark. The coral, *Astrangia Danæ*, (p. 329,) is much more common than on the shores, and grows larger, some of the specimens becoming four or five inches across, and rising up in the middle into lobes or irregular branches, sometimes nearly two inches high, making very elegant specimens.

Numerous sponges also occur, but they have not yet been carefully studied. One of the most abundant is a species of *Chalina*, which grows up in clusters of slender, soft, smooth branches, five or six inches high, and from a quarter to half an inch in diameter, of a pale yellowish or buff-color while living. It makes very delicate, white, and beautiful specimens when the animal matter has been thoroughly washed out and the sponge dried in the sun, which can be best done by hanging them up in a reversed position, owing to the flexibility of the branches when wet. This species is closely related to the *Chalina oculata*, which also occurs in this region, in the outside cold waters, as off Gay Head, and is abundant farther north and on the coast of Europe; but the present species is much more delicate, with more slender and rounder branches, and it seems to be a southern form, for it is common all along our coast as far, at least, as North Carolina.

The common, irregularly branched, red sponge is found in abundance, and also several light yellow, irregular, soft, massive species of *Tedania*, and the firm, massive, sulphur-yellow *Cliona sulphurea*.

List of species ordinarily found on the rocky bottoms of the bays and sounds.

ARTICULATA.

Insects.

	Page.		Page.
Chironomus halophilus	415	Pallene, sp	421

Crustacea.

	Page.		Page.
Cancer irroratus	395	Mœra levis	315
C. borealis	395	Autonoë, sp	415
Panopeus depressus	395	Amphithoë maculata	315
P. Sayi	395	A. longimana	370
Pelia mutica	395	Unciola irrorata	340
Eupagurus pollicaris	395	Cerapus tubularis (?)	396
E. longicarpus	395	Caprella geometrica	316
Homarus Americanus	395	Caprella, sp	316
Crangon vulgaris	395	Idotea phosphorea	316
Hippolyte pusiola	395	Erichsonia filiformis	316
Mysis Americana	396	Balanus crenatus	396
Heteromysis formosa	396	Numerous small Entomostraca.	
Lepidactylis dytiscus	339		

Annelids.

	Page.		Page.
Lepidonotus squamatus	397	Ophelia simplex	319
L. sublevis	397	Cirrhinereis fragilis	397
Harmothoë imbricata	397	Naraganseta coralii	397
Phyllodoce, sp	397	Sabellaria vulgaris	397
Eulalia, sp	397	Nicolea simplex	397
Eumidia, sp	397	Scionopsis palmata	397
Autolytus cornutus	397	Polycirrus eximius	320
Autolytus, sp	398	Potamilla oculifera	397
Nereis pelagica	397	Sabella microphthalma	397
Podarke obscura	319	Fabricia Leidyi	397
Marphysa Leidyi	319	Serpula dianthus	397
Lumbriconereis opalina	397	Spirorbis, sp	397

Nemerteans.

	Page.		Page.
Cosmocephala ochracea	325	Cerebratulus ? sp	324
Polinia glutinosa	324		

MOLLUSCA.

Gastropods.

	Page.		Page.
Fulgur carica	399	Triforis nigrocinctus	305
Sycotypus canaliculatus	399	Crucibulum striatum	399
Tritia trivittata	354	Crepidula fornicata	355
Urosalpinx cinerea	399	C. unguiformis	355
Astyris lunata	399	Leptochiton apiculatus	399
A. zonalis	399	L. ruber	399
Anachis avara	306	Doto coronata	400
Lacuna vincta	305	Polycera Lessonii	400
Bittium nigrum	305	Æolis, sp	400
Cerithiopsis Greenii	383	Doridella obscura	400
C. Emersonii	417		

Lamellibranchs.

	Page.		Page.
Mya arenaria	401	Mytilus edulis	401
Saxicava arctica	401	Modiola modiolus	401
Argina pexata	401	Anomia glabra	401
Scapharca transversa	401	Ostræa Virginiana	401

Ascidians.

Bryozoa.

RADIATA.

Echinoderms.

Acalephs.

Polyps.

PROTOZOA.

Sponges.

Foraminifera.

6. FAUNA OF THE GRAVELLY AND SHELLY BOTTOMS OF THE BAYS AND SOUNDS.

Bottoms composed of gravel or pebbles, often with small stones, and generally with a considerable proportion of dead and usually broken shells, were of frequent occurence in Vineyard Sound, and a few such localities were found in Buzzard's Bay. Similar bottoms of small extent have also been examined in Long Island Sound, near New Haven. These bottoms are generally the most productive and agreeable for the dredger, for they are the favorite abodes of large numbers of animals of all classes, and the contents of the dredge are often so clean that they require little if any washing in the sieves. They vary much, however, in character, some of them consisting mostly of gravel, with pebbles and perhaps small scattered boulders; others consist largely of broken shells, especially those of *Mactra solidissima* and *Crepidula fornicata*, mixed with more or less gravel, sand, and mud. Others are so completely overgrown with the various large compound ascidians described above, that they might well be called "ascidian bottoms." In many places, however, there are patches of mud or sand, scattered here and there over a bottom which is mostly of gravel and shells, so that the dredge will often bring up more or less mud or sand, with some of the animals peculiar to such patches, mixed with those peculiar to the gravelly bottoms, thus augmenting the number and variety of animals. In other cases more or less mud and sand may be mixed with the gravel throughout, or the bottom may be in process of changing from mud or sand to gravel, or the contrary, owing to frequent changes in the directions of the currents, produced chiefly by the action of storms upon the shoals and bars of sand. Hence it is often difficult to distinguish with certainty the animals properly inhabiting the gravelly and shelly bottoms from those that pertain to the muddy and sandy bottoms, but for our present purposes it is not necessary to make a very sharp distinction between the different lists, for many species are common to all, and the areas of the different kinds of bottom are generally small in this region, and evidently may change their character from time to time.

After a single storm the character of the bottom, in some localities, was found to be greatly altered over wide areas, sometimes several miles in extent, at depths of two to ten fathoms, and the animal life at the bottom was always found to have changed very quickly, when the physical character of the bottom had been modified. The most frequent cause of change was the accumulation of immense quantities of dead seaweeds and eel-grass over bottoms that, a few days before, had been perfectly free from it. Such accumulations must either kill the majority of the animals inhabiting gravelly, sandy, or rocky bottoms, or else cause them to migrate. In all probability the majority of them perish, at such times, beneath the accumulations. In other cases one or two storms sufficed to change gravelly and shelly bottoms to sandy ones, causing, undoubtedly, great destruction of life and a great change in its character over particular areas. These changes in the character of the deposits accumulating on the bottom, attended with extermination of life and changes in its character in particular localities, illustrate on a small scale similar phenomena that have constantly occurred on a grander scale in the history of the past life of the globe, during all the geological ages, from the first commencement of life. Practically it was found quite difficult to find, in this region, large areas of gravelly and shelly bottoms, without some admixture with mud or sand, and it very seldom happened that a continuous series of dredgings could be made on such bottoms without encountering patches of mud and sand. Therefore the accompanying list of species undoubtedly contains many that belong rather to muddy or sandy bottoms than to those now under discussion, for species have not been excluded unless well known, from many observations, to be peculiar, or nearly so, to mud or sand and rarely met with on true hard bottoms.

The following are the principal localities where this kind of bottom was explored in Vineyard Sound and vicinity, but those belonging to the outside cold area are not included:

First. An extensive area extending from off Nobska Point eastward, nearly parallel with the shore, with some interruptions of sandy bottom, as far as Suconesset Shoal, mostly in three to eight fathoms of water; on this bottom were the dredgings of line 6, *a, b, c, d, e, f*; 21, *a, b, c, d*; 22, *a, b, c, d*; 23, *a, b, e, f*; 25, *b, c, d*; 26, *a, b, c, d, e*; 34, *a, b, c, d, e, f*; 35, *a, b, c, d, e*.

Second. Another similar region nearly parallel with the southeastern shores of Naushon and Nonamesset Island and extending out into mid-channel; dredgings on line 5, *a*, *b*; 7, *b*, *c*, *d*; 8, *c*, *d*, *e*, *f*, *g*; 42, *a*, *b*; 43, *a*, *b*, *c*, *d*, *e*, were made on the shallower portion of this ground, mostly in three to eight fathoms; 38, *a*, *b*, *c*; 39, *a*, *b*; 40, *a*, *b*, *c*, *d*; 41, *b*; 44, *a*, *b*, *c*, *d*, *e*; 46, *e*, were made in the deeper parts of the channel, in eight to fifteen fathoms.

Third. Several areas, in the deeper waters of the sound, north and northeast of Holme's Hole, and doubtless continuous with the last area; dredgings, at line 28, *a*, *b*, *c*, *d*, *e*, *f*; 29, *a*, *b*, *c*; 31, *a*, *b*, *c*, *d*, *e*; 32, *a*, *b*, *c*; 33, *a*, *b*, *c*, *d*, were made on these bottoms.

Fourth. A narrow strip of clean gravelly bottom, swept by the strong currents passing around West Chop, and situated between the "Middle Ground" Shoals and Martha's Vineyard, and extending around to East Chop, with an interruption of rocky bottom just opposite West Chop; dredgings on line 37, *a*, *b*, *c*, *d*, *g*, *h*; 47, *a*, and 48, *a*, *b*, *c*, *d*, were made on this area.

Fifth. In the channel, at the entrance to Great Harbor, off Nonamesset Island, and partially extending into the harbor, there is more or less gravelly and shelly bottom, frequently alternating with rocks and often composed chiefly of dead shells, (mainly *Crepidula fornicata*.) This place is swept by the powerful tidal currents running through Wood's Hole Passage; dredgings at line 3, *d*, *e*; 5, *e*, *f*, *g*; 13, *a*, *b*; 18, *a*, *b*, *c*, *d*; 19, *a*; 20, *a*, *b*, and many others not indicated on the chart, were made here.

Sixth. Another area at the other end of Wood's Hole Passage, north of Hadley Harbor, and extending out into Buzzard's Bay a short distance; some parts of this region had a smooth hard bottom of fine gravel and sand, or coarse sand; in other places it was more or less stony; dredgings on line 10, *e*, *f*; 11, *a*, *b*, *c*, *d*, *e*, *g*; 12, *b*, *c*; 70, *a*, *b*, *c*, *d*; 71, *a*, *b*, were on these gravelly bottoms.

Seventh. A shallow region off Cataumet Harbor, in Buzzard's Bay; the bottom here was hard gravel and shells, much overgrown with algæ; dredgings at line 65, *a*, *b*, and others not indicated, were made here.

Eighth. At Quick's Hole, in the channel between Nashawena and Pasque Islands, good gravelly bottom was found; dredgings at line 45, *a*, *b*; 76, *a*, *b*, *c*; 77, *c*, *d*, *e*, *f*, were on this area.

Similar bottoms of small extent were also met with in other places. There are also gravelly bottoms in the southwestern part of Vineyard Sound, near its mouth, as off Menemsha, but as these are inhabited by the more northern species of animals, they will be grouped with those of the outside waters.

The animals of gravelly and shelly bottoms may be burrowing or tube-dwelling species, like many annelids, amphipods, bivalve-shells, &c.; they may be species that adhere directly to the shells and pebbles, like certain hydroids, bryozoa, bivalve-shells, and the numerous ascidians; the latter are quite as numerous here as upon the rocky bottoms, and for the most part of the same species; they may be species that hide among the shells and pebbles or between the ascidians, &c., like many of the larger annelids, some of the crabs, and other crustacea, &c.; they may be species that live among or attached to the hydroids, bryozoa, ascidians, and algæ which grow upon the shells and pebbles; such are many of the small crustacea, some annelids, many small gastropod shells, and most of the more delicate bryozoa and hydroids; or they may be larger kinds that creep or swim about over the bottom, in search of food, such as the lobster, the larger crabs, hermit-crabs, large gastropod mollusks, star-fishes, sea-urchins, holothurians, &c. Owing to the great abundance of animal life on bottoms of this character they are the favorite feeding-grounds of many kinds of fishes, such as the tautog, scup, black bass, haddock, and cod, together with many others that are less valuable. Most of the "banks" and "fishing-grounds" resorted to by the line fishermen have either gravelly and shelly or else rocky bottoms, and those banks most frequented by fishes are almost always found to be rich dredging-grounds. The gravelly banks in this region are, in winter and spring, fishing-grounds for cod and haddock, but these fishes retreat to colder waters in the summer.

Among the Crustacea the most abundant and important species are the lobster, *Homarus Americanus*, (p. 395,) the common shrimp, *Crangon vulgaris*, (p. 339, Plate III, fig. 10,) the common rock-crab, *Cancer irroratus*, (p. 312,) *Panopeus Sayi*, (p. 312,) *P. depressus*, (p. 312, Plate I, fig. 3,) the larger hermit-crab, *Eupagurus pollicaris*, (p. 313,) the smaller hermit-crab, *E. longicarpus* (p. 313,) the *Heteromysis formosa*, (p. 396,) *Mysis Americana*, (p. 396,) *Unicola irrorata*, (p. 340, Plate IV fig. 19,) *Amphithoë maculata*, (p. 315, Plate IV. fig. 16,) *Corophium cylindricum*, (p. 370,) which lives among the hydroids, and a species of *Autonoë*, which lives in the crevices among the lobes of the sandy ascidians (*Amarœcium pellucidum*) in large numbers. The barnacle, *Balanus crenatus*, (p. 396,) is very abundant.

One of the most interesting of the Crustacea met with was the *Heterocrypta granulata*, which occurred off Falmouth and near Suconesset light-ship. This is one of the triangular crabs in which the carapax is smooth; the chelipeds are long and triangular. It is a southern species, occurring on the Florida coast, and is new to our fauna.

Another triangular crab, the *Pelia mutica*, also occurs on these bottoms, but this has a rough carapax, and resembles a small specimen of the common spider-crabs, *Libinia*.

Clinging to and creeping over the hydroids and ascidians a singular long-legged Pycnogonid is often met with on shelly bottoms. This is the *Phoxichilidium maxillare*, (Plate VII, fig. 35.) It is most frequently deep purple in color, but gray and brown specimens are often met with.

The larvæ of a fly, *Chironomus halophilus*, was dredged in five fathoms.

The Annelids are quite numerous, and the majority of them are the same as those found on the rocky bottoms, for the same species inhabit the interstices of the massive ascidians, found equally on both kinds of bottom, and the same tube-dwelling species can attach themselves to stones and shells just as well as to rocks. Most of the additional species are burrowing kinds, and some of them probably inhabited patches of mud or sand. Among the more interesting species are *Nephthys bucera*, (Plate XII, fig. 58;) *Anthostoma acutum* V., a new species; *Scolecolepis cirrata*, new to the American coast; *Scalibregma brevicauda* V., a very interesting new species; *Cirratulus tenuis* V., a new species; *Ampharete setosa* V., also a new species; *Serpula dianthus* V., (p. 322.) Several rare or undescribed species were also met with that have not yet been fully identified. Among these were a peculiar species of *Nereis*; a large *Anthostoma;* a young *Polydora;* an apparently undescribed species of *Samytha;* a species of *Euchone*, perhaps identical with *E. elegans* V.; the calcareous tubes of a small worm, perhaps a *Vermilia*, which have two carina on the upper side.

Two species of Sipunculoids occurred, one of which is probably undescribed. The other is the *Phascolosoma cæmentarium*, (Plate XVIII, fig. 92,) a species very common on all the northern coasts of New England in deep water. This worm takes possession of a dead shell of some small Gastropod, like the hermit-crabs, but as the aperture is always too large for the passage of its body, it fills up the space around it with a very hard and durable cement, composed of mud and sand united together by a secretion from the animal, leaving only a small, round opening, through which the worm can extend the anterior part of its body to the distance of one or two inches, and into which it can entirely withdraw at will. It thus lives permanently in its borrowed shell, dragging it about wherever it wishes to go, by the powerful contractions of its body, which can be extended in all directions and is very changeable in form. When fully extended the forward or retractile part is long and slender, and furnished close to the end with a circle of small, slender tentacles, which surround the mouth; there is a band of minute spinules just back of the tentacles; the anal orifice is at the base of the retractile part; the region posterior to this has a firmer and more granulous skin, and is furnished toward the posterior end with a broad band of scattered, blackish, acute, recurved spinules, more or less triangular in form, which evidently aid it in retaining its position in the shell. As it grows too large for its habitation, instead of changing it for a larger shell, as the hermit-crabs do, it gradually extends its tube outward beyond the aperture by adding new materials to it. Some of the fishes often suddenly cut short this labor by swallowing the worm, shell and all.

In July the common squids, *Loligo Pealii*, (Plate XX, figs. 102-105,) were taken in considerable numbers by means of the trawl, on gravelly and shelly bottoms off Falmouth, and with them large quantities of the eggs contained in large bunches or groups of long, gelatinous capsules. They were apparently spawning at that time.

Although the Gastropod mollusks are seldom very numerous at any particular spot on these bottoms, yet a pretty large number of species occur, and they are quite generally diffused. Many of them have already been enumerated as occurring on rocky bottoms. The *Fulgur carica*, (p. 355, Plate XX, fig. 124,) and the *Sycotypus canaliculatus*, (p. 355,) are found chiefly on these bottoms, and are often very abundant. Over a barrel of living specimens were obtained on a single excursion. The *Lunatia heros*, (p. 354, Plate XXIII, figs. 133–136,) though generally found on the sandy bottoms, also occurred in great numbers and of very large size on some of the gravelly bottoms. The pretty little *Natica pusilla* (Plate XXIII, fig. 132) is often common on these bottoms; it is usually delicately painted with brown.

The *Crepidula fornicata* (p. 355, Plate XXIII, figs. 129, 129*a*) was one of the most abundant species, often occurring adhering to each other in great clusters, the lowest ones in the group adhering in turn to dead bivalve shells, pebbles, shells of living *Fulgur* and *Sycotypus*, and still more frequently to these shells when dead and occupied by the larger hermit-crabs, (*Eupagurus pollicaris.*) The dead shells of this *Crepidula* were often found in great accumulations, covering considerable areas of bottom, and with but little admixture, either with other shells or with sand and gravel.

The *Crepidula unguiformis*, (p. 355, Plate XXIII, fig. 127,) though very common, did not occur in such great quantities. *Crucibulum striatum* (p. 399, Plate XXIII, figs. 125, 126) is also common, adhering to various dead shells.

The *Vermetus radicula* (Plate XXIV, fig. 157) is a very curious shell, looking, when full grown, very much like the tube of an Annelid, such as *Serpula* or *Protula*, but the inhabitant is a genuine Gastropod, and has a thin, spiral, horny operculum, for closing the aperture when it withdraws. When young this shell often forms a very regular, closely coiled, spiral shell, looking like that of a *Turritella*, and sometimes does not become irregular until the spire is more than an inch long, but sooner or later it goes off on a tangent and becomes irregular and crooked. Sometimes several of these shells interlock irregularly and thus form large clusters.

The curious and minute *Cæcum pulchellum* (Plate XXIV, fig. 158) is occasionally met with in considerable numbers, though very liable to be overlooked owing to its very small size. *Cæcum costatum* V. is of less frequent occurrence, and easily distinguished by the prominent ridges or ribs that run lengthwise of the shell.

Wherever algæ occur in abundance on these bottoms, the *Bittium nigrum* (p. 305, XXIV, fig. 154) is found in immense numbers, and it is generally associated with *Lacuna vincta* (p. 305, Plate XXIV, fig. 139) and with a few specimens of *Triforis nigrocinctus*, (p. 305, Plate XXIV, fig. 152,) *Cerithiopsis Greenii*, (Plate XXIV, fig. 153,) *Astyris lunata*, (Plate XXI, fig. 110,) *Anachis avara*, (Plate XXI, fig. 109,) &c. On the shelly bottoms *Cerithiopsis terebralis* and *C. Emersonii* ofter occur, but they are not usually common. On similar bottoms, sometimes adhering to

Pecten and other shells, we often met with the various species of *Odostomia*, among which *O. seminuda* (Plate XXIV, fig. 148,) was much the most common; but *O. producta*, (Plate XXIV, fig. 143,) *O. impressa*, (Plate XXIV, fig. 147,) and *O. trifida*, (Plate XXIV, fig. 145,) occurred in shallow water; and also *Turbonilla elegans*, (Plate XXIV, fig. 155,) which is a very handsome, glossy, brown shell; and *T. interrupta*, which is a similar shell, but more slender, with less convex whorls. The *Eulima oleacea* (Plate XXIV, fig. 149) is a very elegant, white, polished, and shining shell, and generally rare, but in two instances we found several of them adhering to the skin of the large Holothurian, *Thyone Briareus*, upon which it seemed to live as a quasi parasite or "commensal."

On shelly and muddy bottoms we occasionally found *Scalaria lineata*, (Plate XXI, fig. 123,) and *S. multistriata*, (Plate XXI, fig. 122,) both of which are rare and elegant shells. The *Pleurotoma bicarinatum* (Plate XXI, fig. 106) occurred rarely.

The bivalve shells are also quite numerous on these bottoms. Among them the *Mactra solidissima* (p. 358, Plate XXVIII, fig. 203) is most conspicuous on account of its great size and frequent occurrence; its dead shells were often very abundantly scattered over the bottom, and were generally incrusted with numerous bryozoa and hydroids. The *Gouldia mactracea* (Plate XXIX, figs. 206, 207) was quite common in many localities in a living state, while the dead shells were generally diffused. Among the other species that are common or abundant are *Scapharca transversa*, (Plate XXX, fig. 228,) *Clidiophora trilineata*, (Plate XXVII, fig. 193,) *Nucula proxima*, (Plate XXX, fig. 230,) *Mytilus edulis*, (Plate XXXI, fig. 234,) *Modiola modiolus*, (Plate XXXI, fig. 237,) *Crenella glandula*, (Plate XXXI, fig. 233,) *Pecten irradians*, (Plate XXXII, fig. 243,) *Anomia glabra*, (Plate XXXII, figs. 241, 242.) The *Modiolaria nigra* (Plate XXXI, fig. 236) occurred only in few localities in the deep water of the middle of the Sound, associated with the common muscle. The *Cumingia tellinoides* (Plate XXX, fig. 221) was found living occasionally, but its dead shells were quite common. The same is true of *Corbula contracta*, (Plate XXVII, fig. 191,) which was perhaps a little more commonly found living than the last. The *Cyclas dentata* (Plate XXIX) fig. 211,) is a handsomely sculptured, pure white shell, which we met with only a few times in the living state, though dead valves often occurred. The same remarks will apply to *Coclodesma Leanum*, (Plate XXVII, fig. 198,) of which the shells were much more common. The *Kellia planulata* (p. 310,) and *Montacuta elevata* also occasionally occur on shelly bottoms, but were seldom obtained alive. The *Cyclocardia borealis* (Plate XXIX, fig. 216) and *C. Novangliæ* (Plate XXIX, fig. 215) were quite common in the deeper waters.

The *Gastranella tumida* V., (Plate XXVII, fig. 190) is a small and rare shell, recently discovered, and has, as yet, been found only on a shelly bottom among hydroids, near New Haven, in 4 or 5 fathoms. The *Angulus modestatus* V. (Plate XXX, fig. 224) is a species recently described from specimens dredged by us in Vineyard Sound. It is often handsomely banded with light red and pale yellow. It is still a rare species, but has been dredged also near New Haven.

The Ascidians, with the exception of one or two additional species seldom met with, are the same as those of the rocky bottoms, and they often occur in immense quantities, especially the massive sandy ones, *Amarœcium pellucidum*, (p. 401,) and the "sea-pork," *A. stellatum*, (p. 402,) which together often almost entirely cover the bottom over areas many acres in extent. They furnish excellent hiding-places in the openings and crevices between their lobes for numerous Crustacea and Annelids, many of which can be easily secured by putting the masses of these ascidians into buckets of water and leaving them until the water begins to get stale, when they will come out of their retreats in large numbers and seek the surface or edges of the water for oxygen. Or they may be pulled apart directly and the various creatures secured at once.

The *Molgula arenata* (Plate XXXIII, fig. 251) is a nearly globular, but often somewhat flattened species, which covers itself over with closely adherent grains of sand or gravel. It is most common on sandy bottoms but is found also on gravelly ones.

The *Ciona tenella* is an elongated, erect species, attached at base to rocks, dead shells, &c. It is remarkable for the transparency, whiteness, and softness of its integument, and for the bright orange ocelli around its orifices. It is rare in this region, but very common in the Bay of Fundy.

The Bryozoa are very abundant, especially on the shelly bottoms. Some of them grow on algæ, hydroids, ascidians, &c.; and many form incrustations on the dead shells and pebbles. The two most abundant and prominent species are *Bugula turrita* (p. 311, Plate XXXIV, figs. 258, 259) and *Escharella variabilis*, (p. 312, Plate XXXIII, fig. 256.) The former grows attached to the various sea-weeds in great quantities, forming delicate white plumes, often six inches to a foot in length. The latter mostly forms calcareous incrustations over the surfaces of dead shells and pebbles, thin at first, but eventually becoming thickened by the formation of layer over layer, until the crust may become half an inch to an inch in thickness, with a tabulated and vesicular structure in the interior. The masses thus formed often closely resemble genuine corals, especially some of the ancient fossil forms, and they often occur in great quantities. When living the color is dull red, but when recently dried they have a yellowish-green color, which easily bleaches out, however, by exposure to the sun and air. *Vesicularia dichotoma*, (p. 404,) *Alcyonidium ramosum*, (p. 404, Plate XXXIV, fig. 257,) and *Crisia eburnea* (p. 311, Plate XXXIV, figs. 260, 261) are usually abundant. Most of the remaining species have also been mentioned in the previous pages as inhabitants of rocky bottoms, or else among the shore species.

Among the species not previously mentioned are *Cellepora scabra*, which forms branching, coral-like masses on the slender red algæ; a species of *Lepralia*, found with the last, and also on shells, which is allied to *L. Pallasiana* of Europe; *Mollia hyalina*, which forms circular disks, with irregular, more or less oblique cells; and *Membranipora tenuis*, which is common on the pebbles, often covering their whole surface with a delicate lace-like incrustation, made up of very small, crowded, oval or oblong cells, which have the inner part of the front partly closed over, but with an irregular, mostly three-lobed aperture toward the outer end, which is bordered by small, irregular spinules.

The *Vesicularia fusca* was also found in a few instances, in deep water. It had not been previously known on the American coast. Good specimens of the *Caberea Ellisii* were also dredged in the deeper parts of Vineyard Sound, attached to ascidians.

Of Echinoderms the number of species is not large. The common green star-fish, *Asterias arenicola* (Plate XXXV, fig. 269) is very common; the *Cribrella sanguinolenta*, (p. 407,) is comparatively rare; and the green sea-urchin, *S. Dröbachiensis*, (p. 406,) is quite infrequent. The purple sea-urchin, *Arbacia punctulata*, (p. 326,) is, however, quite common in many localities. The largest and finest specimens were taken off Holmes' Hole, but it was quite abundant, though of moderate size, in Great Harbor and Wood's Hole passage. The *Thyone Briareus* (p. 362) is not uncommon in shallow water, especially among weeds; it has already been mentioned, (p. 418,) as carrying *Eulima oleacea* attached to its skin.

Another Holothurian, the *Pentamera pulchella*, seems to be quite common, judging by the numerous specimens thrown on Nobska beach by the storms, and preserved for us by Mr. Vinal N. Edwards, during the past winter, but it was dredged only in one locality, off Holmes' Hole, by Messrs. T. M. Prudden and T. H. Russell. It is a southern species, not previously known north of the Carolina coasts. It is easily distinguished from the preceding species by its light color, and by having the locomotive-suckers arranged in five broad and very distinct longitudinal bands, with naked spaces between them.

A very delicate little Ophiurian, the *Amphipholis elegans*, was occasionally met with on the shelly bottoms. This is a northern species, much more common in the Bay of Fundy, where it is found from low-water mark to 80 fathoms, and it is found also on the northern coasts of Europe. It has a nearly circular disk, covered with smooth scales, regularly arranged, and each of the scales, on the sides of the slender rays, bears three short, blunt spines. Its color is usually light gray or whitish, frequently more or less marked with dark gray or brown.

The Hydroids are numerous on these bottoms, and mostly of the same species that have been mentioned as occuring on rocky bottoms.

The Polyps are few and essentially the same as those on the rocky bottoms. The only additional species was a small, slender, undescribed species of *Edwardsia*, *E. lineata* V., living in the interstices among ascidians and the tubes of *Sabella* and *Potamilla*.

Sponges also occur in considerable numbers. Among them the most conspicuous is the *Cliona sulphurea*, a bright sulphur-yellow species, growing into hemispherical or irregular, massive forms, of firm texture, the surface covered with scattered, low, wart-like, soft prominences, about an eighth of an inch in diameter, which contract when the sponge is dried, leaving shallow pits. The sponge commences as a boring species, on various dead shells, and as it grows it penetrates the shells in every direction, forming irregular holes and galleries, which continue to grow larger as more and more of the substance of the shell is absorbed, until the shells are reduced to a completely honey-combed, brittle mass, or a mere skeleton; finally the sponge begins to protrude from the surface, and grows up into mammilliform masses, or small, rounded crusts, which continue to grow and spread in every direction, until finally they may form masses six or eight inches in diameter, with the base spreading over and enveloping various dead shells, pebbles, and the coral, *Astrangia Danæ*, though it often happens that living specimens of the latter grow upon the sponge. Owing to the remarkable boring habits of this and other allied sponges, they are very important in the economy of the sea, for they are the principal agents in the disintegration and decay of the shells that accumulate over the bottoms, thus performing the same function in the sea that fungi and insects perform on the land—the removal of dead organisms that otherwise would accumulate in vast quantities. In this work they are aided, in most regions, either by certain boring Annelids, (*Dodecacerea*, &c.,) or by various boring mollusks, (*Lithodomus*, *Pholas*, *Gastrochæna*, &c.,) but the greater part of this work seems to be effected by the sponges.

Numerous species of Foraminifera were obtained on these and also on the rocky bottoms, but they have not yet been studied. The most common kind occurs attached by one side to dead shells, algæ, &c. It consists of several chambers arranged in a spiral manner, and to the naked eye resembles a minute depressed spiral shell.

List of species inhabiting gravelly and shelly bottoms of the bays and sounds.

ARTICULATA.

Insects.

	Page.		Page.
Chironomus halophilus.....	415	Muscidæ, larva	335

Pycnogonids.

	Page.		Page.
Phoxichilidium maxillare.	415	Pallene, sp.................	409

Crustacea.

	Page.
Cancer irroratus	415
Panopeus depressus	415
P. Sayi	415
Pelia mutica	415
Heterocrypta granulata	415
Eupagurus pollicaris	415
E. longicarpus	415
Homarus Americanus	415
Crangon vulgaris	415
Hippolyte pusiola	395
Mysis Americana	415
Heteromysis formosa	415
Lepidactylis dytiscus	339
Mœra levis	315
Autonoë, sp	415
Amphithoë maculata	415
Unciola irrorata	415
Corophium cylindricum	415
Caprella, sp	316
Idotea phosphorea	316
Erichsonia filiformis	316
Epelys trilobus	370
Balanus crenatus	415
Numerous Entomostraca.	

Annelids.

	Page.
Lepidonotus squamatus	320
L. sublevis	320
Harmothoë imbricata	321
Sthenelais picta	348
Nephthys picta	348
N. bucera	416
Phyllodoce, sp	349
Eulalia, sp	349
Eulalia, sp	349
Eumidia, sp	349
Eteone, sp	349
Autolytus cornutus	397
A., sp., banded	398
Nereis pelagica	319
N. limbata	318
Nereis, sp	416
Diopatra cuprea	346
Marphysa Leidyi	319
Lumbriconereis opalina	320
L. tenuis	320
Anthostoma acutum	416
Anthostoma, sp	416
Scolecolepis cirrata	416
Polydora, sp	416
Scalibregma brevicauda	416
Cirratulus tenuis	416
C. grandis	319
Cirrhinereis fragilis	397
Naraganseta coralii	397
Dodecacerea, sp	397
Clymenella torquata	343
Sabellaria vulgaris	349
Cistenides Gouldii	349
Ampharete setosa	416
Samytha, sp	416
Amphitrite ornata	320
Nicolea simplex	321
Polycirrus eximius	320
Potamilla oculifera	322
Sabella microphthalma	323
Euchone, sp	416
Fabricia Leidyi	323
Serpula dianthus	416
Vermilia, sp	416
Spirorbis spirillum	323

Sipunculoids.

	Page.
Phascolosoma cæmentarium	416
Phascolosoma, sp	416

Nemerteans.

MOLLUSCA.

Cephalopods.

Gastropods.

Lamellibranchs.

Polyps.

PROTOZOA.

Sponges.

Foraminifera.

II. 7.—FAUNA OF THE SANDY BOTTOMS OF THE BAYS AND SOUNDS.

The sandy bottoms in Vineyard Sound are chiefly found in shallow water, either along the shores or on the banks and shoals. In Buzzard's Bay they were met with only in few places, near the shore, and have no great extent. To the eastward of Vineyard Sound, throughout the greater part of Nantucket Sound, Muskeget Channel, and the waters south and southeast of Nantucket and Cape Cod, the bottom is generally sandy, sometimes passing into gravelly and shelly.

The true sandy bottoms are not favorable to many kinds of animals, and where the sands are constantly changing, as on most of the shoals in this region, the bottom is sometimes almost barren of life, though certain burrowing species may occur.

The following are some of the special localities where dredgings were made on sandy bottoms: In Buzzard's Bay, at line 11, *d, e, f;* 64, *a, b;* 66, *a, b;* 67, *a, b;* 68, *a, b;* 71, *a, b, d;* 73, *a, b, c, e, f.* In Vineyard Sound, at line 14, *g, h;* 25, *a, b;* 27, *a, b;* 30, *a, b;* 37, *h, i;* 43, *a, b;* 46, *c, d;* 47, *d, e;* 48, *a, b.* A large portion of the species occurring on these bottoms have been mentioned before either as inhabitants of the sandy shores at low water, or as living upon gravelly and shelly bottoms. With the exception of a few species living attached to scattered shells or stones, nearly all the species are such as are adapted to burrowing beneath the surface of the sand, though many of them may also occur creeping on its surface.

The most abundant and characteristic species of Crustacea are the lobster, *Homarus Americanus*, (p. 313,) the common shrimp, *Crangon vulgaris*, (p. 339, Plate III, fig. 10,) the "lady-crab," *Platyonichus ocellatus*, (p. 338, Plate I, fig. 4,) the larger hermit-crab, *Eupagurus pollicaris*, (p. 313,) the smaller hermit-crab, *Eupagurus longicarpus*, (p. 313,) *Anthura brunnea*, *Conilera concharum*, *Unciola irrorata*, (p. 340, Plate IV, fig. 19.)

Of Annelids a considerable number of burrowing species occur, and also a few tube-dwelling species, which attach their tubes to dead shells; among these last are *Sabellaria vulgaris* (p. 321, Plate XVII, figs. 88, 88*a*,) and *Serpula dianthus*, (p. 322.)

The Gastropods are not numerous, and but few are peculiar to sandy bottoms; the majority found have their proper homes on shelly or muddy bottoms and live in much smaller numbers in sandy places; others enumerated in the following list inhabit the patches of eel-grass and algæ that are often scattered over the sandy bottoms in shallow water. A few species, however, have their proper homes on the sandy bottoms. Among the most important of these are *Lunatia heros*, (p. 353, Plate XXIII, figs. 133–136,) *Neverita duplicata*, (p. 354, Plate XXIII, fig. 130,) *Natica pusilla*, (p. 354, Plate XXIII, fig. 132,) *Cylichna oryza*, (Plate XXV, fig. 164,) *Utriculus canaliculatus*, (Plate XXV, fig. 160.)

The bivalve shells are more numerous, and most of them are species that burrow beneath the surface. The most common and characteristic species are *Ensatella Americana*, (p. 356, Plate XXVI, fig. 182, and Plate XXXII, fig. 245,) *Siliqua costata*, (p. 358, Plate XXXII, fig. 244,) *Mactra solidissima*, (p. 358, Plate XXVIII, fig. 202,) *Angulus tener*, (p. 358, Plate XXVI, fig. 180, and Plate XXX, 223, shell;) *Tottenia gemma*, (p. 359, Plate XXX, fig. 220,) *Lyonsia hyalina*, (p. 358, Plate XXVII, fig. 194.) In certain localities, where eel-grass grows, the scollop, *Pecten irradians*, (p. 361, Plate XXXII, fig. 243,) occurs in considerable abundance. The common muscle, *Mytilus edulis*, (Plate XXI, fig. 234,) occasionally occurs in patches or beds. *Lævicardium Mortoni* (p. 358, Plate XXIX, fig. 208) is sometimes abundant in sheltered localities. The *Ceronia arctata* appears to be abundant in some places, as it is sometimes thrown on the sandy beaches in large numbers, but it was seldom dredged. The *Thracia Conradi* lives on sandy bottoms, buried six inches or more beneath the surface, but is seldom obtained alive. The dead shells were occasionally dredged in Vineyard Sound.

Very few Ascidians occur. The most frequent one is *Molgula arenata*, (p. 419, Plate XXXIII, fig. 251,) which lives free in the sand and covers itself with a coating of closely adherent grains of sand. Another species, *M. pellucida*, is occasionally met with; this also lives free in the sand, but does not attach the sand to itself. It has a clean translucent integument, a round body, and two tubes which are large and swollen at their bases. Where eel-grass or algæ afford opportunities for its attachment, the *M. Manhattensis* (p. 311, Plate XXXIII, fig. 250) generally occurs.

The Bryozoa are not numerous, unless where dead shells are scattered over the sand for their attachment, when many of the same species that inhabit shelly bottoms may occur. The only species that are frequent on the true sandy bottoms are *Bugula turrita*, (Plate XXXIV, figs. 258, 259,) which occurs attached to eel-grass, &c., and *Escharella variabilis*, (p. 311, Plate XXXIII, fig. 256,) which incrusts dead shells or other solid objects; with the last, *Membranipora lineata*, (p. 406,) and several other species may sometimes be found.

Several species of Echinoderms inhabit the sandy bottoms. The most abundant one is the "sand-dollar," *Echinarachnius parma*, (p. 362, Plate XXXV, fig. 267,) which occurs in immense numbers on nearly all sandy bottoms, except on the most exposed shoals. Another related species, *Melitta testudinaria*, was dredged two or three times in Vineyard Sound, but the specimens were dead and broken. It is a very abundant species south of Cape Hatteras, and may be distinguished by having five large oblong perforations near the edge.

At least three species of Holothurians live upon the sandy bottoms. The most common one is the *Thyone Briareus*, (p. 362,) conspicuous on account of its large size and dark purplish-brown color, as well as for the numerous long papillæ that cover its body. It was found on a sandy bottom off Waquoit, with the *Eulima oleacea* (Plate XXIV, fig. 149) adhering to its surface, just as they occurred together on shelly bottoms, (see p. 418.) The *Pentamera pulchella*, (p. 420,) also inhabits sandy bottoms, in shallow water. During the past winter Mr. Vinal N. Edwards collected numerous specimens of this and the preceding species on Nobsca beach, after storms. They doubtless live in the sand, in shallow water, a short distance off the beach. In similar situations the *Caudina arenata*, (p. 362,) occasionally occurs, but it is apparently rare in this region. It has a thick, yellowish white, harsh skin, without suckers, and its body tapers off into a slender caudal portion. The common star-fish, *Asterias arenicola*, (p. 326, Plate XXXV, fig. 269,) is not uncommon on sandy bottoms, though more abundant in rocky and shelly localities. The *Ophiura olivacea* (p. 363) lives among the patches of eel-grass in shallow water on the sandy bottoms, and travels over the surface of the sand quite rapidly by means of its slender, flexible rays.

Of Hydroids very few species ordinarily inhabit sandy bottoms, and the only one that is usually met with is *Hydractinia polyclina*, (p. 328,) which lives on the shells occupied by hermit-crabs. Others occasionally grow on the eel-grass or on dead shells.

The *Cliona sulphurea*, (p. 421,) is the only large sponge that is commonly met with on sandy bottoms, but another bright yellow siliceous sponge, forming smooth, firm, crest-like lobes and plates, occurred on Edgartown beach.

List of species inhabiting the sandy bottoms of the bays and sounds.

ARTICULATA.

Crustacea.

	Page.		Page.
Cancer irroratus	312	Lepidactylis dytiscus	339
Carcinus granulatus	312	Unciola irrorata	426
Platyonichus ocellatus	436	Idotea cæca	340
Hippa talpoida	338	Epelys trilobus	370
Eupagurus pollicaris	426	Conilera concharum	426
E. longicarpus	426	Anthura brunnea	426
Homarus Americanus	426	Limulus Polyphemus	340
Crangon vulgaris	426		

Annelids.

	Page.		Page.
Sthenelais picta	348	A. acutum	416
Nephthys picta	348	Scolecolepis cirrata	416
Eteone, sp	349	Polydora, sp	416
Neresis pelagica	319	Clymenella torquata	343
Lumbriconereis opalina	320	Sabellaria vulgaris	426
Rhynchobolus dibranchiatus	341	Cistenides Gouldii	323
R. Americanus	342	Amphitrite ornata	320
Anthostoma robustum	343	Serpula dianthus	426

Nemerteans.

	Page.		Page.
Meckelia ingens	349	M. rosea	350

Sipunculoids.

	Page.		Page.
Phascolosoma Gouldii	353	P. cæmentarium	416

MOLLUSCA.

Gastropods.

	Page.		Page.
Fulgur carica	355	Odostomia seminuda	417
Sycotypus canaliculatus	355	Turbonilla interrupta	418
Eupleura caudata	371	Bittium nigrum	305
Urosalpinx cinerea	306	Triforis nigrocinctus	305
Tritia trivittata	354	Cerithiopsis Greenii	417
Ilyanassa obsoleta	354	C. terebralis	417
Anachis avara	306	C. Emersonii	417
Astyris lunata	306	Cæcum pulchellum	417

Polyps.

PROTOZOA.

Sponges.

Foraminifera.

II. 8.—FAUNA OF THE MUDDY BOTTOMS OF THE BAYS AND SOUNDS.

The muddy bottoms are inhabited by a considerable number of species, which find their true homes in such localities. Most of these are either burrowing or tube-dwelling kinds. A few creep or swim about over the surface or conceal themselves in the superficial layer of mud and vegetable *débris*.

The character of the mud itself is quite various, and the different kinds are often inhabited by different groups of animals. The mud may be very thick, heavy, and tenacious, consisting chiefly of clay; such mud is usually inhabited by few species of animals. It may consist of finely comminuted sand, mixed with more or less clay; such bottoms are more favorable to animal life. In other places it consists partly of one of the preceding kinds intimately mixed with large quantities of decaying vegetable *débris*, derived chiefly from eel-grass and algæ; such mud, unless too fetid, is often full of animal life. In some cases, especially in well-sheltered localities, where the water is tolerably pure, the mud may contain large quantities of living and dead microscopic organisms, both animal and vegetable, and these may even constitute more than one-half of the bulk of the mud, which, in such cases, is peculiarly soft and flocculent; such mud is extremely favorable to many kinds of animals that feed on the microscopic organisms, especially the bivalve shells, Holothurians, and many Annelids, and the "menhaden" among fishes. The last variety of bottom, when it has a substratum of sand or gravel a few inches below the surface, is the most favorable kind for *oysters*, which grow very rapidly and become very fat in such places.

In Vineyard Sound and Nantucket Sound muddy bottoms are not common, and are mostly of small extent, situated in coves, harbors, or in places where the tides form eddies around projecting points of land, or in the lee of shoals.

In Buzzard's Bay the bottom is muddy over the greater part of its area, except a region of sandy and shelly bottom in the central part.

In Long Island Sound the bottom is generally muddy throughout its length and breadth, though small areas of rocks, gravel, and sand occur at various places.

The special localities, indicated on the chart, where dredgings were made on muddy bettoms, not including the outside dredgings, are as follows: In Buzzard's Bay, at line 67, *b*; 68, *a*, *b*, *c*: 74, *a*, *b*; 75, *a*, *b*, *c*, *d*, *e*, *f*; in Hadley Harbor, at 10, *a*, *b*, *c*, *d*; in Great Harbor, at 17, *b*, *c*; 19, *b*; in Robinson's Hole, at 78, *a*, *b*, *c*; in Vineyard Sound, at 47, *b*, *c*. Numerous other dredgings were made on muddy bottoms in this region that are not indicated on the chart.

In Long Island Sound numerous dredgings have been made by the writer, with Mr. S. I. Smith and others, during eight years. These extend from a few miles west of the entrance of New Haven Harbor to the Thimble Islands and Faulkner's Island on the east; and from the Connecticut shore nearly across the sound. The greater part of these dredgings were on muddy bottoms, and generally in 3 to 8 fathoms of water.

The following are some of the most common and important of the Crustacea living on these muddy bottoms: the spider-crab, *Libinia canaliculata*, (p. 368,) *L. dubia*, (p. 368,) *Panopeus depressus*, (p. 312, Plate I, fig. 3,) *P. Sayi*, (p. 312,) the "blue-crab," *Callinectes hastatus*, (p. 367,) *Mysis Americana*, (p. 396,) *Ptilocheirus pinguis*, (p. 431,) *Unciola irrorata*, (p. 340, Plate IV, fig. 19,) *Limulus Polyphemus*, (p. 340.) Numerous tube-dwelling Amphipods, including several species of *Ampelisca* and genera belonging to the *Lysianassinæ* occur, some of them in great numbers, and also additional species of crabs and shrimps. All these are of special importance, because they furnish great quantities of food for the fishes frequenting muddy bottoms.

Of Annelids numerous burrowing and tube-dwelling kinds are to be found, some of them in great abundance. One of the most abundant and conspicuous species is *Nephthys ingens*, (Plate XII, figs. 59, 60.) This worm burrows in mud of all kinds, even in that which is so filled with decaying vegetable *débris* as to be very fetid. It grows to the length of more than six inches, with a diameter of a quarter of an inch or more, though most of the specimens are about half this size. The body is whitish, with a red median blood-vessel, but the lateral appendages are dark and the setæ nearly black. It is very active, and wriggles about energetically by undulating its body laterally, to the right and left; this motion enables it to burrow quickly, or to swim quite rapidly. When captured it is very apt to break off the posterior part of its body, but can reproduce it.

The *Diopatra cuprea* (p. 346, Plate XIII, figs. 67, 68) is often abundant where the mud is somewhat firm; the dredge often brings up large quantities of the projecting ends of its large tubes, but the occupant usually escapes by retreating below the surface. The two species of *Rhynchobolus* are also quite common, but *R. dibranchiatus* (p. 341, Plate X, figs. 43, 44) is generally the most abundant. The curious *Travisia carnea* V. is seldom met with, and, like *Brada setosa* V., appears to be rare in this region. The *Trophonia affinis* (Plate XIV, fig. 75) is more common, though found chiefly in the deeper waters, and more frequently in the cold waters outside, as off Cuttyhunk Island and off Block Island. *Ampharete setosa* V. has been found only in Long Island Sound, near New Haven. The *Melinna cristata* is a northern and European species; it was found in the deeper part of Vineyard Sound, inhabiting flexible tubes covered with fine mud. *Euchone elegans* V. (Plate XVI, fig. 84) was found in the deeper parts of Vineyard Sound, living in small tubes of mud; it was much more abundant in the deeper waters outside. The *Meckelia ingens* (p. 349, Plate XIX, figs. 96, 96*a*) occasionally occurs on muddy bottoms, though more common on sandy ones.

Of Gastropod mollusks a comparatively small number of species occur that are characteristic of these bottoms. There are several species that occur on eel-grass, when it grows on the muddy bottoms, which are not included in the following list. They have been mentioned when speaking of the fauna of muddy and sandy shores.

Among the species of special interest were *Mangilia cerina*, which is a rare and little-known species; *Bela plicata* (p. 383, Plate XXI, fig. 107); *Turbonilla elegans*, (p. 418, Plate XXIV, fig. 155), which was recently described from specimens obtained in Vineyard Sound by us; *T. interrupta*, (p. 418;) two species of *Scalaria*, (p. 418;) *Cylichna oryza*, (Plate XXV, fig. 164;) *Amphisphyra pellucida*, (Plate XXV, fig. 162;) and *Utriculus canaliculatus*, (Plate XXV, fig. 160).

The bivalve shells are much more numerous and are mostly burrowing kinds. Among the most abundant are *Mulinia lateralis*, (p. 373, Plate XXVI, fig. 184 B,) which occurs in immense quantities, especially in soft sticky mud; *Clidiophora trilineata*, (Plate XXVII, fig. 193;) *Tellina tenta* (Plate XXX, fig. 225,) which is often very abundant in soft mud, in sheltered places, as in Hadley Harbor; *Callista convexa*, (Plate XXX, fig. 219;) *Nucula proxima*, (Plate XXX, fig. 230;) *Yoldia limatula*, (Plate XXX, 232;) *Astarte castanea*, (Plate XXIX, fig. 204;) and *Mytilus edulis*, (p. 307.)

The last-named shell, which is the common muscle, occurs in patches, "beds," or "banks," often of great extent. One of these muscle-beds, in which the animals were living, was found extending quite across the mouth of Cuttyhunk Harbor, at line 75, *f*, on the chart; another at Quick's Hole, at line 76, *c*, and 45, *a*, *b*; others at 77, *d*, *e*, *f*; 46, *b*, *c*, *d*. In several instances large beds of dead muscles were found, with few living ones, and in all these cases there were on them large numbers of star-fishes, either *Asterias arenicola*, in case of those in Vineyard Sound; or *Asterias vulgaris* on those in the deeper and colder waters near the entrance of the Sound and off Gay Head; and sometimes both kinds, at intermediate localities. These star-fishes had no doubt devoured the muscles. Among the localities of this kind are, 47, *a*, *b*, *c*, *d*; 53, *b*, *c*; 56, *b*, *c*, *d*; 55, *a*, *b*, *c*; 63, *a*, *b*; 58, *d*; 54, *b*. As this species of muscle grows to full size, under favorable circumstances, in one year, it is probable that these muscle-beds vary greatly in size and position in different years. They afford habitations for various kinds of animals that belong properly on shelly or stony bottoms, such as *Arbacia punctulata* (p. 326,) *Cribrella sanguinolenta*, (p. 407,) and various shells, ascidians, hydroids, &c. The *Modiolaria nigra* (Plate XXXI, fig. 236) was found in small numbers, but of good size, associated with the common muscle, in the deeper part of Vineyard Sound.

The oyster does not usually occur on true muddy bottoms in this region, unless placed there by human agency, but unless attacked by the star-fishes or other enemies they will flourish well in such localities. Beds of oysters on muddy bottoms always afford lodgment for large numbers of animals that belong properly to the shelly and rocky bottoms; these have mostly been omitted from the following list.

Among the shells of peculiar interest that live in the mud are the species of *Pholas*. The largest and finest species, *P. costata*, has been found living in New Bedford Harbor, according to Dr. Gould. It lived buried in the mud two or three feet below the surface, and the specimens were dug out by the harbor-dredging machines. This is a southern species, found quite commonly on the coasts of South Carolina and Florida, and in the Gulf of Mexico. With the last, *P. truncata* (p. 372, Plate XXVII, fig. 200) was also obtained, but this is quite common in mud and peat-banks, above low-water mark. Of both the preceding species we dredged dead shells at Wood's Hole and in Great Harbor, and with them we found fragments of another, *Zirphæa crispata*, which is a northern and European species. It is seldom that living adult specimens of such deep-burrowing shells can be obtained by the ordinary dredge, and they are rarely thrown up by the waves.

Ascidians are not often found on the muddy bottoms, and most of those that do occur adhere to the shells of oysters, muscles, &c., or to eel-grass. Hydroids and Bryozoa are likewise nearly wanting on true muddy bottoms, though a few may occur on the eel-grass and oysters.

Of Echinoderms there are but few species. The *Thyone Briareus* (p. 362) sometimes occurs where there is growing eel-grass. The common star-fish, *Asterias arenicola*, (p. 326,) has been mentioned above as inhabiting muscle-beds and oyster-beds. The *Amphipholis abdita* V. is a singular Ophiuran, with a small body and very long, slender, flexible, greenish arms, having three spines on each side arm-plate. The arms are sometimes six inches long. The creature buries itself deeply beneath the surface of the soft mud, and projects one or more of the long arms partially above the surface of the mud. On this account it is seldom dredged entire; the projecting arms are usually cut off by the dredge, and the animal escapes; and as it has the power of restoring lost arms, this is only a temporary inconvenience. The same thing probably happens when a voracious fish seizes one of the arms.

List of species inhabiting muddy bottoms of the bays and sounds.

ARTICULATA.

Crustacea.

	Page.		Page.
Pinnotheres ostreum	367	Squilla empusa	369
P. maculatus	459	Lysianassinæ, several species	431
Cancer irroratus	312	Phoxus Kroyeri	
Panopeus depressus	431	Melita nitida	314
P. Sayi	431	Ampelisca, two species	431
Carcinus granulatus	312	Ptilocheirus pinguis	431
Callinectes hastatus	431	Amphithoë compta	370
Libinia canaliculata	431	Corophium cylindricum	415
L. dubia	431	Unciola irrorata	431
Eupagurus pollicaris	313	Epelys trilobus	370
E. longicarpus	313	E. montosus	370
Callianassa Stimpsoni	369	Limulus Polyphemus	431
Crangon vulgaris	339	Numerous Entomostraca	
Mysis Americana	431		

Annelids.

	Page.		Page.
Nephthys ingens	431	Travisia carnea	431
Phyllodoce, sp	349	Trophonia affinis	432
Eulalia, sp	349	Brada setosa	431
Nereis pelagica	319	Cistenides Gouldii	323
Diopatra cuprea	431	Ampharete setosa	432
Marphysa Leidyi	319	Melinna cristata	432
Lumbriconereis opalina	320	Polycirrus eximius	320
Rhynchobolus Americanus	342	Chætobranchus sanguineus	320
R. dibranchiatus	431	Euchone elegans	432

Nemerteans.

	Page.		Page.
Meckelia ingens	432	Cosmocephala ochracea	325
Cerebratulus, sp	324		

Sipunculoids.

	Page.
Phascolosoma cæmentarium	416

Nematodes.

	Page.		Page.
Pontonema marinum	325	P. vacillatum	326

MOLLUSCA.

Gastropods.

	Page.		Page.
Mangilia cerina	432	Crepidula fornicata	355
Bela plicata	432	C. convexa	355
Tritia trivittata	354	C. unguiformis	355
Ilyanassa obsoleta	354	Scalaria lineata	432
Eupleura caudata	371	S. multistriata	432
Odostomia seminuda	417	Utriculus canaliculatus	432
O. fusca	307	Bulla solitaria	371
Turbonilla interrupta	432	Amphisphyra pellucida	432
T. elegans	432	Cylichna oryza	432

Lamellibranchs.

	Page.		Page.
Pholas costata	433	Cardium pinnulatum	423
P. truncata	433	Kellia planulata	310
Mya arenaria	309	Montacuta elevata	418
Clidiophora trilineata	432	Solenomya velum	360
Lyonsia hyalina	358	Astarte castanea	432
Periploma papyracea	429	Cyclocardia borealis	418
Mulinia lateralis	432	C. Novangliæ	418
Tagelus gibbus	373	Nucula proxima	432
T. divisus		Yoldia limatula	432
Cumingia tellinoides	418	Argina pexata	309
Macoma fusca	359	Mytilus edulis	432
Angulus tener	358	Modiolaria nigra	433
Tellina tenta	432	Crenella glandula	418
Callista convexa	432	Anomia glabra	311
Venus mercenaria	359	Ostræa Virginiana	433
Petricola pholadiformis	372		

Ascidians.

	Page.		Page.
Molgula Manhattensis	311	Cynthia partita	311

RADIATA.

Echinoderms.

	Page.		Page.
Thyone Briareus	433	Amphipholis abdita	433
Asterias arenicola	433		

II. 9.—FREE SWIMMING AND SURFACE ANIMALS.

Under this head I have included all the animals found swimming free, whether in the bays and sounds, or in the colder region outside. Nor have I, in this case, attempted to separate those of the estuaries and other brackish waters, although such a distinction might be useful had we sufficient data to make it even tolerably complete. But hitherto very little surface-collecting has been done in waters that are really brackish; and, moreover, since every tide must bring in myriads of free-swimming creatures with the waters from outside, it will always be difficult to distinguish between those that are thus transported and those that properly belong to the brackish waters. A distinction between the free-swimming animals of the bays or sounds and those of the open coast has not been made, partly on account of the constant intermixture of the waters and their inhabitants by the tides, and partly because the observations that were made do not indicate any marked difference in the life or in the average temperature of the surface waters, though the waters of the shallow bays become more highly heated by the direct heat of the sun in summer. The waters of the open coast are evidently more or less warmed by the Gulf Stream, and in fact numerous species of animals that properly belong to the fauna of the Gulf Stream are constantly brought into Vineyard and Nantucket Sounds by the currents, showing conclusively that a portion of the Gulf Stream water must also take the same course.

In Vineyard Sound, during August and the first part of September, the temperature of the surface water in the middle of the day was generally from 68° to 71° Fahrenheit; September 9, off Tarpaulin Cove, the surface temperature was 66°; off to the west of Gay Head, in mid-channel, it was 67° Fahrenheit; but farther out, off No Man's Land, on the same day, it was 62°, (bottom, in 18 fathoms, 62½°;) a short distance west of No Man's Land it was 63°, (bottom, in 11 fathoms, 59°;) about sixteen miles off Newport, at the 29-fathom locality, it was 62° on September 14, (at the bottom 59°;) off Cuttyhunk, in 25 fathoms, it was 64° at the surface on September 13, (bottom 62½°.) According to the record made by Captain B. J. Edwards, during the past winter, from observations taken at 9 a. m. every morning, at the end of the Government wharf at Wood's Hole, (where the temperature must be nearly identical with that of Vineyard Sound,) the average temperature of the surface water was 31° Fahrenheit, from December 27 to February 28. The average temperature for that hour during January was 31.42°; the lowest was 29° on January 29, with the wind N. W.; the highest was 38° on January 17, with the wind S. W.; on the 18th, 19th, and 22d it was 35°. The average for February was 30.75°; the coldest was 29°, on February 24 and 25; the highest 33°, on February 8, 17, and 19. The temperature at the bottom (at the depth of nine feet) was also taken, but rarely differed more than one degree from that of the surface, being sometimes a little lower and sometimes higher than that of the surface, but generally the same. The higher temperatures usually occurred with, or following, southerly or southeasterly winds, (from the direction of the Gulf Stream,) while the lowest ones generally accompanied or followed northerly winds. The tides must obviously also have some effect in modifying the temperature.

It must not be inferred from the preceding remarks that a distinct or constant current flows into these waters from the region of the Gulf Stream, for the facts do not warrant such a belief, nor is there any difficulty in explaining the phenomena in another way. All that is necessary to account for the higher temperatures of this region, and the frequent occurrence of Gulf Stream animals, is to suppose that when southerly or southeasterly winds blow continuously for a considerable time they cause a superficial flow or drift of warmer water from the Gulf Stream region toward these shores, which may also be aided by the tides; such a surface-drift will gradually lose its distinctness as it approaches the coast and mingles more and more with the cooler waters beneath, but the animals borne along by it will still serve to show its direction and origin, even after its temperature becomes identical with that of the adjacent waters. Such surface currents would necessarily be intermittent in character and variable in direction and extent, as well as in duration and temperature. They would also be more frequent in summer than in winter, according with the prevalent direction of the winds. So far as known to me all the facts are in harmony with this view. Accordingly the waters of Vineyard Sound are quite cold in winter, and only occasionally receive a little heat from the Gulf Stream region, and that, probably, largely through the medium of the air itself; but in summer these waters are very warm, for they not only receive frequent accessions of warm water from the Gulf Stream, but they are also favorably situated to be rapidly warmed by the direct heat of the sun.

The fauna of the surface in this region is very rich and varied, especially in summer. In winter, life is also abundant in the surface waters, but very different in character from that found in summer. Had collections been made in spring and autumn, still other groups of animals would doubtless have been found. Our knowledge of the surface animals of Vineyard Sound, in winter, is wholly based on a series of surface-dredgings made by Mr. Vinal N. Edwards in January, February, and March of the past winter. A separate list of the species contained in these collections, so far as identified, has been prepared to follow the general list. The most noticeable feature of the winter collections is the entire absence of the larval forms of crabs, shrimps, lobsters, star-fishes, sea-urchins, annelids, &c., which so abound in the same waters in summer. On the other hand there is a great abundance of Entomostraca, *Sagitta*, several northern Amphipods, species of *Mysis*, &c., together with eggs and young of certain fishes.

In the general list of surface species only those that have been actually observed are introduced, but it must be remembered that the greater part of the crustacea, annelids, mollusks, and echinoderms are well known to have free-swimming young, or larval forms, and that the list might easily be doubled by the introduction of such species, on theoretical grounds; but, by omitting them, the list serves to indicate how much yet remains to be done in this direction. There are large numbers of common species of which neither the young nor the eggs are known, and there are many others of which the eggs, or young, or both, are known, but the time required for the hatching of the eggs and the development of the young is not known. The dates given in the lists refer only to the time of actual capture of the species, and it must not be inferred that at other seasons of the year any of the species so designated are not to be found; for, doubtless, many of those that swim free when adult may be found all the year round. And possibly some species may breed during every month of the year. But the breeding season of most species is probably of short duration, and therefore the larvæ and young may occur only at particular seasons.

Mr. A. Agassiz has made a very large collection of the surface animals in Vineyard Sound, Buzzard's Bay, and off Newport, and to his labors we owe the knowledge of a large proportion of the jelly-fishes. He has also described the larvæ and young of several Annelids and Nemerteans, and has described and beautifully illustrated the larvæ and young of the common star-fishes, (*Asterias*,) and the green sea-urchin, (*Strongylocentrotus Dröbachiensis*.) The *Salpa Cabotti* (Plate XXXIII, figs. 254, 255) was also well described and illustrated by him; and also other species, but a large part of the collection has not yet been elaborated.

Our surface collections were made both in the day and evening, at various hours, chiefly by means of towing-nets and hand-nets. The evening or night hours are generally more productive than the day-time in this kind of collecting, but we were unable, owing to lack of time and superabundance of other specimens, to do as much night-collecting as we desired.

Among the Crustacea there are a considerable number of species that swim at the surface when adult, and others till nearly half-grown, but the majority are free-swimmers only when quite young, or even only when in the zoëa and megalops stages, through which they seem, from Mr. S. I. Smith's observations on several of our species, to pass in a short time. The males of the common oyster-crab, *Pinnotheres ostreum*, (p. 367, Plate I, fig. 2,) were often caught in the day-time swimming at the surface in the middle of Vineyard Sound. The lady-crab, *Platyonichus ocellatus*, (p. 338,) of full size, was also occasionally caught swimming actively at the surface. The "blue-crab," or common edible crab, *Callinectes hastatus*, is well known to be an active swimmer, when adult, but most of those seen at the surface were young. The larvæ of *Cancer irroratus*, (p. 312, Plate VIII, figs. 37, 37*a*,) and of *Platyonichus* in the zoëa and megalops stages, were taken in vast numbers, especially in bright sunshine, together with similar larvæ of many other species. The larvæ and young of the lobster (Plate IX, figs. 38, 39) were also abundant in mid-summer. The numerous specimens obtained have enabled Mr. S. I. Smith to describe the interesting metamorphoses of our lobster, which were entirely unknown before. The young swim actively at the surface, like a shrimp, until more than half an inch long. The larvæ and young of the various species of shrimps are also abundant. The curious larvæ of *Squilla empusa* (Plate VIII, fig. 36) were often met with.

Several species of Amphipods are also common at the surface. The most abundant were *Calliopius læviusculus*, of which Mr. V. N. Edwards also took numerous large specimens in February and March; *Gammarus natator*, which was usually common, and occurred in immense numbers August 10 and on several other occasions; and a *Hyperia*, which infests several species of large jelly-fishes, and also swims free at will. The *Phronima* is a related genus, but is very remarkable for its extreme transparency, which renders it almost invisible in water. *Idotea irrorata* (p. 316, Plate V, fig. 23) and *I. robusta*, Plate V, fig. 24) were very common among masses of floating eel-grass and sea-weeds, and the latter was also very often found swimming entirely free.

A species of *Sapphirina* (Plate VII, fig. 33) was found in great numbers among *Salpæ*, off Gay Head, on several occasions, early in September. This is one of the most brilliant creatures inhabiting the sea. It reflects the most gorgeous colors, blue, red, purple, and green, like fire-opal, although when seen in some positions, by transmitted light, it is colorless and almost transparent. Under the microscope, when living, it is a splendid object, whether seen by transmitted or reflected light, the colors constantly changing, as it is turned in different positions. When seen beneath the surface of the sea, in large numbers, the appearance is very singular, for each one as it turns in the right position reflects a bright gleam of light, of some brilliant color, and then immediately becomes invisible, and these scintillations come from different directions and various depths, many of them being much farther beneath the surface than any less brilliant object could be seen. In some cases one or more were found in the branchial cavity of *Salpæ*, but whether this is normal or accidental was not determined.

The species of *Argulus* are parasitic on the exterior of fishes, but we found at least three species swimming free at the surface. It is, therefore, probable that they are able to leave their hosts for a time, and thus to migrate from one fish to another. The species of *Caligus* are also parasites on fishes, to which they firmly adhere, but the half-grown young of one species was taken at the surface in the towing-nets.

Numerous species of Annelids, in the larval and young stages, were taken at the surface, but many of them have not yet been identified, for owing to the great changes they undergo, this is often impossible, unless the specimens can be raised, or at least connected with the adults by a large series of specimens. For a few this has been done. Several species also swim at the surface in the adult state, especially in the evening. With some this seems to be a habit peculiar to the breeding season, and sometimes only the males are met with.

Among the species most frequently taken in the adult state at the surface, are *Nereis virens*, (Plate XI, figs. 47–50,) chiefly males; *Nereis limbata*, (Plate XI, fig. 51,) mostly males, which occurred both in the evening and day-time; *Nectonereis megalops*, (Plate XII, figs. 62, 63,) which was quite common in the evening; *Autolytus cornutus*, (Plate XIII, figs. 65, 66,) the males, females, and asexual forms; *Podarke obscura*, (Plate XII, fig. 61,) which was extremely abundant in the evening; and several other species. The *Sagitta elegans* was taken at Wood's Hole, July 1, and off Gay Head, among *Salpæ*, September 8. It is a very small and delicate species, and so transparent as to be nearly invisible in water. A larger and stouter species of *Sagitta* was taken in large numbers at Wood's Hole, by Mr. V. N. Edwards, January 30, Febuary 10, and February 27, and at Savin Rock, near New Haven, May 5. This species has a longer caudal portion, with a small terminal fin; some of the specimens were nearly an inch long and many contained in the cavity of the body, posteriorly, a parasitic nematode worm, about half as long as the body. This parasite is round, not very slender; the head has three prominent angles; tail with a small, acute, terminal mucro.

Many of the Mollusca swim free by means of vibrating cilia, for a short time in the larval stages of growth, but as such larvæ are very minute and the period often quite short, these young are not often taken in the nets.

The Cephalopods of this region are all free-swimming species, from the time when they leave the eggs through life, though they may rest upon the bottom when depositing their spawn. Numerous specimens of the "squid," *Loligo Pealii*, (Plate XX, figs. 102–104, embryos and young,) were thus taken by the trawl in July, together with large clusters of their eggs. Later in the season the free-swimming young of this species, from a quarter of an inch to an inch in length, (fig. 105,) were often taken at the surface and were also found in the stomach of the red jelly-fish, *Cyanea arctica*, in considerable numbers. The adults were frequently taken during the whole summer in the pounds. Some of these were over a foot in length, but most of them were not more than five or six inches long. The color when living is very changeable, owing to the alternate contractions of the color-vesicles or spots, but the spots of different colors are much crowded, especially on the back, and the red and brown predominate, so as to give a general reddish or purplish brown color, and this is usually the color of preserved specimens. The clusters of gelatinous egg-capsules of this species were found in great abundance off Falmouth, on a shelly and weedy bottom, as already mentioned, (p. 416;) and near New Haven light-house large clusters, apparently of the same species, were found by Professer Todd, earlier in the season, (June 19.) Some of these masses were six or eight inches in diameter, consisting of hundreds of capsules, like fig. 102, each of which is usually three or four inches long and contains numerous eggs. These last contained embryos in different stages of development, two of which are represented in Plate XX, figs. 103, 104. Even at this early period some of the pigment vesicles are already developed in the mantle and arms, and during life, if examined under the microscope, these orange and purple vesicles may be seen to rapidly contract and expand and change colors, as in the adult, only the phenomena may be more clearly seen, owing to the greater transparency of the skin in the embryos. They are, therefore, beautiful objects to observe under the microscope. At this stage of development the eyes were brown. In these embryos the yolk is finally absorbed through the mouth, which corresponds, therefore, in this respect, to an "umbilicus." The more advanced of these embryos (fig. 103) were capable of swimming about, when removed from the eggs, by means of the jets of water from the siphon.

Another species, *Loligo pallida* V., (Plate XX, figs. 101, 101*a*,) occurs abundantly, in autumn, in the western part of Long Island Sound, from whence Robert Benner, esq., has sent me numerous specimens. This is a pale, translucent, gelatinous-looking species, with much fewer spots than usual, even on the back, and is nearly white beneath. It is a stout species, commonly five or six inches long, exclusive of the arms, but grows considerably larger than that. It is often taken in the seines in large numbers with menhaden, upon which it probably feeds. These squids are eagerly devoured, even when full grown, by many of the larger fishes, such as blue-fish, black-bass, striped-bass, &c. When young they are preyed upon by a still larger variety of fishes, as well as by the jelly-fishes, &c.

Another species of "squid," *Ommastrephes illecebrosa*, has been recorded from Greenport, Long Island, by Mr. Sanderson Smith, but I have not met with it myself, south of Cape Cod. It is common in Massachusetts Bay and very abundant in the Bay of Fundy. Messrs. S. I. Smith and Oscar Harger observed it at Provincetown, Massachusetts, among the wharves, in large numbers, July 28, engaged in capturing and devouring the young mackerel, which were swimming about in "schools," and at that time were about four or five inches long. In attacking the mackerel they would suddenly dart backward among the fish with the velocity of an arrow, and as suddenly turn obliquely to the right or left and seize a fish, which was almost instantly killed by a bite in the back of the neck with the sharp beaks. The bite was always made in the same place, cutting out a triangular piece of flesh, and was deep enough to penetrate to the spinal cord. The attacks were not always successful, and were sometimes repeated a dozen times before one of these active and wary fishes could be caught. Sometimes after making several unsuccessful attempts one of the squids would suddenly drop to the bottom, and, resting upon the sand, would change its color to that of the sand so perfectly as to be almost invisible. In this way it would wait until the fishes came back, and when they were swimming close to or over the ambuscade, the squid, by a sudden dart, would be pretty sure to secure a fish. Ordinarily when swimming they were thickly spotted with red and brown, but when darting among the mackerel they appeared translucent and pale. The mackerel, however, seemed to have learned that the shallow water is the safest for them and would hug the shore as closely as possible, so that in pursuing them many of the squids became stranded and perished by hundreds, for when they once touch the shore they begin to pump water from their siphons with great energy, and this usually forces them farther and farther up the beach. At such times they often discharge their ink in large quantities. The attacks on the young mackerel were observed mostly at or near high-water, for at other times the mackerel were seldom seen, though the squids were seen swimming about at all hours; and these attacks were observed both in the day and evening. But it is probable, from various observations, that this and the other species of squids are partially nocturnal in their habits, or at least are more active in the night than in the day. Those that are caught in the pounds and weirs mostly enter in the night, and evidently when swimming along the shores in "schools." They are often found in the morning stranded on the beaches in immense numbers, especially when there is a full moon, and it is thought by many of the fishermen that this is because, like many other nocturnal animals, they have the habit of turning toward and gazing at a bright light, and since they swim backwards they get ashore on the beaches opposite the position of the moon. This habit is also sometimes taken advantage of by the fishermen who capture them for bait for cod-fish; they go out in dark nights with torches in their boats and by advancing slowly toward a beach drive them ashore. They are also sometimes taken on lines, adhering to the bait used for fishes.

The specimens observed catching young mackerel were mostly eight or ten inches long, and some of them were still larger. The length of time required for these squids to become full grown is unknown, as well as the duration of their lives, but as several distinct sizes were taken in the pounds, and those of each school were of about the same size, it is probable that they are several years in attaining their full size. A specimen, recently caught at Eastport, Maine, was pale bluish white, with green, blue, and yellow iridescence on the sides and lower surface; the whole body was more or less thickly covered with small, unequal, circular, orange-brown and dark brown spots, having crenulate margins; these spots are continually changing in size from mere points, when they are nearly black, to spots 0.04 to 0.06 of an inch in diameter, when they are pale orange-brown, becoming lighter colored as they expand. On the lower side the spots are more scattered, but the intervals are generally less than the diameter of the spots. On the upper side the spots are much crowded and lie in different planes, with the edges often overlapping, and thus increasing the variety of the tints. Along the middle of the back the ground-color is pale flesh-color, with a median dorsal band, along which the spots are tinged with green, in fine specks. Above each eye there is a broad lunate spot of light purplish red, with smaller brown spots. The upper surface of the head is deeply colored by the brown spots, which are here larger, darker, and more crowded than elsewhere, and situated in several strata. The arms and fins are colored like the body, except that the spots appear to be smaller. The suckers are pure white. The eyes are dark blue-black, surrounded by an iridescent border, and in this genus the eyes are provided with distinct lids. In this respect, *Ommastrephes* differs from *Loligo*, for in the species of the latter genus, the integument is continued directly over the eye, the part covering the eye being transparent.

Most of the higher Gastropods inclose their eggs in capsules, which they attach to stones, algæ, or shells, and within these the eggs hatch and the young have a well formed shell before they eat their way out of the capsules, and when free they crawl about by means of the "foot," like the adult. But in the lower orders of Gastropods most of the young, when first hatched, are furnished with vibrating cilia and swim free, by this means, for a short time. These larvæ are very different from the adults, and in case of the naked mollusks (Nudibranchs) the larvæ are furnished with a beautiful, little, glossy, spiral shell, which they afterwards lose.

The Pteropods swim free in all stages. The young and adults swim by means of two wing-like appendages, developed on each side of the neck, which may be compared to the anterior lateral lobes of the foot, seen in Æolis, (fig. 174,) and many other Gastropods, if we suppose these to become enormously enlarged, while the rest of the foot remains in a rudimentary or undeveloped condition, often serving merely for the attachment of the operculum.

The *Styliola vitrea* (Plate XXV, fig. 178) was taken in the day-time at the surface, September 8, among *Salpæ*, off Gay Head. Its shell is a thin, white, transparent, glassy cone, about a third of an inch long, and slightly curved toward the tip. The animal is also white. The *Spirialis Gouldii* has a delicate, white, transparent, spiral shell, when adult having seven whorls, which turn to the left. The shell is marked by very fine revolving lines, visible only under the microscope. This species is seldom met with at the surface in the day-time, but is often abundant in the early evening. According to the observations of Mr. A. Agassiz, in confinement they rarely left the bottom of the jars during the day, merely rising a few inches and then falling again to the bottom. After dark they became very active, swimming actively near the surface of the water. "During the day they often remain suspended for hours in the water simply by spreading their wing-like appendages, and then suddenly drop to the bottom on folding them." Mr. Agassiz captured the specimens upon which his observations were made, at Nahant, Massachusetts, during the summer of 1869, and judging from the figures in Binney's Gould they were probably specimens, not quite adult, of this species. He has also taken adult specimens at Newport. Mr. S. I. Smith captured full grown specimens in the edge of the Gulf Stream, off St. George's Bank, and we have specimens taken from the stomach of mackerel, caught twenty miles south of No Man's Land.

The *Cavolina tidentata* (Plate XXV, fig. 177) is a beautiful and curious species, with a singularly shaped, amber-colored, translucent shell, much larger than that of either of the preceding species. We did not observe it living in these waters, but the shells were twice dredged off Martha's Vineyard, and one of them was perfectly fresh and glossy, as if just dead. It is a southern species which comes north in the Gulf Stream, but it had not been found previously on the coast of New England. Another Gulf Stream species, the *Diacria trispinosa*, is occasionally found at Nantucket, according to Dr. Stimpson, but whether it has been observed there alive is uncertain; eight or nine other species were taken in the Gulf Stream, off St. George's Bank, by Messrs. Smith and Harger in 1872, all of which may, perhaps, occasionally occur about Martha's Vineyard and Nantucket.

Another very interesting and beautiful Pteropod, the *Clione papilionacea*, was taken in considerable numbers at Watch Hill, Rhode Island, April 13, by Professor D. C. Eaton and myself. They were swimming at midday near the surface, associated with *Pleurobrachia rhododactyla*, and appeared to be common at that time. Mr. Vinal N. Edwards obtained two specimens in Vineyard Sound, April 30. This differs from those named above, in being destitute of a shell, as well as in many other characters. The body is stout, somewhat fusiform, tapering gradually to the pointed posterior end; in the largest specimens the length was about 1.5 inches. The head is rounded, with two small conical processes in front, on the upper side. Six tentacle-like organs, or "arms," bearing minute suckers, can be protruded. The wings or fins are large and broad oval in outline.

The body and wings are pale, transparent bluish, with opalescent hues; the mouth and parts around it, the "arms," and part of the head, and some of the internal organs, are tinged with orange; the posterior part of the body is bright reddish orange, for nearly half an inch. Some of the internal organs are orange-brown and olive-brown, and show through the transparent integuments as dark patches. This species has seldom been observed on our coast. Dekay, in 1843, mentioned its occurrence in a single instance, off New York. In 1869, it was taken in considerable numbers at Portland, Maine, by Mr. C. B.

Fuller. It may, nevertheless, occur annually in winter, and yet be seldom observed; for very few naturalists go out to collect marine animals in winter and early spring.

The bivalve shells mostly produce minute young, or larvæ, which are at first provided with vibrating cilia and swim free for several days, as is well known to be the case with the oysters, clams, muscles, *Teredo*, &c. But a few species, like the *Tottenia gemma*, (p. 359,) produce well developed young, furnished at birth with a well formed shell.

The common fixed Ascidians, both simple and compound, mostly produce eggs that hatch into tadpole-shaped young, which swim about for a short time by the undulatory motions of the tail, but finally become fixed by the head-end, and losing, or rather absorbing, the tail-portion, rapidly develop into the ordinary forms of the ascidians. This process, although often very rapid, is a very interesting and complicated one

In *Molgula Manhattensis* there is, according to the observations of Dr. Theodore A. Tellkampf, an alternation of generations. He states that the minute yellow ova were discharged July 18, invested in a viscid yellowish substance, which become attached to the exterior of many specimens. In a few days the "viscid substance" had changed its appearance and became contractile; the ova became larger, round, and of different sizes; "after two or three days the largest protruded somewhat above the surface of the common envelope, and presented a circular or oval aggregation, like that of the *Mammaria* found a year ago;" on the 11th day, the round ova had increased in size, with a central round or oval orifice through which the motion of the ciliæ of the branchial meshes were visible. "The orifice had approached on the 1st of August more or less to one apex; in some specimens, which were now oval, it was terminal." In this stage he names it *Mammaria Manhattensis*, regarding the *Mammaria* as a "nurse;" within each of the *Mammariæ*, at the end opposite the branchial orifice, there was seen a mass of cells, which ultimately developed into a tadpole-shaped larva, similar to that of other ascidians. He observes that the *Mammariæ* increase after the discharge of the larvæ, and that gemmation takes place within the common envelope.* These observations, if correct, are very interesting and important, but they need farther confirmation. The development of the larvæ from the *Mammariæ* into *Molgula* was not traced; neither did he witness the *actual discharge* of the ova, which produced the *Mammariæ*, from the *Molgula*. They may possibly have no relation with one another.

Several kinds of Ascidians, however, swim free in the water during their entire life. The most common Ascidian of this kind is the *Salpa Cabotti*, (Plate XXXIII, figs. 254, 255.) This, like the other species, exists under two different forms; or, in other words, it is one of those animals having alternations of generations. The sexual individuals (fig. 255) are united together into long chains by processes (*c*) from the sides

* Annals of the Lyceum of Natural History of New York, Vol. 10, p. 83, 1872.

of the branchial sac; these chains are often a foot or even a foot and a half long, and contain two rows of individuals, which are united together in such a way that they stand obliquely to the axis of the chain, the branchial openings being all on the upper side of the chain as it floats in the water, while the posterior openings are all on the lower side of the chain, close to the edge. Each individual is connected both with its mate on the right or left side, and to those immediately in front and behind on the same side. The succeeding individuals in the chain overlap considerably. The chains do not appear to break up spontaneously, but when broken apart by accident the individuals are capable of living separately for several days. The chains, when entire, swim about quite rapidly by means of the streams of water passing out of all the cloacal orifices in one direction. The individuals composing the chains, when full grown, are about three quarters of an inch long. They are transparent and white, or pale rose, often with the edges of the mantle and the nucleus bright Prussian blue, and with delicate reticulations of the same blue over the surface of the mantle. Each of the individuals in the chains is hermaphrodite, and each produces a single egg, which develops into an embryo before it is discharged, and finally when it grows to maturity produces an asexual individual, which is always solitary, (Plate XXXIII, fig. 254.) These are larger than those in the chains and are quite different in form, but the color is the same. These when mature produce, by a budding process in their interior, a series of minute individuals united together along a tube into a small chain, (s, fig. 254,) which may be seen coiled up around the nucleus. The chain consists of three sections, those individuals in the section first formed being largest and nearly equal in size; those in the next much smaller; while new ones are just forming at the other end; as the chain grows longer, and the component individuals larger, it projects more and more, and finally the end protrudes from an opening in the tunic, and the little chain becomes detached and is discharged into the sea. These chains consist of twenty to thirty pairs of individual zoöids. This operation is frequently repeated during the summer, and these chains of all sizes, from those just liberated up to the full-grown ones, may be taken at the same time. They appear to grow very rapidly. Thus by autumn these *Salpæ* became exceedingly abundant, at times completely filling the water for miles in every direction, from the surface to the depth of several fathoms, and are so crowded that a bucket of water dipped up at random will often contain several quarts of *Salpæ*. They were found in wonderful abundance on September 8, off Gay Head and throughout the outer part of Vineyard Sound, and on several other occasions were nearly as abundant.

Two species of *Appendicularia* and a species of *Doliolum* were also found in these waters by Mr. A. Agassiz, but we did not observe them. These are also free-swimming Ascidians, related to *Salpa*, but very different in form.

Among the Echinoderms there are no species that swim at the surface when adult, but most of them produce eggs which hatch into very remarkable larvæ, entirely unlike their parents in form and structure, and these swim free in the water, often for a considerable period, by means of vibrating cilia.

The young star-fish or sea-urchin develops gradually within the body of the larva, on the water-tubes, and as it grows larger it gradually absorbs the substance of the larva into its own body. The development of the larvæ of *Asterias vulgaris* (*A. pallida* AG.) and *A. arenicola* (*A. beryl-inus* AG.) has been described by Mr. A. Agassiz, from the time previous to hatching from the eggs till they become young star-fishes, with the essential characters of the adults. He has also described the young of the common green sea-urchin (under the name of *Toxopneustes Dröbachiensis*) in the same way. The *Cribrella saguinolenta*, (p. 407,) like several other star-fishes, does not have free swimming larvæ, but retains and protects the eggs by holding them by means of the suckers around the mouth, curving the body around them at the same time. In this position the eggs hatch and pass through a metamorphosis different from that of *Asterias*, though somewhat analogous to it. The development of this species was described by Professor M. Sars many years ago. Some of the Ophiurans are viviparous, among them the *Amphipholis elegans* (p. 418) found in this region, but others have free-swimming larvæ, and pass through a metamorphosis similar to that of *Asterias*, though the larvæ are quite different. Some of the Holothurians are also viviparous, while others have free-swimming larvæ, but the young of most of the species of this region are still unknown.

The Acalephs all swim free in one stage or another of their existence. Some of the Hydroids, like *Sertularia* and allied genera, are only free-swimmers while in the early embryonic stages, when they are covered by vibrating cilia; but they soon become fixed and ever after remain attached in one place. Others, like the species of *Obelia*, swim free in the embryonic state, and then develop into attached hydroids, which by budding may produce large branching colonies of similar hydroids, but ultimately they produce another kind of buds, which are developed within capsules or gonothecæ. These soon become elegant, little, circular, and disk-shaped jelly-fishes, which are then discharged and swim free in the water; they soon grow larger, acquire more tentacles, and ovaries or spermaries develop along the radiating tubes, the eggs are formed, discharged, and fertilized, and each egg may develop into a ciliated embryo, which in its turn may become attached and start a new hydroid colony. Thus among these animals we find an alternation of generations, complicated by different modes of budding.

In the case of the large red jelly-fish, *Cyanea arctica*, and the common whitish jelly-fish, *Aurelia flavidula*, (Plate XXXVI, fig. 271,) the history is somewhat different. These jelly-fishes produce immense numbers of minute eggs, which are discharged into the water and develop into minute, oblong, ciliated larvæ; these soon become attached by one end and grow up into broad-disked young, like hydroids with long, slender tentacles; each of these after a time sends out stolon-like tubes from the base, and from these tubes buds are developed, each of which grows up into a "scyphostoma," or hydroid-form, like the first one; all these eventually become much elongated, then circular constrictions begin to form along the body, which grow deeper and deeper until they separate the body into a series of concave segments, which are held together by a pedicle in the middle of each, their borders at the same time becoming divided into eight lobes, or four bilobed ones; in the mean time the long tentacles around the upper end or original disk of the "scyphostoma" gradually grow shorter and are finally entirely absorbed; then the first or upper disk breaks off, and finally all the rest, one after another, until a mere stump is left at the base; after becoming detached each of the disks swims about in the water, and gradually develops its mouth, stomach, tentacles, and other organs, and, turning right side up and rapidly growing larger, eventually becomes a large and complicated jelly-fish, like its grandparents or great-grandparents that produced the egg from which the original "scyphostoma" was developed. The stump of the hydroid produces another set of tentacles, even before the separation of all the segments, and grows up again into the elongated or "strobila" form, and again undergoes the same process of transverse division, thus producing successive crops of jelly-fishes. In these cases there are alternations of generations, accompanied both by budding and fissiparity. The young of this species in the "ephyra" stage were found April 17, and at several other times during April, in abundance, by Mr. Vinal N. Edwards. These were less than a quarter of an inch in diameter, and must have become free only a short time before. On April 30 he took young specimens from half an inch to about an inch in diameter. The young of various sizes, up to nearly three inches in diameter, were common at New Haven May 5. All these young specimens were taken in the day-time.

In some jelly-fishes buds may even be produced upon the proboscis of the adult jelly-fish, which develop directly into free jelly-fishes, like the parent. This is the case with the *Dysmorphosa fulgurans*, found in these waters, and with *Lizzia grata*, found farther north.

On the other hand there are many jelly-fishes that do not have a hydroid state, nor bud, nor pass through any marked metamorphosis. This is the case with our *Pleurobrachia rhododactyla*, *Idyia roseola*, and other Ctenophoræ. In these the young, even before hatching, become perfect little jelly-fishes, and swim round and round within the egg by means of the miniature paddles or flappers along their sides. The young are, nevertheless, very different from the adults in form and structure.

It will be apparent, from the preceding remarks, that a complete list of free-swimming animals would necessarily include all the Acalephs of the region, but, as this would uselessly swell the list, only those that have been actually taken at the surface will be here included. Quite a number of the species were not observed by us, but have been recorded by Mr. A. Agassiz, but in some cases he has given neither the time nor date of capture.

A fine large specimen of the beautiful jelly-fish, *Tima formosa*, has been sent to me by Mr. V. N. Edwards, who captured it at Wood's Hole, April 30. He states that the same species was very abundant in February, 1872. It has not been previously recorded as found south of Cape Cod. The specimen received differs from the description given by Mr. A. Agassiz, in having thirty-six tentacles instead of thirty-two.

Among the most common of the larger species in summer were *Mnemiopsis Leidyi*, which occurred in abundance at nearly all hours of the day and evening, and was very phosphorescent at night; *Cyanea arctica*, which ocurred chiefly in the day-time, and was here seldom more than a foot in diameter; *Aurelia flavidula*, (Plate XXXVI, fig. 271,) which was not unfrequently seen in the day-time; *Dactylometra quinquecirra*, (Plate XXXVI, fig. 272,) which was quite common both by night and day in August and September; and *Zygodactyla Grœnlandica*, (Plate XXXVII, fig. 275,) which was common in July, both in the day and evening, but was seldom seen later in the season.

The two species last named, and also the *Cyanea arctica*, were frequently found to be accompanied by several small fishes, of different sizes up to three inches long, which proved to be young "butter-fishes," *Poronotus triacanthus*. These fishes swim beneath the broad disk of these jelly-fishes, surrounded on all sides by the numerous tentacles, which probably serve as a protection from larger fishes that are their enemies, for the tentacles of the jelly-fishes are capable of severely stinging the mouths of most fishes, evidently causing them great pain. As many as ten or twelve of these fishes were often found under a single jelly-fish, and in one case twenty-three were found under a *Cyanea* about ten inches in diameter. They do not appear to suffer at all from contact with the stinging-organs of the tentacles, and are, perhaps, protected from them by the thick coating of tenacious mucus which constantly covers the skin, and gives them their common English name. Mr. A. Agassiz states* that he constantly observed a "Clupeoid" fish under the *Dactylometra* in this region, which had essentially the same habits, according to his account, as the species observed by us, though, if a Clupeoid, it must have been a very different fish.

He says, however, that the fishes observed by him were occasionally devoured by the jelly-fish: "It is strange that the fish should go there for shelter, for every once in a while one of them pays the penalty by being swallowed, without this disturbing the others in the least; they in their turn find food in the lobes of the actinostome, and even eat the folds themselves, until their turn comes to be used as food. I have seen in this way three fishes eaten during the course of as many days.

* Catalogue of North American Acalephæ, p. 49.

The specimens measured about an inch in length." The fishes found by us were from a quarter of an inch to three inches long, and we never saw them swallowed, and never found them in the stomachs of any among the several dozen jelly-fishes, of the different kinds that we found accompanied by the fishes, although we found young squids and other kinds of marine animals in a half-digested condition. It is possible that the observation of Mr. Agassiz was made on them when kept in confinement, and that the fishes devoured were not in a perfectly healthy and natural condition, so as to resist the stings of the nettling organs. But if his fish belonged to a family different from ours, the difference may be peculiar to the respective fishes. Yet our observations afford only negative evidence, and it may be that this is one of the peculiarities of this remarkable companionship; though, if so, we should suppose that the race of *Poronotus* would soon become extinct, for we never observed the young under any other circumstances. The adult fishes of this species, when five or six inches long, were often taken in the pounds in considerable numbers.

Among the mouth-folds and lobes of the ovaries, beneath the disk of *Cyanea*, we very often found large numbers of living specimens of a delicate little jelly-fish, nearly globular in form, the *Margelis Carolinensis*, which we also frequently took in the towing-nets in the evening.

In the winter season the *Mnemiopsis Leidyi* is often abundant in Long Island Sound, and I have also observed it in New York harbor in February, in large numbers. At Wood's Hole Mr. V. N. Edwards found the *Pleurobrachia rhododactyla*, both young and nearly full-grown, very abundant in February and March; at Watch Hill, April 13, I found both adult specimens and young ones not more than an eighth of an inch in diameter. It probably occurs through the entire year, for we frequently met with it in mid-summer in Vineyard Sound. Mr. S. I. Smith also found it very abundant at Fire Island, on the south side of Long Island, in September.

In July and August we obtained several large and perfect specimens of the curious "Portuguese man-of-war," *Physalia Arethusa*. This species occurs as far west as Watch Hill, Rhode Island, where it was observed by Professor D. C. Eaton. The boatmen at that place state that it is frequent there in summer. The float of this species was generally deep, rich crimson or purple, and the hydroids beneath it were commonly bright blue in the specimens observed by us. The float or air-bag is, however, sometimes blue and sometimes rose-color.

According to Professor Agassiz, (Contributions, vol. IV, p. 335,) the floating bag in windy weather always presents the same side to the wind, and it is upon the windward side that the bunches of very long locomotive hydroids of the lower surface are situated, and these at such times are stretched out to an enormous length, and thus act as anchors to retard the motion by friction in passing through the water. The smaller locomotive hydroids, the feeding hydroids, and the reproductive hydroids, are on the lee side.

This species is capable of stinging the hands very severely if they be brought into contact with the hydroids attached to the lower surface of the floating air-bag.

The *Idyia roseola*, so abundant on the coast of New England north of Cape Cod, was only occasionally met with, and in small numbers, while the *Bolina alata*, which is one of the most abundant species on the northern coast of New England, was not seen at all. The *Aurelia flavidula* is less common than north of Cape Cod, but was found in abundance in Buzzard's Bay, in May, by V. N. Edwards.

Many of the Polyps have free-swimming, ciliated embryos, but others, like many of the sea-anemones, are viviparous, discharging the young ones through the mouth. These young are of different sizes, and furnished with a small but variable number of tentacles, but in most other respects they are similar to their parents. Mr. A. Agassiz has, however, recently ascertained that the young of a species of *Edwardsia* swims free in the water for a considerable period, or until it develops at least sixteen tentacles. In this condition it has been described as a different genus and species, (*Arachnactis brachiolata* A. AG.) Whether the other species of this genus all have free-swimming young is still uncertain; if so, these young must differ considerably among themselves, for *Edwardsia farinacea* V., of this coast, has but twelve tentacles when adult, and *E. elegans* V. has but sixteen, while others have as many as forty-eight tentacles, when full grown. Among the Protozoa there are great numbers of free-swimming forms included among those commonly known as Ciliated Infusoria, but those of our coast have been studied but little. The germs of sponges also swim free in the water, by means of cilia. Species of Polycystina would probably be found, if carefully sought for, but we have not yet met with any of them.

List of species taken at the surface of the water on the southern coast of New England.

In this list no attempt has been made to enumerate the numerous species of free Copepod Crustacea, which are very abundant, but have not been carefully studied.

ARTICULATA.

Crustacea.

Pinnotheres ostreum, males and young, (438.)
Cancer irroratus, in the zoea and megalops stages; June, July, (438.)
Platyonichus ocellatus, young and adult; megalops; June, July, (438.)
Callinectes hastatus, young, (438.)
Many other species of Brachyura in the zoea and megalops stages.
Hippa talpoida, young, 5 or 6^{mm} in length; early in September, (339.)
Eupagurus, several species in the larval stages; July to September.
Gebia affinis, young, 4^{mm} long; early in September.
Homarus Americanus, larvæ and young; July, (395.)
Crangon vulgaris, larvæ and young; June and July.

Virbius zostericola, larvæ and young ; July to September.
Palæmonetes vulgaris, larvæ and young ; July to September.
Larval forms and young of other species of Macroura.
Squilla empusa, larvæ in different stages ; August, (439.)
Mysis Americana, young and adult; April, May, (396.)
Heteromysis formosa, young and adult.
Thysanopoda, sp. Vineyard Sound; April 30, (V. N. Edwards.)
Cumacea, several species.
Lysianassinæ, several species, young and adult.
Urothoë, sp.
Monoculodes, sp.
Calliopius læviusculus, adult and young; summer and winter, (439.)
Pontogeneia inermis, full grown ; winter.
Gammarus natator, adult and young; summer and winter, (439.)
Mœra levis.
Ampelisca, sp., young.
Amphithoë maculata, young.
A. longimana, young even 5 or 6^{mm} long.
Hyperia, species; summer, (439.)
Phronima, sp.; September 8, (439.)
Idotea irrorata, (439.)
I. robusta, (439.)
I. phosphorea.
Erichsonia filiformis.
Epelys trilobus.
Tanais filum.
Sapphirina, sp.; September, (439.)
Free Copepods of many genera and numerous species.
Argulus laticauda; August, (439.)
A. latus; July.
A. megalops; September 8.
Caligus rapax; September 8, (439.)
Balanus balanoides, larvæ; April, May, June, (304.)
Lepas fascicularis; June and July, in Vineyard Sound, (382.)
Limulus Polyphemus, young, (340.)

Worms.

Phyllodoce, sp., adult; July 3; evening.
Phyllodoce, sp., young; evening.
Eulalia, sp., young; September 3; evening.
Eulalia, sp., young; evening.
Eumidia, sp., young; September 8; evening.
Eteone, sp., young; evening.
Autolytus cornutus, male, female, and asexual forms; July 29 to August 18; evening. Watch Hill; April 13, asexual form, (440.)
Autolytus, sp., asexual individuals, (398.)

Gattiola, sp., young; September 3; evening.
Syllis (?), sp., young; September 3; evening.
Rhynchobolus Americanus, young; September 3; evening.
Nereis virens, adult males; April; day-time, (440.)
N. limbata, adult males filled with milt, September 3, evening; September 5, at Fire Island, day. Females, September 3, (few;) young, common, August, September, evening, (440.)
N. pelagica, young; August, September; evening.
Nectonereis megalops; July 3, 11; September 3, 8; evening, (440.)
Podarke obscura, adult; June 26 to August; evening, (440.)
Spio setosa, young; evening.
Scolecolepis viridis, young; evening.
Polydora ciliatum, young; September 3; evening.
Nicolea simplex, young; August, September; evening.
Amphitrite ornata, young; evening.
Lepræa rubra, young; evening.
Polycirrus eximius, young; August, September; evening.
Spirorbis, sp., young; evening.
Tomopteris, sp., young; evening.
Sagitta elegans, adult; July 1, September 8; day-time, (440.)
Sagitta, sp., adult and young; January 30 to May 5; day, (440.)
Balanoglossus aurantiacus; larvæ in the "tornaria" state, (351.)
Meckelia ingens; specimens up to ten inches long; evening, (349.)
Pontonema marinum, adult; February; day-time.
Several other small Nematodes with the last.
Slender round worm, up to six inches long; June 29, July 13; evening.
Young of many other worms; undetermined.

MOLLUSCA.

Cephalopods.

Ommastrephes illecebrosa, adult; July, August, (441.)
Loligo Pealii; June to September; young, July, August, (440.)
L. pallida, adult; October, November, (441.)

Pteropods.

Clione papilionacea, adult; April 13, April 30, (444.)
Styliola vitrea, adult; September 8; day-time, (443.)
Spirialis Gouldii, adult; August; evening, (443.)
Diacria trispinosa, (444.)
Cavolina tridentata, (444.)

Lamellibranchs.

Teredo navalis, larvæ; May, June, (386.)
Mytilus edulis, larvæ; April, (308.)
Ostræa Virginiana, larvæ; June, July, (310.)
Larvæ of many other species, undetermined.

Ascidians.

Salpa Cabotti, adults and young; August and September, (445.)
Doliolum, sp.; summer, (A. AGASSIZ,) (446.)
Appendicularia, sp., (like A. furcata;) summer, (A. AGASSIZ,) (446.)
Appendicularia, sp., (like A. longicauda;) summer, (A. AGASSIZ.)
Larvæ of fixed Ascidians, (445.)

RADIATA.

Echinoderms.

Strongylocentrotus Dröbachiensis, larvæ, (447.)
Asterias arenicola, larvæ; evening, (447.)
A. vulgaris, larvæ; evening, (447.)

Acalephs.

Mnemiopsis Leidyi; February, July to September; day-time, (449.)

Lesueuria hyboptera, adult; September; day-time.

Pleurobrachia rhododactyla, adult and young; January to May, July to September; day-time and evening, (448.)

Idyia roseola, adult; September; day-time, (451.)

Cyanea arctica, adult; August, September; day-time. Young in the "ephyra" stages; April; young of all sizes up to four inches across; May, (449.)

Aurelia flavidula; August, September; day-time, young; May, (449.)

Dactylometra quinquecirra, adult and young; July to September; day and evening, (449.)

Trachynema digitale, young; Wood's Hole, July 1; day-time.

Tiaropsis diademata; Wood's Hole; April 17, (V. N. Edwards.)

Oceania languida, medusæ; June to September; day-time.

Eucheilota ventricularis, young medusæ; evening.

E. duodecimalis, medusa; July.

Obelia, several species, medusæ; evening chiefly, (447.)

Rhegmatodes tenuis, medusæ; September; evening.

Zygodactyla Grœnlandica, medusæ; June to September; day and evening, (449.)

Æquorea albida, medusæ; September; evening.

Tima formosa, adult; February, 1872; April 30, 1873, (449.)

Eutima limpida, medusæ; September; evening.

Lafoëa calcarata, medusæ; September; evening.

Nemopsis Bachei, medusæ; June to September; evening.

Bougainvillia superciliaris, medusæ, April, May, June; evening.

Margelis Carolinensis, medusæ; August and September, chiefly in the evening, (450.)

Dysmorphosa fulgurans, medusæ; evening, (448.)

Modeeria, sp., medusæ.

Turritopsis nutricula, medusæ; July to September; evening.

Stomotoca apicata, medusæ.
Willia ornata, young medusæ; last of September.
Dipurnea conica, medusæ; July; evening.
Gemmaria gemmosa, medusæ; evening.
Pennaria tiarella, medusæ; August, September.
Ectopleura ochracea, medusæ; September.
Nanomia cara, August, September; evening.
Physalia Arethusa, July to September; day, (450.)
Velella mutica, August; day.

Polyps.

Edwardsia, sp., larvæ in the "Arachnactis" stage; September; evening, (451.)

PROTOZOA.

Numerous kinds of ciliated infusoria, (451.)

List of species taken at the surface in winter, December to March.

Crustacea.

Crangon vulgaris, young.
Mysis Americana.
Anonyx, (?,) sp.
Calliopius læviusculus, (439.)
Pontogeneia inermis.
Gammarus natator.
Monoculodes, sp.
Several species and genera of Copepods, very abundant.
Larvæ of Balanus, December 21, January 7 and 8.

Annelids, &c.

Nereis virens, adult males.
Sagitta, sp., adult, abundant, (440.)
Pontonema marinum, adult.
Other Nematodes, undetermined.

Acalephs.

Pleurobrachia rhododactyla, young and adult, abundant, (450.)
Mnemiopsis Leidyi, adult, abundant, (450.)
Cyanea arctica, young; March.
Tima formosa, adult, (449.)

II. 10.—ANIMALS PARASITIC ON FISHES, ETC.

Large numbers of fishes were examined, both internally and externally, for parasites, and a large collection of such parasites was made. The internal parasites were collected mainly by Dr. Edward Palmer, and will be of great interest when carefully studied and described. As yet, nothing more than a casual examination of them has been made. These internal parasites were found in nearly all kinds of fishes, chiefly in the stomach and intestines, but also very frequently in the flesh, or among the abdominal viscera, or in the air-bladder, or even in the eyes, &c. The internal parasites were mostly worms, but these belong to four very distinct orders.

1st. The "round-worms," *Nematodes.*

These are related to the round-worms so frequent in the intestines of children, and also to the notorious *Trichina* of man and the hog. One or more species are found in the intestine and stomach of nearly every kind of fish, and frequently, also, in the liver, peritoneum, eyes, and various other organs. One species, two or three inches long, is very frequently found coiled up spirally in the flesh of the cod. Another large species is frequently found in the flesh of the tom-cod, or frost-fish. Although these are not dangerous to man, they are very disagreeable when found in fish intended for food.

A species belonging to this group is very frequently found in the body-cavity of one of our species of *Sagitta* (see page 440).

2d. The flat-worms or "flukes," *Trematodes.*

These are short, more or less broad, depressed worms, which are provided with one, two, or more suckers, for adhering firmly to the membranes. They pass through very remarkable transformations, as do most of the other parasitic worms. Species belonging to this group are common in the stomach, œsophagus, and intestine, and also encysted or in follicles in the mouth, liver, peritoneum, and various other parts of the body.

3d. The thorn-headed worms, *Acanthocephala.*

These have an elongated roundish body, with a proboscis at the anterior end, covered with hooks, or recurved spines. The proboscis and front end of the body can be withdrawn and thrust out at pleasure. Such worms are very common in the stomachs and intestines of fishes, and are, perhaps, the worst parasites that torment them. The young of these worms also occur quite frequently, encysted in the liver, peritoneum, throat, mouth, and other organs.

4th. The "tape-worms," or *Cestodes.*

These are long flat worms, divided into many distinct segments, and are very frequently found in the intestines of most fishes. There are numerous species of them, ranging in size from less than an inch to many feet in length.

Although parasitic worms are found in nearly all kinds of fishes, they are most frequent and in the greatest variety in the large and very voracious kinds, such as sharks, rays, the angler or goose-fish, salmon, blue fish, cod, haddock, &c.

Nor are other marine animals free from these internal parasites. Certain species have been found in crustacea, others in mollusks, &c. Mr. A. Agassiz has briefly described, but not named, a remarkable worm that he found very common in the jelly-fish, *Mnemiopsis Leidyi*, and the young of this or a different species was observed by me in the same Acaleph. It appeared to be a species of *Scolex*. It was pale purple, with light yellowish orange stripes. I have previously mentioned a round worm (*Ascaris?*) which frequently occurs in winter in one of our species of *Sagitta*.

Most of the species that, in the adult state, inhabit fishes, live while young, or in the larval stages, in smaller fishes, or in other animals, upon which the larger fishes feed, and from which they thus derive their parasites.

Besides the parasitic worms there are also many internal parasites that belong to the Protozoa.

The *external* parasites of fishes are also numerous. They are chiefly crustacea and leeches.

Among the Crustacea there are a few species of Amphipods that are parasitic. One of these, *Laphystius sturionis*, lives upon the gills of fishes and upon the surface of the body. It was found on the gills of the "goose-fish," (*Lophius*,) in Vineyard Sound, and on the back of skates at Eastport. It is remarkable in having large claws developed on the third and fourth pairs of legs, those of the first and second being small. Its color is light red.

Certain Isopod crustacea, belonging to the genus *Livoneca* (Plate VI fig. 29) and allied genera, live in the mouths and on the gills of fishes, clinging firmly to the membrane of the roof of the mouth, or other parts, by means of their strong sharp claws. These are generally unsymmetrical in form. The species of the genus *Bopyrus* live on the gills, under the carapax of shrimp and other crustacea, producing large tumors. A species is common on species of *Hippolyte* in the Bay of Fundy; and a species has been found in this region. The genus *Cepon* is allied to the last, and our species occurs under the carapax of the "fiddler-crabs" in this region.

Among the Entomostraca the number of parasitic species is still greater, but most of these live on the external surface and gills of fishes, though some of them occur also in the mouth. The species of *Pandarus* and allied genera adhere firmly to the skin, and are provided with a proboscis. They are very common on sharks, but occur also on other fishes. A *Pandari* (te VII, fig. 31) and *Nogagus Latreillii* (Plate VII, fig. 32) were both found on "Atwood's shark," the "man-eater" of this region, associated also with *Nogagus tenax*. The species of "*Nogagus*" are merely the males of other genera, for no one has yet determined both males and females of the various species. The young of one species, *Caligus rapax*, were found swimming free at the surface.

The species of *Argulus* and allied genera are less strictly parasitic, or rather they adhere less closely, and apparently leave the fishes at pleasure and migrate from one to another. Three species belonging to this group were taken at the surface with the towing-nets. The Lerneans are remarkable creatures. The females are generally very curious in form and very much larger than the more active and less abnormal males, and they are very low in structure, the reproductive system being enormously developed at the expense of nearly all the other organs. They live upon the exterior and gills of fishes, with the head deeply buried in the flesh, and subsist by sucking the blood of their victims. The *Lernæonema radiatum* (Plate VII, fig. 30) is very common on the menhaden, and is also found on the alewives.

There are many kinds of parasitic leeches. One of the most remarkable is the *Branchiobdella Ravenelii*, (Plate XVIII, fig. 89.) This genus is peculiar in having broad, foliaceous, lobed or scolloped gills along the sides of the body. The large species figured was found several times on the large "sting-rays," several of them usually occurring together, on a large spot which had become sore and much inflamed by their repeated bites. It is a very active species.

The *Cystobranchus vividus* is a much smaller and quite slender leech, which has small, papilliform, whitish gills that alternately contract and expand along the sides of the body, each surrounded by a semicircular white spot. The colors are brownish or purplish, with three rows of small white spots on the back. This species is frequent on the common minnow, (*Fundulus pisculentus*,) in autumn and winter, and lives both in brackish water and fresh water. With the last, on the minnows, is found another slender leech, destitute of gills; this is the *Ichthyobdella Funduli*. It has, like the last, four ocelli. The color is pale green with darker green and brown specks, often with whitish transverse bands anteriorly, and a white ring behind the head, at the constriction; sometimes there is a narrow pale dorsal line.

A long, slender, sub-cylindrical leech, the *Pontobdella rapax* V., (Plate XVIII, fig. 91,) is quite common on the upper side of the "summer-flounder," (*Chænopsetta ocellaris*.) It is a very active species, dark olive or brown in color, with a row of square or oblong whitish spots along each side; the suckers are pale greenish white. The young are reddish brown, without spots.

A species of *Pontobdella* was found adhering to *Mysis Americana*, near New Haven, May 5, in three instances, but whether this be its normal habit is uncertain.

The *Malacobdella obesa* V. (Plate XVIII, fig. 90) is a large, stout, yellowish white leech, often two inches long, which is quite common in the branchial cavity of the "long clam," (*Mya arenaria*.)

The *Malacobdella mercenaria* V. is another similar species, but smaller and more slender, which lives in the same way in the "round clam" (*Venus mercenaria*.)

The *Myzobdella lugubris* is a small leech, which lives on the "edible crab" (*Callinectes hastatus*,) adhering to the soft membranes between the joints and at the base of the legs.

List of external parasites observed on fishes and other marine animals of Southern New England.

In the following list I have included all the determined species observed in these waters, whether living in the sounds, or in the outer waters, or in the brackish waters of the estuaries, for most of these parasitic species are capable of living in as diverse conditions as do the animals which they infest, and most of the fishes pass from time to time into each of the divisions named, though some, like the cod, are chiefly found in the colder outer waters, and even there only in winter.

The list is undoubtedly very incomplete for it is based chiefly on collections made during two seasons, and mainly in the summer months. In addition to the true parasites I have, for greater convenience, included in the list some that merely live on or with other animals, either for the sake of shelter, or to feed upon their excretions, or to share their food. Some of these would be properly classed as "commensals."

ARTICULATA.

Crustacea.

Pinnotheres ostreum, (p. 367,) in oysters.
P. maculatus, in Mytilus edulis.
Laphystius sturionis, on goose-fish and skate, (457.)
Hyperia, species, on jelly-fishes, (439.)
Nerocila munda, on file-fish.
Conilera concharum.
Livoneca ovalis, on blue-fish, (457.)
Cepon distortus, in branchial cavity of Gelasimus, (457.)
Ergasilus labraces, on striped-bass.
Argulus catostomi, on the sucker, (Catostomus.)
A. laticauda, (457.)
A. latus.
A. megalops.
A. alosæ, on "alewives."
Caligus curtus, on cod-fish.
C. rapax, on sting-ray, (Trygon hastata.)
Lepeophtheirus, sp., on sting-ray.
Lepeophtheirus, sp., on flounder, (Chænopsetta ocellaris.)
Echthrogalus coleoptratus, on mackerel-shark, (Lamna punctata.)
E. denticulatus, on Atwood's shark, (Carcharodon Atwoodi.)
Pandarus Cranchii, (?) on dusky shark, (Platypodon obscurus.)
Pandarus, sp., on Atwood's shark, (Carcharodon Atwoodi.)
Nogagus Latreillii, on Atwood's shark, (457.)
N. tenax, on Atwood's shark, (457.)
Pandarus sinuatus, on the "dog-fish," (Mustelus canis.)
Cecrops Latreillii, on Othagoriscus mola.

Anthosoma crassum, on mackerel-shark.
Lernæa branchialis, on cod-fish.
Penella plumosa, on Diodon pilosus and Rhombus, sp.
Anchorella uncinata, on cod-fish.
Lernæonema radiatum, on menhaden, (458.)
Lernæonema, sp., on a species of Carangus.
Coronula diadema, on whales.

Leeches.

Branchiobdella Ravenelii, on sting-rays; August, September, (458.)
Cystobranchus vividus, on minnows; October to December 18, (458.)
Ichthyobdella Funduli, on minnows; with last, (458.)
Ichthyobdella, sp., dredged off New London, April.
Pontobdella rapax, on flounders, (458.)
Malacobdella obesa, in long clams, (458.)
M. mercenaria, in round clams, (458.)
Myzobdella lugubris, on the edible crab, (458.)
Bdelloura candida, on gills of *Limulus.*

MOLLUSCA.

Gastropods.

Stylifer Stimpsonii, on the green sea-urchin.
Eulima oleacea, on *Thyone Briareus*, (418.)

III.—Fauna of the estuaries, harbors, ponds, and marshes.

The region about Vineyard Sound and Buzzard's Bay, like that of the entire southern coast of New England and the coast farther south, is characterized by large numbers of ponds, lagoons, and estuaries, having a more or less interrupted communication with the sea. These are usually quite shallow, though often of great extent. The bottom is generally muddy, with occasional patches of sand, but at the surface usually consists largely of decaying vegetable and animal *débris* mixed with mud.

The "eel-grass" (*Zostera marina*) grows in the shallower waters in great quantities, sometimes in small scattered patches, at other times covering large areas. Some of these ponds and estuaries receive considerable, though variable, quantities of fresh water from streams flowing into them, while others receive but little, except the surface drainage of the land immediately around them; but in most of them the fresh water is in sufficient quantities to give a "brackish" character to the waters. Owing to the narrow and often shallow channels by which the ponds communicate with the open waters, the tide is usually irregular, and its rise and fall often much less than outside, so that the waters have little tidal motion. The shallowness of the water and the abundant eel-grass also impede the motion caused by the wind, so that these bodies of water are comparatively quiet under ordinary circumstances. The same causes allow the water to become highly heated during the summer. It is evident that the heat and quietness of the waters are unfavorable for the rapid absorbtion of oxygen from the air, while by the rapid decay of the dead materials of the bottom large quantities of carbonic acid and other gases must be evolved, which would in some cases soon render the water fatal to all animal life, were it not for the presence of the eel-grass, *Ulva*, and other plants that flourish in such waters, which, while absorbing the excess of carbonic acid, also help to give the requisite amount of oxygen to the water. During storms the mud of the bottom is quickly disturbed, causing the escape of noxious gases, and rendering the water turbid, while the eel-grass is torn up in large quantities, thus adding to the decaying materials of the bottom and shores. Moreover, in case of rain-storms or spring-freshets, the sudden addition of large volumes of fresh water often causes great changes in the density and character of the water, sufficient to kill species not adapted to such varying and peculiar conditions.

We accordingly find that although animal life is usually very abundant, the number of species that habitually live and prosper in these impure and decidedly brackish waters is comparatively small. But such as do occur are usually found in great quantities, and are remarkable for their hardiness and ability to live under widely varying conditions. Many of them are strictly southern species, which do not extend much farther north; but there are some, like the long clam, muscle, &c., which extend even to the Arctic Ocean and the coasts of Europe.

Many of the estuaries and harbors, and some of the ponds, have a much freer communication with the sea, and then the water is less brackish and generally less impure in other respects, and the number of species of animals becomes much greater. In other cases the water is so little brackish that the fauna is nearly identical with that of the outer bays. A few of these species are almost restricted to the brackish waters, but by far the greater number are able to live in pure sea-water, and are accordingly also found in the bays and sounds. There are various degrees of preference shown by the different species; some are very abundant in the brackish waters and very seldom found outside; some evidently prefer the estuaries but are also abundant in the sounds; some flourish equally well in both situations; many are common in the estuaries but much more abundant in the pure waters of the sounds; and a large number which are occasionally found in the brackish waters, especially where but little freshened, have their proper homes in the pure waters outside.

Most of our food-fishes frequent the ponds and estuaries, either for the sake of food or for the purpose of spawning, and many spend the earlier part of their lives entirely in such waters. It is apparent, therefore, that among the few species of invertebrate animals living in the brackish waters, there are some that are of great importance as food for fishes. It is true that many of the larger fishes frequent the estuaries to prey upon smaller ones, some of which are extremely abundant in these waters. But the small fishes, like minnows, as well as the young of the larger ones, feed chiefly upon the small crustacea, worms, and shells that live in the waters that they inhabit. Therefore the entire value of the estuaries as feeding-grounds for the larger fishes depends directly upon those species of crustacea, &c., that naturally live in brackish water.

In discussing the fauna of the estuaries I have found it most convenient to group the species under the following divisions: 1. Those of sandy shores and bottoms. 2. Those of muddy shores and bottoms. 3. Those inhabiting oyster-beds. 4. Those inhabiting the eel-grass. 5. Those attached to rocks, piles of wharves, floating timber, buoys, &c.

The lists could be greatly extended by including all the species to be found near the mouths of estuaries, or in those harbors and ponds that are scarcely brackish, for in these localities the fauna is nearly identical with that of the bays and sounds, and the lists already given on previous pages will also apply very well to such places.

As a general rule only those species that are abundant, or at least frequent, in waters distinctly brackish, have been included in the lists.

III, 1.—ANIMALS INHABITING THE SANDY SHORES AND BOTTOMS OF BRACKISH WATERS.

Sandy shores and bottoms are generally less common and less extensive than muddy ones, and occur chiefly toward the mouths of estuaries, or on the more exposed borders of the larger ponds and harbors, where the wave-action is greatest.

When such bottoms are covered with eel-grass, as often happens, the animals are quite numerous, but when destitute of vegetation the species of animals are but few, and mostly of the kinds that burrow. But when there is a mixture of mud with the sand the variety is much greater.

Near high-water mark, colonies of the "sand-fiddler," *Gelasimus pugilator*, (p. 336,) often occur, as on the sandy beaches outside. In the same situations the beach-fleas, *Talorchestia longicornis* and *T. megalophthalma* (p. 336,) also occur, burrowing in the sand; while the *Orchestia agilis* SMITH is abundant under the vegetable *débris* at high-water mark.

Several species of salt-water insects also occur, burrowing in the sandy beaches at and below high-water mark. Among these are several beetles, which live in such situations, both in the larval and adult conditions. The *Bledius cordatus* is one of the most abundant of these. This is a small, dark-colored, "rover-beetle," with very short elytra. It makes small, perpendicular holes in the sand near high-water mark, throwing up a little mound of sand around the burrows. A larger species, *Bledius pallipennis*, occurs lower down, at about half-tide mark and makes similar burrows, but they are larger and deeper. This species is yellowish brown in color. The larva of a fly belonging to the Muscidæ, and growing to the length of three-quarters of an inch, occurs beneath the sand at low-water mark, and was also dredged off-shore in three or four fathoms of water.

In the shallow waters and on the flats the common shrimp, *Crangon vulgaris*, (p. 339, Plate III, fig. 10,) is always to be found in abundance where the water is not too much freshened by the rivers. The prawn, *Palæmonetes vulgaris*, (p. 339, Plate II, fig. 9,) is also frequent on the sandy bottoms, though more abundant among the eel-grass, and this species extends far up the estuaries into the mouths of rivers, where the water is but little salt.

The most abundant Annelids are *Nereis virens*, (Plate XI, figs. 47–50,) *N. limbata*, (Plate XI, fig. 51,) *Rhynchobolus dibranchiatus*, (Plate X, figs 43, 44,) *R. Americanus*, (Plate X, figs. 45, 46,) and *Scolecolepis viridis* V., (p. 345,) all of which burrow in the sand at low-water mark in the same way as on the shores of the sounds.

Under vegetable *débris* and stones, at high-water mark, the *Halodrillus littoralis* (p. 324) and *Clitellio irroratus* (p. 324) occur in abundance. The *Lumbriculus tenuis* burrows among the roots of grass at high-water mark.

The most abundant Gastropod shells are *Ilyanassa obsoleta*, (Plate XXI, fig. 13,) *Tritia trivittata*, (Plate XXI, fig. 112,) *Bittium nigrum*, (Plate XXIV, fig. 154,) *Astyris lunata*, (Plate XXI, fig. 110,) which occur on the flats and on the bottom in shallow water, but all are more common among eel-grass. The *Melampus bidentatus* (Plate XXV, figs. 169, 169*a*) is very abundant among the grass and weeds at and just above high-water mark. It contributes largely to the food of the minnows and other small fishes, as well as to that of many aquatic birds. The *Crepidula convexa* (Plate XXIII, fig. 128) is frequent on the dead shells occupied by the small hermit-crab, *Eupagurus longicarpus*, (p. 313,) which is abundant, running over the bottom in shallow water.

The most abundant bivalves are the long clam, *Mya arenaria*, (Plate XXVI, fig. 179,) and *Macoma fusca*, (Plate XXX, fig. 222.) These both occur burrowing in the sand between tides, and both occur far up the estuaries, where the water is very brackish, but they are most abundant where there is a mixture of sand and mud. In the estuaries the long clam is extremely abundant all along the coast from New Jersey to the Arctic Ocean, as well as on all the northern coasts of Europe It also occurs south of Cape Hatteras, as at Beaufort, North Carolina, but in greatly diminished numbers. North of New York it is very extensively used as an article of food. North of Cape Cod it is the common "clam" of the fishermen; and north of Boston it almost entirely displaces, in the markets, the "round-clam," or "quahog," *Venus mercenaria*, which is the common clam at New York and farther south. Along the southern coast of New England both species are abundant, and both are sold in large quantities in the markets. South of New

York the long clam is but little sought as an article of food, except for local use. On the coast of New Jersey it is often called the "maninose clam," from the Indian name (frequently corrupted to "nanny-nose.") It is also sometimes called the "soft-shelled clam," in distinction from the "quahog," which is called "hard-shelled." The "long clams" of certain localities on Long Island Sound, as, for instance, those from Guilford, Connecticut, are of very excellent quality, and are very highly esteemed.

The Guilford clams are assorted into regular sizes, and are bought from the fishermen on the spot by the hundred. Those of large size bring about $3 per hundred; these are retailed in the market at New Haven for 60 cents per dozen. Smaller sizes bring 48 cents and 36 cents per dozen. During unusually low tides in winter clams of extraordinary size are obtained at Guilford, below the zone ordinarily uncovered by the tide; these often weigh a pound or more, and sell for about $1.25 per dozen; occasionally the weight is as much as a pound and a half, and the shells become six or eight inches in length.

The ordinary long clams of small and moderate sizes bring 95 cents, $1.25, and $2 per bushel at wholesale; these retail in our markets at 50 cents to 75 cents per peck, the smallest sizes being cheapest, while the reverse is the case with the round clams.

In New Haven the long clams are chiefly sold in winter, being "out of season" in summer, when the round clams supply the markets. But in New York the long clams are sold during the whole year.

Large quantities of these clams are also collected on the northern coasts of New England and put up for bait, to be used in the cod-fishery at the banks of Newfoundland.

The total amount collected and used annually is probably not less than 1,000,000 bushels.

List of species inhabiting sandy shores and bottoms of estuaries.

ARTICULATA.

Insects.

	Page.		Page.
Larvæ of fly, (Muscidæ)....	463	Bledius cordatus	462
Ephydra, sp., larvæ	466	B. pallipennis.............	462
Cicindela, larvæ...........	335	Heterocera undatus	335
Bembidium constrictum....		Phaleria testacea..........	
B. contractum		Anurida maritima.........	331
Phytosus littoralis.........	335		

Crustacea.

	Page.		Page.
Gelasimus pugilator.......	462	Orchestia agilis	462
Cancer irroratus...........	312	Talorchestia longicornis....	462
Carcinus granulatus.......	312	T. megalophthalma........	462
Eupagurus longicarpus	463	Epelys trilobus............	370
Palæmonetes vulgaris......	463	Limulus Polyphemus	340
Crangon vulgaris..........	463		

Annelids.

	Page.
Nereis virens	463
N. limbata	463
Rhynchobolus Americanus	463
R. dibranchiatus	463
Spio robustus	345
Scolecolepis viridis	463
S. tenuis	345
Clymenella torquata	343
Cistenides Gouldii	323
Sabellaria vulgaris	321
Lumbriculus tenuis	463
Clitellio irroratus	463
Halodrillus littoralis	463

Nemerteans.

	Page.
Meckelia ingens	349
Meckelia rosea	350

MOLLUSCA.

Gastropods.

	Page.
Ilyanassa obsoleta	463
Tritia trivittata	463
Eupleura caudata	371
Astyris lunata	463
Odostomia trifida	307
Bittium nigrum	463
Crepidula convexa	463
Melampus bidentatus	463

Lamellibranchs.

	Page.
Mya arenaria	463
Macoma fusca	463
Angulus tener	358
Tottenia gemma	359
Venus mercenaria	463
Lævicardium Mortoni	358
Solenomya velum	360
Mytilus edulis	307
Modiola plicatula	307
Pecten irradians	361

III. 2.—ANIMALS INHABITING THE MUDDY SHORES AND BOTTOMS OF BRACKISH WATERS.

The bottoms of the sheltered estuaries, ponds, and harbors, are almost invariably muddy, throughout the greater part of their extent, from low-water mark to their greatest depths, or, in other words, wherever the waves do not act with considerable force. The shores between tides are also muddy in the more protected localities, where the waves do not have sufficient power to remove the fine sediments. The upper and narrower parts of nearly all the estuaries in this region are, on this account, muddy, for the rapidity of the tide is seldom sufficient to entirely remove the fine sediments brought down by the streams.

A large part of the muddy bottoms is generally covered in summer by extensive patches of eel-grass. Over other portions large beds of oysters are always planted, thus greatly modifying the natural conditions of such localities and introducing a large number of species not properly belonging to the true muddy bottoms.

The shores of the muddy estuaries and ponds, or lagoons, are usually low, flat, and bordered by more or less extensive salt-marshes, with the surface generally just above high-water mark of ordinary tides, but liable to inundation by unusually high tides. These marshes are always traversed by winding and sluggish tidal streams of brackish water and by smaller ditches, and the surface is often diversified by small pools or ponds of impure brackish water, in which there is generally a deep deposit of soft, slimy mud and decaying organic matter, which often becomes putrid, and exhales fetid gases. All such waters, whether in the ditches or pools, and however filthy they may be, are inhabited by certain kinds of invertebrate animals, and they are also frequented by multitudes of minnows and other small fishes, which undoubtedly find abundant food in such places.

In these brackish pools and ditches we find certain beetles, both in the adult and larval stages. Among these the most conspicuous is *Hydrophilus quadristriatus* HORN.; a large, black species, which appears to be common. The larva of the salt-marsh musquito (*Culex*, sp.,) also lives in such situations, and the adults in August, September, and October, so swarm in these marshes as to render it extremely unpleasant to go on or near them. The larvæ of an *Ephydra* also occurs, and many other insects will doubtless be found in these places when carefully sought for.

One Amphipod, the *Gammarus mucronatus*, commonly lives in the most brackish pools and among the grass on the marshes. The prawn, *Palæmonetes vulgaris*, (Plate II, fig. 9,) is also very abundant in these pools and ditches, even where the water is but little salt, and also occurs in immense numbers on the muddy bottoms and among the eel-grass of the estuaries. In the pools there are also myriads of small Entomostraca of many kinds, upon which the prawn and other species feed, while the Entomostraca find an abundance of ciliated Infusoria and other microscopic animals for food.

We find several species of crabs burrowing in muddy banks along the shores of the estuaries, as well as along banks of the streams and ditches in the salt-marshes. The most abundant of these is the marsh fiddler-crab, *Gelasimus pugnax*, which is often so abundant that the banks are completely honey-combed and undermined by them. These holes are of various sizes up to about three-quarters of an inch in diameter, and descend more or less perpendicularly, often to the depth of two feet or more. Occasionally in summer these crabs will leave their holes and scatter over the surface of the marshes, which at such times seem to be perfectly alive with them, but when disturbed they will scamper away in every direction and speedily retreat to their holes, but occasionally, at least, they do not find their own, for sometimes the rightful owner will be seen forcibly ejecting several intruders. It is probable that at such times of general retreat each one gets into the first hole that he can find. Associated with this "fiddler" another related crab, the *Sesarma reticulata*, is occasionally found in considerable numbers. This is a stout-looking, reddish brown crab, with a squarish carapax; its large claws are stout and nearly equal in both sexes, instead of being very unequal, as in the male "fiddlers." It lives in holes like the "fiddlers," but its holes are usually much larger, often an inch or an inch and a half in diameter. It is much less active than the "fiddlers," but can pinch very powerfully with its large claws, which are always promptly used when an opportunity occurs.

The *Carcinus granulatus* (p. 312) of large size may often be found concealed in the cavities under the banks undermined by the two preceding species, along the ditches and streams in the salt-marshes. On the marshes farther up the estuaries, and along the mouths of rivers and brooks, and extending up even to places where the water is quite fresh, another and much larger species of "fiddler-crab" occurs, often in abundance; this is the *Gelasimus minax.* It can be easily distinguished by its much larger size and by having a patch of red at the joints of the legs. Its habits have been carefully studied by Mr. T. M. Prudden of New Haven, but his interesting account of them has not yet been published. He has also investigated its anatomy. According to Mr. Prudden this species, like *G. pugilator*, (see p. 336,) is a vegetarian. He often saw it engaged in scraping up and eating a minute green algoid plant, which covers the surface of the mud. The male uses its small claw exclusively in obtaining its food and conveying it to the mouth. The female uses either of her small ones indifferently. In enlarging its burrows Mr. Prudden observed that these crabs scraped off the mud from the inside of the burrow by means of the claws of the ambulatory legs, and having formed the mud into a pellet, pushed it up out of the hole by means of the elbow-like joint at the base of the great claw, when this is folded down. He also ascertained that this crab often constructs a regular oven-like arch of mud over the mouth of its burrow. This arch-way is horizontal, and large and long enough to contain the crab, who quietly sits in this curious door-way on the lookout for his enemies of all kinds.

This species can live out of water and without food for many days. It can also live in perfectly fresh water. One large male was kept in my laboratory in a glass jar containing nothing but a little siliceous sand, moistened with pure fresh water, for over six months. During this whole period he seemed to be constantly in motion, walking round and round the jar and trying to climb out. He was never observed to rest or appear tired, and after months of confinement and starvation was just as pugnacious as ever.

Although some of the colonies of this species live nearly or quite up to fresh water, others are found farther down on the marshes, where the water is quite brackish, and thus there is a middle ground where this and *G. pugnax* occur together. This was found by Mr. Prudden to be the case, both on the marshes bordering West River and on those of Mill River near New Haven. They are abundant along both these streams. The holes made by this species are much larger than those of *G. pugnax*. Some of them are an inch and a half to two inches in diameter.

The "blue crab" or common edible crab, *Callinectes hastatus*, (p. 367,) frequents the brackish streams and estuaries, where it is often taken in large quantities for the markets. These are usually brought to market early in May, but the "soft-shelled" ones, which are more highly esteemed, are taken later. These soft-shelled individuals are merely those that have recently shed their old shells, while the new shell has not had time to harden. The period of shedding seems to be irregular and long continued, for soft-shelled crabs are taken nearly all summer. The young and half-grown specimens of this crab may often be found in considerable numbers hiding in the holes and hollows beneath the banks during the flood-tide. When disturbed, they swim away quietly into deeper water. These small crabs are devoured by many of the larger fishes. During flood-tide the large crabs swim up the streams like many fishes, and retreat again with the ebb. They feed largely on fishes, and often do much damage by eating fishes caught in set-nets, frequently making large holes in the nets at the same time.

The "mud-crabs," *Panopeus Sayi* (p. 312) and *P. depressus*, (Plate I, fig. 3,) are very common in all the muddy estuaries and harbors. *P. Harrisii* also occurs in similar places; it is far less common, and apparently usually lives higher up toward high-water mark, under stones, &c., but it has been found on the salt-marshes at the mouth of Charles River, according to Dr. A. A. Gould.

The *Orchestia palustris* SMITH, is found on the salt-marshes, where it occurs under drift-wood, vegetable *débris*, &c., extending its range nearly or quite up to fresh water, and at times living in places that are almost dry, above high-water mark.

The *Squilla empusa* (p. 369) burrows in muddy shores and bottoms at or below low-water mark.

The *Gebia affinis* (p. 368, Plate II, fig. 7) also lives in similar places in deep burrows, as described on a previous page.

The "horseshoe-crab," *Limulus Polyphemus* (p. 340,) is also a common inhabitant of muddy bottoms, in estuaries, where it grows to great size.

The most common Annelids are partly the same as those given above for the sandy shores. The *Nereis virens* is generally very abundant; the two species of *Rhynchobolus* are common; and also *Lumbriconereis opalina*, (Plate XIII, figs. 69, 70;) *Cirratulus grandis*, (Plate XV, figs. 80, 81;) *Polycirrus eximius*, (p. 320, Plate XVI, fig. 85;) *Chætobranchus sanguineus*, (p. 320;) and several other less conspicuous species.

Among the Gastropods by far the most abundant species is the *Ilya-*

nassa obsoleta, (p. 354, Plate XXI, fig. 113,) which creeps over the flats and muddy bottoms in countless multitudes, sometimes almost covering the entire surface. When left by the tide, on the flats, especially in cold weather, they will creep into the small pools and depressions of the surface, where they often huddle together in great crowds, sometimes forming many layers, one above another. This is probably the most abundant shell, of any considerable size, on the coast of the United States. It occurs abundantly from the Gulf of Mexico to Massachusetts Bay. It is essentially a scavenger, and owing to its vast numbers its services in that line must be of great value. It occurs far up the estuaries, where the water is decidedly brackish, but flourishes equally well on the outer shores.

The *Littorinella minuta* (Plate XXIV, fig. 140) also occurs in vast numbers on the mud-flats, and in the pools and ditches of the salt-marshes, but it is a small and inconspicuous species. It is, however, not overlooked by the small fishes and various aquatic birds, for they feed largely upon it.

The *Melampus bidentatus* (Plate XXV, figs. 169, 169*a*) is also extremely abundant on the muddy salt-marshes, creeping over the general surface, or in the shallow pools and ditches, and among the grass, creeping up the stalks. In shallow water, where not too brackish, the *Bulla solitaria* (Plate XXV, fig. 161) is sometimes found in considerable numbers, creeping over soft, muddy bottoms. It is a favorite article of food with the flounders.

Among the Lamellibranchs, one of the most common species is the *Modiola plicatula*, (Plate XXXI, fig. 258,) which occurs everywhere on the muddy banks at and above high-water mark, and also over the salt-marshes, along the borders of ditches and streams, and wherever there is sufficient moisture, partially imbedding its shell in the mud or among the roots of grass, and anchoring itself by means of a stout byssus. The long clam, *Mya arenaria*, (p. 463) and the *Macoma fusca*, (Plate XXX, fig. 222) are almost everywhere abundant on the shores between tides.

The "round clam," *Venus mercenaria*, (p. 359, Plate XXVI, fig. 184,) occurs on the muddy bottoms in shallow water, often in great abundance, especially where the mud is somewhat firm, or where there is an admixture of sand, and the water is not very much freshened. This clam is usually taken in such places by means of long-handled tongs, and sometimes with the dredge. It is especially abundant in the estuaries and harbors opening into Long Island Sound. The quantity of this clam taken annually for food is enormous, but it is impossible, at present, to get reliable statistics, either for this or the long clam, for they are mostly taken and sold, a few bushels at a time, by individual fishermen, and the traffic is diffused along the whole coast, from Florida to Boston; but it is probable that more than 1,500,000 bushels are annually consumed.

In the New Haven markets the round clams retail at $2 to $3 per bushel for the small ones, and $1 to $2 per bushel for the large ones.

The common muscle, *Mytilus edulis*, (p. 307, Plate XXXI, fig. 234,) is also extremely abundant on the muddy bottoms, forming immense beds in many places. It is taken in vast quantities for fertilizing the land, but is seldom used as food on our coast, although it is used extensively in some parts of Europe.

The muddy bottoms of the estuaries, ponds, and harbors, especially when composed largely of organic matter in a living state, afford the best localities for "planting" oysters, and they are extensively utilized for this purpose. The oysters thus planted are mostly brought from farther south, but young "natives" are also transplanted on a large scale in some localities.

It is, however, very certain that the oysters did not originally grow on muddy bottoms, for the young cannot maintain themselves during early life unless attached to some solid substance.

Therefore, where large oyster-beds have been planted, the bottom should no longer be classed as "muddy," but rather as a "shelly bottom," for a large number of animals, in addition to those of true muddy bottoms, live among or attached to the oysters.

Along the peaty and clayey banks, especially where undermined by the waves, even nearly up to high-water mark, the *Petricola pholadiformis* (p. 372, Plate XXVI, fig. 199,) and *Pholas truncata*, (Plate XXVII, fig. 200,) are often found in their deep burrows in considerable numbers. The *Tagelus gibba* (Plate XXVI, fig. 181, and Plate XXX, fig. 217,) burrows at and below low-water mark on the muddy and argillaceous shores of the estuaries, as well as on the shores of the bays. On muddy bottoms, toward the outer parts of the estuaries and harbors, the *Mulinia lateralis* (Plate XXVI, fig. 184, B) often occurs in great abundance. And in similar places, even where the bottom consists largely of decaying vegetable matter, the *Tellina tenta* (Plate XXX, fig. 225) and *Solenomya velum* (Plate XXIX, fig. 210) are sometimes found in considerable numbers. The *Callista convexa* (Plate XXX, fig. 219) also occurs in similar places.

The Ascidians, Bryozoa, and Radiata are almost entirely wanting on the muddy shores and bottoms of estuaries, unless in localities where eel-grass or oyster-beds afford them suitable stations; but such localities will be discussed farther on.

List of species inhabiting the muddy shores and bottoms of brackish waters.

ARTICULATA.

Insects.

	Page.		Page.
Cicindela marginata	335	Culex, sp	466
Hydrophilus quadristriatus	466	Ephydra, sp	466

Crustacea.

Annelids.

Nemerteans.

Nematodes.

MOLLUSCA.

Gastropods.

Lamellibranchs.

III. 3.—ANIMALS INHABITING OYSTER-BEDS IN BRACKISH WATERS.

Although the oyster-beds are generally planted on bottoms that were originally muddy, when covered wholly or partially with living oysters or with dead oyster-shells, such bottoms may properly be regarded as "shelly bottoms" analogous to the natural shelly bottoms of the outer waters. The shells of the oysters afford suitable attachment for various shells, bryozoa, ascidians, hydroids, sponges, &c., which could not otherwise maintain their existence on muddy bottoms, while other kinds of animals, such as crab s, annelids, &c., find shelter beneath the shells or in their interstices. Some species have apparently been introduced from farther south with the oysters; among these are *Modiola hamatus* and *Panopeus Herbstii*, neither of which is positively known to be fully naturalized on our shores.

In planting the oysters they are more or less uniformly scattered over the bottom, from somewhat above low-water mark to the depth of ten or twelve feet. The oysters thus planted are brought mostly from the waters of Virginia and Maryland in spring. During the summer they usually increase greatly in size, and often become very fat and improve in flavor. They are taken up in the fall, for if left exposed to the freezing weather of our winters, at least all those in very shallow water would be killed. They often double in bulk during the summer. Besides the immense quantities of oysters thus brought from farther south to be "planted" in our waters, large quantities of young "natives" are also collected from the localities where they naturally breed, and are planted on muddy bottoms in the brackish waters, where they grow very rapidly, usually attaining a size suitable for the market in two or three years.

These "native oysters," although of the same species as those brought from the south, are more hardy, and will live through the winter if covered by a depth of water sufficient to prevent them from freezing. The young oysters that attach themselves to stones, ledges, &c., between tides, often in great abundance, nearly all perish by freezing during the winter. They mostly become an inch to an inch and a half in diameter during the first summer. The period of spawning lasts for some time.

but most of it seems to be done in May, June, and July. The young, after swimming about for a short time, attach themselves to any suitable hard object, such as rocks, shells, timber, brush, &c. On our coast very few attempts have been made to raise the young oysters by artificial means, because the young oysters, of a size suitable to plant, can generally be bought at a price less than the actual cost of raising them. The time will doubtless come, however, when this will no longer be the case, and then the methods so successfully employed on the coast of France may be resorted to with great advantage.

The young oysters must find some solid substance to which they can attach themselves, before losing their locomotive organs, otherwise they will fall to the bottom and perish in the mud. It is evident, therefore, that although the oysters planted on muddy bottoms of the right kind will grow most rapidly, owing to the great abundance of their microscopic food in the mud and turbid water; yet such localities are unfavorable for breeding-grounds, because the young, or "spat," will find no suitable objects to which they can attach themselves, unless, by chance, to the shells of the old oysters. Therefore, if it be desired to have the oysters in such localities produce the young ones necessary to maintain the bed permanently, it will be necessary to place hard objects on the bottom, to which they may adhere. Stones, broken bricks, &c., may be used for this purpose, but nothing is better than old oyster-shells, and they are generally cheaper than anything else.

On the coast of France bundles of twigs or fagots, prepared tiles, and other objects have been used to catch the young, and they are allowed to remain on such objects until they become large enough to be removed and planted elsewhere.

It is obvious that the best breeding-grounds are on hard bottoms, where there are large quantities of dead shells, pebbles, &c., to which the young will be sure to adhere. But such bottoms are not the best localities for the rapid growth and fattening of the oysters. Therefore it is always found profitable to transplant the young oysters, when large enough, from hard bottoms to the muddy bottoms of the estuaries, where their natural food most abounds.

All muddy bottoms are not equally adapted for this purpose. The great differences to be found in the muddy bottoms of various localities have already been mentioned on a previous page. (See p. 430.) Those bottoms that are composed mainly of tenacious clay are unsuitable, both because the oysters become imbedded too deeply in the clay, and because such mud contains but little organic matter. Those that consist of clay or sand mixed with decaying vegetable matter, and have a black, putrid layer just beneath the surface are also unsuitable and should be avoided. Those that consist of very deep, soft, pasty mud, though the mud itself may be of good quality, are apt to allow the oysters to sink too deeply beneath the surface and thus become smothered in the mud.

The most suitable localities are those sheltered places where there is a firm substratum of sand or gravel, overlaid with a few inches of soft, flocculent mud, consisting largely of living microscopic animals and plants, Infusoria, Diatoms, &c. Such localities are to be found in most of our shallow estuaries, harbors, and brackish ponds, and on such grounds the oysters grow and become fat with surprising rapidity.

The character of such bottoms is very liable to be changed by storms, especially in winter, either by the removal of the organic mud to some other part of the bottom or shore, or by the washing in of silt or clay in quantities sufficient to cover the bottom and destroy the living organisms. Thus it happens that a locality may be an excellent oyster-ground one year and comparatively worthless the next, or a poor locality may in the next year become a good one. And on this account the great reputation that the oysters of a particular locality often acquire in a favorable year may not belong to them in subsequent years, for the quality of the oysters changes with the character of the food and bottom where they grow. I have already mentioned several of the more important enemies of the oysters on former pages. (See pp. 306, 326.) The star-fishes, which are among the most destructive of these, do not flourish in brackish waters, and this is, therefore, a great advantage.

The quantity of oysters taken from our waters is far greater than is generally supposed by those not familiar with this important business. The best statistics are necessarily very incomplete, but they are sufficient to show the almost incredible magnitude of this industry, which is, moreover, rapidly increasing as the facilities for transporting the oysters to all parts of the country, even to the Pacific coast, are multiplied.

According to the official report of Hunter Davidson, commissioner, upon the oyster-fisheries, &c., of Maryland, January, 1872,* the quantity of oysters taken in Maryland waters in the year 1869–'70 was 11,233,475 bushels, which, at an average value of 35 cents per bushel, would amount to $4,031,716. To catch and convey these to market 8,070 men were employed on the water; 7,190,400 bushels were taken by 642 vessels (tonnage 14,436) engaged in dredging, and employing 4,060 hands. The balance, 2,043,075 bushels, were taken by 1,647 boats or "canoes," using tongs and rakes, and employing 3,410 hands.

In 1870–'71, 597 vessels, (tonnage 13,425,) engaged in dredging, and employing 3,775 hands, took 6,686,400 bushels; and 1,649 "canoes" took, with tongs, 2,261,403 bushels, employing 3,507 hands; making the total amount for the year, 10,947,803 bushels, valued at $3,831,731. Many of these oysters were sold at $1 to $1.50 per bushel, while others were sold for less than twenty-five cents, but it is probable that the estimated average value (thirty-five cents) is considerably below the actual value.

The quantity taken in the waters of Virginia is probably quite as large as that from Maryland.

Large quantities are also taken along the coast of New Jersey, Long

* Report on the Oyster-Fisheries, Potomac River Shad and Herring Fisheries, and the Water-fowl of Maryland, to his excellency the governor and other commissioners of the State oyster-police force, January, 1872.

Island, and Connecticut. It is, therefore, probable that the total amount taken on the coast north of Cape Hatteras is not less than 30,000,000 bushels annually, having a value of more than $20,000,000. In making this estimate we should allow for the great increase in bulk and value of many of the Maryland and Virginia oysters that are transplanted to northern waters, and allowed to grow before using. The average value of the northern oysters, both native and transplanted, is probably more than seventy-five cents per bushel. It is, therefore, probable that the above estimate is considerably too low.

The great oyster-markets of the country are Baltimore and New York. In Baltimore immense quantities of oysters are put up in kegs and cans to supply the distant parts of our own country and also to ship to nearly all foreign countries. In 1867 it was estimated that more than 10,000 persons were employed in this branch of the business. There were then thirty packing-houses, employing 4,500 openers. In addition to the packing business great quantities of oysters are sold at Baltimore and sent away in the shell. The total quantity sold at Baltimore exceeded 7,000,000 bushels, of which about 5,000,000 bushels came from Maryland waters, and the balance from Virginia. Of these over 1,000,000 bushels were sent to New York, 700,000 to Fair Haven, Connecticut, where an extensive packing business is carried on, 450,000 to Philadelphia, 350,000 to Boston.

The oyster trade of New York, several years ago, was estimated at over $8,000,000, employing 2,500 vessels, and it has greatly increased since that estimate was made.

Among the most common shells that are found attached to oysters are *Crepidula fornicata* (Plate XXIII, figs. 129, 129*a*) and *C. unguiformis*, (Plate XXIII, fig. 127.) They both occur together on the upper as well as the under valves, and in all cases retain their ordinary characters, except that the latter is more regular in form, and usually has the upper surface slightly convex, instead of being much distorted and with a concave upper surface, as the larger specimens that live on the inside of dead univalves usually are. Its color, when living on the oysters, is always white, while the *C. fornicata* is always more or less marked with brown.

The common muscle, *Mytilus edulis*, (p. 307) frequently occurs attached to oysters, and when it accumulates on the oyster-beds in large quantities it is very injurious. The *Modiola hamatus* (p. 374) is a very peculiar-looking muscle, having a broad, often hatchet-shaped, distorted shell, covered with prominent radiating ribs, many of which are forked. Its color is yellowish or brownish. It somewhat resembles *Modiola plicatula*, but is broader and has coarser ribs. This muscle is sometimes found in New Haven Harbor, living on the oyster-beds in considerable numbers, and of full size, attached to the oysters, either singly or in clusters, by the byssal threads. It has been observed only in the summer and fall and it may not have survived the winters, for it is possible that all the individuals may have been brought from the south, in the spring, when quite small, attached to the oysters. It may be, however, that it has really become naturalized on our shores. It is very common in the Gulf of Mexico, and on other parts of the southern coast. The *Anomia glabra* (p. 311, Plate XXII, figs. 241, 242, 242*a*) is also very commonly found adhering to oysters.

The hard sandy tubes of *Sabellaria vulgaris* (p. 321, Plate XVII, figs 88, 88*a*) and the calcareous tubes of *Serpula dianthus* (p. 322) are very frequent upon oyster-shells, and occasionally those of *Potamilla oculifera*, (p 322, Plate XVII, fig. 86,) *Scionopsis palmata*, (p. 321,) and other species are met with. Many other Annelids are to be found burrowing or hiding beneath the oysters. The common green star-fish, *Asterias arenicola*, (p. 326, Plate XXXV, fig. 269,) occasionally occurs on the oyster-beds near the mouths of estuaries, but is seldom sufficiently abundant in the brackish waters to do serious damage to the oyster-beds.

In the brackish waters the "drill," *Urosalpinx cinerea*, (p. 306, Plate XXI, fig. 116,) is the worst enemy of the oyster, and is sometimes so numerous as to do very serious damage.

Several species of Hydroids grow adhering to oysters. The most abundant of these, in brackish water, is usually *Halecium gracile* V., (p. 328,) but two or three species of *Obelia* and some other forms occur.

Of Bryozoa, one of the most common species is the *Escharella variabilis*, (p. 312, Plate XXXIII, fig. 256,) which forms calcareous incrustations. The *Bugula turrita*, (p. 311, Plate XXXIV, figs 258, 259,) and *Vesicularia dichotoma* V. (p. 404) are also common. The *Alcyonidium hirsutum*, (p. 404,) which forms soft fleshy crusts over the surface of the shells, is quite frequently seen.

The common red sponge (p. 330) is often abundant on the oyster-beds where the water is not much freshened.

List of species inhabiting oyster-beds in brackish waters.

ARTICULATA.

Insects.

	Page.
Chironomus oceanicus	379

Crustacea.

	Page.		Page.
Pinnotheres ostreum	367	E. longicarpus	313
Cancer irroratus	312	Crangon vulgaris	339
Panopeus Herbstii	472	Mysis Americana	370
P. Sayi	312	Melita nitida	314
P. depressus	312	Ampelisca, sp	431
Carcinus granulatus	312	Unciola irrorata	340
Libinia canaliculata	368	Corophium cylindricum	370
Eupagurus pollicaris	313	Epelys trilobus	370

Annelids.

Nemerteans and Planarians.

Nematodes.

MOLLUSCA.

Gastropods.

Lamellibranchs.

Ascidians.

	Page.		Page.
Cynthia partita	311	Molgula Manhattensis	311

Bryozoa.

	Page.		Page.
Bugula turrita	476	Vesicularia dichotoma	476
Escharella variabilis	476	Alcyonidium hirsutum	476
Membranipora lineata	406	Pedicellina Americana	405

RADIATA.

Echinoderms.

	Page.
Asterias arenicola	476

Acalephs.

	Page.		Page.
Obelia gelatinosa	391	Halecium gracile	476
O. diaphana	327	Sertularia argentea	408
O. pyriformis	390		

Polyps.

	Page.		Page.
Metridium marginatum	329	Sagartia leucolena	329

PROTOZOA.

Sponges.

	Page.		Page.
Tedania, species	330	Red branching sponge	476
Halichondria, sp	330		

III. 4.—Animals inhabiting eel-grass in brackish waters.

A large portion of the shallow parts of nearly all the harbors, estuaries, and ponds is occupied by a dense growth of eel-grass, *Zostera marina*, in summer. This plant flourishes both on sandy and muddy bottoms. During the fall and winter it is mostly torn up and drifted away by storms, but in the spring a new crop starts up and grows very rapidly, the narrow, ribbon-like leaves often becoming six feet or more in length during the summer.

These tracts of eel-grass are the favorite resorts of a considerable number of animals, which seek these places either for food or concealment and shelter, or for both combined. Other species, including certain hydroids, bryozoa, and ascidians, grow attached to the leaves of the eel-grass.

Many small fishes frequent the patches of eel-grass, and find there abundance of food and unusual safety from their enemies.

Among the most common Crustacea found among the eel-grass are the edible crab, *Callinectes hastatus*, (p. 367;) *Panopeus Sayi*, (p. 312;) *P. depressus*, (Plate I, fig. 3;) *Eupagurus longicarpus*, (p. 313;) the prawn, *Palæmonetes vulgaris*, (p. 369, Plate II, fig. 9;) the common shrimp, *Crangon vulgaris*, (p. 339, Plate III, fig. 10;) the green shrimp, *Virbius zostericola*, (p. 369, Plate III, fig. 11;) *Mysis stenolepis*, (p. 370, Plate III, fig. 12;) *M. Americana*, (p. 370;) *Idotea irrorata*, (p. 316, Plate V, fig. 23;) *Melita nitida*, (p. 314.) The common prawn (Plate II, fig. 9) has its true home among the eel-grass, and here it occurs in countless numbers. Its translucent body, marked with irregular, ill-defined, dark blotches and spots, admirably adapts it for concealment among the discolored and dead leaves of the plant, at or near the bottom.

Where the eel-grass grows on sandy bottoms the common shrimp is scarcely less abundant. The *Virbius* is often abundant, associated with the common prawn, and having similar habits. All these shrimps and prawns are eagerly devoured by the fishes. The *Idotea irrorata* is generally very abundant, and clings firmly to the leaves of the eel-grass lengthwise. Its body is generally curiously and variously colored with green and brown, &c., and these colors are often so arranged as to imitate very perfectly the colors of the eel-grass when partially dead or discolored. Sometimes the right or left half of the body will be bright green, while the opposite half will be dark brown. In other cases there will be a dorsal bright green stripe, while the sides will be dark brown, just like one of the leaves of the eel-grass that is discolored at the edges, but green in the middle. More commonly these colors are irregularly disposed in blotches.

The *Erichsonia attenuata* Harger, is a remarkably slender species, which also lives clinging to the eel-grass. Its colors are green and brown, and quite variable.

Several species of Amphipods are also abundant among the eel-grass. One of the most common of these is the *Gammarus mucronatus*, (p. 466,) which is easily distinguished by the dorsal teeth on the abdominal segments. *Microdeutopus minax* Smith, is a very small species, which sometimes occurs in great abundance in the small brackish ponds. It is remarkable for its relatively large and very broad hands, armed beneath with three prominent teeth. The hands are nearly as large as the entire body.

Among the Mollusks several interesting species occur. The *Ilyanassa obsoleta*, (p. 371, Plate XXI, fig. 113;) *Bittium nigrum*, (p. 305, Plate XXIV, fig. 154;) and *Astyris lunata*, (p. 306, Plate XXI, fig. 110,) are generally the most abundant species. The *Nassa vibex* (p. 371, Plate XXI, fig. 114) is met with occasionally, living on and about the roots of eel-grass, but it is an uncommon shell in our waters, though quite abundant on the southern coasts. The *Crepidula convexa* (p. 371, Plate XXIII, fig. 128) may be found, both adhering to the leaves of eel-grass and attached to shells occupied by the smaller hermit-crabs.

The curious little naked mollusk, *Elysiella catulus*, (Plate XXV, fig. 171,) is often quite common on the leaves of eel-grass in our harbors. It also has the power of floating with the bottom of the foot at the surface of the water. Its small size and bright green color, like that of the growing leaves of the *Zostera*, cause it to be easily overlooked.

The related species, *Elysia chlorotica*, (Plate XXV, fig. 172,) appears to have similar habits, but is much less common. Its color is also green. The pretty *Doto coronata* (p. 400, Plate XXV, fig. 170) also occasionally occurs on the leaves of eel-grass.

A green Planarian is frequent on the eel-grass, and also a bright red species.

List of species inhabiting the eel-grass in brackish waters.

ARTICULATA.

Insects.

	Page.
Chironomus oceanicus	379

Crustacea.

	Page.		Page.
Panopeus depressus	479	Melita nitida	479
P. Sayi	479	Microdeutopus minax	479
Callinectes hastatus	479	Amphithoë valida	315
Carcinus granulatus	312	A. longimana	370
Libinia canaliculata	368	A. compta	370
L. dubia	368	Corophium cylindricum	370
Eupagurus longicarpus	479	Caprella geometrica	382
Crangon vulgaris	479	Idotea irrorata	479
Virbius zostericola	479	Erichsonia attenuata	479
Palæmonetes vulgaris	479	Epelys trilobus	370
Mysis stenolepis	479	Balanus eburneus	381
M. Americana	479	Limulus Polyphemus	340
Gammarus mucronatus	479		

Annelids.

	Page.		Page.
Lepidonotus squamatus	320	Nicolea simplex	321
Podarke obscura	319	Scionopsis palmata	321
Autolytus cornutus	397	Polycinus eximius	320
Nereis limbata	318	Spirorbis, sp	323

Nemerteans and Planarians.

	Page.		Page.
Polinia glutinosa	324	Planarian, (red sp.)	480
Cerebratulus, sp	324	Planarian, (dark green sp.)	480

MOLLUSCA.

Gastropods.

	Page.		Page.
Illyanassa obsoleta	479	Littorinella minuta	469
Nassa vibex	479	Crepidula convexa	479
Astyris lunata	479	Doto coronata	480
Anachis avara	306	Elysia chlorotica	480
Bittium nigrum	479	Elysiella catulus	480
Triforis nigrocinctus	305		

Lamellibranchs.

	Page.		Page.
Argina pexata	309	Pecten irradians	361
Mytilus edulis	470	Ostræa Virginiana	472

Ascidians.

	Page.		Page.
Molgula Manhattensis	311	Botryllus Gouldii	375

Bryozoa.

	Page.		Page.
Bugula turrita	311	Escharella variabilis	312
Vesicularia dichotoma	404	Membranipora, lineata	406

RADIATA.

Acalephs.

	Page.		Page.
Obelia diaphana	327	Hydractinia polyclina	328
Obelia, sp	476		

Polyps.

	Page.
Sagartia leucolena	329

III. 5.—Animals living on or among piles of wharves, bridges, floating timber, rocks, etc., in brackish waters.

The piles of wharves in brackish harbors are often inhabited by an abundance of animal life. The same species are mostly to be found also on piles of wharves in the purer waters of the sounds, and many of them have, therefore, already been mentioned in a previous place, (p. 378.) There are some of these species, however, that appear to flourish best in waters that are decidedly brackish.

Among the most conspicuous of these is the beautiful Tubularian

Parypha crocea, (p. 390, Plate, XXXVI, fig. 274,) which grows in large tufts, several inches in height, and often covers large surfaces of the piles and timbers at and just below low-water mark. Associated with this the *Obelia gelatinosa* (p. 391) often occurs in large quantities. This is a large and very beautiful species, having a large dark colored stem, composed of numerous united tubes, but the terminal branches are white and delicate, and the cells have an elegant bell-shaped form, with a toothed margin. It grows to the length of a foot or more. This species occurs on the piles of Long Wharf, in New Haven Harbor, in great abundance, associated with the preceding; at this place the water is not only quite brackish, but is very impure, on account of sewerage, &c.

Other species of *Obelia* also occur in similar places. The *Balanus eburneus* is a very abundant barnacle in brackish waters, growing upon piles, timbers, oyster-stakes, and every other kind of fixed wood-work, and also upon the bottoms of vessels and floating timber. As already remarked (p. 381) it is capable of living even in fresh water. The *Balanus balanoides* also occurs where the water is less brackish. The piles and timbers of the wharves are often badly damaged by the perforations of *Teredo navalis* (p. 384, Plate XXVI, fig. 183) even where the water is very brackish.*

The *Limnoria lignorum* (p. 379) also attacks wood-work in waters that are somewhat brackish.

Lists of species inhabiting piles of wharves, floating timbers, &c., in brackish waters.

ARTICULATA.

Insects.

	Page.		Page.
Chironomus oceanicus	331	Anurida maritima	331

Crustacea.

	Page.		Page.
Panopeus depressus	312	Jæra copiosa	315
Microdeutopus minax	479	Idotea irrorata	316
Amphithoë compta	370	Limnoria lignorum	482
Corophium cylindricum	370	Balanus balanoides	482
Caprella, sp	316	B. eburneus	482

* Since the account of the *Teredo navalis*, on page 384, has been in type, I have learned some additional facts in regard to it from Mr. V. N. Edwards. The statement that the buoys are taken up every six months does not apply to the spar-buoys, which are taken up only once a year, in April and May. Mr. Edwards states that the *Teredos* would destroy an unpainted spar-buoy in one year, but when painted with verdigris they will only work where the paint becomes rubbed off. They grow to full size in one year. They first attack buoys or piles just below the water's edge, but eventually will destroy the entire submerged part of the spar-buoys. He thinks that some of them live through the winter.

Annelids.

Turbellarians.

Nematodes.

MOLLUSCA.

Gastropods.

Lamellibranchs.

Ascidians.

Bryozoa.

RADIATA.

Hydroids.

	Page.		Page.
Obelia gelatinosa..........	482	Halecium gracile..........	328
O. pyriformis	390	Parypha crocea	482
O. diaphana	327		

Polyps.

	Page.		Page.
Sagartia leucolena.........	329	Metridium marginatum....	329

IV.—Fauna of the ocean shores and outer cold waters.

All along this coast, from Cape Cod to Stonington, Connecticut, there is a belt or current of cold water which impinges directly against the outer islands and the open coast, especially where there are points of land projecting outward toward the deeper waters. This is especially noticeable at Gay Head, on Martha's Vineyard, No Man's Land, Cuttyhunk Island, Montauk Point, Block Island, Point Judith, and Watch Hill. This cold water is undoubtedly derived from the Arctic current, which passes slowly southward in deep water off our coast, but whether an actual current, distinguishable from the tidal currents, exists in the waters of moderate depth along the coast is still uncertain. The tidal currents apparently have the effect of bringing the cold water of the outside regions up into the shallower localities along the shores, and it is probable that the presence of the cold water in moderate depths is due to the joint action of the tides and the slow-moving Arctic current, which impinges more or less against and upon the slope of the submerged eastern border of the continent. But the position, extent, and temperature of this cold water along our shores varies greatly, according to the direction of the tidal currents and the surface currents caused by the wind. We have shown, on a former page, that at times these local winds and tidal currents are able even to bring Gulf Stream water and its characteristic animals directly upon this coast, even as far westward as Watch Hill, Rhode Island, where the *Physalia* is often cast ashore in summer. At such times the cold current must necessarily be wholly displaced, or disguised by intermixture with the warmer waters. When the tide is flowing from Long Island Sound, Vineyard Sound, or other large bodies of warm water, the cold waters will also be displaced and the temperature raised even at the distance of twenty or thirty miles from the shore in summer. In winter there is comparatively little effect from the Gulf Stream, owing to the prevalence of northerly winds, and there is also far less effect from the warm waters of the shallow bays and sounds carried by the tides. Therefore the full effect of the northern current is felt only in winter, and it doubtless adds to the cold proper to the season and land climate.

In winter and early spring we accordingly find numerous species of northern animals and algæ which disappear partially or wholly in many of these localities in summer. In April, May, and June, the cod and haddock resort in large numbers to the banks and reefs off Stonington, Watch Hill, No Man's Land, and other similar places, but are quite unknown there later in the summer.

In consequence of the varying temperatures of the currents which alternately pass over certain of these localities, there is a very peculiar admixture of northern and southern species, side by side. This is particularly the case on the reefs between Watch Hill and Fisher's Island, where the southern *Astrangia Danæ* is associated with the northern *Alcyonium carneum*, *Cribrella sanguinolenta*, and many other northern forms.

The temperature of the bottom-water during the last of August and first of September was found to vary from 57° F. to 63°, in sixteen to twenty-nine fathoms off Martha's Vineyard and Buzzard's Bay, (see chart.) The surface temperatures were at the same time 62° to 64°, and occasionally as high as 67°, when affected by warmer currents.

IV. 1.—SPECIES INHABITING ROCKY SHORES OF THE OPEN COAST.

The principal localities under this head at which we have made collections are No Man's Land, Cuttyhunk Island, Gay Head, and Watch Hill, Rhode Island. Dr. J. E. Leidy has published a partial list of the species found at Point Judith,* and we have more or less information concerning the fauna of several other similar localities. In all these places the assemblage of animals is nearly the same, and in general not very different from what we find on the rocky shores of the sounds and bays, (see p. 303.) A large part of the species of these shores have, therefore, already been mentioned in connection with the fauna of the bays and sounds.

There are, however, many species that are characteristic of the latter, which are found but rarely, or not at all, on the colder and more exposed outer shores; and these are characterized by the abundance of some northern species which are rare or wanting on the inner shores, or which occur there only in winter.

Among the most abundant species of shells are *Purpura lapillus*, (p. 306, Plate XXI, figs. 118, 119;) *Littorina palliata*, (p. 305, Plate XXIV, fig. 138;) *L. rudis*, (p. 305, Plate XXIV, fig. 137;) *Acmæa testudinalis*, (p. 307, Plate XXIV, figs. 158, 159;) and *Lacuna vincta*, (p. 305, Plate XXIV, fig. 139,) all of which occur adhering to the rocks or algæ, even in the most exposed situations. These are all hardy northern species, which extend their range to Greenland or beyond, and although all of them are to be found, more or less frequently, on the inner shores, they are there less abundant and generally of smaller size. The *Littorina palliata* is extremely abundant on the *Fucus*, and individuals were found at Watch Hill, copulating, April 12. The *Lacuna vincta* breeds still

* Journal of the Academy of Natural Sciences of Philadelphia, 2d series, vol. iii, 1855.

earlier in the season, for its eggs were found attached to algæ and eel-grass at the date named. The eggs of this species are small, yellowish white, imbedded in a gelatinous mass, having an annular form, but showing a break or suture on one side. These annular egg-masses are attached by one side to the surfaces of flat algæ or eel-grass in large numbers; they are from .12 to .20 of an inch in diameter.

The *Æolis papillosa* was found at Watch Hill, under stones, April 12, and with it were long, much convoluted, gelatinous cords, filled with minute pale red or salmon-colored eggs, which probably belong to this species, which is a northern one, and has not hitherto been recorded as from south of Cape Cod. It is very abundant in the Bay of Fundy, and similar egg-clusters are found there under rocks during the entire summer.

Among and between the stones the northern purple star-fish, *Asterias vulgaris* (p. 432) is often found at low-water, and also the green sea-urchin, *Strongylocentrotus Dröbachiensis* (p. 406, Plate XXXV, fig. 268) during the spring tides.

The *Balanus balanoides* (p. 305) is quite as abundant on the most exposed rocks as elsewhere. The minute bivalve young of this species were found just attaching themselves to the lower surfaces of rocks in immense numbers at Watch Hill on the 12th of April.

Beneath the stones the rock-crab, *Cancer irroratus*, (p. 312,) is very common, and occasionally the much rarer *Cancer borealis* is found dead on these shores. It was thus found at Gay Head and No Man's Land, but it is doubtful whether it lives above low-water mark. In the lower part of the fucus zone the large *Gammarus ornatus* (p. 314, Plate IV, fig. 15) is always to be found in great abundance under stones, and in the upper half of the fucus zone the smaller species, *Gammarus annulatas* (p. 314) and *Gammarus marinus* often occur in great numbers, associated with *Jæra copiosa* (p. 315) and *Idotea irrorata* (p. 316, Plate V, fig. 23.) The *Gammarus marinus* occurs higher up than either of the other species, and is sometimes abundant even near high-water mark, where the soil beneath the stones is barely moist at low-water. The *Amphithoë maculata* (p. 315, Plate IV, fig. 16) is also a common species under stones; and both green and reddish brown varieties occur.

Another species of *Amphithoë*, of smaller size, was found swimming free in the rocky pools at Watch Hill, April 12. In this the general color was red, or brownish red; the body was transversely banded with pale flesh-color or whitish, alternating with bands of dark red or brown, which are made up of minute crowded specks; the antennæ are annulated with pale red, and are thickly specked, on the bands and at the base, with darker red. The *Hyale littoralis* (p. 315) is a small but very active Amphipod, which is often abundant near high-water mark on the rocky shores, clinging to the *Fucus* and other algæ, or swimming in the tide-pools. It is capable of leaping actively like the beach-fleas, (*Orchestia* *agilis*,) which it somewhat resembles in form. The color is very variable; it is often bright yellowish green, but frequently dark green, brownish green, or brown.

The *Nereis virens* (p. 317, Pl. XI, figs. 47–49) is very abundant in burrows beneath the rocks. The males of this species, six to ten inches or more in length, and of a dark green color, were found at Watch Hill, April 12, in great numbers, swimming about in the pools of water among the rocks, with an undulatory motion, and discharging their milt in large quantities. Various other Annelids burrow or build tubes beneath the stones. *A. planaria* and *Leptoplana folium* creep over their lower surfaces.

Attached to the stems of *Fucus* at low-water, several Hydroids may usually be found, but the *Sertularia pumila* (p. 327, Pl. XXXVII, fig. 279) is by far the most abundant. The *Obelia geniculata* is also very common, attached to *Laminaria* and other algæ. Various Bryozoa occur attached to stones and to *Fucus* and other algæ. The *Alcyonidium hispidum* (p. 312) is one of the most abundant species, and usually invests the stems and fronds of *Fucus vesiculosus*, but also often covers broad surfaces of the rocks. The *A. hirsutum* is often associated with the preceding species on the rocks; it forms broad, thin, soft crusts, covered with small soft prominences, but is without the spines or bristles seen in the latter. The Zoöids are also much smaller.

The *Farrella familiaris* is a singular and delicate species, which occurs both on the under side of rocks and on algæ. The body is small, fusiform, attached by a long and very slender, flexible pedicel. When it surrounds the stems of small algæ, the whitish pedicels project outward in all directions, and thus produce the appearance of a delicate chenille-cord. This is a northern and European species. It was also dredged on Saint George's bank in 1872.

List of species found on the outer rocky shores.

ARTICULATA.

Crustacea.

	Page.		Page.
Cancer irroratus	486	Gammarus marinus	486
Cancer borealis	486	Amphithoë maculata	486
Panopeus depressus	312	Amphithoë, sp	486
Panopeus Sayi	312	Caprella, sp	316
Homarus Americanus	492	Jæra copiosa	486
Orchestia agilis	315	Idotea irrorata	486
Hyale littoralis	486	I. phosphorea	316
Calliopius læviusculus	315	Erichsonia filiformis	316
Gammarus ornatus	486	Balanus balanoides	486
Gammarus annulatus	486		

Annelids.

	Page.		Page.
Lepidonotus squamatus	320	Cirrhinereis fragilis	397
Harmothoë imbricata	321	Clymenella torquata	343
Phyllodoce cantenula	494	Polycirrus eximius	320
Eteone robusta	349	Sabellaria vulgaris	321
Autolytus cornutus	397	Potamilla oculifera	322
Nereis virens	487	Fabricia Leidyi	323
N. pelagica	319	Serpula dianthus	322
Ophelia simplex	319	Spirorbis, sp	323

Turbellaria.

	Page.		Page.
Planaria, species	487	Nemertes socialis	324
Leptoplana folium	487	Nemertes, sp	498
Procerodes frequens	325	Monocelis agilis	325

Nematodes.

	Page.		Page.
Pontonema marinum	325	Pontonema vacillatum	326

MOLLUSCA.

Gastropods.

	Page.		Page.
Buccinum undatum	494	L. neritoidea	495
Tritia trivittata	354	Bittium nigrum	305
Urosalpinx cinerea	306	Acmæa testudinalis	485
Purpura lapillus	485	Doris bifida	307
Astyris lunata	306	Polycera Lessonii	400
Littorina palliata	485	Dendronotus arborescens	495
L. rudis	485	Æolis papillosa	486
Lacuna vincta	485	Tergipes despectus	495

Lamellibranchs.

	Page.		Page.
Saxicava arctica	309	Mytilus edulis	307
Mya arenaria	309	Modiola modiolus	309
Kellia planulata	310	Anomia glabra	311

Ascidians.

	Page.		Page.
Cynthia partita	311	Amarœcium pellucidum	401
Molgula Manhattensis	311		

Bryozoa.

	Page.		Page.
Alcyonidium hirsutum	487	Bugula flabellata	311
A. hispidum	487	Membranipora pilosa	406
Vesicularia gracilis	389	M. lineata	406
V. cuscuta	404	Escharella variabilis	312
V. fusca	420	Discopora coccinea	333
Farrella familiaris	487	Lepralia, sp	420
Tubulipora flabellaris	405	Cellepora ramulosa	312
Crisia eburnea	311	Pedicellina Americana	405

RADIATA.

Echinoderms.

	Page.		Page.
Strongylocentrotus Dröbachiensis	496	Asterias vulgaris	496
		Cribrella sanguinolenta	407

Acalephs.

	Page.		Page.
Obelia pyriformis	390	Sertularia pumila	487
O. geniculata	487	S. argentea	408
O. flabellata	390	Pennaria tiarella	327
O. diaphana	327	Clava leptostyla	328
Campanularia flexuosa	327	Hydractinia polyclina	228

Polyps.

	Page.		Page.
Metridium marginatum	329	Sagartia leucolena	329

IV. 2.—SPECIES INHABITING THE SANDY SHORES OF THE OPEN COAST.

Owing to the force of the waves the sand and gravel of the exposed shores are kept in constant motion in stormy weather, and are often disturbed to a considerable depth, especially in winter. Therefore the conditions are very unfavorable for the existence of animal life. The fauna of such shores is, accordingly, very meager, as compared with that of the more sheltered sandy shores of the bays and sounds.

It often happens that one may examine these sandy beaches for a mile or more at low-water without finding more than half a dozen species of animals that actually live on them, though many may be found thrown up by the waves from below low-water mark.

In coves or other localities that are somewhat sheltered, the number of species is greater, and most of them are identical with those found on the sandy shores of the sounds.

Toward high-water mark the *Talorchestia longicornis* (p. 336) and *T.*

megalophthalma (p. 336) are everywhere common, burrowing in the sand. The *Cancer irroratus* (p. 338) and *Platyonichus ocellatus* (p. 338) are rather common at and just below low-water mark. The *Hippa talpoida* (p. 338, Plate II, fig. 5) is occasionally found, and the young sometimes occur in large numbers, burrowing in the sand at low-water mark. The common shrimp, *Crangon vulgaris,* (p. 339, Plate III, fig. 10,) is usually abundant where there are sheltered sandy flats.

The Annelids are less numerous than on the sandy shores of the sounds, but such as do occur are mostly of the same species. One of the most interesting is the *Nerine agilis,* (p. 346,) which is very remarkable for the rapidity with which it burrows in the sand.

The Mollusks are few in number. One of the most abundant of the Gastropods is the *Lunatia heros,* (p. 353, Plate XXIII, figs. 133–136,) which burrows just beneath the surface of the sand, at and below low-water mark. The *Neverita duplicata* (p. 354, Plate XXIII, fig. 130) is also occasionally found, but is much less abundant than in the bays.

Of Lamellibranchs there are but few species that can maintain themselves in such situations. Among these the "long clam," *Mya arenaria,* (p. 463,) the "razor-shell," *Ensatella Americana,* (p. 356,) and the "surf-clam," *Mactra solidissima,* (p. 358,) are the most common.

Very few, if any, Radiates are to be found on the exposed sandy shores, unless thrown up by the waves from deeper water. In places that are somewhat protected from the violence of the surf, the *Leptosynapta Girardii* (p. 361, Plate XXXV, figs. 265, 266) is often found burrowing in the sand at low-water mark. Sometimes, in similar places, the "sand-dollar," *Echinarachnius parma,* (p. 362, Plate XXXV, fig. 267,) is found in large numbers at extreme low-water mark.

There are no Hydroids and Polyps that properly inhabit such shores.

List of species inhabiting the sandy shores of the open coast.

ARTICULATA.

Crustacea.

	Page.		Page.
Ocypoda arenaria, (young)	337	Crangon vulgaris	490
Cancer irroratus	490	Orchestia agilis	336
Cancer borealis	486	Talorchestia longicornis	489
Platyonichus ocellatus	490	T. megalophthalma	489
Hippa talpoida	490	Unciola irrorata	340
Eupagurus pollicaris	313	Idotea cæca	340

Annelids.

	Page.		Page.
Nereis virens	317	Scolecolepis viridis	345
N. limbata	318	Clymenella torquata	343
Rhynchobolus Americanus	342	Amphitrite ornata	320
Nerine agilis	490	Polycirrus eximius	320

MOLLUSCA.

Gastropods.

	Page.		Page.
Sycotypus canaliculatus	399	C. unguiformis	354
Tritia trivittata............	354	Lunatia heros..............	490
Crepidula fornicata.........	355	Neverita duplicata	490

Lamellibranchs.

	Page.		Page.
Ensatella Americana	490	Mya arenaria	490
Siliqua costata.............	426	Mactra solidissima........	490

RADIATA.

Echinoderms.

	Page.		Page.
Leptosynapta Girardii......	490	Echinarachnius parma.....	490

IV. 3.—ANIMALS INHABITING ROCKY BOTTOMS OFF THE OPEN COAST.

The fauna of the rocky bottoms in these outer waters is rich and interesting, and decidedly northern in character, though there is usually an admixture with southern species.

The principal localities where dredgings were made on this kind of ground are: First, off Gay Head and Devil's Bridge, at localities marked on the chart, 53, *a*, *b*, *c*, *d*; 55, *a*, *b*, *c*; 56, *a*, *b*, *c*, *d*; 57, *a*, *b*, *c*, *d*; 58, *a*, *b*, *c*; 59, *a*, *b*, *c*; 60, *a*, *b*, *c*; 61, *a*, *b*, *c*; 62, *a*, *b*, *c*; 63, *a*, *b*; 83, *a*, *b*, *c*. Second, between Gay Head and No Man's Land, and to the westward of the latter island, at localities 82, *a*, *b*; 84, *a*, *b*, *c*, *d*; at these localities cod are caught in the spring. Third, on and about the rocky reef extending from Watch Hill, Rhode Island, to Fisher's Island, and forming, in part, the physical boundary of the eastern end of Long Island Sound; this is also a locality where cod and haddock are caught in spring. The dredgings at this place were made by Professor D. C. Eaton, Mr. C. A. Burt, and myself, April 13, 1873. Fourth, a locality off Cuttyhunk Island, where dredgings were made, April, 1872, by Mr. T. M. Prudden, Mr. T. H. Russell, and others.

The four localities named are characterized by a similar fauna, but each one yielded some species not found in the others, though more numerous dredgings might have revealed them. The reef off Watch Hill is of peculiar interest on account of the singular blending of the northern and southern faunæ at that place, as mentioned above. It seems to be nearly at the extreme western range of many northern species, though some of them may occur sparingly in certain favorable localities still farther westward, in Long Island Sound itself. Many northern algæ were also collected there by Professor Eaton, in abundance, and some of them have not been found farther westward, and others but rarely. Among these were *Ptilota elegans* and *Delesseria sinuosa*, both of which were abundant on the reef in four or five fathoms, associated with large quantities of *Phyllophora Brodiæi*, and *P. membranifolia; Euthora cristata* and *Lithothamnion polymorphum* also occurred. The "dulse," *Rhodymenia palmata*, *Laminaria digitata*, *L. saccharina*, and *L. longicrura*, all of which are decidedly northern species, were large and abundant.

A similar assemblage of algæ was also found on the rocks, in shallow water, off Gay Head, though some of the species just named were not found there.

Among the Crustacea of these localities, the most important is the lobster, *Homarus Americanus*, (p. 395,) which finds its proper habitat in such places. It is very abundant off Gay Head, and among the reefs and rocks off Watch Hill and Stonington, Connecticut. It also occurs plentifully in similar localities off New London, Connecticut, and still farther west in Long Island Sound. At all these and many other localities large quantities are caught for the markets. They are nearly all taken in "lobster pots" baited with refuse fish, &c.

The lobster fishing begins in this region in the latter part of March or early in April, according to the season. By the middle of April they are usually taken in large quantities and shipped alive to New York, New Haven, and other cities. The extent of this trade is enormous even in this region, while north of Cape Cod, along the whole northern coast of New England, and on the shores of Nova Scotia, the lobster is taken in still larger quantities. At present we have no reliable data for estimating the number annually caught, but it probably amounts to several millions.

In winter the supply comes from the northern coasts of Massachusetts and Maine, where they may be taken in moderately deep water at all seasons. According to Captain N. E. Atwood* they do not come into shallow water at Provincetown until June and remain there until October, when they disappear again. He also states that those that visit that locality are nearly all females; "they appear to come near the shore for the purpose of depositing their young, after which they pass away and others in turn take their places, as is indicated by the change that is constantly taking place, for when the fishermen are catching great quantities of large, good hard-shell lobsters, and they are unusually abundant, perhaps the next day there will be a new kind, smaller and not of so good quality, the former ones having passed away and others come to take their places." "In Boston the number of lobsters sold annually cannot be much short of a million. The male lobster is preferred and is the most salable, as this city has always been supplied from the northern shore of Massachusetts and coast of Maine, where the

---

* Proceedings Boston Society of Natural History, vol. x, p. 11, 1866.

males are most plentiful. It is a great advantage to the fishermen that the people prefer males. In New York it is very different in this particular, that city being supplied from Cape Cod after June, and the female lobster thus considered much the best. I have sold many lobsters in New York, and males sell at only about half price; the male is much poorer than the female in meat." Captain Atwood states, in the same place, that northward and eastward of Plymouth, Massachusetts, "three-quarters at least are males at all seasons of the year." Among those that I have examined from New London, Waterford, and Stonington, Connecticut, in our markets, I have not noticed any marked inequality in the number of the sexes. Mr. Smith examined the lobsters in the market at Provincetown on two occasions in August and September, without finding any decided differences in the number of males and females. He also repeatedly examined those in the fish-markets at Eastport, Maine, in summer, with the same result. It is possible therefore, that the fishermen do not correctly distinguish the sexes, when the females are without eggs, and that an erroneous opinion has thus become current among them.

There is a great difference in the breeding season on different parts of the coast. The lobsters from New London and Stonington often lay their eggs as early as the last of April or first of May; while at Halifax, Mr. Smith found females with recently laid eggs in September. At Eastport, Maine, the females carry their eggs in mid-summer. In the male the genital orifices are in the bases of the last pair of legs; in the female they are at the bases of the middle pair. This will always serve to distinguish the sexes, but they also differ in the structure of the abdominal appendages.

The rock-crab, *Cancer irroratus*, (p. 312,) is very common on these bottoms, and *C. borealis* (p. 395) also inhabits them, judging from the large dead specimens found on the adjacent beaches, but we only dredged a few small living specimens. One of these was taken on the reef between Watch Hill and Fisher's Island, in 4 or 5 fathoms, among algæ. It is more convex, and much more hairy than the preceding species, and the teeth along the sides of the carapax are quite different.

A large and handsomely colored shrimp, *Pandalus annulicornis* (Plate II, fig. 6,) often occurs in the deeper waters, outside, but is far more common farther north, as in the Bay of Fundy. The common shrimp, *Crangon vulgaris*, (p. 339, Plate III, fig. 10,) is common, especially where there are spots of sand among the rocks. The little bright-colored shrimp, *Hippolyte pusiola*, (p. 395,) is frequently met with among the red algæ. The *Unciola irrorata*, (p. 340, Plate IV, fig. 19,) and *Amphithoë maculata*, (p. 315, Plate IV, fig. 16,) together with several other Amphipods, are common, especially among the red algæ, and some of them are handsomely marked with red and other bright colors.

Among these are *Podocerus fucicola*, which is a small species and quite variable in color; some of those from the reef at Watch Hill had a transverse dorsal band of red or orange on each segment, and similar ones on the epimera, and were minutely specked with dark brown; the antennæ and legs were annulated with white and light red or orange. Another species of *Podocerus* was still more abundant among the red algæ; in this the males and females differ greatly in size, form, and color. The females are much smaller and stouter than the males; their colors were generally red and white, in strong contrast, though some were purplish and more like the males in color; most of the females have the head and few anterior segments dark red; then a band of white; then three or four bands of dark red, on the middle of the body, which are often confluent into a large dorsal spot of red or brown; these are followed by a broad white band or spot; the abdominal rings are alternately banded with red and white; part of the epimera are red. The antennæ and legs are more or less annulated and spotted with red. The eyes are black. In the male the color is generally reddish or purplish brown, but irregularly specked with darker brown, and with the intervals between the segments pale red.

Species of *Caprella* occur in considerable numbers, clinging, in grotesque attitudes, upon the delicate algæ and hydroids. The *Idotea irrorata*, (p. 316, Plate V, fig. 23,) is also very common, living among the algæ, and *Erichsonia filiformis* (p. 316, Plate VI, fig. 26,) is often associated with it.

The Annelids living upon such bottoms are difficult to obtain, since they mostly burrow beneath the stones or live in tubes attached to the rocks. The few species obtained are, with few exceptions, not different from those found in the sounds, on similar bottoms. The *Autolytus cornutus*, (p. 397, Plate XIII, figs. 65, 66,) and another species of the same genus were found in abundance, living in tubes attached to the fronds of *Laminaria* among hydroids, (*Obelia geniculata.*) On the same fronds were long, crooked tubes, formed of grains of sand and small bits of shells, belonging to *Nicolea simplex*, (p. 397.)

Burrowing in the corals of *Astrangia Danæ* we found, on the reef off Watch Hill, the singular Annelid named *Naraganseta coralii* by Dr. Leidy, who obtained his specimens at Point Judith. The specimens found by us were mostly very dark greenish brown or black, but some had dark, orange-colored branchiæ. The *Lepidonotus angustus*, *Phyllodoce gracilis*, *P. catenula*, and *Eumidia Americana* are new and interesting species. *Nereis fucata* occurs rarely.

Of Gastropods many species already enumerated as inhabitants of the rocky shores occur also on the rocky bottoms in abundance, but there are a number of additional species. One of the largest is the "whelk," *Buccinum undatum*, (Plate XXI, fig. 121.) This is a decidedly northern and arctic shell, found also on all the northern coasts of Europe, though several authors believe that the American and European shells are distinct species.

One of the most interesting of the northern shells that occur here is the *Leptochiton ruber*, (p. 399, Plate XXV, fig. 166.) This adheres to rocks and stones that are incrusted by the red nullipore *Lithothamnion polymorphum*, with which its red color, of various shades, agrees very closely. It is a far more abundant shell in the Bay of Fundy, where it also lives among the same nullipore. Among the other less common northern species, met with on these bottoms, are *Rissoa exarata; Lacuna neritoidea;* and *Astyris rosacea.*

Several very interesting species of naked mollusks (*Nudibranchs*) occur on these bottoms, creeping over algæ and hydroids, and feeding upon the latter. One of the most conspicuous of these is the *Dendronotus arborescens*, which is a northern form, and had not been found south of Cape Cod until this spring, when we dredged it on the reef off Watch Hill, in four or five fathoms. It can be easily distinguished by the two rows of large arborescently-branched gills along the back; by the branched lobes of the tentacle-sheaths and the arborescently divided branch on their outer side, near the base; and by the very narrow and almost linear foot, which is adapted for creeping over hydroids.

The *Onchydoris pallida* was dredged by Messrs. Prudden and Russell, off Cuttyhunk Island, in April, 1872. It has not been previously recorded from south of Cape Cod, but it is common in the Bay of Fundy. It can easily be recognized by its pale yellow color, and the long, blunt-conical papillæ that cover its back.

The *Æolis papillosa* and *Tergipes despectus* were both found at Watch Hill this spring, April 13, and are new additions to the fauna of southern New England. The former was found, with its eggs, among the roots of *Laminaria*; the latter was abundant in four or five fathoms, creeping over *Obelia geniculata*, which was abundant on the fronds of *Laminaria.* Its eggs, inclosed in small masses of gelatinous matter were attached to the *Obelia* in large numbers. The *Doto coronata*, (Plate XXV, fig. 170,) was associated with the *Tergipes* on the *Obelia.* An undetermined species of *Æolis*, with bright red branchiæ, was dredged off Gay Head, on a rocky bottom.

The Lamellibranchs are not of much interest, and scarcely any are peculiar to this kind of bottom. The *Modiola modiolus* (p. 309, Plate XXXI, fig. 237) is one of the most common and characteristic species. The northern scaly or spiny *Anomia aculeata* (Plate XXXII, figs. 239, 240) is common; it adheres to rocks, shells, and the roots and stems of large algæ.

Among the Ascidians there are several northern species, not before found so far south. The *Cynthia carnea* (Plate XXXIII, figs. 247, 248) was found off Gay Head in ten fathoms. The young specimens were numerous on the stones and shells. In contraction they are low and flat, with a thin margin; the color is light red, or flesh-color. With this a few young specimens of *Cynthia echinata* were found. These are peculiar in being covered by stellate spines. The color of the young specimens is pink, the apertures rose-red. The *Molgula papillosa* also occurred sparingly with the last two species. This is also a northern species, common in the Bay of Fundy. Among the compound Ascidians the only species found here that did not occur also in Vineyard Sound was *Amarœcium pallidum*, a small species, which forms small rounded or turbinated whitish masses, of a firm gelatinous appearance, but with fine grains of sand imbedded in the substance. It is a common species in the Bay of Fundy.

The Bryozoa are represented by numerous species, some of which are very abundant. The *Membranipora pilosa* (Plate XXXIV, figs. 262, 263) is one of the most abundant. It incrusts, and often entirely covers, the fronds of various algæ, especially of *Phyllophora Brodiæi*, *P. membranifolia*, *Rhodymenia palmata*, *Delesseria sinuosa*, &c. On the reef off Watch Hill it was particularly abundant on these and other algæ, shells, &c. It is easily distinguished by the single long spine at the proximal end of the cell, and by the shorter ones along the sides. With the preceding, *Crisia eburnea*, (p. 311, Plate XXXIV, figs. 260, 261;) *Tubulipora flabellaris*; *Cellepora ramulosa*, (p. 312;) and a species of *Discopora*, allied to *D. coccinea*, were very abundant, adhering to the more slender red algæ. A species of *Lepralia*, of a reddish color, and forming both incrusting and lichen-like corals, was common. In this the apertures of the cells are large, operculated, broadest proximally, and each one has a short, stout, conical spine at its proximal border, which is scarcely visible except in a profile view.

The *Bugula Murrayana*, which forms clusters of broad, thin, flexible fronds nearly two inches high, was dredged several times. It is very common in the Bay of Fundy. An incrusting species of *Alcyonidium*, perhaps identical with *A. gelatinosum* of Europe, occurred on the red algæ. A species of *Cellularia*, allied to *A. ternata*, was also obtained.

The Echinoderms are represented by the common green sea-urchin, *Strongylocentrotus Dröbachiensis*, (p. 406, Plate XXXV, fig. 268,) which is common off Gay Head, and as far as off New London, though far less abundant than in the Bay of Fundy; by the common red or purple star-fish, *Asterias vulgaris*, (p. 407,) which was abundant off Gay Head and on the reef off Watch Hill; *Cribrella sanguinolenta*, (p. 407,) which is not uncommon as far west as the Watch Hill reef, and off New London; and by the *Ophiopholis aculeata*, (Plate XXXV, fig. 270,) which was only once met with off Gay Head, but of which we dredged several specimens on the reef off Watch Hill. The last-named species is extremely abundant in the Bay of Fundy and northward, from low-water to the depth of more than one hundred fathoms.

The Hydroids are very numerous on the rocky and stony bottoms, attached to algæ, stones, shells, ascidians, &c. One of the most abundant is *Obelia geniculata*, (p. 407,) which grows on the fronds of *Laminaria*, *Rhodymenia*, and other algæ; it often nearly covers one or both sides of the broad fronds of *Laminaria*, for the distance of two or three feet, the creeping stems forming an intricate net-work from which the upright stems arise in great abundance to the height of an inch or more. This species was particularly abundant on the reef off Watch Hill, and those obtained on the 13th of April were loaded with the reproductive capsules, (gonothecæ.)

At the same place we obtained luxuriant specimens of *O. flabellata*, (p. 390,) some of which were eight or ten inches long and profusely branched; these also bore reproductive capsules at the same date.

The curious *Antennularia antennina* was dredged off Gay Head in eight fathoms, where a number of large and fine specimens were obtained. This species had not been previously recorded from America, but it is not uncommon in the Bay of Fundy.

The Alcyonoid Polyps are represented by the northern *Alcyonium carneum*, (Plate XXXVIII, fig. 283,) which we dredged off Gay Head, off Cuttyhunk, and on the reef at Watch Hill. This species grows up into lobed or arborescently branched forms, with the delicate, translucent polyps mostly clustered toward the ends of the branches. The general color is translucent, pale yellow, or salmon, sometimes more or less tinged with orange or red. Among the Actinoids there is a species of *Edwardsia*, (*E. lineata* V.,) which is as yet undescribed. It occurred in considerable numbers crowded into the openings and interstices between ascidians, worm-tubes, &c. It is peculiar in having no distinct naked basal portion, at least in the numerous specimens hitherto seen, for in all cases the rough epidermis extended entirely over the base. The tentacles are long, slender, thirty or more, and each usually has a flake-white line down the center. The disk is usually marked with radiating white lines. This species was dredged off Gay Head and also on the reef off Watch Hill.

The Sponges are numerous on the outer rocky bottoms, and belong to about a dozen species, most of which are still undetermined; but they are nearly all northern forms, common in the Bay of Fundy.

One of the most common is the *Chalina oculata*, which forms thick, upright, more or less flattened stalks, which, as they grow larger, fork and divide into more or less numerous, and often digitate branches, which vary greatly in form and thickness; scattered over the surface are round orifices, about a tenth of an inch in diameter. The color is dull orange-red, when living, but the color disappears when the animal matter is removed, leaving the sponge white. The texture is open and quite delicate. Another very curious species, (*Polymastia?*) when young, forms yellowish white incrustations over stones and shells; later, it rises at several points into long, slender, round, tapering, finger-like prolongations, which do not branch, but are often so grouped as to give a digitate appearance to the whole. This was dredged off Gay Head in 18 to 20 fathoms, and is also common in the Bay of Fundy. One of the most abundant species of this region forms very irregularly shaped, uneven, pale yellow masses, attached to the stems and fronds of *Phyllophora* and other small algæ, and often, as it grows larger, spreading over and entirely covering and destroying the algæ. The large openings (oscula) are irregularly scattered over the surface and quite unequal in size, varying from less than .05 to .10 of an inch or more in diameter. The texture is rather close when dried, showing a finely reticulated texture at the surface. This appears to belong to the genus *Tedania*. Another species, apparently of the same genus, occurs with the last, and has the same habits, but its color is pale buff, or yellowish white, and its texture is much firmer and more compact. Another species, occurring with the last two on the *Phyllophora*, at Watch Hill, forms small, irregular, deep yellow masses, of a soft and somewhat gelatinous consistency.

Foraminifera of several species are abundant, attached to the fronds of the red algæ, to the rough integument of Ascidians, to stones, shells, worm-tubes, &c., but they have not yet been identified.

List of species inhabiting the stony and rocky bottoms on the open coast.

ARTICULATA.

Crustacea.

	Page.		Page.
Cancer irroratus	493	Mœra levis	315
C. borealis	493	Amphithoë maculata	493
Libinia canaliculata	339	Unciola irrorata	493
Eupagurus longicarpus	313	Cerapus rubricornis	565
E. Bernhardus	501	Podocerus fucicola	493
Homarus Americanus	492	Podocerus, species	494
Crangon vulgaris	493	Caprella, species	494
Hippolyte pusiola	493	Idotea irrorata	494
Pandalus annulicornis	493	I. phosphorea	316
Lysianassinæ, (one species)	431	Erichsonia filiformis	494
Pontogeneia inermis	452	Balanus crenatus	396

Annelids.

	Page.		Page.
Lepidonotus squamatus	320	Clymenella torquata	343
L. Augustus	494	Naraganseta coralii	494
Harmothoë imbricata	321	Sabellaria vulgaris	321
Phyllodoce gracilis	494	Polycirrus eximius	320
P. catenula	494	Nicolea simplex	494
Eumidia Americana	494	Potamilla oculifera	322
Autolytus cornutus	494	Sabella microphthalma	323
Autolytus, species	494	Spirorbis spirillum	323
Nereis pelagica	319	S. perrecta ?	504
N. fucata	494	Serpula dianthus	322
Lumbriconereis fragilis	501		

Nemerteans and Planarians.

	Page.		Page.
Nemertes, species	505	Leptoplana folium	487

MOLLUSCA.

Gastropods.

Lamellibranchs.

Ascidians.

Bryozoa.

RADIATES.

Echinoderms.

	Page.
Strongylocentrotus Dröbachiensis	496
Asterias vulgaris	496
A. arenicola	326
Cribrella sanguinolenta	496
Ophiopholis aculeata	496

Acalephs.

	Page.
Clytia Johnstoni	408
C. intermedia	408
Orthopyxis caliculata	408
Platypyxis cylindrica	408
Campanularia volubilis	408
C. flexuosa	327
Obelia geniculata	496
O. dichôtoma	407
O. flabellata	497
O. diaphana	327
Sertularia argentea	408
S. cupressina	408
Hydrallmania falcata	408
Plumularia, species	407
Antennularia antennina	497
Eudendrium ramosum	408
E. dispar	408
Pennaria tiarella	327
Thamnocnidia tenella	407
Hydractinia polyclina	328

Polyps.

	Page.
Alcyonium carneum	497
Metridium marginatum	329
Edwardsia lineata	497
Astrangia Danæ	408

PROTOZOA.

Sponges.

	Page.
Chalina oculata	497
Tedania, two species	498
Renieria, species	330
Cliona sulphurea	421
Polymastiá (?)	497
Grantia ciliata	330
Leucosolenia botryoides (?)	391

IV. 4.—FAUNA OF THE SANDY AND GRAVELLY BOTTOMS OFF THE OPEN COAST.

The bottom off the southern shores of Nantucket and Martha's Vineyard is sandy or gravelly over large areas, from low-water mark down to 25 fathoms or more. Tracts of similar bottom occur off Cuttyhunk Island and farther west. In many of these places, especially in the shallower waters, near shore, the material of the bottom is nearly pure siliceous sand, varying in fineness from coarse gravel to the finest sand, and as these sands are generally loose and moved by the storm-waves, in shallow water, their inhabitants are but few. In deeper water, at depths of 20 to 25 fathoms or more, the material is usually a very fine sand, often firmly compacted, and not infrequently mixed with more or less fine mud. Such localities are favorable for a much greater variety of animals, and especially for many burrowing annelids, crustacea, and bivalve shells. Bottoms of this character pass by insensible gradations into the true muddy bottoms, so that it is very difficult to make any sharp distinction between them, or between the animals that inhabit them. Several localities at which we dredged were quite intermediate in character, so that it is difficult to decide in which division they should be put. Yet there is a very wide difference between the animals of the pure sandy and of the soft muddy bottoms. Most of the localities where the bottom was of this mixed or intermediate character, and of very fine material, have been classed with the muddy bottoms, because the animals inhabiting them agree more closely with those of the true muddy bottoms than with those of the genuine sandy ones. But in each case I shall endeavor to give an idea of the fauna of typical localities of pure sand, of true mud, of muddy sand, and of sandy mud, so that the more general lists given under the sandy and muddy bottoms, respectively, need not cause confusion.

The special localities where dredgings were made on sandy bottoms are as follows: line 80, *a*, 16½ fathoms, siliceous sand; *b*, 18½ fathoms, siliceous sand; 81, *a*, *b*, 16½ fathoms, sand; 85, *a*, *b*, 15½ fathoms, siliceous sand and gravel; 86, *a*, *b*, 25 fathoms, sand and gravel, with some mud and small stones; off Watch Hill, 6 to 8 fathoms, loose siliceous sand, with some stones. Besides these a few other dredgings were made on similar bottoms, but not recorded.

Among the Crustacea that are characteristic of the true sandy bottoms are *Platyonichus ocellatus*, (p. 388, Plate I, fig. 4,) which is, however, more common in the sounds; *Eupagurus Bernhardus*, a decidedly northern hermit crab; *Crangon vulgaris*, (p. 339, Plate III, fig. 10;) *Ptilocheirus pinguis; Idotea Tuftsii.* Where the bottom is of loose siliceous sand, the common *Unciola irrorata* (p. 340, Plate IV, fig. 19) frequently occurs, usually associated with but few others, except a species of *Anonyx*, or some closely allied genus, which seems to live exclusively on such bottoms. This last species is rather stout, pale grayish or yellowish white, usually tinged with purple on the back The posterior portion is more decidedly purple, together with the caudal appendages and some of the last epimera. This was dredged off Watch Hill.

Several interesting species occurred on the bottoms of fine compact mud and sand, in 20–29 fathoms. Among these were *Phoxus Kroyeri*, which is a northern species; *Siphonœcetes cuspidatus* SMITH, an undescribed species; *Byblis serrata* SMITH, another very interesting new species; undetermined species of *Ampelisca*, &c.

Few Annelids are peculiar to true sandy bottoms. Among those of most interest are *Sthenelais picta* V., (p. 348;) *Lumbriconereis fragilis*, a northern and European species; *Anthostoma acutum* V.; and *Scolecolepis cirrata.* The last is a northern species found in the Bay of Fundy and north to the Arctic Ocean, and also on the northern coasts of Europe.

The color is chocolate-brown, with bright red, ligulate, dorsal branchiæ on the anterior third of the body. The two large tentacles exceed in length three times the breadth of the body; they are often coiled up, and are greenish in color. This worm is three or four inches long.

A large purple *Meckelia* (*M. lurida* V.) was dredged in two localities.

Among the Mollusks there are but few species that are characteristic of these bottoms, and probably none that are peculiar to them, unless some of the Ascidians should prove to be so. The *Molgula arenata* (p. 426, Plate XXXIII, fig. 251) is often common even on loose siliceous sand and gravel, with which it forms a coating over its body. The *Molgula producta* was dredged in some numbers on a bottom of fine sand, with some mud. The integument is thin, translucent, closely covered with a layer of fine sand; the tubes are transparent, whitish or flesh-color, sometimes pink at the ends; anal tube with four, and branchial with six, flake-white, longitudinal stripes, and often with a circle of flake-white spots at the base outside, and other spots within. The anal orifice is square, but the branchial is either subcircular or squarish, in expansion, and destitute of distinct lobes or papillæ, in this respect differing from all the other species of the genus. The branchial tube is generally a little the longest, and both of them are somewhat tapered, with a swollen base.

The *Glandula arenicola* is another nearly globular Ascidian, which lives, like the two preceding, free in the sand, and covers itself with a closely-adherent coating of sand. This species grows to be about half an inch in diameter, and can easily be distinguished from the last by its much smaller tubes, both of which have small square orifices, and by its thicker and firmer integument, in which the sand appears to be somewhat imbedded. At the base there are some slender fibers for anchoring it more securely in the sand. This was dredged by Mr. Prudden, off Cuttyhunk Island, in 1872. Messrs. Smith and Harger dredged it in great abundance last year on St. George's Bank, on a bottom of clear siliceous sand, in 28 fathoms. Dr. Dawson has also dredged it in Murray Bay, in the St. Lawrence River. It is, therefore, a decidedly northern species.

Another species of *Glandula* also occurred on the true sandy bottoms. The specimens of this were all small, mostly less than a fifth of an inch in diameter, and the integument was densely covered by rather coarse and very firmly adherent grains of sand, in several layers; the sand completely concealed the tubes from view in all the specimens observed, and it was not sufficiently studied while living to afford an accurate description.

The Bryozoa and Hydroids that are found on the sandy bottoms are mostly attached to dead shells and small stones that are scattered over the surface.

Of Echinoderms several species occur on the hard bottoms of fine, compact sand, or sandy mud, but most of these are more at home on rocky bottoms.

On the bottoms of loose siliceous sand the *Echinarachnius parma* (p. 362, Plate XXXV, fig. 267) is often very abundant. Several hundred are sometimes obtained at a single cast of the dredge. At locality 81, *b*, off the south coast of Martha's Vineyard, in 21 fathoms, on a bottom of clear siliceous sand, Dr. A. S. Packard dredged a fine specimen of a rare and little known Holothurian, the *Stereoderma unisemita*. This has not been found before, so far as known to me, since the two original specimens were described twenty years ago. One of those was from the Banks of Newfoundland, and the other was supposed to have been from off Massachusetts Bay. As both the original specimens appear to have been lost or destroyed, this rediscovery was of considerable interest. This specimen was about three inches long, and half an inch in diameter, fusiform, tapering to each end; the body and suckers were pale flesh-color, and the integument is filled with a great abundance of small calcareous plates.

Most of the Polyps and Sponges that occur on these sandy bottoms are attached to the scattering dead shells and small stones or pebbles, and belong properly on the rocky and stony bottoms. One large and fine sponge seems, however, to be peculiar to the sandy bottoms. This is a firm, siliceous sponge, with a very compact and fine texture. It is quite irregular in shape, but often grows in the form of elongated, compressed masses, attached by one edge; these masses are often six inches or more in length and one or two in thickness, and perhaps two or three high. Some of the largest specimens consist of two or three such crest-like plates or lobes attached together at base. When living the color is bright sulphur-yellow or lemon-yellow, and the surface is nearly smooth. One fine living specimen, of large size, was dredged by Dr. Packard off the southern shore of Martha's Vineyard, at locality 80, *b*, on a bottom of clear siliceous sand. Numerous specimens were also found thrown on Edgartown beach. These were mostly bleached out white and more or less worn. This species has not yet been identified. I have specimens of it from the coast of Virginia.

A very curious organism, of which the nature is still uncertain, but which was supposed, at the time it was taken, to belong to the sandy Foraminifera, was often extremely abundant in the clear siliceous sand. They were nearly circular, somewhat flattened or biscuit-shaped, and entirely covered by adherent grains of sand, except that there were several dark-colored, hook-like processes projecting from the circumference. The size was generally less than a fifth of an inch in diameter, and more frequently not more than .12 to .15 of an inch. When dried they became very friable, and the sand fell asunder at a slight touch, so that they then appeared like mere lumps of sand, but they retain their firmness when preserved in alcohol. They were often so abundant in the fine sand that when a dredge-full was washed through a moderately fine sieve several hundreds or thousands would sometimes remain in the sieve.

List of species inhabiting sandy and gravelly bottoms.

In the following list I have included nearly all the species that ordinarily occurred on those bottoms in which sand predominated, even though some of them are more strictly muddy-bottom species. Others belong more properly on rocky, stony, or shelly bottoms, but are introduced here because they occur attached to the scattered shells and stones that are always liable to be met with on sandy bottoms.

In order to designate those species that are more strictly characteristic of the clear sandy bottoms, I have prefixed to them a dagger, (thus: †.) To show the character of the fauna on the bottoms of mixed or intermediate character, I have selected a single locality, 86, *b*, southwest of Cuttyhunk Island and opposite the mouth of Buzzard's Bay, where the depth was twenty-five fathoms, and the bottom consisted of fine sand mixed with some mud and gravel, with a few small scattered stones, and have prefixed an asterisk (thus: *) to such species as occurred at that particular locality, though most of them occurred also at other localities.

ARTICULATES.

Crustacea.

	Page.		Page.
†Cancer irroratus	312	*Phoxus Kroyeri	501
C. borealis	493	*Ampelisca, sp	507
Panopeus depressus	312	Byblis serrata	501
†Platyonichus ocellatus	501	Mœra levis	315
Hyas coarctatus	548	*†Unciola irrorata	501
†Eupagurus pollicaris	313	*Ptilocheirus pinguis	501
†E. Bernhardus	501	†Anonyx (?), sp	501
†Homarus Americanus	492	*Siphonœcetes cuspidatus	501
*Pandalus annulicornis	493	†Idotea Tuftsii	501
†*Crangon vulgaris	501	Epelys montosus	370
*Diastylis quadrispinosa, and other species of Cumacea	507		

Annelids.

	Page.		Page.
Lepidonotus squamatus	320	†*Scolecolepis cirrata	501
*Harmothoë imbricata	321	*Ampharete gracilis	508
†Sthenelais picta	501	†*Clymenella torquata	343
*Nephthys ingens	431	*Nicomache dispar	512
Phyllodoce catenula	494	*Ammochares, sp	508
Nereis plagica	397	*Trophonia affinis	507
*Ninoë nigripes	508	*Ammotrypane fimbriata	508
†Lumbriconeris fragilis	501	*Cistenides Gouldii	323
*Rhynchobolus dibranchiatus	341	*Potamilla oculifera	322
†Anthostoma acutum	501	*Euchone elegans	433
		*Spirorbis porrecta?	498

Nemerteans and Planarians.

	Page.		Page.
*Meckelia lurida	502	*Leptoplana folium	487
Nemertes, (?) red sp.	498		

Sipunculoids.

	Page.
*Phascolosoma cæmentarium	416

MOLLUSCA.

Gastropods.

	Page.		Page.
*Neptunea pygmæa	508	Crepidula fornicata	355
Buccinum undatum	494	C. unguiformis	355
Astyris lunata	306	†Lunatia heros	426
Anachis avara	306	Rissoa exarata	495
†*Tritia trivittata	354	*Margarita obscura	508
*Crucibulum striatum	417		

Lamellibranchs.

	Page.		Page.
†Mya arenaria, (young)	472	†Astarte castanea	432
†*Ensatella Americana	356	†A. quadrans	509
†Siliqua costata	358	*A. undata	508
Corbula contracta	418	†*Cyclocardia borealis	418
Clidiophora trilineata	432	†*C. Novangliæ	418
*Lyonsia hyalina	358	*Yoldia sapotilla	509
*Periploma papyracea	509	*Nucula proxima	432
Cochlodesma Leanum	418	Scapharca transversa	309
†Angulus tener	358	*Modiolaria corrugata	509
*Cumingia tellinoides	418	Pecten tenuicostatus	509
*Callista convexa	432	Anomia aculeata	495
*Cardium pinnulatum	423		

Ascidians.

	Page.		Page.
*Cynthia partita	311	†Glandula arenicola	502
†Molgula arenata	502	†Glandula, sp.	502
†*M. producta	502	*Amarœcium pallidum	496
*M. Manhattensis	311		

Bryozoa.

	Page.		Page.
*Crisia eburnea	311	Bugula Murrayana	496
*Caberea Ellisii	420	*Cellepora ramulosa	312

RADIATA.

Echinoderms.

	Page.		Page.
†Stereoderma unisemita	503	Asterias vulgaris	496
†*Echinarachnius parma	503	*Cribrella sanguinolenta	407
Strongylocentrotus Dröbachiensis	406	Ophiopholis aculeata	496

Acalephs.

	Page.		Page.
*Platypyxis cylindrica	408	*Plumularia, sp	407
*Clytia Johnstoni	408	Hydractinia polyclina	328
Eudendrium ramosum	408		

Polyps.

	Page.		Page.
Edwardsia lineata	497	Alcyonium carneum	497

PROTOZOA.

Sponges.

	Page.		Page.
Chalina oculata	497	†Massive siliceous sponge	503
Polymastia (?)	497		

IV. 5.—Fauna of the muddy bottoms off the open coast.

Within the depths to which our dredgings extended, very few true muddy bottoms occur. The deposits of mud on the open coast usually begin to occur only at the depths of twenty-five to thirty fathoms, and even at these depths there is a considerable admixture with fine siliceous sand. The central and deeper portion of the depression in line with the axis of Vineyard Sound is, however, occupied off to the west of Gay Head and No Man's Land by a deposit of fine, soft, sticky mud, filled with the tubes of Annelids and Amphipods, (*Ampelisca*, &c.) Dredgings were made on this bottom at localities 85, *c*, in 18 fathoms; *d*, 19 fathoms; *e*, 11 fathoms. On September 9, the temperature at 85, *c*, was 58° Fahrenheit at the bottom, and 62° at the surface; at *d*, it was 57° at the bottom and 62° at the surface; at *e*, it was 59° at the bottom and 63° at the surface. This muddy bottom abounded in Annelids, small Crustacea, and bivalve shells.

In several other localities, where the bottom was a mixture of mud and fine sand, the mud seemed to predominate and to determine the character of the life, so that such localities have been classed with the muddy bottoms, though the fauna differed considerably from that of the soft muddy bottoms referred to above. In the following list, however, I have specially designated the species found in the typical localities of each kind.

The principal localities where we dredged on the bottoms of fine sandy mud are as follows: 80, *c*, south of Martha's Vineyard, in 21 fathoms; 84, *b*, southwest of Gay Head, in 16 fathoms; 87, *a*, *b*, about fifteen miles east of Block Island, in 29 fathoms. At the last locality the temperature, on September 14, was 62° F. at the surface, and 59° at the bottom.

Among the Crustacea none was more abundant on the soft, muddy bottoms than a small species of *Ampelisca*, which inhabits soft, flabby tubes, covered with fine mud. When taken out of the water these tubes are always collapsed and flat, and they were so abundant in the mud that it was almost impossible to wash it through the sieves, because they soon became completely clogged up with the tubes. When a quantity of the mud was left in a bucket of water these Crustacea would come out of the tubes and rise to the surface in large numbers. This species is generally quite pale, or nearly white. Its body is much compressed.

Another variety, or perhaps a distinct species, found with the last, is pale flesh-color, with a row of bright red spots along the middle of the back; the antennæ were specked with red; eyes bright red; epimera reticulated with red lines; and the legs and caudal appendages are more or less marked with red.

The *Unciola irrorata*, (p. 340,) *Ptilocheirus pinguis*, and other Amphipods, were associated with the preceding species.

The *Diastylis quadrispinosa* (Plate III, fig. 13) was very abundant on the soft muddy bottoms, together with other species of Cumacea, not yet identified. It is pale flesh-color, with a reddish purple patch at the posterior part of the carapax, and two small spots of pink.

The Annelids were very numerous, both on the soft muddy bottoms and in the sandy mud. One of the most conspicuous species is the *Aphrodita aculeata*, which was common in the soft mud. This is a large, stout Annelid, the largest specimen obtained measuring about 3 inches in length, and about half as much in breadth. It is remarkable for the exceedingly numerous and long setæ of many kinds, which cover its sides and back, except along a narrow dorsal space; some of these setæ are stout, and nearly an inch long, with sharp points, and barbed near the end, and they curve over the back much like the quills of a porcupine, and are liable to inflict painful wounds, if the creatures are carelessly handled. These setæ usually reflect bright, iridescent colors.

Several other northern European species, found also in the Bay of Fundy and at Saint George's Banks, were also met with. Among these were *Lumbriconereis fragilis*, *Scolecolepis cirrata*, *Melinna cristata*, *Terebellides Stroëmi*, and several more common species.

The *Nephthys ingens* (p. 431, Plate XII, figs. 59–60) is a very abundant species on these bottoms and grows to a large size.

The curious *Sternaspis fossor* (Plate XIV, fig. 74) is quite common; and the *Trophonia affinis* (Plate XIV, fig. 75) was dredged several times.

Many other species were also common, or even abundant, in the various localities, and quite a number proved to be undescribed, and therefore their descriptions will be found in the systematic catalogue accompanying this report. Among these were *Lycidice Americana*, *Ninoë nigripes*, *Anthostoma*, sp., *Acutum*, *Ammotrypane fimbriata*, *Travisia carnea*, Eone gracilis, *Brada setosa*, *Nicomache dispar*, *Rhodine attenuata*, a species of *Ammochares*, *Ampharete gracilis*, *Euchone elegans*, and a species of *Nematonereis*.

Several species of *Nemerteans* also occur on these bottoms. The largest and most interesting is a large species of *Meckelia*, (*M. lurida*, V.) This grows to the length of 8 or 10 inches, and .25 broad; its color is deep chocolate-brown, with paler margins. It generally breaks up into numerous fragments when caught. Another species, belonging, perhaps, to the genus *Cerebratulus*, but not sufficiently studied while living, was 2 or 3 inches long in extension, and .05 to .08 of an inch broad. Its color was dark olive-green, darkest anteriorly, the head with a white margin. The lateral fossæ of the head were long and deep; the eyes incon spicuous, perhaps wanting; proboscis emitted from a terminal pore; the ventral orifice, or mouth, placed well forward. Both this and the preceding were found at the 29-fathom locality, in sandy mud, but the former also occurred in soft mud, in 19 fathoms.

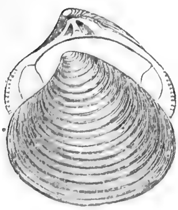
One of the most abundant Gastropods is *Neptunea pygmæa*, (Plate XXI, fig. 115,) which is a rather northern shell, very common in the Bay of Fundy. The specimens from this region are, however, quite as large as any that I have seen from farther north. The small disk-shaped egg-capsules of this shell were found in great abundance early in September attached to various bivalve shells, as well as to the shells of the *Neptunea* itself.

Buccinum undatum, (Plate XXI, Fig. 121;) *Bela harpularia*, (Plate XXI, fig. 108;) *Lunatia immaculata*, (Plate XXIII, fig. 131;) *Margarita obscura*, (Plate XXIV, fig. 156;) *Astyris rosacea;* and *Cylichna alba*, (Plate XXV, fig. 163,) are all northern shells, which were met with in small numbers on the muddy bottoms.

The Lamellibranchs were quite abundant. One of the most conspicuous is the northern *Cyprina Islandica*, (Plate XXVIII, fig. 201,) which was quite common at several localities, especially in soft mud.

Many of the shells from the deeper dredgings in this region are northern and even arctic species, several of which have been supposed not to occur south of Cape Cod. Among these northern forms are *Macoma proxima*, of which we dredged a few small specimens; *Cyclocardia borealis* and *C. Novangliæ* (p. 418,) both of which were common; *Astarte undata*, (Plate XXIX, fig. 203,) which was dredged in considerable abundance at several localities. A large proportion of the shells of this species, obtained here, were quite different in appearance from the varieties that occur in such abundance in the Bay of Fundy. The latter,

Fig. 3.



although quite variable in form and sculpture, are generally compressed; those from this region are mostly rather swollen, and often decidedly obese. These correspond with the type-specimen of *A. lutea* PERKINS, from New Haven, (fig. 3,) which I have been able, through the kindness of Dr. Perkins, to compare directly with our specimens. This form is, perhaps, sufficiently well marked to be designated a sa variety, *(lutea,)* but many specimens intermediate between this and the ordinary forms occurred. This variety resembles the European *A. sulcata* more closely than do any of the other varieties of our species, but in the character of the hinge, lunule, beaks, and sculpture, it differs decidedly from any European specimens that I have seen. The *Astarte quadrans* (Plate XXIX, fig. 205) was rarely met with. Good-sized specimens of the large scollop, *Pecten tenuicostatus*, were dredged off Gay Head on hard bottoms, and also on the muddy bottom, in 29 fathoms, and in several other localities. The northern *Anomia aculeata* (Plate XXXII, figs. 239, 240) occurred adhering to dead shells. The *Modiolaria corrugata* (Plate XXXI, fig. 235) was dredged several times in the deepest localities, but *M. lævigata*, recorded by Mr. Sanderson Smith, was not met with by us; nor *Leda tenuisulcata*, which has been found off Newport, Rhode Island. The *Nucula delphinodonta* (Plate XXX, fig. 229) was common on soft muddy bottoms. The *Lucina filosa* (Plate XXIX, fig. 212) appeared to be not uncommon on similar bottoms, but most of the specimens obtained were less than an inch in diameter. Small specimens of *Periploma papyracea* (Plate XXVII, fig. 197) were frequently dredged. The specimens of *Thracia truncata* (Plate XXVII, fig. 195) were few and small. The *Cryptodon obesus* V., (Plate XXIX, fig. 214,) was first discovered in this region, but all the specimens were of large size and dead, though mostly quite fresh. I have since seen smaller specimens from Labrador, &c. *C. Gouldii* (Plate xxix, fig. 213,) is more common. *Yoldia sapotilla* (Plate XXX, fig. 231) was generally abundant, especially in the soft mud, but *Y. obesa* was only met with once, and in small numbers, in 29 fathoms; *Y. thraci-formis* we did not meet with, but Dr. Simpson records it from off Long Island.

Of Ascidians very few species occur. The most abundant is *Eugyra pilularis*, (Plate XXXIII, fig. 249,) which, in contraction, looks like a round ball of mud, for it completely covers itself with a thick coating of fine sand or mud, which is held in place partly by delicate fibrous processes from the integument, those from the base being longer, and serving to anchor the little creature in the sand by attaching a considerable quantity of sand to themselves. When the sand is removed, the integument is found to be thin and quite translucent, the tubes, when extended, are long and transparent, close together, and inclosed by a naked band which surrounds the base of both. It is also very

Figure 3. Original figure of *Astarte lutea*, natural size. From the Proceedings of the Boston Society of Natural History.

common in the Bay of Fundy, &c. The *Molgula producta* (p. 502) also occurred on the sandy mud at the 29-fathom locality.

The Echinoderms appear to be very scarce on these bottoms. The only one of special interest was the *Molpadia oölitica*, a small, round, rather slender species, about an inch and a half long, of a uniform flesh-color. Of this only one specimen was dredged, at the 29-fathom locality, fifteen miles east of No Man's Land, by Dr. Packard. It had not been observed alive before, the only specimens previously known having been taken from the stomachs of fishes.

The most interesting Hydroid that lives on the muddy bottoms is *Corymorpha pendula*, (Plate XXXVI, fig. 273.) This is a very beautiful species, which grows singly, with the bulb-like base of the stem inserted into the mud.

Two interesting species of Polyps were found on the muddy bottoms. One of these, the *Edwardsia farinacea*, occurred only on the soft muddy bottom off Gay Head, in 19 fathoms. It is a cylindrical species, about an inch long, and .10 or .12 of an inch in diameter, remarkable for having only 12 tentacles, which are equal, unusually short, thick, and blunt. The coating of mud in the middle region is thin and easily removed.

The single specimen obtained here had only 10 tentacles, but in other respects it agrees essentially with those found on similar bottoms at several localities in the Bay of Fundy, all of which had 12 tentacles. The body is whitish or flesh-color, the naked portion below the tentacles; in the specimen from off Gay Head, was striped with 10 longitudinal lines or bands of brown, corresponding with the tentacles; these bands were varied with flake-white specks and mottlings, the spots of white becoming more distinct near the tentacles; these bands were alternately lighter and darker. Tentacles translucent at tip, tranversely barred on the inside, with about five brown bands and spots, the lower ones often V-shaped or W-shaped, and some of them extend around to the outside of the tentacles; alternating with these brown bands were bars and spots of yellow and of white. The disk was pale yellow, varied with small brown spots, mostly forming radiating rows from the mouth to the bases of the tentacles, and there were two spots of brown between the bases of adjacent tentacles; mouth with ten lobes, which were also brown, with a fine light line extending from between them to the intervals between the tentacles. The specimens from the Bay of Fundy vary considerably in color, but the above is one of the more frequent styles of coloration.

The *Epizoanthus Americanus* (Plate XXXVIII, figs. 286, 287) is a very singular species, which either lives attached to stones, as in the deeper parts of the Bay of Fundy and off Saint George's Bank, in 430 fathoms, or else it attaches itself to univalve shells, inhabited by hermit-crabs. All those obtained in this region had the latter habit, and were from the 29-fathom place, fifteen miles east of Block Island, on sandy mud. After one original young polyp has found lodgment and attached itself to the shell, its base begins to expand over the surface of the shell, and from this basal membrane buds arise, which soon grow larger and become like the parent polyp, while the basal membrane continues to extend itself and new buds to develop, until the whole shell becomes incrusted by the membrane, inside and out, while a number of beautiful polyps arise from the upper side of the shell, and turn their mouths in different directions. The number of the polyps in these colonies varies, according to the size of the shell, from three to ten or more. Finally, by some chemical process, the polyps, or rather their basal membranes, dissolve the shell entirely, and apparently absorb it into themselves. And yet the membranes retain the spiral form of the shell very perfectly, and the hermit crab eventually actually lives inside the membranes of the polyps, which continue to grow and even to enlarge the chamber for the use of the crab, so that it need not change its habitation for a larger one as it grows older. When fully expanded these polyps are about an inch high, and are capable of changing their form considerably, but they are generally more or less cylindrical, or else hour-glass shaped. There are 38 or more tentacles, in full grown ones, and they are subequal, long, slender, acute, arranged in two close circles, and usually held in a recurved position, (as in fig. 287,) with those of the outer circle more recurved than those of the inner ones; corresponding with the bases of the alternate tentacles there is an outer circle of triangular points or lobes, covered externally, like the rest of the exterior of the body, with adherent and imbedded grains of fine sand. The mouth is bilabiate, often somewhat raised on a conical protrusion of the disk, the lips many-lobed, or plicate. The integument of the body when fully expanded is translucent, pale flesh-color, or salmon-color; disk and tentacles salmon-color, or pale orange, sometimes white, the lips and inside of the mouth brighter orange.

List of species inhabiting bottoms composed of soft mud and sandy mud off the outer coast.

In the following list those species that were found on the soft, sticky mud, in 11 to 19 fathoms, off Gay Head, are designated by the sign ‡, prefixed to their names. Those that occurred at 87, *a*, *b*, in 29 fathoms, fine sandy mud, fifteen miles east of Block Island, are designated by an asterisk prefixed.

ARTICULATA.

Crustacea.

	Page.		Page.
‡ Libinia canaliculata	339	* ‡ Ampelisca, sp	507
Eupagurus longicarpus	313	* Byblis serrata	501
* Pandalus annulicornis	493	* ‡ Ptilocheirus pinguis	507
Hippolyte pusiola	395	* ‡ Unciola irrorata	507
Crangon vulgaris	339	* Siphonœcetes cuspidatus	501
* ‡ Diastylis quadrispinosa	507	‡ Epelys montosus	370
Phoxus Kroyeri	501	E. trilobus	370
* Mœra levis	315	Anthura brachiata	573

Annelids.

	Page.
* ‡ Aphrodita aculeata	507
* Harmothoë imbricata	321
Lepidonotus squamatus	320
* ‡ Nephthys ingens	507
N. bucera	416
‡ Eumidia, sp	397
Phyllodoce, sp	397
* Nereis pelagica	397
‡ Lycidice Americana	508
* ‡ Lumbriconereis fragilis	507
* Nematonereis, sp	508
* Ninoë nigripes	508
‡ Eone gracilis	508
‡ Anthostoma acutum	508
Anthostoma, sp	508
* Scolecolepis cirrata	507
‡ Ammotrypane fimbriata	508
‡ Travisia carnea	508
Brada setosa	508
* ‡ Trophonia affinis	507
‡ Sternaspis fossor	507
* Cirrhinereis fragilis	397
* ‡ Clymenella torquata	343
* Ammochares, sp	508
* Nicomache dispar	508
Rhodine attenuata	508
Cistenides Gouldii	323
* Ampharete gracilis	508
Melinna cristata	507
* Terebellides Stroëmi	507
‡ Polycirrus eximius	320
Potamilla oculifera	322
* ‡ Euchone elegans	508
* Spirorbis, sp	397

Nemerteans and Planarians.

	Page.
* ‡ Meckelia lurida	508
Cerebratulus, (?) green sp	508
* Polinia glutinosa	324
* Leptoplana folium	487

Sipunculoids.

	Page.
* ‡ Phascolosoma cæmentarium	416

MOLLUSCA.

Gastropods.

	Page.
Bela harpularia	508
‡ Buccinum undatum	508
* ‡ Neptunea pygmæa	508
* Tritia trivittata	354
Astyris lunata	306
* Astyris rosacea	508
* Crucibulum striatum	399
Crepidula unguiformis	355
C. fornicata	355
* Lunatia heros, var. triseriata	354
* L. immaculata	508
* Margarita obscura	508
* Cylichna alba	508

Lamellibranchs.

	Page.
Ensatella Americana	356
* Siliqua costata	358
‡ Corbula contracta	418
* ‡ Clidiophora trilineata	432
* ‡ Lyonsia hyalina	358
* ‡ Periploma papyracea	509

	Page.
* ‡ Thracia truncata	509
Angulus tener	358
* Macoma proxima	508
Cumingia tellinoides	418
* ‡ Callista convexa	432
* ‡ Cyprina Islandica	508
* ‡ Cardium pinnulatum	423
* ‡ Lucina filosa	509
* Cryptodon Gouldii	509
* ‡ C. obesus	509
* ‡ Astarte castanea	432
‡ A. quadrans	509
* ‡ A. undata	508
* Cyclocardia borealis	508
* C. Novangliæ	508
* ‡ Nucula proxima	432
* ‡ N. delphinodonta	509
‡ Yoldia limatula	432
* ‡ Y. sapotilla	509
Y. thraciformis	509
* Y. obesa	509
Leda tenuisulcata	509
Argina pexata	309
Scapharca transversa	309
Mytilus edulis	307
* ‡ Modiolaria nigra	433
M. corrugata	509
M. lævigata	509
* ‡ Crenella glandula	418
* ‡ Pecten tenuicostatus	509
* Anomia aculeata	509

Ascidians.

	Page.
* ‡ Eugyra pilularis	509
* Molgula producta	510
Cynthia partita	311

Bryozoa.

	Page.
* Caberea Ellisii	420
* Bugula Murrayana	496

RADIATA.

Echinoderms.

	Page.
* Molpadia oölitica	510
Strongylocentrotus Dröbachiensis	406
‡ Asterias vulgaris	496
‡ Cribrella sanguinolenta	407

Acalephs.

	Page.
* Clytia Johnstoni	408
* Eudendrium ramosum	408
* Corymorpha pendula	510

Polyps.

	Page.
‡ Edwardsia farinacea	510
* Epizoanthus Americanus	510

B.—LISTS OF SPECIES FOUND IN THE STOMACHS OF FISHES—FOOD OF FISHES.

In the following lists I have brought together the principal results of the various recorded examinations of stomachs of fishes in this region, up to the present time, whether done in connection with the United States Fish Commission or independently. The special dates and localities are given in each case.

The observations from June to September, 1871, were made in connection with the work of the commission. Those from May to July, 1872, are based on collections made at Wood's Hole by Mr. Vinal N. Edwards, for Professor Baird. Those at Great Egg Harbor, New Jersey, April, 1871, were made by Mr. S. I. Smith and the writer while on an independent visit to that place.* The observations made at Eastport, Maine, in 1872, are not included in this report.

The names of the fishes used in this list are those adopted by Professor Baird, and agree, for the most part, with those used by Professor Theodore Gill in his Catalogue of the Fishes of the Eastern Coast of North America.

STRIPED BASS; ROCK-FISH, OR "ROCK;" (*Roccus lineatus.*)

At Great Egg Harbor, New Jersey, April, 1871, several specimens, freshly caught in seines, with menhaden, &c., contained *Crangon vulgaris* (shrimp) in large quantities.

A specimen caught at Wood's Hole, July 22, 1872, contained a large mass of "sea-cabbage," *Ulva latissima*, and the remains of a small fish.

Specimens taken at Wood's Hole, August, 1871, contained crabs, *Cancer irroratus;* and lobsters, *Homarus Americanus.*

WHITE PERCH; (*Morone Americana.*)

Numerous specimens caught with the preceding at Great Egg Harbor, New Jersey, contained *Crangon vulgaris.*

BLACK BASS; SEA-BASS; (*Centropristis fuscus.*)

Specimens caught in Vineyard Sound, June 10, contained the common crab, *Cancer irroratus;* the mud-crab, *Panopeus Sayi;* three species of fishes.

Another caught May 25 contained a squid, *Loligo pallida.*

SCUP; PORGEE; (*Stenotomus argyrops.*)

Forty young specimens, one year old, taken at Wood's Hole in August, contained large numbers of Amphipod Crustacea, among which were *Unciola irrorata, Ampelisca,* sp., &c.; several small mud-crabs, *Panopeus depressus; Idotea irrorata; Nereis virens,* and numerous other Annelids of several species, too much digested for identification.

* The results of the observations made at Great Egg Harbor were published by the writer in the American Naturalist, vol. v, p. 397, 1871.

Other specimens, opened at various times, show that this fish is a very general feeder, eating all kinds of small Crustacea, Annelids, bivalve and univalve mollusks, &c.

TAUTOG; BLACK FISH; (*Tautoga onitis.*)

Specimens caught at Wood's Hole, May 23, contained the common rock-crab, *Cancer irroratus;* hermit-crabs, *Eupagurus longicarpus;* shells, *Tritia trivittata*, all crushed.

Others caught May 26 contained *Eupagurus pollicaris; E. longicarpus;* the barnacle, *Balanus crenatus;* the squid, *Loligo Pealii; Tritia trivittata.* Others taken May 29 had *Cancer irroratus;* mud-crabs, *Panopeus depressus;* lady-crabs, *Platyonichus ocellatus;* shells, *Tritia trivittata, Crepidula fornicata, Argina pexata*, and the scollop, *Pecten irradians;* barnacles, *Balanus crenatus*, all well broken up.

Another taken May 31 contained *Platyonichus ocellatus; Tritia trivittata.*

Others taken June 3 contained the mud-crab, *Panopeus depressus;* triangular crab, *Pelia mutica; Crepidula unguiformis; Triforis nigrocinctus;* the common muscle, *Mytilus edulis;* and the "horse-muscle," *Modiola modiolus.*

Another, on June 10, contained the common rock-crab, *Cancer irroratus;* mud-crab, *Panopeus Sayi; Nucula proxima;* several ascidians, *Cynthia partita* and *Leptoclinum albidum.*

Two caught July 8 and 15 contained small lobsters, *Homarus Americanus; Crepidula fornicata; Bittium nigrum;* a bryozoan, *Crisia eburnea;* sand-dollars, *Echinarachnius parma.*

A specimen caught in August contained long-clams, *Mya arenaria;* muscles, *Mytilus edulis; Petricola pholadiformis.*

WEAK-FISH; SQUETEAGUE; (*Cynoscion regalis.*)

Several caught in seines at Great Egg Harbor, New Jersey, April, 1871, with menhaden, &c., contained large quantities of shrimp, *Crangon vulgaris*, unmixed with other food.

Specimens taken at Wood's Hole, in July, often contained sand-crabs, *Platyonichus ocellatus;* and very frequently squids, *Loligo Pealii.*

KING-FISH; (*Menticirrus nebulosus.*)

Four specimens taken in seines at Great Egg Harbor, April, 1871, contained only shrimp, *Crangon vulgaris.*

Others taken at Wood's Hole, May 29, were filled with *Crangon vulgaris.*

Specimens taken in July contained rock-crabs, *Cancer irroratus;* squids, *Loligo Pealii.*

RUDDER-FISH; (*Palinurichthys perciformis.*)

A specimen caught at Wood's Hole, in August, contained a small *Squilla empusa;* and young squids, *Loligo Pealii.*

MACKEREL; (*Scomber vernalis.*)

Specimens taken July 18, twenty miles south of No Mans Land, contained shrimps, *Thysanopoda*, sp.; larval crabs in the zoëa and megalops stages of development; young of hermit-crabs; young of lady-crabs, *Platyonichus ocellatus;* young of two undetermined Macroura; numerous small Copepod Crustacea; numerous shells of a Pteropod, *Spirialis Gouldii.*

SMALL TUNNY; (*Orcynus thunnina.*)

One specimen caught at Wood's Hole, in August, contained eleven squids, *Loligo Pealii.*

BONITO; (*Sarda pelamys.*)

Specimens taken at Wood's Hole, in August, contained an abundance of shrimp, *Crangon vulgaris.*

BLUE-FISH; HORSE-MACKEREL; (*Pomatomus saltatrix.*)

Specimens caught at Wood's Hole, in August, frequently contained squids, *Loligo Pealii;* also various fishes.

Off Fire Island, Long Island, August, 1870, Mr. S. I. Smith saw blue-fishes feeding eagerly on the free-swimming males (heteronereis) of *Nereis limbata*, (p. 318,) which was then very abundant.

SEA-ROBIN; (*Prionotus Carolinus.*)

A specimen caught at Wood's Hole, May 27, contained shrimp, *Crangon vulgaris;* and a small flounder.

Another caught May 29 contained Amphipod Crustacea, *Anonyx* (?), sp.; and *Crangon vulgaris.*

Specimens dredged in Vineyard Sound, in August, contained mud-crabs, *Panopeus Sayi;* rock-crabs, *Cancer irroratus;* and several small fishes.

TOAD-FISH; (*Batrachus tau.*)

Several specimens examined at Great Egg Harbor, New Jersey, April, 1871, contained young edible crabs, *Callinectes hastatus* of various sizes up to those with the carapax two inches broad; shrimp, *Crangon vulgaris;* prawn, *Palæmonetes vulgaris; Ilyanassa obsoleta;* various fishes, especially the pipe-fish, *Syngnathus Peckianus;* and the anchovy, *Engraulis vittatus.*

A specimen caught at Wood's Hole, in July, contained the common rock-crab, *Cancer irroratus.*

GOOSE-FISH; ANGLER; (*Lophius Americanus.*)

A specimen caught in Vineyard Sound, in June, contained crabs, *Cancer irroratus;* and squids, *Loligo Pealii.*

COD; (*Gadus morrhua, var.*)

The cod-fishes devour a great variety of Crustacea, Annelids, Mollusks, star-fishes, &c. They swallow large bivalve shells, and after digesting the contents spit out the shells, which are often almost uninjured. They are also very fond of shrimps, and of crabs, which they frequently swallow whole, even when of large size. The brittle star-fishes (*Ophiurans*) are also much relished by them. I have taken large masses of the *Ophiopholis aculeata* from their stomachs on the coasts of Maine and Labrador; and in some cases the stomach would be distended with this one kind, unmixed with any other food.

In this region I have not been able to make any new observations on the food of the cod. This deficiency is partially supplied, however, by the observations made by me on the coast of Maine, &c., coupled with the very numerous observations made at Stonington, Connecticut, many years ago, by Mr. J. H. Trumbull, who examined large numbers of the stomachs of cod and haddock, caught within a few miles of that place, for the sake of the rare shells that they contained. This collection of shells, thus made, was put into the hands of the Rev. J. H. Linsley, who incorporated the results into his "Catalogue of the Shells of Connecticut," which was published after his death, and in a somewhat unfinished state, in the American Journal of Science, Series I, vol. xlviii, p. 271, 1845. In that list a large number of species are particularly mentioned as from the stomachs of cod and haddock, at Stonington, all of which were collected by Mr. Trumbull, as he has informed me, from fishes caught on the fishing-grounds near by, on the reefs off Watch Hill, &c. Many other northern shells, recorded by Mr. Linsley as from Stonington, but without particulars, were doubtless also taken from the fish-stomachs by Mr. Trumbull. There was no record made of the Crustacea, &c., found by him at the same time.

The following list includes the species mentioned by Mr. Linsley as from the cod. For greater convenience the original names given by him are added in parentheses, when differing from those used in this report:

List of mollusks, &c., obtained by Mr. J. H. Trumbull, from cod-fish caught near Stonington, Connecticut.

GASTROPODS.

Sipho Islandicus (?), young, (Fusus corneus.)
Ptychatractus ligatus, (Fasciolaria ligata.)
Turbonilla interrupta, (Turritella interrupta.)
Turritella erosa.
Rissoa exarata, (?), (Cingula arenaria.)
Lunatia immaculata, (Natica immaculata.)
Amphisphyra pellucida, (Bulla debilis.)
Chiton marmoreus, (?), (Chiton fulminatus.)

LAMELLIBRANCHS.

Martesia cuneiformis, (Pholas cuneiformis.)
Periploma papyracea, (Anatina papyracea.)
Thracia truncata.

Tagelus divisus, (Solecurtus fragilis.)
Semele equalis, (?), (Amphidesma æqualis.)
Ceronia arctata, (Mesodesma arctata.)
Montacuta elevata, (Montacuta bidentata.)
Callista convexa, young, (Cytherea morrhuana.)
Cardium pinnulatum.
Cyprina Islandica.
Gouldia mactracea, (Astarte mactracea.)
Yoldia sapotilla, (Nucula sapotilla.)
Y. limatula, (N. limatula.)
Nucula proxima.
N. tenuis.
Modiolaria nigra, (Modiola nexa.)
Crenella glandula, (M. glandula.)
Pecten tenuicostatus, young, (Pecten fuscus.)

ECHINODERMS.

Echinarachnius parma.

HADDOCK; (*Melanogrammus æglifinus.*)

The haddock is not much unlike the cod in the character of its food. It is, perhaps, still more omnivorous, or, at least, it generally contains a greater variety of species of shells, &c.; many of the shells that it habitually feeds upon are burrowing species, and it probably roots them out of the mud and sand.

A complete list of the animals devoured by the haddock would doubtless include nearly all the species belonging to this fauna. We have had few opportunities for making observations on the food of the haddock south of Cape Cod, but have examined many from farther north.

A specimen taken at Wood's Hole, November 6, 1872, contained a large quantity of *Gammarus natator*, and a few specimens of *Crangon vulgaris.* Another from Nantucket contained the same species.

The following species of shells were mentioned by Mr. Linsley, in his catalogue, as from the haddock:

List of mollusks obtained from stomachs of haddock, at Stonington, Connecticut, by Mr. J. H. Trumbull.

Neptunea pygmæa, (Fusus Trumbulli.)
Astyris zonalis, (Buccinum zonale.)
Bulbus flavus, (?), (Natica flava.)
Margarita obscura,
Actæon puncto-striata, (Tornatella puncto-striata.)
Cylichna alba, (Bulla triticea.)
Serripes Grœnlandicus, (?), (Cardium Grœnlandicum.)

The above list doubtless contains only a small portion of the species collected by Mr. Trumbull, but they are all that are specially recorded.

As an illustration of the character and diversity of the haddock's food, I add a list of the species taken from the stomach of a single specimen, from the Boston market, and doubtless caught in Massachusetts Bay, September, 1871.

GASTROPODS.

Natica clausa.
Margarita Grœnlandica.

LAMELLIBRANCHS.

Leda tenuisulcata.
Nucula proxima.
N. tenuis.
Crenella glandula.

ECHINODERMS.

Psolus phantapus.
Lophothuria Fabricii.

In addition to these there were fragments of shrimp, probably *Pandalus annulicornis*, and numerous Annelids, too much digested for identification.

TOM-COD; FROST-FISH; (*Microgadus tom-codus.*)

Several specimens from New Haven Harbor, January 30, contained numerous Amphipods, among which were *Mœra levis; Gammarus, sp.; Ampelisca, sp.;* an undetermined Macrouran; numerous Entomostraca; the larva of *Chironomus oceanicus.*

A lot taken in a small pond at Wood's Hole, in March, by Mr. Vinal N. Edwards, contained the common shrimp, *Crangon vulgaris;* large numbers of the green shrimp, *Virbius zostericola;* the prawn, *Palæmonetes vulgaris;* large quantities of Amphipods, especially of *Gammarus annulatus*, *G. natator*, *Calliopius læviuscula*, and *Microdeutopus minax;* and smaller numbers of *Gammarus ornatus* and *G. mucronatus.*

Another lot of twelve, taken in April at the same place, contained most of the above, and in addition several other Amphipods, viz: *Mœra levis*, *Pontogeneia inermis*, *Ptilocheirus pinguis*, and *Caprella;* also *Nereis virens*, and various small fishes.

OCELLATED FLOUNDER; SUMMER FLOUNDER; (*Chænopsetta ocellaris.*)

Several specimens taken in the seines, at Great Egg Harbor, New Jersey, in April, contained large quantities of shrimp, *Crangon vulgaris* and *Mysis Americana;* one contained a full-grown *Gebia affinis.*

One caught at Wood's Hole, June 6, contained twenty-six specimens of *Yoldia limatula;* and numerous shells of *Nucula proxima*, *Angulus tener*, and *Tritia trivittata;* and Amphipod Crustacea belonging to the genus *Ampelisca.*

Specimens caught at Wood's Hole, in July, contained rock-crabs, *Cancer irroratus; Pinnixa cylindrica; Crangon vulgaris;* squids, *Loligo Pealii; Angulus tener; Nucula proxima;* and many "sand-dollars," *Echinarachnius parma.*

WINTER FLOUNDER; (*Pseudopleuronectes Americanus.*)

A specimen caught at Wood's Hole, in August, contained large numbers of *Bulla solitaria.*

SPOTTED FLOUNDER; (*Lophopsetta maculata.*)

Numerous specimens caught in seines at Great Egg Harbor, April, 1871, contained large quantities of shrimp, especially *Mysis Americana* and *Crangon vulgaris;* the prawn, *Palæmonetes vulgaris;* numerous Amphipods, *Gammarus mucronatus;* one contained a *Gebia affinis.*

MINNOW; (*Fundulus pisculentus.*)

Specimens caught in July, at Wood's Hole, contained large numbers of *Melampus bidentatus*, unmixed with other food.

SEA-HERRING; (*Clupea elongata.*)

Specimens taken in Vineyard Sound, May 20, contained several shrimp, *Crangon vulgaris*, about 1.5 inches long; *Mysis Americana*, and large numbers of an Amphipod, *Gammarus natator;* also small fishes.

SHAD; (*Alosa tyrannus.*)

Several specimens taken in the seines, at Great Egg Harbor, April, 1871, contained finely-divided fragments of numerous Crustacea, among which were shrimp, *Mysis Americana.*

Several from the mouth of the Connecticut River, May, 1872, contained fragments of small Crustacea, (*Mysis*, &c.)

HICKORY SHAD; (*Pomolobus mediocris.*)

Several specimens taken in the seines at Great Egg Harbor, April, 1872, contained large quantities of fragmentary Crustacea; one contained recognizable fragments of shrimp, *Crangon vulgaris.*

MENHADEN; (*Brevoortia menhaden.*)

A large number of specimens freshly caught in seines at Great Egg Harbor, April, 1871, were examined, and all were found to have their stomachs filled with *large quantities of dark mud.* They undoubtedly swallow this mud for the sake of the microscopic animal and vegetable organisms that it contains. Their complicated and capacious digestive apparatus seems well adapted for this crude and bulky food.

FILE-FISH; (*Ceratacanthus aurantiacus.*)

A specimen taken at Wood's Hole, in August, contained a quantity of the finely-divided stems and branches of a Hydroid, *Pennaria tiarella.*

DUSKY SHARK; (*Eulamia obscura.*)

Several specimens caught at Wood's Hole, in July and August, contained lobsters, *Homarus Americanus;* rock-crabs, *Cancer irroratus.*

BLUE SHARK; (*Eulamia Milberti.*)

A large specimen caught at Wood's Hole, in August, contained a quantity of small bivalve-shells, *Yoldia sapotilla.*

TIGER-SHARK; (*Galerocerdo tigrina.*)

Specimens caught at Wood's Hole, in August, contained large univalve shells, *Buccinum undatum* and *Lunatia heros.*

DOG-FISH; (*Mustelus canis.*)

Several specimens caught at Wood's Hole, in August, contained lobsters, *Homarus Americanus;* spider-crabs, *Libinia canaliculata;* rock-crabs, *Cancer irroratus.*

SAND-SHARK; (*Eugomphodus littoralis.*)

Many specimens taken at Wood's Hole, in July and August, contained lobsters, *Homarus Americanus,* in abundance; *Cancer irroratus;* and squids, *Loligo Pealii.*

COMMON SKATE; "SUMMER SKATE;" (*Raia diaphana.*)

A specimen taken at Wood's Hole, May 14, contained rock-crabs, *Cancer irroratus;* a young skate; a long slender fish, (*Ammodytes?.*) Another, caught in July, contained *Cancer irroratus.*

PEAKED-NOSE SKATE; (*Raia lævis?.*)

Specimens caught in Vineyard Sound, May 14, contained numerous shrimps, *Crangon vulgaris;* several *Conilera concharum;* several Annelids, among them *Nephthys ingens; Meckelia ingens;* two specimens of *Phascolosoma Gouldii;* razor-shells, *Ensatella Americana,* (the "foot" only, of many specimens;) a small fish, *Ctenolabrus burgall.* Specimens taken at Menemsha, in July, contained large numbers of crabs, *Cancer irroratus;* and of lobsters, *Homarus Americanus.*

STING-RAY; (*Trygon centroura.*)

Specimens caught at Wood's Hole, in July and August, contained large numbers of crabs, *Cancer irroratus;* squids, *Loligo Pealii;* clams, *Mya arenaria; Lunatia heros.*

LONG-TAILED STING-RAY; (*Myliobatis Freminvillei.*)

Specimens taken in Vineyard Sound, in July, contained an abundance of lobsters, *Homarus Americanus;* crabs, *Cancer irroratus;* also clams, *Mya arenaria;* and *Lunatia heros.*

"RABBIT-FISH."

A specimen taken at Wood's Hole, in July, contained a lobster, *Homarus Americanus.*

"FOG-FISH."

A specimen caught at Wood's Hole, July 1, contained hermit-crabs, *Eupagurus pollicaris.*

C.—THE METAMORPHOSES OF THE LOBSTER, AND OTHER CRUSTACEA.—BY S. I. SMITH.

Most of the larger crustaceans of our coast, whatever may be their habits when adult, are, in the early stages of their existence after hatching from the eggs, essentially free-swimming animals, living a large part of the time near the surface of the water. In this stage they are constantly exposed to the attacks of other predaceous animals, and, as they occur in vast numbers, afford food for many valuable fishes. They are most abundant at the surface in calm, clear weather, and they especially resort, like the young of many other marine animals, to spots and streaks of smooth water where the tidal currents meet.

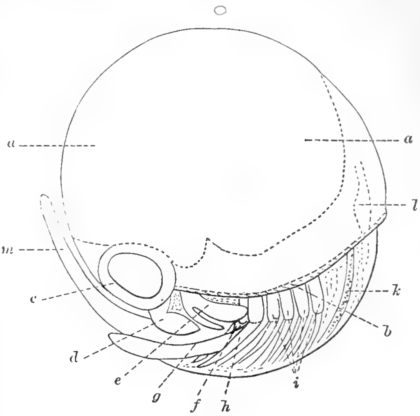
Very little has yet been written upon the forms or habits of the young crustaceans of our own coast; but, in connection with the investigations carried on in Vineyard Sound and Buzzard's Bay, a great amount of material for such work was collected. This material has not yet been fully studied, and only a sketch of some of the more important results is presented in this report. During the few weeks in June and July, in which I was myself at Wood's Hole, the time was so fully occupied in collecting, that very little time was left for studying the animals while alive; hence most of the observations which follow, except occasionally those on color, have been subsequently made from specimens preserved in alcohol. While at Wood's Hole, I was much assisted in obtaining these young animals by every one then associated there in the work of the commission; and I would especially acknowledge such assistance from Dr. W. G. Farlow, Mr. V. N. Edwards, and Capt. John B. Smith. After I left, the collecting was kept up as before, and many valuable notes were made by Professors Verrill and J. E. Todd.

Special attention was given to the early stages of the lobster, as perhaps the most important crustacean found on our coast, and I have gone more fully into the account of its early history than that of any other species. As this will serve as an example to illustrate the development of most of the other Macrourans, it is presented first.

Numerous specimens of the free-swimming young of the lobster, in different stages of growth, were obtained in Vineyard Sound during July, but it was too late for any observations upon the young within the egg. This deficiency was partially supplied by a few observations at New Haven in 1872. Eggs taken May 2, from lobsters captured at New London, Connecticut, had embryos well advanced, as represented in fig. 4. In this stage the eggs are slightly elongated spheroids, about 2.1^{mm} in the longer diameter, and 1.9^{mm} in the shorter. One side is rendered very opaque dark green by the unabsorbed yolk mass, while the other shows the eyes as two large black spots, and the red pigment spots on the edge of the carapax, bases of the legs, &c., as irregular lines of pink markings.

In a side view of the embryo, the lower edge of the carapax (*b*, figure) is clearly defined and extends in a gentle curve from the middle of the eye to the posterior border of the embryo. This margin of the carapax is marked with dendritic spots of red pigment. The whole dorsal portion, fully one-half the embryo, is still occupied by the unabsorbed portion of the yolk, (*a*, *a*,) of which the lower margin, represented in the figure by a dotted line, extends from close above the eye in a curve nearly parallel with the lower margin of the carapax, but with a sharp indentation a little way behind the eye. The eyes (*c*) are large, nearly round, not entirely separated from the surrounding tissues, and with a central portion of black pigment. The antennulæ (*d*) are simple, sack-like appendages, arising from just beneath the eyes, with the terminal portion turned backward and marked with several large dendritic spots of red pigment. The antennæ (*e*) are but little larger than the antennulæ and are sack-like and without articulations, but the scale and flagellum are separated and bent backward, the scale being represented by the large and somewhat expanded lobe, and the flagellum by a shorter and slender lobe which arises from near the base of the scale. The mandibles, both pairs of maxillæ, and the first and second pairs of maxillipeds are not sufficiently developed to be seen without removing the antennæ and the edge of the carapax, and are only represented by several small lobes, of which the anterior, apparently representing the mandibles, are distinctly defined, while those that follow are much smaller, indistinct, and confused. The first and second maxillipeds are each represented by a small lobe divided at the extremity. The external maxillipeds (*f*) are well developed and almost exactly like the posterior cephalothoracic legs. Both the branches are simple and sack-like, the main branch, or endognathus,† much larger and slightly longer than the outer branch, or exognathus, which is quite slender. The five pairs of

Fig. 4.*



No. 510

*Embryo, some time before hatching, removed from the external envelope and shown in a side view enlarged twenty diameters; *a*, *a*, dark-green yolk mass still unabsorbed; *b*, lateral margin of the carapax marked with many dendritic spots of red pigment; *c*, eye; *d*, antennula; *e*, antenna; *f*, external maxilliped; *g*, great cheliped which forms the big claw of the adult; *h*, outer swimming branch or exopodus of the same; *i*, the four ambulatory legs with their exopodal branches; *k*, intestine; *l*, heart; *m*, bilobed tail seen edgewise. [Drawn by S. I. Smith.]

† To prevent confusion, the terms here used are those proposed by Milne Edwards to designate the different branches of the cephalothoracic appendages: *endopodus*, for the main branch of a leg; *exopodus*, for the accessory branch, (*a* in fig. *D*, Plate IX;) *epipodus*, for the flabelliform appendage, (*b*;) and *endognathus*, *exognathus*, and *epignathus*, for the corresponding branches of the mouth organs.

cephalothoracic legs (*g*, *h*, *i*) are all similar and of about the same size, except the main branch of the first pair, (*g*,) which is much larger than that of the others, but is still sack-like and entirely without articulations. The outer or exopodal branches of all the legs are slender, wholly unarticulated, sack-like processes, while the inner or main (endopodal) branches of the four posterior pairs are similar, but much stouter and slightly longer processes arising from the same bases. The bases of all the legs are marked with dendritic spots of red pigment like those upon the lower margin of the carapax.

The abdomen (*m*) is curved round beneath the cephalothorax, the extremity extending between and considerably in front of the eyes. The segments are scarcely distinguishable. The extremity, as seen from beneath the embryo, is slightly expanded into a somewhat oval form, and very deeply divided by a narrow sinus, rounded at the extremity. The lobes into which the tail is thus divided are narrow, and somewhat approach each other toward the extremities, where they are each armed along the inner edge with six small obtuse teeth.

The heart (*l*) is readily seen, while the embryo is alive, by its regular pulsations. It appears as a slight enlargement in the dorsal vessel, just under the posterior portion of the carapax. The intestine (*k*) is distinctly visible in the anterior portion of the abdomen as a well defined, transparent tube, in which float little granular masses. This material within the intestine is constantly oscillating back and forth as long as the embryo is alive.

The subsequent development of the embryo within the egg was not observed. The following observations on the young larvæ, after they have left the eggs, have all been made upon specimens obtained in Vineyard Sound, or the adjacent waters, during July. These specimens were mostly taken at the surface in the day-time, either with the towing or hand net. They represent three quite different stages in the true larval condition, besides a later stage approaching closely the adult. The exact age of the larvæ of the first stage was not ascertained, but was probably only a few days, and they had, most likely, molted not more than once. Between the third stage, here described, and the last, there is probably an intermediate form wanting.

First stage.—In this stage, (Plate IX, Figs. A, B, C, D,) the young are free-swimming Schizopods about a third of an inch (7.8 to 8.0^{mm}) in length, without abdominal appendages, and with six pairs of pediform cephalothoracic appendages, each with the exopodus developed into a powerful swimming organ. The general appearance is represented in the figures. The eyes are bright blue; the anterior portion and the lower margin of the carapax and the bases of the legs are speckled with orange; the lower margin, the whole of the penultimate, and the basal portion of the ultimate segment of the abdomen, are brilliant reddish orange.

The antennulæ (Fig. *C*.) are short and sack-like, with a single articulation at the base, and three setæ at the tip. The antennæ have large well developed scales, furnished along the inner margin with long plumose hairs, but the flagellum is shorter than the scale, not divided into segments, and has three plumose setæ at tip. The mandibles are unlike on the two sides; the inferior edges are armed with acute teeth, except at the posterior angle, where there is a small molar area; the palpi are very small, with the three segments just indicated. The exognathus in both pairs of maxillæ is composed of only one article, and is furnished with several setæ at tip. In the first maxillipeds the exognathus is an unarticulated process, furnished with short plumose hairs on the outer side. The second maxillipeds have the principal branch cylindrical, not flattened and appressed to the inner mouth organs as in the adult; the exognathus is short, and as yet scarcely flabelliform; and the epignathus is a simple process, with not even the rudiment of a branchia. The external maxillipeds are pediform, the endognathus as long as and much resembling the endopodi of the posterior legs, while the exognathus is like the exopodi of all the legs, being half as long as the endognathus, and the terminal portion furnished along the edges with long plumose hairs. The epignathus and the branchiæ are very rudimentary, represented by minute sack-like processes. The anterior cephalothoracic legs, (Fig. *D*,) which in the adult develop into the big claws, are exactly alike, and no longer than the external maxillipeds. The pediform branch is, however, somewhat stouter than in the other legs, and subcheliform. The legs of the second and third pairs are similar to the first, but not as stout. The legs of the fourth and fifth pairs are still more slender, and styliform at the extremity, as in the adult.

The exopodal branches of all the legs and of the external maxillipeds are quite similar, and differ very little in size. In life, while the animal is poised at rest in the water, they are carried horizontally, as represented in Figure *B*, or are curved up over the carapax, sometimes so as almost to cover it. The blood circulates rapidly in these appendages, and they undoubtedly serve, to a certain extent, as respiratory organs, as well as for locomotion. By careful examination, small processes were found representing the normal number of branchiæ to each leg.* These rudimentary branchiæ, however, differ somewhat in different specimens, being very small, and scarcely distinguishable, in what appear to be younger individuals, from the rudimentary epipodi, while in others, apparently older, they are further developed, being larger, more cellular in structure than the epipodi, and even showing an approach to crenulation in the margins, as shown in Figure *D*.

The abdomen is slender, the second to the fifth segments each armed with a large dorsal spine, curved backward, and with the lateral angles

* The number of branchiæ, or branchial pyramids, in the American lobster is twenty on each side; a single small one upon the second maxilliped, three well developed ones upon the external maxilliped, three upon the first cephalothoracic leg, four each upon the second, third, and fourth, and one upon the fifth.

produced into long spines, and the sixth segment with two dorsal spines. The proportional size and the outline of the last segment are shown in Figure *B*; its posterior margin is armed with a long and stout central spine, and each side with fourteen or fifteen plumose spines or setæ, which are articulated to the margin.

In this stage the young were first taken July 1, when they were seen swimming rapidly about at the surface of the water among great numbers of zoëæ, megalops, and copeopods. Their motions and habits recall at once the species of *Mysis* and *Thysanopoda*, but their motions are not quite as rapid and are more irregular. Their bright colors render them conspicuous objects, and they must be readily seen and captured by fishes. They were frequently taken at the surface in different parts of Vineyard Sound from July 1 to 7, and several were taken off Newport, Rhode Island, as late as July 15, and they would very likely be found also in June, judging from the stage of development to which the embryos had advanced early in May in Long Island Sound. Besides the specimens taken in the open water of the Sound, a great number were obtained July 6, from the well of a lobster-smack, where they were swimming in great abundance near the surface of the water, having undoubtedly been recently hatched from the eggs carried by the female lobsters confined in the well. Some of these specimens lived in vessels of fresh sea-water for two days, but all efforts to keep them alive long enough to observe their molting failed. They appeared, while thus in confinement, to feed principally upon very minute animals of different kinds, but were several times seen to devour small zoëæ, and occasionally when much crowded, so that some of them became exhausted, they fed upon each other, the stronger ones eating the weaker.

Second stage.—In the next stage the young lobsters have increased somewhat in size, and the abdominal legs of the second to the fifth segments have appeared. The rostrum is much broader, and there are several teeth along the edges. The basal segments of the antennulæ have become defined, and the secondary flagellum has appeared, but is not subdivided into segments. The antennæ and mouth organs have undergone but slight changes. The first cephalothoracic legs are proportionally larger and stouter than in the first stage, and have become truly cheliform. The succeeding legs have changed little. The epidodi of all the legs and of the external maxillipeds have increased in size, and the branchial processes are distinctly lobed along the edges, and have begun to assume the form of true branchiæ. The segments of the abdomen have the same number of spines, but they are relatively somewhat smaller, and the last segment is relatively smaller and broader at base. The appendages of the second to the fifth segments differ considerably in size in different specimens, but are nearly as long as the segments themselves; their terminal lamellæ, however, are represented only by simple sack-like appendages, without sign of segmentation, or clothing of hairs or setæ. The penultimate segment is still without appendages.

Specimens in this stage were taken only twice, July 1 and 15. They have the same habits and general appearance as in the first stage, but are readily distinguished by the possession of rudimentary abdominal legs. In color they are almost exactly the same, only the orange-colored markings are perhaps a little less intense.

Third stage.—In the third stage (Plate IX, figs. *E*, *F*, *G*,) the larvæ are about half an inch (12 to 13^{mm}) in length, and the integument is of a much firmer consistency than in the earlier stages. The antennulæ are still rudimentary, and considerably shorter than the rostrum, although the secondary flagellum has increased in length, and begins to show division into numerous segments. The antennæ retain the most marked feature of the early stages—the large size of the scale—but the flagellum is much longer than the scale, and begins to show division into segments. The mandibles, maxillæ, and first and second maxillipeds have changed very little, although in the second maxillipeds the extremity of the exognathus begins to assume a flagelliform character, and the branchia is represented by a small process upon the side of the epignathus. The external maxillipeds have begun to lose their pediform character. The anterior legs have increased enormously in size, and those of the second and third pairs have become truly chelate, while the swimming exopodal branches of all the legs, as well as of the external maxillipeds, are relatively much smaller and more unimportant. The epipodi (fig. *G*) are furnished with hairs along the edges, and begin to assume the characters of these appendages in the adult. The branchiæ (fig. *G*) have developed rapidly, and have a single series of well-marked lobes along each side. The abdomen still has the spines characteristic of the earlier stages, though all of them are much reduced in size. The appendages of the second to the fifth segments have become conspicuous, their lamellæ have more than doubled in length, and the margins of the terminal half are furnished with very short ciliated setæ. The appendages of the penultimate segment (fig. *F*) are well developed, although quite different from those in the adult. The outer lamella wants wholly the transverse articulation near its extremity, and both are margined, except the outer edge of the outer lamella, with long plumose hairs. The last segment is relatively smaller and more quadrangular in outline, and the spines of the posterior margin are much smaller.

The only specimens procured in this stage were taken July 8 and 15. In color they were less brilliant than in the earlier stages, the orange markings being duller and whole animal slightly tinged with greenish brown.

In the next stage observed, the animal, about three-fifths of an inch (14 to 17^{mm}) long, has lost all its schizopodal characters, and has assumed the more important features of the adult lobster. It still retains, however, the free-swimming habit of the true larval forms, and was frequently taken at the surface, both in the towing and hand net. Although resembling the adult in many features, it differs so much that, were it an adult form, it would undoubtedly be regarded as a distinct genus. The rostrum is bifid at tip, and armed with three or four teeth on each side toward the base, and in some specimens with a minute additional spine, on one or both sides, close to the tip. The flagella of the antennulæ extend scarcely beyond the tip of the rostrum. The antennal scale is very much reduced in size, but is still conspicuous and furnished with long plumose hairs along the inner margin, while the flagellum is as long as the carapax. The palpi of the mandibles have assumed the adult character, but the mandibles themselves have not acquired the massive molar character which they have in the older animal. The other mouth-organs have nearly the adult form. The anterior legs, although quite large, are still slender and just alike on the two sides, while all the cephalothoracic legs retain a distinct process in place of the swimming exopodi of the larva. The lateral angles of the second to the fifth abdominal segments are prolonged downward into long spiniform teeth, the appendages of these segments are proportionately much longer than in the adult, and the margins of their terminal lamellæ are furnished with very long plumose hairs. The lamellæ of the appendages of the penultimate segment are oval, and margined with long plumose hairs. The terminal segment is nearly quadrangular, as wide at the extremity as at the base, the posterior margin arcuate, but not extending beyond the prominent lateral angles, and furnished with hairs like those on the margins of the lamellæ of the appendages of the penultimate segment.

In color they resemble closely the adult, but the green color of the back is lighter, and the yellowish markings upon the claws and body are proportionately larger.

In this stage, the young lobsters swim very rapidly by means of the abdominal legs, and dart backward, when disturbed, with the caudal appendages, frequently jumping out of the water in this way like shrimp, which their movements in the water much resemble. They appear to be truly surface animals, as in the earlier stages, and were often seen swimming about among other surface animals. They were frequently taken from the 8th to the 28th of July, and very likely occur much later.

From the dates at which the different forms were taken, it is probable that they pass through all the stages here described in the course of a single season. How late the young, after reaching the lobster-like form, retain their free-swimming habit was not ascertained.

The young of the different kinds of shrimp, *Crangon vulgaris*, *Palæmonetes vulgaris*, and *Virbius zostericola*, when hatched from the egg, are free-swimming animals, similar in their habits to the young of the lobster. In structure, however, they are quite unlike the larvæ of the lobster, and approach more the zoëa stages of the crabs, which are described farther on. When they first leave the egg, they are without the five pairs of cephalothoracic legs, the abdomen is without appendages, and much as it is in the first stage of the young lobster, while the maxillipeds are developed into long locomotive appendages, somewhat like the external maxillipeds of the first stage of the young lobster. While yet in the free-swimming condition the cephalothoracic legs are developed, the maxillipeds assume the adult form, and the abdominal limbs appear. The young of these shrimp are very much smaller than the young of the lobster, but they remain for a considerable time in this immature state, and were very frequently taken at the surface in the towing-net.

The young of *Crangon vulgaris* are hatched in the neighborhood of Vineyard Sound, in May and June, and arrive at the adult form before they are more than 4 or 5^{mm} long. Specimens of this size were taken at Wood's Hole, at the surface, on the evening of July 3. Later in the season much larger specimens were frequently taken at the surface both in the evening and day-time.

The young of *Palæmonetes vulgaris* did not appear till near the middle of July. Soon after hatching, the young are 3^{mm} long. The cephalothorax is short and broad with a slender spiniform rostrum in front, an enormous compound eye each side at the anterior margin, and a small simple eye in the middle of the carapax. The antennulæ are quite rudimentary, being short and thick appendages projecting a little way in front of the head; the peduncle bears at its extremity a very short obtuse segment representing the primary flagellum, and inside, at the base of this, a much longer plumose seta. The antennæ are slightly longer, than the antennulæ; the short peduncle bears a stout appendage, corresponding to the antennal scale, the terminal portion of which is articulated and furnished with long plumose setæ, and on the inside at the base of the scale, a slender process corresponding to the flagellum, and terminated by a long plumose seta. The first and second pairs of maxillæ are well formed and approach those of the adult. The three pairs of maxillipeds are all developed into powerful locomotive appendages; the inner branches, or endognathi, being slender pediform appendages terminated by long spines, while the outer branches, or epignathi, are long swimming appendages like the swimming branches of the legs of the young lobsters in the first stage. Both branches of the first maxillipeds are considerably shorter than those of the following pairs, but otherwise like them, and the inner branch of the second pair is somewhat shorter than that of the third, but its outer branch is about as long as that of the third pair. The five pairs of cephalothoracic legs are wanting or only represented by a cluster of minute sack-like processes just behind the outer maxillipeds. The abdomen is long and slender, wholly without appendages beneath, and the last segment is expanded into a short and very broad caudal lamina, the posterior margin of which is truncate with the lateral angles rounded; these angles each bear three, and the posterior margin itself eight more stout plumose setæ, the setæ of the posterior margin being longer than those upon the angles, and separated by broader spaces in which the margin is armed with numerous very small setæ. They arrive at the adult form before they are more than 5^{mm}

long, and they were often taken at the surface until 8 to 12^{mm} in length, the larger ones being taken in the first part of September.

The young of *Virbius zostericola* appear at about the same time as those of *Palæmonetes*, or a very little later, and pass through quite similar changes. The young attain the adult form when not more than 3^{mm} in length, and were frequently taken at the surface, both in the daytime and the evening, until they were 10^{mm} long, those 8 to 10^{mm} long being common in late August and early September.

The larval forms of several other Macrourans were taken at different times, but none of these were abundant, and I have not been able to connect them with the adult forms of any of the common species of the New England coast.

The young of *Gebia affinis*, only 4^{mm} long, but with nearly the form of the adult, was taken at the surface on the evening of September 3. The young of *Callianassa Stimpsoni*, about 4^{mm} long and with nearly all the adult characters, was also taken at the surface early in September.

The hermit-crabs (species of *Eupagurus*) when first hatched have much resemblance to the young of shrimp at the same period, and have similar habits. The young of one of the species, after it has passed through the earlier stages, and when it is about 3^{mm} long, and has all the cephalothoracic appendages similar to those of the adult, has still a symmetrical abdomen, like that of a shrimp, with long swimming-legs upon the second, third, fourth, and fifth segments, and broad laminated appendages upon the penultimate segment. Young, in this and the earlier stages, were common at the surface in Vineyard Sound during the last of August and the first of September.

Hippa talpoida probably passes through a metamorphosis similar to that of the hermit-crabs. The young attain nearly the adult form before they are more than 5 or 6^{mm} long, and specimens of this size were taken at the surface in Vineyard Sound on the evening of September 3. I have also found, early in September, the young a little larger upon the outer shores of Fire Island Beach, where they were left in large numbers by a high tide, and soon buried themselves in the sand.

All, or at least nearly all, the species of Brachyura living on the coast of New England pass through very complete and remarkable metamorphoses. The most distinct stages through which they pass were long ago described as two groups of crustaceans, far removed from the adult forms of which they were the young. The names zoëa and megalops, originally applied to these groups, are conveniently retained for the two best marked stages in the development of the crabs.

The young of the common crab, (*Cancer irroratus*,) in the earlier or zoëa stage, when first hatched from the egg, are somewhat like the form figured on Plate VIII, (fig. 37, the latest stage of the zoëa of *Cancer irroratus*, just before it changes to the megalops,) but the spines upon the carapax are all much longer in proportion, and there are no signs of the abdominal legs or of any of the future legs of the megalops and crab. In this stage they are very small, much smaller than in the stage figured. After they have increased very much in size, and have molted probably several times, they appear as in the figure just referred to. The terminal segment of the abdomen, seen only in a side-view in the figure, is very broad and divided nearly to the base by a broad sinus, each side the margins project in long, spiniform, diverging processes, at the base of which the margin of the sinus is armed with six to eight spines on each side. When alive they are translucent, with deposits of dark pigment forming spots at the articulations of the abdomen and a few upon the cephalothorax and its appendages. In this stage they were taken at the surface in Vineyard Sound, in immense numbers, from June 23 to late in August. They were most abundant in the early part of July, and appeared in the greatest numbers on calm, sunny days.

Several zoëæ of this stage were observed to change directly to the megalops form, (Plate VIII, fig. 38.) Shortly before the change took place they were not quite as active as previously, but still continued to swim about until they appeared to be seized by violent convulsions, and after a moment began to wriggle rapidly out of the old zoëa skin, and at once appeared in the full megalops form. The new integument seems to stiffen at once, for in a very few moments after freeing itself from the old skin the new megalops was swimming about as actively as the oldest individuals.

In this megalops stage the animal begins to resemble the adult. The five pairs of cephalothoracic legs are much like those of the adult, and the mouth-organs have assumed nearly their final form. The eyes, however, are still enormous in size, the carapax is elongated and has a slender rostrum and a long spine projecting from the cardiac region far over the posterior border, and the abdomen is carried extended, and is furnished with powerful swimming-legs as in the Macroura. In color and habits they are quite similar to the later stage of the zoëæ from which they came; their motions appear, however, to be more regular and not so rapid, although they swim with great facility. In this megalops the dactyli of the posterior cephalothoracic legs are styliform, and are each furnished at the tip with three peculiar setæ of different lengths and with strongly curved extremities, the longest one simple and about as long as the dactylus itself, while the one next in length is armed along the inner side of the curved extremity with what appear to be minute teeth, and the shortest one is again simple.

According to the observations made at Wood's Hole, the young of *Cancer irroratus* remain in the megalops stage only a very short time, and at the first molt change to a form very near that of the adult. Notwithstanding this, they occurred in vast numbers, and were taken in the towing-nets in greater quantities even than in the zoëa stage. Their time of occurrence seemed nearly simultaneous with that of the zoëæ, and the two forms were almost always associated. The exact time any particular individual remained in this stage was observed only a few times. One full-grown zoëa (like the specimen figured) obtained June 23, and placed in a vessel by itself, changed to a megalops between 9 and 11½ a. m. of June 24, and did not molt again till the forenoon of June 27, when it became a young crab of the form described farther on. Of two other zoëæ obtained at the same time, and placed together in a dish, one changed to a megalops between 9 and 11½ a. m. of June 24, the other during the following night; these both changed to crabs during the night of June 26 and 27.

The following memorandum on a large number of the same lot of both stages of the young, kept together in a vessel of fresh sea-water, also indicates the rapidity of these changes. In the columns "zoëa" and "megalops" the total number of individuals in each of these stages is given; under "crabs" the number which had appeared since the last observation, and under "dead" the number which had died since the last observation:

Time of observation.	Zoëa.	Megalops.	Crabs.	Dead.
June 23, 7 p. m.	15	22	0	0
June 24, 5 a. m.	5	23	2	7
June 24, 9 a. m.	4	22	2	0
June 24, 11½ a. m.	2	22	1	1
June 24, 7 p. m.	1	22	1	0
June 25, 6 a. m.	0	20	0	3
June 25, 2 p. m.	....	19	1	0
June 26, 6 a. m.	....	16	1	2
June 27, 6 a. m.	....	14	2	0
June 27, 2½ p. m.	....	12	0	2
June 27, 7 p. m.	....	11	0	1
June 28, 7 a. m.	....	9	2	0
June 28, 4 p. m.	....	4	3	2
June 29, 7 a. m.	....	2	2	....

In the two or three instances in which the change from the megalops to the young crab was actually observed, the megalops sank to the bottom of the dish and remained quiet for some time before the molting took place. The muscular movements seemed to be much less violent than in the molting at the close of the zoëa stage, and the little crab worked himself out of the megalops skin quite slowly. For a short time after their appearance the young crabs were soft and inactive, but the integument very soon stiffened, and in the course of two or three hours they acquired all the pugnacity of the adult. They swam about with ease and were constantly attacking each other and their companions in the earlier stages. Many of the deaths recorded in the above memorandum were due to them, and on this account they were removed from the vessel at each observation. In this early stage the young crabs are quite different from the adult. The carapace is about 3^{mm} long and slightly less in breadth. The front is much more prominent than in the adult, but still has the same number of lobes and the same general form. The antero-lateral margin is much more longitudinal than in the adult, and is armed with the five normal teeth, which are long and acute, and four very much smaller secondary teeth alternating with the normal ones. The antennæ and ambulatory legs are proportionally longer than in the adult. The young crabs in this stage were once or twice taken in the towing-net, but they were not common at the surface, although a large number were found, with a few in the megalops stage, among hydroids upon a floating barrel in Vineyard Sound, July 7.

The young of *Platyonichus ocellatus* in the zoëa and megalops stages were frequently taken in the towing-net from the last of June till August, but they were much less abundant than the young of *Cancer irroratus*. On June 29, however, they occurred in great numbers. Twenty-two out of forty of those in the zoëa state changed to the megalops during the first twenty-four hours, and in the same time ten out of fifty in the megalops stage changed to the adult form, so that they probably do not remain in the megalops state longer than the young of *Cancer irroratus*. They apparently do not molt during the megalops stage.

The megalops of the *Platyonichus* is about the size of that of *Cancer irroratus*, and resembles it much in general appearance, but the carapax is much broader in proportion, the rostrum is a little longer, and there is a marked prominence at the anterior margin of the orbit, representing the lateral tooth of the front of the adult, and a similar prominence, representing the stout postorbital tooth, at the posterior angle of the orbit. The spine upon the cardiac region is rather more slender than in the megalops of the *Cancer*. The chelipeds are more elongated, and much like those of the adult *Platyonichus*, except that they want the stout spines of the latter. The dactyli of the posterior legs already approach in form those of the adult, being expanded into narrow oval plates a fourth as broad as long. The tips of each of these dactyli are furnished with four peculiar setæ of different lengths and with strongly curved extremities, the longest and two shortest of which are simple, while next to the longest one is furnished along the inner side of the curved extremity with little, closely set, sack-like appendages.

Another megalops, belonging apparently to some swimming-crab, was several times taken in the towing-net, in Vineyard Sound, from August 11 to September 3, and was also taken by Mr. Harger and myself, east of George's Bank, latitude 41° 25′ north, longitude 63° 55′ east, September 14. It would fall in the genus *Cyllene* of Dana, and is closely allied to his *Cyllene furciger* (Crust. U. S. Expl. Expd., p. 494, Plate XXXI, fig. 8) from the Sooloo Sea. In one specimen the carapax, including the rostrum, is 2.0^{mm} long, excluding rostrum, 1.6^{mm}, breadth, 1.1^{mm}. The front is quite narrow between the bases of the ocular peduncles, and has a long and slender rostrum. There are no prominences either side of the orbit and no dorsal spine upon the carapax. The fourth segment of the sternum is armed each side, just within the bases of the legs, with a long and broad spine projecting backward and slightly outward, as in *Cyllene furciger*. The chelipeds and ambulatory legs are long and slender, and the dactyli of the posterior pair of legs are expanded and lamellar, as in the megalops of *Platyonichus*. The abdomen is about as long as the carapax excluding the rostrum, and the fifth segment is armed with a stout spine each side of the postero-lateral angles.

A very large megalops, quite different in structure from those already mentioned, is occasionally found thrown upon outer beaches on the southern coast of New England and Long Island, but is apparently much more common upon the coast of the Southern States. This is undoubtedly the young of *Ocypoda arenaria*, and was long ago described by Say (Journal Acad. Nat. Sci., Philadelphia, vol. i, p. 157, 1817) as *Monolepis inermis*, and it is partially figured by Dana, (Crust. U. S. Expl. Exp., Plate XXXI, fig. 6.) The carapax is very convex above, broader behind, and has no dorsal spine. The front is deflexed sharply downward and a little backward, and the extremity is tricuspidate, the median tooth being long and narrowly triangular, while the lateral teeth are small and obtuse. The sides are high and impressed so as to receive the three anterior pairs of ambulatory legs. The third pair of ambulatory legs are closely appressed along the upper edge of the carapax and extend forward over the eyes, their dactyli being curved down over the eyes and along each side of the front. The posterior legs are small and weak, and each is folded up and lies in a groove on the latero-posterior surface of the carapax. The external maxillipeds have almost exactly the same structure as in the adult *Ocypoda*, and, as in the adult *Ocypoda*, there is a tuft of peculiar hairs between the bases of the second and third ambulatory legs. I have specimens of this megalops from Block Island, and have myself collected it, late in August, at Fire Island Beach, Long Island. In the largest specimen from the last locality the carapax is 6.4^{mm} long and 5.6^{mm} broad.

A large number of young specimens of the *Ocypoda*, collected at Fire Island Beach, indicate plainly that they had only recently changed from this megalops. The smallest of these specimens, in which the carapax is 5.6 to 6.0^{mm} long and 6.1 to 6.5^{mm} broad, differ from the adult so much that they might very easily be mistaken for a different species. The carapax is very slightly broader than long, and very convex above. The front is broad, not narrowed between the bases of the ocular peduncles, and triangular at the extremity. The margin of the orbit is not transverse but inclines obliquely backward. The ambulatory legs are nearly naked, and those of the posterior pair are proportionately much smaller than in the adult.

The adult *Ocypoda* is terrestrial in its habits, living in deep holes above high-water mark on sandy beaches, but the young in the zoëa state are undoubtedly deposited in the water, where they lead a free-swimming existence like true pelagic animals, until they become full-grown in the megalops state. Say mentions that his specimens were found cast upon the beach by the refluent tide and "appeared desirous to protect themselves by burrowing in the sand, in order to wait the return of the tide," but they were more likely awaiting the final change to the terrestrial state. The tufts of peculiar hairs between the bases of the second and third ambulatory legs, and, in the adult, connected with the respiration, are present in the full-grown megalops, and are undoubtedly provided to fit the animal for its terrestrial existence as soon as it is thrown upon the shore. The young in the magalops stage occur on the shore of Long Island, in August, and perhaps earlier. At Fire Island Beach in 1870 no specimens of *Ocypoda* were discovered till the last of August, and those first found were the smallest ones obtained; by the middle of September, however, they were common on the outer beach, and many of them were twice as large as those first obtained. Although careful search was made along the beach for several miles, not a specimen of the adult or half-grown crab could be found; every individual there had evidently landed and developed during the season. Probably all those living the year before had perished during the winter, and it is possible that this species never survives long enough to attain its full growth, so far north.

A small megalops, taken in the towing-nets in considerable numbers at Wood's Hole on the evening of September 3, resembles in several characters the megalops of *Ocypoda*, and is probably the young of one of the species of *Gelasimus*. The carapax is 1.0^{mm} long and 0.7 broad. The front is narrowly triangular, deflexed perpendicularly, somewhat excavated between the eyes, and terminates in a long, slender, and acute tip. The sides are high and impressed for the reception of the three anterior ambulatory legs as in the megalops of *Ocypoda*, although in the alcoholic specimens examined the legs are not closed against the sides. The posterior ambulatory legs are small, and lodged in grooves on the surface of the carapax, much as in the megalops of *Ocypoda*. The external maxillipeds are very much like those of the megalops of *Ocypoda*.

A peculiar megalops, belonging apparently to some Grapsoid group of crabs, was several times taken in the towing-net in Vineyard Sound from August 5 to September 3, on the latter date in the evening. In these the carapax is 1.2 to 1.3^{mm} in length and 0.9 to 1.0^{mm} in breadth. The front is broad, concave above between the eyes; the middle portion projects obliquely downward and terminates in a short, obtuse rostrum; while the lateral angles project forward into a prominent tooth above each eye, so that, when seen from above, the frontal margin appears transverse and tridentate, the teeth being separated by considerable spaces. There are no dorsal spines or tubercles upon the carapax. The sides are high, and are apparently impressed for the reception of the anterior ambulatory legs. The posterior ambulatory legs are subequal with the others and have styliform dactyli. The ischial and meral segments of the external maxillipeds are short and broad.

Another megalops, of which several specimens were taken in the towing-net, in Vineyard Sound, August 5, has a remarkable, elongated and tuberculated carapax. The carapax, including the rostrum, is 1.3^{mm} long and 0.84^{mm} broad, is armed above with several large tubercles, and the posterior margin is arcuate and armed with a median tubercular prominence. The front is somewhat excavated above and expanded each side in front of the eyes, the anterior margin being transverse, as seen from above, with a short and spiniform rostrum curved obliquely downward. The chelipeds have slender hands and the ambulatory legs are long and slender, the posterior pair being subequal with the others, and all having the dactyli styliform. The abdominal legs are very long.

Several other forms of zoëa and megalops were taken in Vineyard Sound and vicinity, but, as they were not traced to the adult forms and were none of them very abundant, they are not here described.

Squilla empusa passes through a remarkable metamorphosis, but none of the earliest stages were observed. Specimens in one of the later larval stages (Plate VIII, fig. 36) were taken at the surface in Vineyard Sound, August 11. These are nearly 6^{mm} long. The carapax is proportionally much larger than in the adult, covering completely the whole cephalothorax, has a long slender rostrum projecting far in front of the eyes, and the lateral angles projecting backward in two slender processes as long as the rostrum. There is also on each side, just behind the eye, a small tooth on the margin of the carapax, and another similar one on the posterior margin just beneath each of the posterior processes. The eyes are very large and almost spherical. The antennulæ are short, projecting scarcely beyond the eyes, and biramous, one of the flagella being short and unsegmented, the other longer and composed of three segments. The antennæ are still without flagella, and the scale is quite small. The first pair of legs (the appendages corresponding to the first pair of maxillipeds in the Macroura, &c.) are well developed, long, and slender, like those of the adult. The great claws are proportionally larger than in the adult, and have very much the same structure. Of the six succeeding pairs of cephalothoracic legs, only the three anterior, subcheliform ones are as yet developed, and these are quite small, those of the third pair being smaller than the others, and projecting but slightly beyond the carapax; the three posterior, styliform legs are entirely wanting, or represented only by slight sack-like protuberances. The abdomen is not quite as long as the cephalothorax, including the rostrum and posterior processes, and the five anterior segments are subequal in length, smoothly rounded above, and furnished with well developed swimming-legs, much like those of many macrouranas. The sixth segment is much shorter than the others, and has rudimentary appendages scarcely longer than the segment itself. In these appendages the spiniform process from the base is long and simple, not biramous, as in the adult, and the lamellæ are small, much shorter than this process, and the outer one has no articulated terminal portion. The terminal segment is as long as the four preceding segments, about as broad as long, the lateral margins slightly convex in outline, and each armed with two sharp teeth, while the posterior margin is concave in outline, with the lateral angles projecting into sharp teeth, between which the edge is armed with about twenty small and equal slender spines.

D.—CATALOGUE OF THE MARINE INVETEBRATE ANIMALS OF THE SOUTHERN COAST OF NEW ENGLAND, AND ADJACENT WATERS.—BY A. E. VERRILL, S. I. SMITH, AND OSCAR HARGER.

In the following catalogue nearly all the marine invertebrates which are known to inhabit the coast between Cape Cod and New York are included, except those belonging to certain groups which have not yet been studied by any one, sufficiently for their identification. Such are chiefly minute or microscopic species, belonging to the Entomostraca, Foraminifera, Ciliated Infusoria, &c., together with the intestinal worms of fishes and other animals. Our sponges, also, have hitherto received very little attention, and it has not yet been possible to identify but a small number of the species. It is not to be supposed, however, that the list is complete in any group, for every season in the past has served to greatly increase the number of species in almost every class and order, and this will doubtless be the case for many years to come. But as no attempt has hitherto been made to enumerate the marine animals of this region, excepting the shells and radiates, it is hoped that this catalogue will prove useful, both to show what is already known concerning this fauna, and to serve as a basis for future work in the same direction.

In some instances species that have not actually been found on the part of the coast mentioned, but which occur on the shores of Long Island and New Jersey, under such circumstances as to render it pretty certain that they will also be found farther north, have been included in the catalogue, but the special localities have always been given in such cases.

In order not to make the list too long, only those synonyms are given which are really necessary to make apparent the origin of the names, and to refer the student to some of the best descriptions and figures in the works that are generally most accessible, and in which more complete synonymy may be found.

For the same reason, in describing the new species, the descriptions have been made as brief as seemed consistent with the purpose in view, viz: to enable students and others who may not be experienced naturalists to identify the species that they may meet with. To this end, the portions of the descriptions relating to strictly microscopic parts have frequently been omitted, when more obvious characters, sufficient to distinguish the species, could be found.

References to the plates at the end of this volume have been inserted, and also to the pages in the first part of the report where brief descriptions, remarks on the habits, or other information may be found.

The catalogue of the Crustacea was prepared by Mr. S. I. Smith and Mr. Oscar Harger. The rest of the catalogue is by Professor A. E. Verrill, with the exception of the descriptions of the insects, which have been furnished by Dr. A. S. Packard and Dr. G. H. Horn; the Pycnogonids, which have been determined by Mr. S. I. Smith; and a few of the Bryozoa, which were identified by Professor A. Hyatt, who also furnished most of the figures of the species belonging to that class.

Hitherto there has been no attempt to enumerate the marine invertebrates of the entire southern coast of New England. Several partial lists have been published, however, and these have been of considerable use in the preparation of the following catalogue.

In the Report on the Invertebrata of Massachusetts, by Dr. A. A. Gould, 1841, numerous localities for shells on the southern coast of Massachusetts are mentioned.

A catalogue of the shells of Connecticut, by James H. Linsley, was published in the American Journal of Science, vol. 48, 1845. In "Shells of New England," 1851, Dr. William Stimpson gave much accurate information concerning the distribution of our Mollusca. In 1869 Dr. G. H. Perkins published a very useful catalogue, in the Proceedings of the Boston Society of Natural History, vol. xiii, p. 109, entitled "Molluscan Fauna of New Haven."

The "Report on the Mollusca of Long Island, New York, and of its Dependencies," by Sanderson Smith and Temple Prime, in the Annals of the Lyceum of Natural History, vol. ix, p. 377, 1870, also contains much useful information.

A paper by Dr. Joseph Leidy, entitled "Contributions toward a Knowledge of the Marine Invertebrate Fauna of the Coasts of Rhode Island and New Jersey," in the Journal of the Philadelphia Academy, vol. iii, 1855, although very incomplete, contains the only published lists of the Annelids and Crustacea of this region. In his "Catalogue of North American Acalephæ," 1865, Mr. A. Agassiz has enumerated all the species discovered on this coast up to that time. Other papers will also be referred to in the synonymy.

ARTICULATA.

INSECTA.

The insects included in the following catalogue have mostly been determined by A. S. Packard, jr., M. D., and by George H. Horn, M. D., who have also kindly furnished descriptions of the new species. Our thanks are also due to Dr. H. A. Hagen, who has identified some of the species. The Pycnogonids have been determined by Mr. S. I. Smith.

DIPTERA.

CHIRONOMUS HALOPHILUS Packard, sp. nov. (p 415.)

Full-grown larvæ were dredged in 10 fathoms in Vineyard Sound, several miles from land, among compound Ascidians, (A. E. V.;) and several young larvæ were dredged in 8 to 10 fathoms in Wood's Hole Passage, September 10, (A. S. P.)

"This is a true *Chironomus*, the body being long and slender, with the usual respiratory filaments at the end of the body. Head red as usual, chitinous; antennæ slender, ending in two unequal spines; eyes black, forming conspicuous dots; mandibles acute, three-toothed.

From lower side of antepenultimate segment arise two pairs of long fleshy filaments, twice as long as the diameter of body, not containing tracheæ, so far as I can see; and from the end of penultimate segment a dorsal minute tubercle, forming a cylindrical papilla, giving rise to eight respiratory hairs about as long as the segment is thick; anal legs long and slender, with a crown of about twelve spines. Two prothoracic feet, as usual. In one larva the semi-pupa was forming; length, 11^{mm}, (.45 inch.)

This species belongs in the same section of the genus with *Chironomus plumosus*, figured by Reaumer, (vol. iv, Pl. 14, figs. 11 and 12; and vol. v.)"—A. S. P.

CHIRONOMUS OCEANICUS Packard. (p. 331.)

Proceedings of the Essex Institute, vol. vi, p. 42, figs. 1–4, 1869.

Specimens apparently belonging to this species have been obtained near New Haven, at low-water mark, among confervæ. It occurs at Salem, Massachusetts; Casco Bay; and the Bay of Fundy, from low-water mark to 20 fathoms.

CULEX, species undetermined. (p. 466.)

A species of mosquito is excessively abundant on the salt-marshes in autumn, and the larvæ inhabit the brackish waters of the ditches and pools.

MUSCIDÆ.—Larvæ of an undetermined fly. (p. 415.)

This larva was found living beneath the surface of the sand, at low-water mark, on the shore of Great Egg Harbor, at Beesley's Point, New Jersey, April 28, 1871. (A. E. V.) The same larva, or an allied species, was found May 5, under stones below high-water mark. "Specimens were brought to me from New Jersey, and kept living in sea-water for some time. The following description is from the living specimens: Body white, long, slender, cylindrical, tapering gradually from the penul-penultimate segment toward the head; thirteen segments, counting the head as one. Segments smooth, thickened at the hinder edge, the sutures being distinct; tegument very thin and transparent, allowing the viscera to be easily distinguished. The terminal segment of the body is conical; seen from beneath it is nearly a fourth longer than broad, the end subacute and deeply cleft by a furrow which diminishes in size and depth to beyond the middle of the segment, where it fades out. This conical extension is flattened vertically above; from the middle of the same ring project the supra-anal, conical, fleshy tubercles, one-fourth the length of the entire ring, which give rise to two main tracheæ running to the head, and which separate and close together at the will of the animal. When extended the prothoracic ring is considerably longer than the others. Head one-third as large as prothorax, and a little more than half as wide. Length, 9^{mm}.

I cannot detect any spiracles on either of the thoracic rings. The tracheæ are not nearly so regular as in the larvæ of the *Anthomyia ceparum*, with living specimens of which I placed it side by side; head much the same, showing it may be of this family. Minute antennæ present; no traces of them in *Anthomyia*, and their presence throws a doubt whether it be a muscid."—A. S. P.

ERISTALIS, species undetermined.

One large-sized larva was found in Vineyard Sound among algæ in April, by Mr. Vinal N. Edwards.

EPHYDRA, species undetermined. (p. 466.)

Packard, Proceedings Essex Institute, vol. vi, p. 50.

Shores of Narragansett Bay, puparium found under sea-weeds by Dr. T. d'Orexmieul. According to Dr. Packard, "scarcely distinguishable from *E. halophila* Packard, which lives in salt brine at the salt-works in Gallatin County, Illinois."

COLEOPTERA.*

A number of species of tiger-beetles (*Cicindela*) are common on the sandy shores and beaches just above high-water mark, and some of them are seldom found away from the sea-shore, while others are also found far inland. The larvæ of some of these, and perhaps of all, live below high water, but this has not yet been observed in the case of several

* The Coleoptera were mostly determined by Dr. George H. Horn.

in the following list, which includes those most characteristic of the sea-shores.

CICINDELA GENEROSA Dejean. (p. 336.)

Spécies Général des Coléoptères, vol. v, p. 231, (teste Lec.;) Gould. Boston Journal Nat. Hist., vol. i, p. 42. Pl. 3, fig. 2.

Adult common on sandy beaches at high-water mark; larvæ burrowing in sand below high-water mark, in company with the species of *Talorchestia*.

CICINDELA DORSALIS Say. (p. 364.)

Journal Academy Nat. Sciences of Philadelphia, vol. i, p. 20; Gould, op. cit., p. 47.

Martha's Vineyard, on the sandy beaches.

CICINDELA MARGINATA Fabricius. (p. 470.)

Systema Eleutheratorum, vol. i, p. 241; Gould, op. cit., p. 48.

Barren spots in salt marshes that are occasionally covered by the tides.

CICINDELA REPANDA Dejean. (p. 364.)

Spécies Gén. des Coléoptères, vol. i, p. 74.

With the last, and on sandy beaches at Martha's Vineyard, &c.

CICINDELA HIRTICOLLIS Say. (p. 364.)

Trans. Amer. Phil. Society, new series, vol. i, p. 411, Pl. 13, fig. 2.

With last, also at a distance from the coast.

CICINDELA DUODECIMGUTTATA Dejean.

Spéc. Gén. des Coléop., vol. i, p. 73; Gould, op. cit., p. 51.

Sandy beaches near the salt water; appears both in spring and autumn.

GEOPINUS INCRASSATUS (Dej.) (p. 364.)

Spécies Gén. des Coléopères, vol. iv, p. 21.

Several specimens were found on the outer beach of Great Egg Harbor, New Jersey, burrowing in sand between tides. This species is not confined to the coast, but occurs even west of the Mississippi in sandy places, (Horn.)

BEMBIDIUM CONSTRICTUM Leconte. (p. 464.)

Annals Lyceum Nat. Hist., N. Y., vol. iv, p. 362.

Between tides at Great Egg Harbor, New Jersey.

B. CONTRACTUM Say. (p. 464.)

Trans. Amer. Phil. Soc., vol. ii, p. 85.

Between tides at Great Egg Harbor. This and the preceding occur also along the margins of streams emptying into the ocean. (Horn.)

HYDROPHILUS (TROPISTERNUS) QUADRISTRIATUS Horn. (p. 466.)

Trans. Amer. Entomol. Soc., 1871, p. 331.

In brackish pools, near Beesley's Point, New Jersey, associated with *Palæmonetes vulgaris* and other brackish-water species.

"Elongate oval, more attenuate in front, black, with slight olivaceous tinge; surface densely, finely, and equally punctured. Head with a sigmoid row of coarse punctures on each side, meeting at the vertex. Antennæ and palpi testaceous. Thorax with a small fovea on each side, near the anterior margin, behind and within the eyes, and an angulate row of punctures on each side near the middle, and a few coarse punctures very irregularly disposed. Elytra with four striæ of moderate punctures, the first two sutural and extending nearly from base to apex, inclosing at base a short scutellar row; the outer two rows subhumeral, obliterated at base, extending nearly to apex, and becoming confused, extending toward the inner rows. Body beneath black, opaque, and pubescent, abdomen with a row of brownish patches at the sides of each segment. Legs pale testaceous, femora at base and tarsi black. Length, .38 inch; (9.5^{mm}.)

Resembles *lateralis* in form, but more narrowed in front than behind. The elytra are evenly punctured, and the body along the median line moderately convex. It differs from all our species by the four distinct striæ of punctures on each elytron. The outer two correspond in position with the eighth and ninth, and traces of a third, fourth, and fifth are visible at base."—Horn.

PHILHYDRUS REFLEXIPENNIS Zimmermann.

Trans. Amer. Entomol. Soc., 1869, p. 250.

Great Egg Harbor, between tides.

This and the next occur also inland. (Horn.)

P. PERPLEXUS, Leconte.

Proc. Philad. Acad. Nat. Sci., 1855, p. 371.

Great Egg Harbor, between tides.

PHYTOSUS LITTORALIS Horn. (p. 464.)

Trans. Amer. Entomol. Soc., 1871, p. 331.

"Head brownish testaceous, moderately shining, sparsely clothed with yellowish hairs, front feebly concave; parts of mouth and antennæ testaceous, the latter darker at tip. Thorax paler than the head, as broad as long, disk depressed, sides strongly rounded in front, behind the middle sinuate; base truncate, feebly emarginate at middle, and but slightly broader than half the width of thorax at middle; surface sparsely punctured and pubescent. Elytra pale testaceous, sparsely punctured and pubescent, short, sides strongly divergent behind; body apterous. Abdomen elongate oval, broader behind the middle, piceous, shining, and very sparsely pubescent. Legs pale testaceous. Last segment of abdomen ♂ slightly prolonged at middle and sinuate on each side. Length, .08 inch, (2^{mm}.)

The male resembles in its several characters *P. Balticus* Kraatz, of Europe, but the median prolongation of the last abdominal segment is broader. The penultimate segment is subcarinate along the median line behind. The mandibles in the present species are much more exsert than in the species from California.

This is an interesting addition to our insect fauna. Its occurrence has been looked for on the ground of the occurrence of a species on the Pacific Coast, for, as a rule, (rapidly losing its exceptions,) any genus represented in Europe and on the Pacific Coast will have a representation in the Atlantic faunal region."—Horn.

This species was found burrowing in sand, between tides, at Beesley's Point, New Jersey.

BLEDIUS CORDATUS (Say.) (p. 462.)

Trans. Amer. Phil. Soc., vol. iv, p. 461.

This small species occurred in considerable abundance near Beesley's Point. It forms its small burrows in the loose sand at and just below high-water mark, in company with *Talorchestia longicornis*, *Scyphacella arenicola* SMITH, &c. It throws up a small heap of sand around the opening of its burrows, which are much smaller than those of the following species.

"This species is somewhat variable in the form of the elytral dark spot. The elytra are pale testaceous or nearly white in color, and normally with a cordate space of brownish color, and with the apex in front. This spot may become a narrow median fusiform space, or be divided so that the suture is pale; the spot frequently becomes larger by the apex of the cordate spot, extending to the scutellum and along the basal margin."—Horn.

BLEDIUS PALLIPENNIS (Say.) (p. 462.)

Journal Acad. Nat. Sci., Philad., vol. iii, p. 155.

Shores of Great Egg Harbor, near Beesley's Point, common, burrowing perpendicularly in moist sand considerably below high-water mark. The holes are round, with a small heap of sand around the orifice. This species is also found far inland. (Horn.)

HETEROCERUS UNDATUS Melsheimer. (p. 464.)

Proc. Acad. Nat. Sci., Philad., vol. ii, p. 98.

Beesley's Point, burrowing in sand, between tides. This species occurs also on the margins of inland streams. (Horn.)

PHALERIA TESTACEA Say.

Long's Expedition, vol. ii, p. 280.

Somer's Point, on the shore of Great Egg Harbor, between tides.

NEUROPTERA.

MOLANNA, species undetermined. (p. 379.)

This larva was found in a firm, straight, flattened, tapering tube, made of grains of sand, and attached to the piles of a wharf, below high-water mark, at Menemsha Bight, on Martha's Vineyard, October, 1871, by Dr. Edward Palmer.

ANURIDA MARITIMA (Guerin.) (p. 331.)

This Podurid is very abundant on the under surfaces of large stones from high-water mark to about half tide, New Haven, Wood's Hole, Nantucket; also on the coasts of Europe and Greenland. (Fabricius.)

ARACHNIDA.

CHERNES OBLONGUS Say. (p. 331.)

Hagen, Record of American Entomology for 1868, p. 51.

Under stones near low-water mark, at Wood's Hole, (S. I. S.,) several specimens were found together. This species is recorded from Florida and Georgia. I am not aware that it has been observed below high-water mark before. These specimens were identified by Dr. Hagen.

TROMBIDIUM, species. (p. 331.)

Several species of mites belonging to this or allied genera are found beneath stones near high-water mark, or even running over the *fuci* and rocks near low-water mark, but it is uncertain whether they become submerged by the rising tide or rise on its surface.

BDELLA MARINA Packard, sp. nov. (p. 331.)

Savin Rock, near New Haven, under stones between tides.

"Elongated pyriform, of the usual form of the genus, the body being thickest at the insertion of the third pair of legs. Body with a few scattered hairs, especially toward the end. Palpi twice as long as labium, hairy toward the tip, four-jointed, basal joint not so long as second, third, and fourth conjointly; second a third shorter than third. Mandibles very acutely conical, projecting one-fourth their length beyond the beak, with about four hairs on the outer side; tips very slender acute, corneous. Legs rather hairy; fourth pair but little longer than the others. Claws consisting of two portions, the basal much compressed, subovate, with about six hairs on the under edge, and carrying a stout curved claw. Beak half as long as the body is wide. Length 2.5^{mm}.

"It differs from Say's *Bdella oblonga* ('from Georgia, under bark of trees,' &c.) in its pyriform shape, the shorter first joint of the palpi, and much shorter beak."—A. S. P.

PYCNOGONIDEA.

PHOXICHILIDIUM MAXILLARE Stimpson. Plate VII, fig. 35. (p. 415.)

Marine Invertebrata of Grand Manan, p. 37, 1853.

Common in Vineyard Sound and the Bay of Fundy.

PALLENE, species. (p. 421.)

A small species, perhaps young, found upon piles of the wharf at Wood's Hole, and dredged in Vineyard Sound, in 14 fathoms, off Tarpaulin Cove on Ascidians, and off Holmes's Hole on Hydroids; also off Watch Hill, Rhode Island, and New Haven.

CRUSTACEA.

The following catalogue of the Crustacea has been prepared by Mr. S. I. Smith, excepting the portion relating to the Isopoda, which has been written by Mr. O. Harger.* The list is by no means complete, even for the higher groups which are treated, and no attempt has been made to enumerate the Ostracoids and free-swimming Copepods. Among the Amphipods, the difficult group of Lysianassinæ has not been studied, as the species require careful comparison with those of our northern coast and of Europe. The same is true of the species of *Ampelisca*, and partially of some other genera. In several cases species are omitted which are as yet only represented in our collections by imperfect, young, or too few specimens. The catalogue is intended, however, to include every species which has been mentioned, on good authority, in any published work as inhabiting the southern coast of New England.

BRACHYURA.

GELASIMUS MINAX Leconte. (p. 467.)

Proceedings Acad. Nat. Sci., Philadelphia, vol. vii, 1855, p. 403; Smith, Trans. Conn. Acad., vol. ii, p. 128, Pl. 2, fig. 4, Pl. 4, fig. 1, 1870.

Southern coast of New England to Florida. This species, the largest of our "fiddler-crabs," lives upon salt marshes, usually farther from the sea than the others, and frequently where the water is most of the time nearly fresh.

GELASIMUS PUGNAX Smith. (p. 466.)

Trans. Conn. Acad., vol. ii, p. 131, Pl. 2, fig. 1, Pl. 4, fig. 2. *G. vocans*, var. A, De Kay, Nat. Hist. of New York, p. 14, Pl. 6, fig. 10, 1844, (not *Cancer vocans* Linné.) *G. pugilator* Leconte, loc. cit., p. 403, (not of Bosc.)

From Cape Cod to Florida, the Gulf of Mexico, and the West Indies. It makes its burrows only upon salt marshes, but is often seen in great companies wandering out upon muddy or sandy flats, or even upon the beaches of the bays and sounds.

GELASIMUS PUGILATOR Latreille. (p. 336.)

Nouveau Dictionnaire d'Hist. nat., 2è édit., tome xii, p. 520, 1817; Smith, Trans. Conn. Acad., vol. ii, p. 136, Pl. 4, fig. 7, 1870. *Ocypode pugilator* Bosc, Hist. nat. des Crust., tome i, p. 167, 1820. *Gelasimus vocans* DeKay, op. cit., p. 14, Pl. 6, fig. 9.

Cape Cod to Florida, upon muddy and sandy flats and beaches.

OCYPODA ARENARIA Say. (pp. 337, 534.)

Journal Acad. Nat. Sci., Philadelphia, vol. i, p. 69, 1817; Edwards, Hist. nat. des Crust., tome ii, p. 44, Pl. 19, figs. 13, 14.

This species, which is common upon the sandy beaches from New Jersey southward, and which I have found upon Fire Island Beach, Long

* The description of *Scyphacella arenicola* and the reference of *Idotea triloba* to *Epelys* are taken from Mr. Smith's unpublished manuscript, and his name, therefore, appears as authority in these cases.

Island, will very likely be found rarely upon the beaches at Nantucket, and on the southern part of Cape Cod. It lives in deep burrows, above the reach of tides, upon sandy beaches. It is readily distinguished from the "fiddlers" by the nearly equal claws or hands, which are alike in both sexes, and by its color, which is almost exactly like the sand upon which it lives. It is carnivorous and very active, running with great rapidity when pursued.

The synonymy of this species is in much confusion, and I have not attempted to rectify it here, although there are apparently several names which antedate that of Say. The Brazilian species, usually called *rhombea* appears to be identical with ours, and if it is really the *rhombea* of Fabricius, his name should undoubtedly be retained.

SESARMA RETICULATA Say. (p. 467.)

Journal Acad. Nat. Sci., Philadelphia, vol. i, pp. 73, 76, Pl. 4, fig. 6, 1817; p. 442, 1818; Smith, Trans. Conn. Acad., vol. ii, p. 156.

From Long Island Sound to Florida, usually upon salt marshes and associated with *Gelasimus pugnax*.

PINNIXA CYLINDRICA Say. Plate I, fig. 1. (p. 367.)

Journal Acad. Nat. Sci., Philadelphia, vol. i, p. 452, 1818.

Vineyard Sound and Long Island Sound to South Carolina.

PINNOTHERES OSTREUM Say. Plate I, fig. 2, male. (p. 367.)

Loc. cit., p. 67, Pl. 4, fig. 5, 1817; DeKay, op. cit., p. 12, Pl. 7, fig. 16.

Massachusetts to South Carolina.

PINNOTHERES MACULATUS Say. (p. 434.)

Loc. cit. p. 450, 1818.

It lives in *Mytilus edulis* on the New England coast, and is found from Cape Cod to South Carolina.

CANCER IRRORATUS Say. (pp. 312, 530.)

Loc. cit., p. 59, Pl. 4, fig. 2, 1817; Stimpson, Annals Lyceum Nat. Hist., New York, vol. vii, p. 50, 1859. *Platycarcinus irroratus* Edwards, Hist. nat. des Crust., tome i, p. 414, 1834; DeKay, op. cit., Pl. 2, fig. 2. *Cancer Sayi* Gould, Report on the Invertebrata of Massachusetts, 1st edit., p. 323, 1841. *Platycarcinus Sayi* DeKay, op. cit., p. 7. *Cancer borealis* Packard, Memoirs Boston Nat. Hist. Soc., vol. i, p. 303, 1867.

Labrador to South Carolina.

CANCER BOREALIS Stimpson. (pp. 486, 493.)

Loc. cit., p. 50, 1859. *Cancer irroratus* Gould, op. cit., p. 322.

Nova Scotia to Vineyard Sound and No Man's Land. It very likely occurs both north and south of these limits, as it seems to be rare or local, and is often, perhaps, confounded with the far more common *C. irroratus*, although it is a perfectly distinct species.

PANOPEUS HERBSTII Edwards. (p. 472.)

Op. cit., vol. i, 403, 1834; Smith, Proceedings Boston Soc. Nat. Hist., vol. xii, p. 276, 1859.

Long Island Sound to Brazil, but not common north of New Jersey. It is readily distinguished from the following species, by the tubercle on the subhepatic region, just below the first lobe of the antero-lateral border of the carapax; by the postorbital tooth being separated from the second tooth of the antero-lateral margin by a rounded sinus; and by the dactylus of the larger cheliped having a stout tooth near the base within.

PANOPEUS DEPRESSUS Smith. Plate I, fig. 3. (p. 312.)

Loc. cit., p. 283, 1859.

From Cape Cod to Florida, and often carried with oysters much farther north. It is, perhaps, native in Massachusetts Bay.

PANOPIUS SAYI Smith. (p. 312.)

Loc. cit., p. 284, 1859.

Associated with the last, and having the same range. It is easily distinguished from the last species by its narrower, more convex, and swollen carapax, and by the more projecting and arcuate front. The terminal segment of the abdomen of the male is also quite different in the two species; in *P. Sayi* it is broader than the preceding segment, about two-thirds as long as broad, the edges slightly concave, and the tip abruptly triangular, while in *P. depressus* it is narrower than the preceding segment, about three-fourths as long as broad, the edges convex, and the tip broadly rounded.

PANOPEUS HARRISII Stimpson. (p. 313.)

Loc. cit., p. 55, 1859. *Pilumnus Harrisii* Gould, op. cit., p. 326, 1841.

Massachusetts Bay to Florida.

CARCINUS GRANULATUS (Say, sp.) (p. 312.)

Cancer granulatus Say, loc. cit., p. 61, 1817. *Carcinus mænas* Gould, op. cit., p. 321; DeKay, op. cit., p. 8, Pl. 5, figs. 5, 6. (?) *Carcinus mænas* Leach, Edwards, &c.

Cape Cod to New Jersey, and perhaps much farther south. Our species may, very likely, be the same as the *Carcinus mænas* of Europe, but its not extending north on our own coast throws some doubt upon this until there has been a careful comparison of specimens from the two sides of the Atlantic.

PLATYONICHUS OCELLATUS Latreille. Plate I, fig. 4. (pp. 338, 533.)

Encyclopédie méthodique, tome xvi, p. 152; DeKay, op. cit., p. 9, Pl. 1, fig. 1, Pl. 5, fig. 7. *Cancer ocellatus* Herbst, Krabben und Krebse, Band iii, erstes Heft, p. 61, Pl. 49, fig. 4, 1799. *Portunus pictus* Say, loc. cit., p. 62, Pl. 4, fig. 4, 1817.

Cape Cod to Florida.

CALLINECTES HASTATUS Ordway. (pp. 367, 468.)

Boston Journal Nat. Hist., vol. vii, p. 568, 1863. *Lupa hastata* Say, loc. cit., p. 65, 1817. *Lupa diacantha* DeKay, op. cit., p. 10, Pl. 3, fig. 3.

Cape Cod to Florida, and occasionally in Massachusetts Bay.

LIBINIA CANALICULATA Say. (p. 368.)

Loc. cit., p. 77, Pl. 4, fig. 1, 1817; DeKay, op. cit., p. 2, Pl. 4, fig. 4; Streets, Proceedings Acad. Nat. Sci., Philadelphia, 1870, p. 105, 1871.

Found as far north as Casco Bay, on the coast of Maine, and common from Massachusetts Bay southward, at least as far as Florida.

LIBINIA DUBIA Edwards. (p. 368.)

Op. cit., tome i, p. 300, Pl. 14 *bis*, fig. 2, 1834; Streets, loc. cit., p. 104.

Cape Cod to Florida.

PELIA MUTICA Stimpson. (p. 415)

Annals Lyceum Nat. Hist., New York, vol. vii, p. 177, 1860. *Pisa mutica* Gibbes, Proceedings Amer. Association Adv. Sci., 3d meeting, p. 171, 1850.

Vineyard Sound to Florida.

HYAS COARCTATUS Leach. (p. 504.)

Trans. Linn. Soc., London, vol. xi, p. 329, 1815. Régne animal de Cuvier, 3me édit., Pl. 32, fig. 3. *Lissa fissirostra* Say, loc. cit., p. 79, 1817.

Leidy mentions this species as having been found on the coast of New Jersey, and Say mentions it from the coast of Long Island, but it seems to be rare south of Cape Cod. It lives in deep water from Cape Cod northward, and on the European coast, and is frequently found in the stomachs of the cod-fish.

HETEROCRYPTA GRANULATA Stimpson. (p. 315.)

Annals Lyceum Nat. Hist., New York, vol. x, p. 102, 1871. *Cryptopodia granulata* Gibbes, loc. cit., p. 173; and Proceedings Elliott Soc., Charleston, vol. i, p. 35, wood cut.

This species, dredged several times in Vineyard Sound, was before known only from North Carolina to Florida and the West Indies.

ANOMOURA.

HIPPA TALPOIDA Say. Plate II, fig. 5. (pp. 338, 530.)

Loc. cit., p. 160, 1817.

Cape Cod to Florida.

EUPAGURUS POLLICARS Stimpson. (p. 313.)

Annals Lyceum Nat. Hist., New York, vol. vii, p. 92, 1859. *Pagurus pollicaris* Say, loc. cit., p. 162, 1817; Gould, op. cit., p. 329; DeKay, op. cit., p. 19, Pl. 8, fig. 21.

Massachusetts to Florida.

EUPAGURUS BERNHARDUS Stimpson. (p. 501.)

Loc. cit., p. 89, 1859. *Pagurus Bernhardus* (Linné sp.,) Fabricius, Entomologia systematica, vol. ii, p. 469, 1793; Gould, op. cit., p. 329; DeKay, op. cit., p. 20.

Vineyard Sound, &c., in deep water, more abundant north of Cape Cod, and extending to Northern Europe on one side, and to Puget Sound on the other.

EUPAGURUS PUBESCENS Stimpson.

Loc. cit., p. 89, 1859; and Proceedings Acad. Nat. Sci., Philadelphia, 1858, p. 237, 1859. *Pagurus pubescens* Kroyer, Naturh. Tidsskrift, Bind ii, p. 251, 1838.

This species has been taken in deep water off the coast of New Jersey, and will, doubtless, be found off Long Island and Vineyard Sounds. It extends northward to Greenland and Northern Europe.

EUPAGURUS LONGICARPUS Stimpson. (p. 339.)

Proceedings Acad. Nat. Sci., Philadelphia, 1858, p. 237, 1859. *Pagurus longicarpus* Say, loc. cit., p. 163, 1817; Gould, op. cit., p. 330; DeKay, op. cit., p. 20, Pl. 8, fig. 22.

Massachusetts Bay to South Carolina.

MACROURA.

GEBIA AFFINIS Say. Plate II, fig. 7. (pp. 367, 530.)

Loc. cit., p. 195, 1817.

Long Island Sound to South Carolina.

CALLIANASSA STIMPSONI Smith, sp. nov. Plate II, fig. 8. (p. 369.)

Carapax smooth and shining. Greater cheliped (fig. 8) about three times as long as the carapax; carpus and hand convex on both sides; carpus sometimes considerably longer, sometimes not at all longer than broad; both fingers of the same length, and about as long as the basal portion of the dactylus; the prehensile edge of the dactylus without a strong tooth or tubercle at base. Smaller cheliped about half as long as the greater; carpus and hand about equal in length; fingers equal, slender, as long as the basal portion of the propodus. Abdomen smooth and shining above, gradually increasing in breadth to the fifth segment; second segment longest, much longer than broad; third and fifth equal in length; fourth shorter, and sixth a little longer than third or fifth; telson much broader than long, shorter than the fourth segment.

Length of a large specimen, 61^{mm}; length of carapax, 15; length of larger cheliped, 44.

In the character of the chelipeds this species seems to be closely allied to *C. longimana* Stimpson, from Puget Sound.

Our species ranges from the coast of the Southern States north to Long Island Sound.

HOMARUS AMERICANUS Edwards. (pp. 395, 492, 522.)

Hist. nat. des. Crust., tome ii, p. 334, 1837. *Astacus marinus* Say, loc. cit., p. 165, 1817, (not of Fabricius.)

New Jersey to Labrador.

CRANGON VULGARIS Fabricius. Plate III, fig. 10. (pp. 339, 529.)

Supplementum Entomologiæ system., p. 410, 1798. *Crangon septemspinosus* Say, loc. cit., p. 246, 1818.

North Carolina to Labrador and Europe. In depth it extends from low water to 60 or 70 fathoms, and probably much deeper.

HIPPOLYTE PUSIOLA Kroyer. (p. 395.)

Monografisk Fremstlling Hippol., p. 319, Pl. 3, figs. 69–73, 1842.

Vineyard Sound and northward to Greenland and Europe.

VIRBIUS ZOSTERICOLA Smith, sp. nov. Plate III, fig. 11. (p. 369.)

Female: Short and stout. Rostrum about as long as the carapax, and reaching nearly, or quite, to the tip of the antennal scale; the upper edge nearly straight and unarmed, except by two, or rarely three, teeth at the base; under edge with three (sometimes two or four) teeth on the anterior half. Carapax smooth and armed with a stout (supra-orbital) spine on each side at the base of the rostrum and above and a little behind the base of the ocular peduncle, a small (antennal) spine on the anterior margin beneath the ocular peduncle, and a stout (hepatic) spine behind the base of the antennæ. Inner flagellum of the antennula extending very slightly beyond the tip of the antennal scale; outer flagellum considerably shorter. Abdomen geniculated at the third segment; the posterior margin of the third segment prominent above, but not acute.

The males differ from the females in being smaller, much more slender, and in having the rostrum narrower vertically.

The color in life is very variable. Most frequently the entire animal is bright green, sometimes pale, or even translucent, tinged with green. Others were translucent, specked with reddish brown, and with a broad median band of dark brown extending the whole length of the body.

Length of female, 20–26^{mm}; male 15–20.

It is at once distinguished from *V. pleuracanthus* Stimpson, to which, in many characters, it is closely allied, by its very much longer rostrum.

Among eel-grass about Vineyard Sound, and probably common at other points on the coast.

Virbius pleuracanthus Stimpson, (Annals Lyceum Nat. Hist., New York, vol. x, p. 127, 1871,) abundant upon the coast of New Jersey, will very likely be found farther north. In habit it is similar to the species just described.

PANDALUS ANNULICORNIS Leach. Plate II, fig. 6. (p. 493.)

Malacostraca Podophthalmata Britanniæ, Pl. 40, 1815.

Deep water in Vineyard Sound, off Newport, &c.

North of Cape Cod it is common, and extends to Greenland and Europe. In depth it extends down to 430 fathoms at least.

PALÆMONETES VULGARIS Stimpson. Plate II, fig. 9. (pp. 479, 529.)

Annals Lyceum Nat. Hist., New York, vol. x, p. 129, 1871. *Palæmon vulgaris* Say, Journal Acad. Nat. Sci., Philadelphia, vol. i, p. 224, 1818.

Massachusetts to South Carolina.

PENÆUS BRASILIENSIS Latreille.

Edwards, Hist. nat. des Crust., tome ii, p. 414; Gibbes, loc. cit., p. 198; Stimpson, Annals Lyceum Nat. Hist., New York, vol. x, p. 132.

According to Stimpson, this species has been found in the Croton River at Sing Sing, New York, by Professor Baird. It will therefore be very likely to occur in the rivers of Southern New England. It is common on the coast of the Southern States, and extends to Brazil.

SQUILLOIDEA.

SQUILLA EMPUSA Say. (pp. 369, 536.)

Loc. cit., p. 250, 1818; Dekay, op. cit., p. 32, Pl. 13, fig. 54; Gibbes, Proceedings Amer. Assoc., 3d meeting, p. 199.

Florida to Cape Cod.

The young of this species is figured on Plate VIII, fig. 36.

MYSIDEA.

MYSIS STENOLEPIS Smith, sp. nov. Plate III, fig. 12. (p. 370.)

Male: Anterior margin of the carapax produced into a very short, broad, and obtusely rounded rostrum, and each side at the inferior angle into a prominent, acutely triangular tooth, between which and the base of the ocular peduncle there is a broad and deeply rounded sinus. Peduncle of the antennula about a third as long as the carapax along the dorsal line; the sexual appendage slender, tapering, nearly as long as the peduncle; inner flagellum half as long as the outer. Antennal scale rather longer than the carapax along the dorsal line, narrow, about ten times as long as broad, tapering to a slender and acute point, both edges ciliated and nearly straight; flagellum about as long as the rest of the animal. Abdomen somewhat geniculated between the first and second segments; sixth segment about twice as long as the fifth. Appendages of the fourth segment reaching nearly to the distal extremity of the sixth segment; inner ramus slender, slightly longer than the base; outer ramus naked, composed of six segments; the first, third, and fourth subequal in length, and together equaling about three-fourths of the entire length; the second, fifth, and sixth subequal; penultimate segment armed with a stout spine on the outside at the distal extremity, and the last segment terminated by a similar spine. Inner lamella of the appendages of the sixth segment extending slightly beyond the telson, narrow and tapering to an obtuse tip; outer lamella narrow, linear, about seven times as long as broad, nearly a third longer than the inner, both edges ciliated and nearly straight, and the tip narrow and somewhat truncated. Telson considerably longer than the sixth segment, tapering slightly, the sides nearly straight, and each armed with about twenty-four spines; the extremity cleft by a deep sinus rounded at bottom, and its margins convex posteriorly and armed with very numerous slender spines.

Length of a male from tip of rostrum to extremity of telson, 23.2^{mm}; length of carapax along the dorsal line, 6.5; length of antennal scale, 6.7; length of telson, 3.8. Length of female, 30^{mm}.

The females differ but little from the males except in the usual sexual characters. The figure, (Plate III, fig. 12,) made from a small female specimen, does not properly represent the anterior margin of the carapax.

In life the young females are semi-translucent, a spot on each ocular peduncle, the peduncles and inner flagella of the antennulæ, the antennal scale, the telson and caudal lamellæ more or less blackish from deposits of black pigment, while each segment of the abdomen is marked with a rudely stellate spot of black.

Large males of this species were found in the autumn among eel-grass, at New Haven, Connecticut, and the young abundantly in the same situation in May. Young females were collected in abundance during June and July, among the eel-grass in the shallow bays and coves about Vineyard Sound, while adult females, with the marsupial pouches filled with young, were collected, at Wood's Hole, in abundance, April 1, by Mr. V. N. Edwards.

MYSIS AMERICANA. Smith, sp. nov. (p. 396.)

Anterior margin distinctly rostrated, but only slightly projecting; evenly rounded, the inferior angle projecting into a sharp tooth. Antennulæ, in the male, with the densely ciliated sexual appendage similar to that in *M. vulgaris* of Europe; the outer flagellum nearly as long as the body, the inner slightly shorter. Antennal scale about three-fourths as long as the carapax, about nine times as long as broad, tapering regularly from the base to a very long and acute tip; both margins ciliated. Appendages of the fourth segment of the abdomen in the male similar to those in *M. vulgaris.* The outer ramus is slender and naked, and its pair of terminal stylets are equal in length, slender, curved toward the tip, and the distal half armed with numerous short setæ; the ultimate segment of the ramus itself is little more than half as long as the stylets, the penultimate segment four or five times as long as the terminal. Inner lamella of the appendages of the sixth segment about as long as the telson, narrow, slightly broadened at the base, and tapering to a slender but obtuse point; outer lamella once and a half as long as the inner, and eight times as long as broad, slightly tapering, the extremity subtruncate. Telson triangular, broadened at base, the lateral margins slightly convex posteriorly, and armed with stout spines alternating with intervals of several smaller ones; the tip very narrow, truncate, armed with a stout spine each side, and two small ones filling the space between their bases. Length 10 to 12^{mm}.

This species was found, in April, at Beesley's Point, New Jersey, in pools, upon salt-marshes, and at the same locality the stomachs of the spotted flounder were found filled with them. Professor D. C. Eaton found it in great abundance among sea-weeds, &c., just below low-water mark, at New Haven, Connecticut, May 5, 1873. It was also taken in the dredge, in 4 to 6 fathoms, at New Haven, Connecticut, and in 25 fathoms off Vineyard Sound, and has been found in the stomachs of the shad, mackerel, &c.

HETEROMYSIS FORMOSA Smith, gen. et sp. nov. (p. 396.)

Body rather short and stout. Carapax broad behind and tapering anteriorly; the anterior margin produced into an obtusely triangular rostrum. Ocular peduncles short and thickened nearly to the base. Peduncle of the antennula stout, extending to the tip of the antennal scale; the terminal segment in the male wanting the usual elongated sexual process, but having in its place a very dense tuft of long hairs; inner flagellum nearly as long as the carapax; outer flagellum stout at base and more than twice as long as the inner. Antennal scale about three and a half times as long as broad, not quite reaching to the extremity of the peduncle of the antennula, ovate, obtuse at the tip, external margin without a spine and ciliated like the inner; peduncle elongated, penultimate segment considerably longer than the ultimate; flagellum nearly as long as the entire body. Mandibles, maxillæ, first and second maxillipeds, as in *Mysis*. The first pair of legs (second pair of gnathopoda) differ remarkably from those in all the described genera of Mysidæ. The whole leg is stouter than in the succeeding pairs, and the terminal portion, corresponding to the multiarticulate portion of the inner branch (endopodus) in *Mysis*, &c., consists of only three segments including the terminal claw; the first of these segments is stout, slightly shorter than the preceding (meral) segment, and armed with stout spines along the distal portion of the inner margin; the second segment is very short, not longer than broad, and closely articulated to the preceding segment so as to admit of very little motion; the ultimate article is a long, slightly curved claw, freely articulated to the preceding segment. In the five posterior pairs of legs the terminal portion of the inner branch is multiarticulate as in *Mysis*, in the first composed of five segments, besides a stout terminal claw like that in the preceding pair, and in the four remaining pairs of six segments and a slender terminal claw. The exopodal branches of all the legs are well developed.

Abdomen a little more than twice as long as the carapax, the sixth segment a little longer than the fifth. The appendages of the first five segments alike in both sexes; short, rudimentary, and like the same appendages in the female *Mysis*. Inner lamella of the sixth segment projecting very slightly beyond the extremity of the telson, broad, ovate; outer lamella only a little longer than the inner, about two-sevenths as long as broad, inner margin quite convex, outer very slightly, tip rounded. Telson short, broad at base, and narrowed rapidly toward the extremity, the width at base about two-thirds the length, at the extremity only a third as wide as at base; the lateral margins each armed with twelve to fourteen spines, which increase in size distally, and a very long terminal spine; the posterior margins cleft by a sinus deeper than broad, and armed with numerous small spines.

In life the males are semitranslucent and nearly colorless, while in the females the antennulæ, the flagella of the antennæ, the ocular peduncles, the thorax with the marsupial pouch, and the articulations of the caudal appendages are beautiful rose color.

Length of a male, 6.0^{mm}; carapax along the dorsal line, 1.8; antennal scale, 0.70; telson, 0.90. Length of a female, 8.5^{mm}; carapax, 2.5; antennal scale, 0.88; telson, 1.16.

The absence of the sexual appendages from the antennulæ of the male, the peculiar structure of the anterior legs, and the similarity of the abdominal appendages in the two sexes, at once separate the genus *Heteromysis* from all known allied genera.

THYSANOPODA, species. (452.)

A great number of small specimens were taken from the stomach of mackerel caught twenty miles off No Man's Land, July 18, 1871.

Several were also caught swimming at the surface in Vineyard Sound, April 30, 1873, by V. N. Edwards.

A single specimen of a species apparently the same as this was taken at New Haven, Connecticut, May 5, 1873, by Professor D. C. Eaton.

CUMACEA.

DIASTYLIS QUADRISPINOSA, G. O. Sars. Plate III, fig. 13. (p. 507.)

Öfversight af Kongl. Vet.-Akad. Förh., 1871, Stockholm, p. 72.

Dredged in 23 fathoms of Martha's Vineyard and in 29 fathoms of Buzzard's Bay. It is also found in the Bay of Fundy. Sars's specimens were dredged by the Josephine expedition in 18 fathoms off Skinnecock Bay, Long Island, and in 30 to 35 fathoms, latitude 39° 54′ north, longitude 73° 15′ west, off the coast of New Jersey.

Our specimens agree well with Sars's description, except that the second segment of the inner ramus of the lateral caudal appendages has but three, or rarely four, spines upon the inner margin, while in Sars's specimens there were five.

DIASTYLIS SCULPTA Sars.

Loc. cit., p. 71.

With the last species, in 18 fathoms, off Skinnecock Bay, according to Sars.

DIASTYLIS ABBREVIATA Sars.

Loc. cit., p. 74.

Rare in 30 to 35 fathoms, off the coast of New Jersey, with the first species, (Sars.)

EUDORELLA PUSILLA Sars.

Loc. cit., p. 79.

Not infrequent in 18 fathoms, off Skinnecock Bay, (Sars.)

EUDORELLA HISPIDA Sars.

Loc. cit., p. 80.

Rare in 30 to 35 fathoms, with the other species mentioned, off the coast of New Jersey, (Sars.)

AMPHIPODA.

ORCHESTIA AGILIS Smith, sp. nov. Plate IV, fig. 14. (p. 314.)

Male: Antennula not quite reaching the distal extremity of the penultimate segment of the antenna; second and third segments of the peduncle about equal in length, and each slightly longer than the first; flagellum about as long as the two last segments of the peduncle. Antenna less than half as long as the body; segments of the peduncle stout and swollen, the ultimate longer than the penultimate; flagellum stout, compressed vertically, much shorter than the peduncle, composed of twelve to fifteen segments. Propodus in the second pair of legs short and thickened laterally, the palmary margin with a small prominence on the outer edge of the posterior angle, behind which the tip of the dactylus closes, and along the inner edge, inside the dactylus, with a thin ridge, which is broken by a small notch near the posterior angle, so that the margin when viewed laterally shows a broad lobe next the base of the dactylus and two small, rounded lobes next the posterior angle, the tip of the dactylus resting between the small lobes; dactylus slender, curved so as to fit closely the palmary margin, and furnished with very minute setæ along the prehensile margin. Posterior thoracic legs slightly longer than the preceding; carpus in full-grown specimens short, much swollen, and thickened so as to be nearly cylindrical.

Female: Carpus and hand in the second pair of legs unarmed; propodus short, slightly spatulate in outline, with a pair of minute setæ at the base of the dactylus, which is very short, not reaching the extremity of the propodus.

Length: male, 10–15^{mm}; female, 10–14.

Bay of Fundy to New Jersey.

ORCHESTIA PALUSTRIS Smith, sp. nov. (p. 468.)

Male: Antennulæ reaching slightly beyond the distal extremity of the penultimate segment of the peduncle of the antennæ. Antennæ less than half as long as the body; peduncle slender; flagellum slender, longer than the peduncle, composed of eighteen to twenty-six segments. Propodus in the second pair of legs nearly oval in outline, the palmary margin spinous, regularly curved to the posterior angle, which projects on the outer edge in a slight, rounded prominence, within which the tip of the dactylus closes; dactylus slender, curved so as to nearly fit the palmary margin, and furnished with minute setæ along the prehensile margin. Posterior thoracic legs slightly longer than the preceding; carpus and propodus both long and slender.

The female differs from the male as in the last species.

Length, male, 15–22^{mm}; female, 12–18^{mm}.

Cape Cod to New Jersey, and very likely farther north and south.

TALORCHESTIA LONGICORNIS Smith. (p. 336.)

Talitrus longicornis Say, loc. cit., p, 384, 1818. *Orchestia longicornis* Edwards, His. nat. des. Crust., tome iii, p. 18, 1840; De Kay, op. cit., p. 36, Pl. 7, fig. 19.

Cape Cod to New Jersey, and probably farther south.

TALORCHESTIA MEGALOPHTHALMA Smith. (p. 336.)

Orchestia megalophthalma Bate, Catalogue Amphip. Crust., British Museum, p. 22, 1862.

Cape Cod to New Jersey, and probably farther south.

Talitrus quadrifidus, De Kay, (op. cit., p. 36, Pl. 14, fig. 27,) may be based on the female of one of the preceding species, but it so is badly described and figured as to be indeterminable.

HYALE LITTORALIS Smith. (p. 315.)

Allorchestes littoralis Stimpson, Marine Invertebrata of Grand Manan, p. 49., Pl. 3, fig. 36, 1853; Bate, Catalogue Amphip. Crust., British Museum, p. 48, Pl. 8, fig. 2, 1862.

This species was found at New Haven, Connecticut., by Professor Verrill, May 5, 1873, and is one of the inhabitants of rocky shores, piles of wharves, &c. I have found it at Provincetown, Massachusetts, and it is abundant in the Bay of Fundy. It is undoubtedly abundant on the whole New England coast, but its station upon the shore is so high up on the beach that it is likely to be overlooked.

LYSIANASSA, species. (p. 431.)

A species of this genus, as restricted by Boeck, was several times dredged in Vineyard Sound and Buzzard's Bay.

Several other species of *Lysianassinæ* were taken in Vineyard Sound and the neighboring region, but they have not yet been sufficiently studied to be enumerated. The species of this group are much less common and the individuals smaller on the coast of Southern New England than they are upon the coast of Maine and farther north.

LEPIDACTYLIS DYTISCUS Say. (p. 339.)

Loc. cit., p. 380, 1818.

Georgia to Cape Cod.

PHOXUS KROYERI Stimpson. (p. 501.)

Marine Invertebrata of Grand Manan, p. 58, 1853.

Rare in Vineyard Sound and usually in deep water. Common in the Bay of Fundy.

UROTHOË, species. (p. 452.)

A species with long, slender antennæ and very large black eyes, and apparently belonging to this genus, was taken in great numbers at the surface at Wood's Hole, on the evening of July 3, and on one or two other occasions. In life it was whitish, slightly tinged with orange-yellow.

MONOCULODES, species. (p. 452.)

A single specimen taken at the surface in Vineyard Sound, December 21, by Mr. V. N. Edwards.

LAPHYSTIUS STURIONIS Kroyer. (p. 457.)

Nat. Tidsskrift, vol. iv, p. 157, 1842. *Darwinia compressa* Bate, Report Brit. Assoc., 1855, p. 58; Catalogue Amphip. Crust., Brit. Mus., p, 108, Pl. 17, fig. 7; Bate and Westwood, Brit. Sessile-eyed Crust. vol. i, p. 184, wood cut.

A parasitic amphipod, apparently quite identical with this species of Europe, was found in the mouth of a goose-fish (*Lophius Americanus*) taken in Vineyard Sound. A species, apparently the same, was also taken from the back of a skate (*Raia lævis*) in the Bay of Fundy the past summer. It is readily distinguished by its broad depressed form, and by having the third to fifth pairs of legs very stout and their distal segments forming powerful talon-like claws, while the first and second pairs are small and slender.

CALLIOPIUS LÆVIUSCULUS Boeck. (p. 315.)

Crust. Amphipoda borealia et arctica, p. 117, 1870. *Amphithoë lævinscula* Kroyer Grönlands Amfipoder, p. 53, Pl. 3. fig. 13, 1838. *Calliope lævinscula* Bate, Catalogue Amphip. Crust. Brit. Mus., p. 148, Pl. 28, fig. 2, 1862; Bate and Westwood, op. cit., vol. i, p. 156, wood cut.

Vineyard Sound and northward to Greenland, Northern Europe, and Spitzbergen.

PONTOGENEIA INERMIS Boeck. (p. 452.)

Op. cit., p. 114, 1870. *Amphithoë inermis* and *crenulata*, Kroyer, Grönlands Amfipoder, pp. 47, 50, Pl. 3, figs. 11, 12, 1838. *Iphimedia vulgaris* Stimpson, Marine Invertebrata of Grand Manan, p. 53, 1853. *Atylus inermis, crenulatus,* and *vulgaris* Bate, Catalogue Amphip. Crust. Brit. Mus., pp. 138, 139, 142, Pl. 27, figs. 5, 6, 1862. *Atylus vulgaris* Packard, Memoirs Boston Soc. Nat. Hist., vol. i, p. 298, 1867. (Not *Atylus* (*Paramphitoë*) *inermis* Packard, loc. cit., p. 298, Pl. 8, fig. 3.)

Taken at the surface in Vineyard Sound, in March, by Mr. V. N. Edwards. It is abundant, in company with *Calliopius læviusculus*, about the Bay of Fundy in pools left by the tide, and ranges north to Labrador and Greenland.

GAMMARUS ORNATUS Edwards. Plate IV, fig. 15. (p. 314.)

Annales des Sci. nat., tome xx, 1830, p. 367, Pl. 10, figs. 1–10; Hist. nat. des Crust., tome iii, p. 47; Bate, op. cit., p. 212, Pl. 37, fig. 8. *Gammarus locusta* Gould, op. cit., p. 334. *Gammarus pulex* Stimpson, Marine Invert. Grand Manan, p. 55.

New Jersey to Greenland.

GAMMARUS ANNULATUS Smith, sp. nov. (p. 314.)

Anterior margin of the head produced each side beneath the antennulæ into a truncated lobe, which extends farther forward than in *G. ornatus;* eyes scarcely reniform, less elongated than in *G. ornatus*, and their lower margins not reaching, by considerable, the anterior border of the truncated lobe. Antennæ longer than the antennulæ; the ultimate segment of the peduncle longer than the penultimate; the flagellum much more slender, the segments more elongated and with fewer hairs, than in *G. ornatus.* Hands of the first pair of legs more elongated than in *G. ornatus*, and the palmary margins very oblique. Propodus in the second pair very narrow and elongated, subcylindrical, slightly flattened on the inner side, the palmary margin longitudinal, and scarcely distinct from the posterior margin. Fourth segment of the abdomen with a median fascicle of two large and two small spines, but no lateral fascicles. Fifth and sixth segments with both median and lateral fascicles of spines.

Color in life grayish white, the posterior margins of the segments bordered with brown, giving the body an annulated appearance.

Length, 12–18^{mm}.

New Haven, Connecticut, and Eastport, Maine, and doubtless abundant at other points on the coast.

This species closely resembles the fresh-water *G. fasciatus*, but is distinguished from it by the proportions of the segments of the peduncles of the antennæ, and by wanting the lateral fascicles of spines upon the fourth segment of the abdomen.

GAMMARUS NATATOR Smith, sp. nov. (p. 439.)

Male: Eyes large, enlongated, but only slightly reniform. Antennula short and stout, about three-sevenths as long as the body; flagellum but little longer than the peduncle; secondary flagellum nearly half as long as the primary. Antenna considerably longer than the antennula; penultimate segment of the peduncle reaching to the extremity of the peduncle of the antennula; ultimate segment of the peduncle longer than the penultimate; flagellum about two-thirds as long as the peduncle. Both antennulæ and antennæ are furnished with very long hairs, of which many on the antennulæ are plumose. First, second, and third epimera margined on the inferior edges with long cilia. First pair of legs more slender than the second; propodus oval, twice as long as broad, palmary margin continuous with the inferior, with a very narrow lamellar edge, a stout obtuse spine in the middle, and two smaller ones at the inferior angle; dactylus strongly curved. In the second pair the propodus is more than half as broad as long, and somewhat rectangular in outline, except that the palmary margin is slightly oblique; the palmary margin has a narrow lamellar edge, with a slight emargination in the middle, from which a stout obtuse spine arises, and at the inferior angle there are two or three smaller spines, as in the first pair. The inferior edges of the carpi and propodi of both pairs of legs are thickly clothed with long hairs. Natatory legs reaching to the tips of the telson. Second and third segments of the abdomen with the sides produced backward, and the postero-inferior angle acute. Fourth segment with only a median fascicle of spines; fifth and sixth segments with median and lateral fascicles. Rami of the posterior caudal stylets lanceolate, five or six times as long as broad, the outer extending beyond the inner by the length of its terminal article, which is very slender, almost spiniform, the edges of both rami clothed with long plumose hairs. Each division of the telson nearly three times as long as broad.

In the female the hands of the first and second pairs of legs are smaller and slenderer, and the propodi somewhat oval and nearly alike in both pairs; otherwise the females do not differ from the males, except that the rami of the posterior caudal stylets are, perhaps, a very little shorter and broader in proportion.

Length, 10–12^{mm}.

Vineyard Sound, in vast numbers at the surface of the water, usually among floating sea-weeds and eel-grass. Also from stomach of mackerel, May 20.

GAMMARUS MARINUS Leach. (p. 486.)

Trans. Linnean Soc., London, vol. xi, p. 359, 1815; Bate, Catalogue Amphip. Crust., Brit. Mus., p. 215, Pl. 38, fig. 4; Bate and Westwood, Brit. Sessile-eyed Crust., vol. i, p. 370, wood-cut.

A species which I cannot distinguish, by the published figures and descriptions, from this common species of Europe, was not uncommon, associated with *Amphithoë maculata*, under stones at the Wepecket Islands, Gull Island, Cuttyhunk Island, and at other places on Vineyard Sound and Buzzard's Bay. It has also been found at Watch Hill, Rhode Island, and at New Haven, Connecticut, by Professor Verrill. It is at once distinguished from all the other species of our coast by its slender form, slender antennæ, by having the sides of the second and third segments of the abdomen narrow and not produced or acute at the postero-inferior angle, and by having the outer rami of the posterior caudal stylets four or five times as long as the inner.

GAMMARUS MUCRONATUS Say. (p. 479.)

Loc. cit., p, 376, 1818; De Kay, op. cit., p. 37. *Gammaracanthus mucronatus* Bate, op. cit., p. 203.

Readily distinguished from the other species of the coast by having the posterior margin of each of the anterior segments of the abdomen produced into a slender, spiniform, dorsal tooth. In life, it is translucent, tinged with green, or yellowish green, minutely specked with brown or black; these black or brown markings and the green color being frequently so arranged as to give the antennæ and legs a banded appearance. Our species cannot be referred to Bate's genus *Gammaracanthus*, for the dorsal margin is not distinctly carinated, and the third, fourth, and fifth segments of the abdomen are furnished with fascicles of spines.

Usually in brackish water, North Carolina to Cape Cod, and, according to Say, from Florida also.

MŒRA LEVIS Smith, sp. nov. (p. 315.)

Eyes nearly round; black in alcoholic specimens. Antennula two-thirds as long as the body; first and second segments of the peduncle equal in length, third about two-thirds as long as the second; flagellum about as long as the peduncle. Antenna about as long as the peduncle of the antennula; ultimate and penultimate segments equal in length, antepenultimate very short; flagellum much shorterthan the peduncle. Legs of the first pair small; carpus as broad as the propodus, but little longer than broad, the posterior margin straight and furnished with fascicles of stout hairs; palmary margin nearly transverse, slightly arcuate, and armed with short setæ; dactylus slender and fitting closely the palmary margin. Legs of the second pair larger; carpus short, as broad as the base of the propodus, the posterior angle thickly clothed with stout hairs; propodus in the male stout, broadest distally, the palmary margin expanded toward the inferior angle and excavated on the inner side to receive the long and strongly curved dactylus; in the female, elongated, slightly narrowed distally, the posterior margin continuous and nearly parallel with the palmary, and furnished with fascicles of stout hairs. Fifth pair of legs but little longer than the third or fourth; sixth and seventh much longer than the fifth, subequal, stout, their meral and carpal segments considerably expanded, especially in the male. Ultimate caudal stylets projecting a little beyond the preceding pairs; rami short, broad, and with spinous tips; the outer ramus slightly longer and broader than the inner, and its outer margin armed with a very few fascicles of spinules. Telson reaching to the bases of the rami of the posterior caudal stylets, nearly as broad as long, and cleft two-thirds of the way to the base.

Length, 5–7^{mm}.

New Jersey, Long Island Sound, Vineyard Sound.

MELITA NITIDA Smith, sp. nov. (p. 314.)

Eyes small, round, black. Antennula about two-thirds as long as the body; first segment of the peduncle slightly shorter than the second, which is nearly twice as long as the last; flagellum longer than the peduncle. Antenna shorter than the antennula, but the peduncle considerably longer than the peduncle of the antennula, the penultimate segment being scarcely shorter than the penultimate segment of the antennula, while the ultimate segment is subequal with it. First pair of legs with the carpus longer and broader than the propodus; propodus oblong, slightly curved; dactylus very small but stout, curved, and attached in a notch in the middle of the extremity of the propodus, not closing upon the extremity of the propodus but projecting inward. Second pair of legs stout; carpus short, triangular; propodus somewhat oval, the palmary margin oblique, arcuate, continuous with the posterior margin, and armed with a series of minute spines and with numerous stiff hairs, the clothing of hairs continuing round upon the posterior margin to the carpus; dactylus curved, tip resting within the palmary margin. Third pair of legs slightly longer than the fourth. Three posterior pairs slender, the fifth somewhat shorter than the sixth and seventh, which are subequal, and have the anterior margins of the bases armed with small spines and the posterior margins minutely serrate. None of the dorsal margins of the segments of the abdomen serrate or emarginate, but the margin of the fifth segment armed with several slender spines on each side near the median line of the dorsum. Penultimate caudal stylets not quite reaching the tip of the preceding pair. The ultimate pair very long and armed with fascicles of spines along the margins. Divisions of the telson slender, spinous at the tips.

In life dark greenish slate-color, changing in alcohol to dark slate.

Length, 7–9^{mm}.

New Jersey to Cape Cod.

AMPELISCA. Plate IV, fig. 17. (pp. 431, 507.)

The species of this genus found upon our coast have not yet been carefully studied. At least two species were taken in Vineyard Sound and Buzzard's Bay. The genus is readily recognized, but the species are difficult to distinguish.

BYBLIS SERRATA Smith, sp. nov. (p. 501.)

Female: Dorsum rounded above, with no trace of a longitudinal carina upon the abdomen; third segment of the abdomen broadly rounded at the postero-lateral angle. Antennula about as long as the peduncle of the antenna; fourth segment of the peduncle of the antenna longer than the fifth. Inferior margins of the epimera of the first and second pairs of legs serrate, with slender and acute teeth alternating with the marginal cilia; carpus in the first pair scarcely if any longer than the propodus; carpus in the second pair very much longer than the propodus. In the third and fourth pairs of legs the dactylus as long as the propodus. Basal segment in the seventh pair of legs expanding distally, the posterior margin nearly straight, the anterior and inferior margins evenly arcuated, and reaching as far as the distal end of the carpus; carpus about as long as the ischium and merus together, a little less than twice as long as broad, and armed with long spines upon the anterior and distal margins, but the posterior margin wholly unarmed; propodus almost as long as the carpus, and nearly four times as long as broad, anterior margin unarmed, the posterior armed upon the outside with two transverse rows of three or four spines, decreasing in size as they recede from the margin, the distal end with a spine each side the slender dactylus. Rami of the first pair of caudal stylets equal, as long as the base; outer rami of the second pair shorter than the inner; rami of the posterior pair equal, longer than the bases, reaching to the tips of the rami of the first pair. Telson as long as the breadth at base, cleft rather more than half its length, the lateral margins arcuate, and rapidly converging toward the evenly rounded extremity.

Alcoholic specimens are pale yellowish, the epimera, bases of the posterior legs, and the sides of the abdomen specked and mottled with numerous points of dark pigment crowded irregularly together.

Length, 10–12^{mm}.

Deep water off Vineyard Sound and Buzzard's Bay.

PTILOCHEIRUS PINGUIS Stimpson. (p. 431.)

Marine Invertebrata of Grand Manan, p. 56, 1853. *Protomedia pingus* Bate, Catalogue Amphip. Crust. Brit. Mus., p. 170, Pl. 31, fig. 2, 1862.

Common on the whole coast of New England upon muddy bottoms and north to Labrador. In depth it extends down to 150 fathoms, and probably much farther.

MICRODEUTOPUS MINAX Smith, sp. nov. (p. 479.)

Antennula about two-thirds as long as the body; first segment of the peduncle stout, about as long as the head; second segment a little longer and much more slender; third segment nearly half as long as the first; flagellum slender, about a third longer than the peduncle; secondary flagellum very small, consisting usually of but one segment. Antenna about two-thirds as long as the antennula; ultimate and penultimate segments of the peduncle equal in length, and each fully twice as long as the antepenultimate; flagellum scarcely as long as the last segment of the peduncle. Hands of the first pair of legs in the male greatly developed; carpus very large, scarcely longer than the breadth in the middle; superior margin strongly arcuate, the inferior angle produced into a stout process opposed to the propodus, and the inferior margin arcuate and armed distally with two teeth, a large and prominent one at the base of the terminal process, the other small, obtuse, or even obsolete; propodus not more than half as long as the carpus, much longer than broad, the inferior margin with two broad obtuse teeth; dactylus stout, a little shorter than the propodus. Legs of the second pair with the basal segment broad and squamiform; carpus elongated; propodus as long as the carpus and as broad as its distal portion, rectangular, about two and a half times as long as broad; dactylus short and hooked at the tip. In the female the hands of the first pair of legs are only moderately developed; carpus broad; propodus scarcely as broad as the carpus, rectangular, the palmary margin somewhat oblique, and the inferior margin armed with a spine at the obtusely rounded inferior angle. In the second pair the basal segment is not expanded but narrow; the carpus and propodus much as in the male, except that they are clothed with numerous long, plumose hairs. The bases of the first and second pairs of caudal stylets are armed with a long, slender, spiniform process, arising from the distal end just below the bases of the rami. The outer rami of the posterior stylets are a little longer than the inner. All the stylets extend to the same point.

Length, about 4^{mm}.

Long Island Sound and Vineyard Sound.

Another species of *Microdeutopus* was collected in Vineyard Sound, but it was not abundant.

AUTONOE, species. (p. 415.)

A species belonging apparently in this genus, as defined by Boeck, was common in Vineyard Sound, living in tubes in masses of a compound Ascidian (*Amouroucium pellucidum* Verrill) in 3 to 8 fathoms. It is 6 or 7^{mm} in length, and in life the antennulæ and antennæ are obscurely banded and specked with pink; the body above, except upon the fifth segment and the posterior part of the abdomen, is almost black, the color extending down upon the epimera, while the legs and caudal appendages are semi-translucent. The eyes are large and black.

AMPHITHOË MACULATA Stimpson. Plate IV, fig. 16. (p. 315.)
Marine Invertebrata of Grand Manan, p. 53, 1853.
Vineyard Sound to the Bay of Fundy and Labrador.

AMPHITHOË VALIDA Smith, sp. nov. (p. 315.)
Male: Eyes round, black in alcoholic specimens. Antennulæ and antennæ subequal in length. Peduncle of the antennula extending scarcely beyond the distal extremity of penultimate segment of the peduncle of the antenna; the second segment but little longer than the first; ultimate segment short and slender. Ultimate and penultimate segments of the peduncle of the antenna subequal in length. First pair of legs short, compressed; carpus as broad as the propodus; propodus broad, oval in outline, the posterior and palmary margins forming a continuous, nearly semicircular curve; dactylus fitting closely the palmary margin. Second pair of legs very large; carpus small; propodus oblong, broadest at the distal extremity, very large and thickened, the outer surface convex, the inner flattened, palmary margin transverse, with a broad, low, median tooth, and a rounded prominence at the inferior angle, within which the tip of the very stout and strongly curved dactylus closes.

The female differs in having the hands of the first pair of legs slightly more elongated, and those of the second pair smaller than in the male, and the palmary margin slightly oblique.

Color in life, bright-green.

Length, 10–13^{mm}.

New Jersey and Long Island Sound.

AMPHITHOË LONGIMANA Smith, sp. nov. (p. 370.)
Male: Eyes round, and, in specimens preserved in alcohol, black. Antennula slender and as long as the body; second segment of the peduncle a little longer than the first; third segment about half as long as the second; flagellum about twice as long as the peduncle. Antenna considerably stouter and slightly shorter than the antennula, the peduncle about twice as long as the flagellum; third segment of the peduncle a little more than half as long as the first segment of the peduncle of the antennula; fourth segment nearly three times as long as the third; fifth considerably longer than the fourth; flagellum a little longer, or sometimes only as long, as the fifth segment of the peduncle. Hands of the first and second pairs of legs stout and much elongated. Carpus in the first pair nearly as long as the first segment of the peduncle of the antennula, narrow; propodus much more than twice as long as broad, as wide and long as the carpus, of the same width throughout, slightly curved, and the very short palmary margin transverse; dactylus stout, very little curved, more than half as long as the propodus, and projecting far beyond its inferior edge; the posterior margins of

both propodus and carpus densely clothed with long, stiff hairs. Carpus in the second pair of legs short, with an angular prominence upon the posterior side; propodus as long as in the first pair, and much broader, the palmary margin oblique, projecting at the inferior angle, just inside of which there is a deep sinus in the margin. Posterior edges of the bases of the sixth and seventh pairs of legs unarmed.

In the female the antennæ are shorter and not quite as stout, and the hands of the first and second pairs of legs are very much shorter, smaller, and much less hairy; in the first pair the carpus and propodus are very much shorter and proportionally broader, and the palmary margin of the propodus more oblique; in the second pair the propodus is short and somewhat oval, with a slight prominence at the inferior angle of the palmary margin.

Length, 6–9^{mm}.

New Jersey; Great South Bay, Long Island; Vineyard Sound. Common among eel-grass in sheltered situations. The young, even 5 or 6^{mm} long, were taken at the surface in Vineyard Sound several times.

AMPHITHOË COMPTA Smith, sp. nov. (p. 370.)

Eyes small, round, red in life, but fading in alcohol to whitish. Antennula slender, as long as the body; first segment of the peduncle as long as the head; second slightly longer than the first; last a third as long as the second; flagellum very slender, nearly three times as long as the peduncle. There is a rudimentary secondary flagellum, not longer than the first two segments of the primary flagellum and very slender. Antenna a little shorter than the antennula; the peduncle very little shorter than that of the antennula; last two segments about equal in length, the penultimate reaching as far as the same segments of the antennula; flagellum about as long as the peduncle. First and second pairs of legs, in the male, about equal in size, as long as the head and thorax together, and clothed on both margins with long, plumose hairs. Carpus in the first pair longer than, and as broad as, the propodus, the distal extremity truncate and right-angled at the inferior margin; the propodus much longer than broad, the palmary margin oblique, very nearly straight, and armed at the inferior angle upon the inner side with a stout spine. Carpus in the second pair narrower than in the first, the distal extremity obliquely rounded at the inferior angle; propodus as long as the carpus and no broader, the palmary margin less oblique than in the first pair, without any spine, and the inferior angle slightly projecting; dactylus, strongly curved and closing by the margin of the propodus. In the female the legs of the first and second pairs are nearly alike in form, very much smaller and weaker than in the male, and only sparsely clothed with mostly simple hairs, except upon the inferior margin of the carpus in the second pair. In both pairs the carpus is about as long and broad as the propodus; the propodus is short, narrowed toward the carpus, the palmary margin oblique, convex in outline, with the inferior angle rounded and armed with a stout spine on the inside. Second and third segments of the abdomen produced into a slight angular prominence at the postero-inferior angle. The posterior edges of the bases of the sixth and seventh pairs of legs not serrated but armed with two to four small spines. First and second pairs of caudal stylets extending scarcely beyond the posterior pair. In the first pair there is a long, slender spine projecting from the distal extremity of the base beneath the rami.

Length of largest specimen examined, 13^{mm}.

North Carolina to Cape Cod. Common among eel-grass. Taken at surface in Vineyard Sound.

PODOCERUS FUCICOLA Smith. (p. 493.)

Cerapus fucicola Stimpson, Marine Invertebrata of Grand Manan, p. 48, Pl. 3, fig. 34, 1853.

This species was dredged by Professor Verrill, in 4 to 5 fathoms, off Watch Hill, Rhode Island, in April, 1873. It is common in the Bay of Fundy.

PODOCERUS, species. (p. 494.)

Another species of the same genus was taken in abundance with the last. It is a large and dark-colored species.

CERAPUS RUBRICORNIS Stimpson. Plate IV, fig. 18.

Marine Invertebrata of Grand Manan, p. 46, Pl. 3, fig. 33, 1853; Bate, Catalogue Amphip. Crust. Brit. Mus., p. 256, Pl. 45, fig. 4.

Not common south of Cape Cod, but very abundant in the Bay of Fundy and north to the coast of Labrador. In depth it extends down to 100 fathoms at least.

CERAPUS MINAX Smith, sp. nov.

Antennulæ and antennæ about equal in length, rather more than half as long as the body. Second pair of legs greatly developed in the male, the hand nearly half as long as the body; carpus elongated, narrow, nearly three times as long as the breadth in the middle, the posterior angle projecting into a broad process about as long as the dactylus, and armed on the inside with a tooth nearly as stout as the distal part of the process itself, but projecting only about half as far; propodus about half as long as the carpus, twice as long as broad; dactylus considerably shorter than the propodus, the tip in most of the larger specimens furnished with a pencil of long hairs. In the female the hand in the second pair of legs is small; the carpus produced into a long process on the inferior edge of the propodus to the palmary margin; propodus short, broad, somewhat oval, the palmary margin arcuate and armed with several short spines on the portion next the carpal process.

Length, about 4^{mm}.

Long Island Sound, Vineyard Sound.

? CERAPUS TUBULARIS Say. (p. 396.)

Loc. cit., p. 49, Pl. 4, fig. 7–11, 1817.

Several specimens of a small amphipod, dredged, June 27, in Vineyard

Sound, among masses of a large compound Ascidian, (*Amouroucium pellucidum*,) in eight to ten fathoms, off Nobska Point, are probably this species, but unfortunately females only were obtained, while Say describes and figures the male alone. In our specimens, the antennulæ and antennæ are spotted with very dark purplish-brown, the anterior part of the body almost black, the middle and posterior portions spotted with black, or very dark purplish brown. They are between 4 and 5^{mm} long and inhabit unattached tubes as described by Say. The tubes are regularly cylindrical, quite thin and delicate, black, about 5^{mm} long, and 0.4^{mm} in diameter, and are carried about by the animal very much as the larvæ of some of the Phryganeidæ carry about their tubes in fresh water. In the structure of the caudal appendages, our specimens are quite different from the species usually referred to *Cerapus*, but I have not thought best to make any changes in nomenclature until the discovery of the male shall make it certain whether our specimens belong to the species described by Say.

COROPHIUM CYLINDRICUM Smith. (p. 370.)

Podocerus cylindricus, Say loc. cit., p. 387, 1818, (*not* of Bate, Catalogue Amphip. Crust. Brit. Mus., p. 256.)

New Jersey to Vineyard Sound. Very abundant among weeds and hydroids about piles of wharves, and almost everywhere in shallow water.

Length, about 4^{mm}.

SIPHONŒCETES CUSPIDATUS Smith, sp. nov. (p. 501.)

Male: Head produced into a long, slender, acute rostrum, and each side between the antennula and antenna into a long lobe rounded at the end where the eye is situated, and contracted toward the base. Antennula reaching about to the middle of the fourth segment of the peduncle of the antenna; segments of the peduncle equal in length; flagellum scarcely longer than a segment of the peduncle, and composed usually of five segments. Antenna a little longer than the body; third segment of the peduncle a little longer than any segment of the peduncle of the attennula; fourth segment nearly twice as long as the third; last segment nearly one-half longer than the third; flagellum a little shorter than the last segment of the peduncle. Legs much like Kroyer's figures of *S. typicus*, those of the first pair with the carpus twice as long as broad; propodus slightly narrower and a little longer than the carpus, the posterior edge furnished with long hairs and several stout spines. Legs of the second pair much stouter. Posterior caudal stylets with the terminal process fully as long as the ramus itself, the ramus as broad as long, the extremity obtusely rounded and furnished with very long hairs. Telson broader than long, transversely elliptical.

In the female the antennæ and second pair of legs are more slender than in the male.

In alcoholic specimens the antennulæ are marked with narrow bands of black or dark brown upon each segment of the flagellum and at both ends of the second and third segments of the peduncle, and the antennæ are obscurely banded and tinged with a lighter color.

Length, about 6^{mm}.

It inhabits tubes constructed of grains of sand.

In deep water off Vineyard Sound and Buzzard's Bay.

UNCIOLA IRRORATA Say. Plate IV, fig. 19. (p. 340.)

Loc. cit., p. 389, 1818; Stimpson, Marine Invertebrata of Grand Manan, p. 45.

This species grows to a much larger size than described by Say, being frequently 15^{mm} in length.

New Jersey to the Bay of Fundy, and probably much farther north, and from low water to more than 400 fathoms in depth.

HYPERIA, species. (p. 439.)

A large species of *Hyperia* was several times found upon the large red jelly-fish (*Cyanea*) in Vineyard Sound. The same species is common in the Bay of Fundy, but has not been identified with certainty.

Another species of *Hyperia* was taken at the surface, in company with *Salpa*, in Vineyard Sound, early in September.

PHRONIMA, species. (p. 439.)

A species of this peculiar genus was taken at the surface, in company with *Salpa*, off Gay Head, early in September. It is closely allied to the *P. Atlantica* of Guérin. According to Professor Verrill's notes it is, in life, translucent, scarcely tinged with yellowish white, and nearly invisible in the water; the eyes red.

Another form allied to the last was taken with it, and is possibly the male of the same species, but differs from it, and from the characters usually assigned to the genus, in possessing well-developed antennulæ. In life, according to Professor Verrill, it was translucent whitish, the body spotted with dark brown, and the eyes blackish.

THYROPUS, species.

A single specimen of a species of this genus was taken with the *Phronima* and *Salpa*, off Gay Head, early in September.

CAPRELLA GEOMETRICA Say. Plate V, fig. 20. (p. 480.)

Loc. cit., p. 390, 1818; Bate, Catalogue Amphip. Crust. British Mus., p. 357, Pl. 56, fig. 8.

North Carolina to Vineyard Sound, especially among eel-grass; very abundant in Great Egg Harbor, New Jersey, April, 1871.

CAPRELLA, species. (p. 316.)

A larger species of *Caprella*, which is common in the Bay of Fundy, was frequently dredged in Vineyard Sound.

ISOPODA.

SCYPHACELLA Smith, gen. nov.

Near *Scyphax*, Dana.* Antenna composed of eight distinct segments,

* U. S. Exploring Expedition, Crust., p. 734, Pl. 48, fig. 5.

with a geniculation at the articulation of the fourth with the fifth segment; terminal portion, corresponding to the flagellum, composed of three closely articulated segments, besides a minute apical one; mandibles slender, without palpi; exposed portion of the maxillipeds formed of only two segments; the basal one with a narrow, elongated portion, which is abruptly narrowed at the articulation of the terminal segment, and sends a slender process beneath it to the middle of its inner margin; the terminal segment much narrower than the basal, and tapering toward the extremity; legs subequal, the posterior not shorter than the others; terminal segment of the abdomen produced between the posterior caudal appendages, which are short and essentially as in the allied genera.

This genus differs from *Scyphax* most notably in the form of the maxillipeds, which in *Scyphax* have the terminal segment broad and serrately lobed, while in our genus it is elongated, tapering, and has entire margins. In *Scyphax*, also, the posterior pair of thoracic legs are much smaller than the others, and weak; the last segment of the abdomen is truncated at the apex, and the articulations between the segments of the terminal portion of the antennæ are much more complete than in our species. The general form and appearance of the genera are the same, and the known species agree remarkably in habits, the *Scyphax*, according to Dana, occurring on the beach of Parua Harbor, New Zealand, and found in the sand by turning it over for the depth of a few inches.

SCYPHACELLA ARENICOLA Smith, sp. nov. (p. 337.)

Body elliptical; abdomen not abruptly narrower than the thorax; the whole dorsal surface, except the extremity of the abdomen, covered with small, depressed tubercles, which give rise to minute spinules; eyes prominent, round; antenna a little longer than the breadth of the body; first and second segments short, equal; third, fourth, and fifth successively longer, the fifth being rather longer than the terminal portion, which is more slender than the fifth segment, tapers regularly to the tip, and is composed of three successively much shorter segments, and a very short, somewhat spiniform, but obtuse, terminal one; all the segments, except the minute terminal one, scatteringly beset with spinules; legs beset with small spines; the ischial, meral, carpal, and propodal segments subequal; terminal process of the last segment of the abdomen narrow, triangular, with the apex slightly rounded, and the dorsal surface a little concave; posterior caudal appendages much shorter than the abdomen; rami slightly unequal, the outer stout, spinulose, the inner a little shorter and much more slender.

Color, in life, nearly white, with chalky white spots and scattered, blackish dots arranged irregularly. Eyes black.

Length, 3–4^{mm}.

Found at Somers's and Beesley's Points, on Great Egg Harbor, New Jersey, in April, 1871, burrowing in the sand of the beaches, just above ordinary high-water mark, in company with several species of *Staphylinidæ*, and will very likely be found on Long Island and the southern coast of New England.

PHILOSCIA VITTATA Say.

Jour. Acad. Nat. Sci., Philadelphia, vol. i, p. 429, 1818.

Under rubbish below high-water mark, Connecticut and New Jersey.

SPHÆROMA QUADRIDENTATA Say. Plate V, fig. 21. (p. 315.)

Jour. Acad. Nat. Sci. Philadelphia, vol. i, p. 400, 1818.

Massachusetts to Florida.

IDOTEA CÆCA Say. Plate V, fig. 22. (p. 340.)

Loc. cit., p. 424, 1818. Gould, Invertebrata of Massachusetts, p. 337, 1841.

Massachusetts to Florida.

IDOTEA TUFTSII Stimpson. (p. 340.)

Marine Invertebrata of Grand Manan, p. 39, 1853.

Bay of Fundy and off New London, Connecticut.

IDOTEA IRRORATA Edwards. Plate V, fig. 23. (p. 316.)

Hist. nat. des Crust., vol. iii, p. 132, 1840. *Stenosoma irrorata* Say, loc. cit., p. 423, 1818; Gould, Invertebrata of Massachusetts, p. 338, 1841.

Bay of Fundy to Great Egg Harbor, New Jersey.

IDOTEA ROBUSTA Kroyer. Plate V, fig. 24. (p. 439.)

Naturhist. Tidssk., 2d R., Bind ii, p. 108, 1846; Stimpson, Proceedings Acad. Nat. Sci., Philadelphia, 1862, p. 133.

South shore of Long Island to the Arctic Ocean. A pelagic species.

IDOTEA PHOSPHOREA Harger, sp. nov. (p. 316.)

Resembling *I. irrorata* in size and shape, but easily distinguished from that species by the pointed abdomen.

Antennæ less than half the length of the body, antennulæ attaining the end of the third segment of the antennæ. Front slightly excavated with the lateral angles salient. Head about twice as broad as long, turgid, and usually with a pair of tubercles on the vertex. Eyes placed a little before the middle of the lateral margin, hemispherical, black. First segment of thorax produced laterally around the back part of the head nearly to the eyes, showing no epimeral sutures. Second segment much longer on the median line, but shorter at the sides than the first; the epimera occupy the anterior two-thirds of the lateral margin. Third segment slightly longer than the second; the epimera occupying still more of the lateral margin. Fourth segment of about the same length as third; the epimera occupying nearly or quite all the lateral margin. The remaining three thoracic segments gradually decrease in size; the epimera occupy the whole lateral margin and increase in size posteriorly. The first two abdominal segments are distinct and acute at the sides. The third is similar to these at the sides, but is only separated from the last by an incision reaching about half way to the median line, Last segment entire, ovate behind, and cuspidate. The style on the second pair of branchial plates in the male is slender, surpasses the laminæ, and reaches the middle of the terminal cilia; it is obliquely truncated at the end.

Many of the specimens, especially the smaller ones, are furnished with a row of prominent tubercles along the back, and sometimes with lateral rows.

Length, 10–25 ^{mm}; breadth, 3–7.5^{mm}.

Long Island Sound to Bay of Fundy.

ERICHSONIA FILIFORMIS Harger. Plate VI, fig. 26. (p. 316.)

Stenosoma filiformis Say, loc. cit., p. 424, 1818.

Small, slender, and nearly linear in outline. Antennulæ not quite attaining the fourth segment of the antennæ, which are six-jointed, and more than half as long as the body, with the first segment short, second and third increasing in length, last three segments about equal; head elevated between the eyes, where it is surmounted by a bifid tubercle; first and second thoracic segments with a lateral salient angle behind the evident angulated epimera; third and fourth segments with their lateral borders emarginate, and the epimera concealed or rarely visible from above at the emargination; last three thoracic segments angulated in front of the epimera, which are also angular. This arrangement, especially in the smaller specimens, gives the appearance of fourteen serrations on each side of the thorax. There is a row of tubercles along the median line. Abdominal segments consolidated into a single piece, which is furnished with a divergent tooth on each side near the base, and is expanded and obtusely triangular at the apex. The style on the second pair of branchial plates in the male is strong and curved, surpasses the cilia, and is acute and sharply serrate near the end.

Length, 5–9^{mm}.

Vineyard Sound to Great Egg Harbor, New Jersey.

ERICHSONIA ATTENUATA Harger, sp. nov. Plate VI, fig. 27. (p. 370.)

Body smooth, narrowly linear in outline. Antennulæ slightly surpassing the second segment of the antennæ, which are more than half the length of the body, and have the last segment longest. Head excavated in front; eyes small, black, prominent; first thoracic segment short; second, third, and fourth segments about equal in length, twice as long as the first; third segment broadest, last three segments gradually decreasing in length. Epimera visible from above only in the last two or three segments, but the sutures are evident, except in the first segment, and their position moves gradually from the anterior portion of the segment in the second to the posterior in the seventh segment. Abdominal segments consolidated into a single piece, which is slightly dilated laterally near the base, and obtusely triangular at the tip. The style on the second pair of branchial plates in the male is straight, slightly surpasses the cilia, and is acute at the end.

The color in life is usually uniform dark green, sometimes with an obscure dorsal stripe of a lighter color.

Length, 15^{mm}.

Abundant among eel-grass at Great Egg Harbor, New Jersey, and also found at New Haven, Connecticut.

EPELYS TRILOBUS Smith. Plate VI, fig. 28. (p. 370.)

Idotea triloba Say, loc. cit., p. 425, 1818.

Great Egg Harbor, New Jersey to Vineyard Sound.

EPELYS MONTOSUS Harger. (p. 370.)

Idotea montosa Stimpson, Marine Invert., Grand Manan, p. 40, 1853.

Bay of Fundy to Long Island Sound.

JÆRA COPIOSA Stimpson. (p. 315.)

Loc. cit., p. 40, Pl. 3, fig. 29, 1853. *J. nivalis* Packard, Memoirs Boston Soc. Nat. Hist., vol. i, 296, (*non* Kroyer.)

Long Island Sound to Labrador.

LIMNORIA LIGNORUM White. Plate VI, fig. 25. (p. 379.)

Pop. Hist. Brit. Crust., p. 227, Pl. 12, fig. 5. *Cymothoa lignorum* Rathke, Skrivt. af Naturh. Selsk., vol. 101, t. 3, f. 14, 1799, (teste Bate and Westwood.) *Limnoria terebrans* Leach, Trans. Linn. Soc., London, vol. xi, p. 371, 1815. Gould, Invertebrata of Massachusetts, p. 388, 1841.

Great Egg Harbor, New Jersey, to the Bay of Fundy and Europe.

NEROCILA MUNDA Harger, sp. nov. (p. 459.)

Elongated, oval, smooth, and polished. Antennæ and antennulæ nearly equal in length, about as long as the head. Head flattened, about one-third broader than long, slightly narrowing anteriorly, produced and broadly rounded in front, subequally trilobed behind, the middle lobe largest. Eyes black, consisting of an irregularly rounded patch of rather indistinct ocelli visible both above and below. First thoracic segment longer than the others, excavated in front for the three lobes of the head; epimeral sutures of this segment indistinct, but the posterior lateral angles of the segment are somewhat produced and broadly rounded. The next three segments have this angle produced so as to become a small tooth in the fourth thoracic segment; in the last three segments it is much produced, becoming a long acute tooth in the seventh. The epimera of the second segment are rounded behind; the remaining epimera are slightly angular behind, becoming more acute posteriorly; those of the second, third, and fourth segments extend backward about as far as the segment to which they belong, but in the last three segments the produced angles of the segments surpass the epimera, so that the angle of the sixth segment nearly attains the end of the seventh epimeron.

The abdomen is composed of six segments, the first five short and about equal in length; the sixth equal in length to the other five, truncate in front and rounded behind. The spines beneath the abdomen, or "abdominal epimera," are acute, the second a little more slender than the first, and extending not quite to the posterior angle of the fourth abdominal segment. The internal plate of the caudal stylets is oval and obliquely truncate, shorter than the external, which is narrow, ovate, acute behind, extending about half its length beyond the tip of the abdomen and longer than the preceding segment of the stylet. Claws of the anterior feet strongly hooked, those of the posterior feet feebly so.

Color, in alcohol, brown, with two narrow dorsal bands of lighter color.

Length, 15^{mm}; breadth, 7^{mm}.

This species is allied to *N. bivittata*, but differs from that species as figured by Milne Edwards, (Atlas du Règne animal de Cuvier, Crust., Plate 66, fig. 5,) in the shortness of three posterior epimera, the regularly rounded terminal segment of the abdomen, and the shape of the caudal stylets.

A single specimen was obtained on the dorsal fin of *Ceratacanthus aurantiacus.*

CONILERA CONCHARUM Harger. (p. 459.)

Æga concharum Stimpson, Marine Invert. Grand Manan, p. 42, 1853.

Vineyard Sound; Charleston, South Carolina.

LIVONECA OVALIS Harger. Plate VI, fig. 29. (p. 457.)

Cymothoa ovalis Say loc. cit., p. 394, 1818.

These animals are usually distorted, and not, as represented in the figure, symmetrical on the two sides.

The specimen figured was taken from a blue-fish near the gill.

ANTHURA BRUNNEA Harger, sp. nov. (p. 426.)

Nearly uniform in size throughout, but slightly narrower anteriorly. Antennulæ and antennæ nearly equal in length, scarcely longer than the head. Front projecting between and each side of the bases of the antennulæ into prominent angles. Eyes small and situated in the sides of the lateral prominences. Thoracic segments smooth and shining above; the third with a slight semicircular depression on the middle of the anterior margin. This depression is still more strongly marked on the three following segments. First segment slightly longer and narrower than the others; second to fifth about equal; sixth and seventh considerably shorter; the seventh about three-fourths the length of the sixth; all the segments carinated below. Dorsal surface of the basal portion of the abdomen similar to the posterior segment of the thorax, showing no indication of segments. Terminal portion flat, smooth, and narrowly ovate at tip. Appendages of the penultimate segment lamelliform, similar in form to the terminal plate but not quite equaling it. First pair of feet short and thickened. All the feet slightly hairy.

In life whitish mottled with dull, purplish brown above. Eyes black, retaining their color in alcohol. Length, 14–15^{mm}.

Great Egg Harbor, New Jersey, and Vineyard Sound.

ANTHURA BRACHIATA Stimpson. (p. 511.)

Marine Invertebrata of Grand Manan, p. 43, 1853.

This species is greatly constricted at the articulations of the second thoracic segment, and by that character is easily distinguished from *A. brunnea*.

Bay of Fundy to Vineyard Sound.

TANAIS FILUM Stimpson. (p. 381.)

Marine Invertebrata of Grand Manan, p. 43, 1853.

Bay of Fundy to Vineyard Sound.

CEPON DISTORTUS Leidy. (p. 557.)

Jour. Acad. Nat. Sci. Phila., vol. iii, p. 149, Pl. 11, figs. 26–32, 1855.

Branchial cavity of *Gelasimus pugilator*, Atlantic City, New Jersey.

ENTOMOSTRACA.

The Ostracoda and the minute Copeopoda of our coast have not yet been sufficiently studied by any one for us to attempt to enumerate even the more common species.

COPEOPODA.

SAPPHIRINA, species. Plate VII, fig. 33. (p. 439.)

A beautiful species of this remarkable genus was taken off Gay Head, Martha's Vineyard, September 2 and 8.

PHYLLOPODA.

ARTEMIA GRACILIS Verrill.

Amer. Jour. Sci., 2d series, vol. xlviii, p. 248, 1869; Proceedings Amer. Assoc. Adv. Sci., vol. xviii, p. 235, figs. 1 and 2, 1870.

In tubs of concentrated sea-water at New Haven, Connecticut; Charlestown, Massachusetts; and in salt-vats at Falmouth, Massachusetts.

SIPHONOSTOMA.

ERGASILUS LABRACES Kroyer. (p. 459.)

Nat. Tidsskrift, 1863–'64, p. 303, Pl. 11, fig. 2, (teste Zoological Record for 1865.)

According to Kroyer, found upon the striped bass (*Roccus lineatus*) from Baltimore, and liable, therefore, to occur on the coast of New England.

ARGULUS CATOSTOMI Dana and Herrick. (p. 459.)

Amer. Jour. Sci., 1st series, vol. xxx, p. 383, 1836, and vol. xxxi, p. 297, plate, 1837.

Parasitic on the "sucker" (*Catostomus*) in Mill River, near New Haven, Connecticut.

ARGULUS LATICAUDA Smith, sp. nov. (p. 452.)

Carapax orbicular, longer than broad; antero-lateral margin with a deep sinus from which a deep sulcus extends to the center of the carapax; sinus of the posterior margin about twice as deep as broad, extending a little less than a third of the length of the carapax. Eyes large. Body scarcely projecting beyond the posterior margin of the carapax. Tail orbicular, slightly longer than broad, its posterior sinus narrow, extending scarcely a fourth the length. Antennulæ and antennæ much as in *A. Catostomi*, to which the species bears considerable resemblance. The squamiform appendage upon the base of the prehensile legs expands into a broad posterior margin, which is divided into three broad, closely approximated lobes, of which the extremities are broad, truncated, and slightly and irregularly excavated; the terminal portion of the leg is much as in *A. Catostomi*, the ultimate segment longer than the penultimate and armed at the tip with two claws. Natatory legs short, the anterior ones not projecting beyond the carapax.

In alcoholic specimens most of the carapax is opaque and black with a thick deposit of pigment.

Length of entire animal, in the largest specimen, 5^{mm}; length of carapax, 3.7; breadth of carapax, 3.2; length of tail, 1.3; breadth of tail, 1.1.

Found among algæ in Vineyard Sound.

A small specimen taken at surface early in September had the opaque portions of the carapax dark brown in life, and in alcohol it retains about the same color.

ARGULUS LATUS Smith, sp. nov. (p. 452.)

Carapax large, orbicular, broader than long; the antero-lateral border with a broad shallow sinus; the sinus of the posterior margin not deeper than broad, its depth scarcely more than a fifth of the length of the carapax. Body projecting considerably beyond the posterior margin of the carapax. Tail a third as long as the carapax, about two-thirds as broad as long, the lateral margins slightly curved and nearly parallel, the sinus very broad and extending more than a third of the whole length. Disks of the sucking legs about a fourth as wide as the carapax. Squamiform appendage upon the base of the prehensile legs with a pappilose area upon the expanded distal portion, the posterior margin without teeth or lobes, but the outer margin of the expanded portion armed with numerous very small teeth; ultimate segment longer than the penultimate, and apparently without any hooks at the tip. Natatory legs all long, even the anterior projecting beyond the sides of the carapax.

Color of alcoholic specimens yellowish white.

Length, 3.0^{mm}; length of carapax, 2.2; breadth of carapax, 2.5; length of tail, 0.7; breadth of tail, 0.45.

Taken at the surface, in Vineyard Sound, July 1.

ARGULUS MEGALOPS Smith, sp. nov. (p. 452.)

Carapax subelliptical, longer than broad; the antero-lateral margin with a deep sinus; the posterior lobes of the carapax, each side of the shallow and narrow sinus, broady rounded. Eyes very large, their diameter a tenth as great as the breadth of the carapax. Body projecting much beyond the posterior margin of the carapax. Tail somewhat ovate, about two-thirds as broad as long, the sinus only a small notch, extending not more than a tenth of the length. Natatory legs very long, all projecting beyond the carapax. Squamiform appendages upon the bases of the prehensile legs, with a pappilose area upon the expanded portion, and the posterior margin armed with three rather slender teeth, separated by broad spaces; the terminal segment of the leg armed with two small hooks.

Color of alcoholic specimens, yellowish white.

Length, 2.2^{mm}; length of carapax, 1.3; breadth of carapax, 1.0; length of tail, 0.7; breadth of tail, 0.47.

Vineyard Sound, taken at the surface, July 8.

ARGULUS ALOSÆ Gould. (p. 459.)

Invertebrata of Massachusetts, p. 340, 1841.

Parasitic upon the alewife in Massachusetts Bay, according to Gould.

CALIGUS CURTUS Müller. (p. 459.)

Entomostraca, p. 130, Pl. 21, figs. 1, 2, 1785; Kroyer, Nat. Tidsskrift, vol. i, p. 619, Pl. 6, fig. 2, 1837. *Caligus Mülleri* Leach, Encycl. Brit., Suppl., vol. i, p. 405, Pl. 20, figs. 1–8, 1816, (teste Baird et al.;) Baird, British Entomostraca, p. 271, Pl. 32, figs. 4, 5. *Caligus Americanus* Pickering and Dana, Amer. Jour. Sci., vol. xxxiv, p. 225, Pl. 3–5, 1838; Dana, U. S. Expl. Expd., Crust., Pl. 93.

Abundant upon the cod-fish of our coast and of Europe. It is probably the *Caligus piscinus* of Gould and other American writers.

CALIGUS RAPAX Edwards. (p. 457.)

Hist. nat. des Crust., tome iii, p. 453, Pl. 38, fig. 9–12, 1840; Baird, op. cit., p. 270, pl. 32, figs. 2, 3; Steenstrup and Lütken, Bidrag til Kundskab om det aabne Havs Snyltekrebse og Lernæer, p. 359, Pl. 2, fig. 4, 1861.

Vineyard Sound, on the sting ray, (*Trygon centroura*,) and small specimens, both male and female, taken at the surface at Wood's Hole, September 3, in the evening. These specimens from the surface, according to Professor Verrill's notes, were light flesh color, thickly speckled with minute brown spots, the eyes bright red.

LEPEOPHTHEIRUS, species. (p. 459.)

A species with a long tail, and somewhat like the *L. gracilis*, (Van Benaden sp.,) was found upon the sting ray (*Trygon centroura*) taken in Vineyard Sound.

LEPEOPHTHEIRUS, species. (p. 459.)

A species with a very short tail, and approaching Heller's genus *Anuretes*. South shore of Long Island, upon a flounder, (*Chænopsetta ocellaris*.)

The *Lepeophtheirus salmonis* Kroyer, is found upon the salmon of the northern coast of New England.

ECHTHROGALEUS COLEOPTRATUS Steenstrup and Lütken. (p. 459.)

Op. cit., 380. *Dinematura coleoptrata* Guérin, Icongraphie du Règne animal, Crust. Pl. 35, fig. 6. *Dinemoura alta* Baird, British Entomostraca, p. 285, Pl. 33, figs. 6, 7.

Vineyard Sound, September 19, from the back fin of the mackerel-shark, (*Lamna punctata.*) It has been found upon the English coast and off the Azores.

ECHTHROGALEUS DENTICULATUS Smith, sp. nov. (p. 459.)

Carapax broader than long, with a very slight median emargination in the outline of the front. Posterior portion of the body scarcely longer and not quite as wide as the carapax. Dorsal plates, or elytra, covering much more than half the genital segment, their inner and posterior margins armed with a regular series of small teeth. The posterior lobes of the genital segment somewhat triangular and each terminated by a stout spine. Dorsal plate of the tail elongated, obtusely rounded at the extremity, and exposed from above by the very broad sinus in the genital segment. The tail itself broad, somewhat rectangular, but narrowed distally and not projecting behind the dorsal plate; the terminal lamellæ nearly as long as the tail, narrow, linear, nearly three times as long as broad, and armed at the tip with several setæ.

Length, 9^{mm}; breadth of carapax, 5.1; length of elytra along the inner margin, 2.5.

Vineyard Sound, on Atwood's shark, (*Carcharias Atwoodi.*)

? PANDARUS CRANCHII Leach. (p. 459.)

Dict. des Sci. nat., tome xiv, p. 535, 1819, (teste Edwards et al.;) Edwards, Règne animal de Cuvier, 3^{me} éd., Crust., Pl. 78, fig. 2; Steenstrup and Lütken, op. cit., Pl. 11, fig. 22.

A number of specimens of a *Pandarus*, taken from a dusky shark (*Eulamia obscura*) on the south side of Long Island in 1870, differ only very slightly from the figures and descriptions of *P. Cranchii* quoted above.

PANDARUS, species. Plate VII, fig. 31. (p. 457.)

Vineyard Sound, on Atwood's shark, (*Carcharias Atwoodi.*) It is, perhaps, only a variety of the last species, but differs considerably from it, wanting almost wholly the series of spines upon the posterior margin of the carapax, having the caudal appendages shorter and obtuse, besides some slight differences in the natatory legs.

NOGAGUS LATREILLII Leach. Plate VII, fig. 32. (p. 457.)

Dict. des. Sci. nat., tome xiv, p. 536, 1819, (teste Edwards et al.;) Règne animal de Cuvier, Crust., Pl. 79, fig. 3; Hist. nat. des Crust., tome iii, p. 459; Steenstrup and Lütken, op. cit., p. 384, Pl. 9, fig. 18.

Vineyard Sound, in company with the last species, on Atwood's shark.

All the species of *Nogagus* are males of the allied genera, *Pandarus*, *Echthrogaleus*, &c., and are only provisionally retained in a separate group, until it can be determined to which of these genera the different species really belong. This species is probably a *Pandarus*, and very likely the male of the last species.

Our specimens differ slightly from the figures given by Steenstrup and Lütken, the dentiform prominences on the sides of the genital segment in our specimens being much smaller than represented in their figures, the segments of the tail somewhat shorter and broader, and the terminal lamellæ also shorter and broader, while in other respects they agree well. Steenstrup and Lütken's specimens were taken from sharks caught in latitude 31° north, longitude 76° west, (in the Gulf Stream, off the South Carolina coast,) and in latitude 40° south, longitude 31° west, while Leach's came from latitude 1° south, longitude 4° east.

NOGAGUS TENAX Steenstrup and Lütken. (p. 457.)

Op. cit., pp. 384, 388, Pl. 10, fig. 20, 1861.

Vineyard Sound, with the last species, upon Atwood's shark. It has nearly as extended a range as the last species.

It is very different from the last species, having the branches of the posterior pair of natatory legs each composed of a single segment, and the tail also composed of a single segment, which is broader than long, and has the short, truncate caudal lamellæ attached to its obliquely truncated posterior angles. Length, 4.5^{mm}.

This species probably belongs to a different genus from the last, and is perhaps the male of *Echthrogaleus denticulatus*, with which it was associated. Both species of *Nogagus*, the *Pandarus* and *Echthrogaleus denticulatus*, were, however, all found on the same specimen of the shark, so that the association of males and females in one or two instances is not very good proof of their identity.

PANDARUS SINUATUS Say. (p. 459.)

Loc. cit., p. 436, 1818.

This species is apparently, as far as can be judged from Say's description, allied to *P. bicolor* Leach, a European species, which is probably not congeneric with the species which we have previously mentioned.

CECROPS LATREILLII Leach. (p. 459.)

Encyl. Brit., Suppl., vol. i, p. 405, Pl. 20, 1816, (teste Edwards et al.;) Edwards, Hist. nat. des Crust., tome iii, p. 475; Baird, op. cit., p. 293, Pl. 34, figs. 1, 2.

According to Gould, (op. cit., p. 341,) this species has been found upon the sun-fish (*Orthagoriscus mola*) taken on the coast of Massachusetts.

ANTHOSOMA CRASSUM Steenstrup and Lütken. (p. 460.)

Op. cit., p. 367, Pl. 12, fig. 24, 1861. *Caligus crassus* Abildgaard, (teste Steenstrup and Lütken,) Naturh. Selsk. Skr., Bind iii, p. 49, pl. 5, [1794 ?] (teste Kroyer.) *Anthosoma Smithii* Leach, Encycl. Brit., Suppl., vol. i, p. 406, Pl. 20, 1816, (teste Edwards et al.;) Kroyer, Nat. Tidsskrift, vol. i, p. 295, Pl. 2, fig. 2, 1836; Edwards, Hist. nat. des Crust., tome iii, 493, Pl. 39, fig. 5; Règne animal de Cuvier, Crust., Pl. 79, fig. 3; Baird, op. cit., p. 299, Pl. 33, fig. 9.

According to Gould, (op. cit., p. 341,) *Anthosoma Smithii* has been found upon the mackerel-shark (*Lamna punctata*) taken on the coast of Massachusetts.

LERNÆA BRANCHIALIS Linné. (p. 460.)

Systema Naturæ; Edwards, Hist. nat. des Crust., tome iii, p. 528; Steenstrup and Lütken, op. cit., p. 403, Pl. 13, fig. 28.

Found attached to the gills of the cod in the Bay of Fundy, and, undoubtedly, extends as far south as that fish. It is common in Northern Europe.

PENELLA PLUMOSA DeKay. (p. 460.)

Op. cit., p. 60, 1844.

Found, according to DeKay, upon *Diodon pilosus*, and a species of *Rhombus*.

ANCHORELLA UNCINATA Nordmann. (p. 460.)

Mikrographische Beitrage, Heft ii, p. 102, Pl. 8, figs. 8–12, Pl. 10, figs. 1–5, 1832; Baird, op. cit., p. 337, Pl. 35, fig. 9. *Lernæa uncinata* Müller, Zoologia Danica, vol. i, Pl. 33, fig. 2, 1788, (teste Nordmann el al.;) Van Benaden, Poissons des côtes de Belgique, Mémoires Acad. Royale Belgique, tome xxxiii, Pl. 2, fig. 7, 1871.

Found upon cod-fish taken at New London, Connecticut. It is a common European species.

LERNEONEMA RADIATA Stp. and Ltk. Plate VII, fig. 30. (p. 458.)

Op. cit., p. 400, 1861. *Lerneocera radiata* Leseur, Journal Acad. Nat. Sci., Philadelphia, vol. iii, p. 288, Pl. 11, fig. 1, 1824.

At Great Egg Harbor, New Jersey, and in Vineyard Sound and Buzzard's Bay, very common upon the menhaden, (*Brevoortia Menhaden*.)

LERNEONEMA ?, species. (p. 460.)

A species belonging to this, or a closely-allied genus, was found upon a species of *Carangus* taken in Vineyard Sound.

According to Gould, (op. cit., p. 341,) *Penella filosa* Cuvier, (Guérin, op. cit., Zoophytes, Pl. 9. fig. 3; Edwards, Hist. nat. des Crust., tome iii, p. 525,) has been found upon *Orthagoriscus mola*, and might, therefore, occasionally occur south of Cape Cod. The same author also mentions (p. 341) *Chondracanthus cornutus* Cuvier, (Nordmann, op. cit., p. 111, Pl. 9, figs. 5–10; Edwards, Hist. nat. des Crust., tome iii, p. 500, Pl. 40, figs. 18–22,) and *Branchiella Thynni* Cuvier, (Edwards, op. cit., tome iii, p. 512; Steenstrup and Lütken, op. cit., p. 420, Pl. 15, fig. 36,) as occurring upon the coast of Massachusetts.

CIRRIPEDIA.

BALANUS AMPHITRITE Darwin. (p. 381.)

Monograph of the Cirripedia, pp. 240, 614, Pl. 5, fig. 2, 1854.

Found upon the bottoms of ships, but probably does not live long after arriving upon our coast. It is found in all the tropical and warmer temperate seas.

Balanus tintinnabulum Linné, (Darwin, op. cit., pp. 194, 611, Pl. 1, 2, fig. 1,) occurs with the last species, but has not been noticed living. It has about the same range as the *B. amphitrite*.

BALANUS EBURNEUS Gould. (p. 381.)

Op. cit., p. 15, Pl. 1, fig. 6, 1841, Darwin, op. cit., pp. 248, 614, Pl. 5, fig. 4.

From Massachusetts Bay to Florida and the West Indies. It sometimes occurs in brackish or even fresh water. Professor J. Wyman found it living about 50 miles up the St. John's River, Florida, where the water was fresh enough to drink, and the specimens lived well when transferred to a vessel of perfectly fresh water.

BALANUS IMPROVISUS Darwin.

Op. cit., pp. 250, 614, Pl. 6, fig. 1.

Darwin gives this species as occurring in England, Nova Scotia, United States, West Indies, and South America, so that it undoubtedly occurs upon the coast of New England.

BALANUS CRENATUS Bruguière. (p. 381.)

Encyclop. Method., 1798, (teste Darwin;) Darwin, op. cit., pp. 261, 615, Pl. 6, fig. 6. *Balanus rugosus* Gould, op. cit., p. 16, Pl. 1, fig. 10.

Dredged abundantly in Vineyard Sound. It ranges from the arctic regions of the Atlantic to the Cape of Good Hope and the West Indies.

BALANUS BALANOIDES Stimpson. (p. 305.)

Marine Invertebrata of Grand Manan, p. 39, 1853; Darwin, op. cit., pp. 267, 615 Pl. 7, fig. 2. *Lepas balanoides* Linné, Systema Naturæ, 1767, (teste Darwin.) *Balanus ovularis* and *elongatus* Gould, op. cit., pp. 17, 18, Pl. 1, figs. 7, 8.

Extremely abundant between tides. It inhabits the whole North Atlantic.

CORONULA DIADEMA De Blainville. (p. 460.)

Dict. des Sci. nat., 1824, (teste, Darwin;) Gould, op. cit., p. 12; Darwin, op. cit., pp. 417, 623, Pl. 15, fig. 3, Pl. 16, figs. 1, 2, 7. *Lepas diadema* Linné, Systema Naturæ, 1767, (teste Darwin.)

Attached to whales taken on the coast, both north and south of Cape Cod. It is found throughout the whole North Atlantic.

LEPAS FASCICULARIS Ellis and Solander. Plate VII, fig. 34. (p. 382.)

Zoophytes, 1786, (teste Darwin;) Darwin, op. cit., p. 92, Pl. 1, fig. 6.

Found in vast numbers in Vineyard Sound, in June and July, and frequently taken in the Bay of Fundy in August.

LEPAS PECTINATA Spengler. (p. 382.)

Darwin, op. cit., p. 85, Pl. 1, fig. 3. *Anatifa dentata* Gould, op. cit., p. 21, Pl. 1, fig. 11.

Attached to ships' bottoms, but probably does not live long after arriving on our coast. It lives throughout the warmer parts of the Atlantic.

LEPAS ANATIFERA Linné. (p. 382.)

Systema Naturæ, 1767, (teste Darwin;) Darwin, op. cit., p. 73, Pl. 1, fig. 1.

Occurs in the same way as the last species. It is common to the Atlantic, Pacific, and Indian Oceans, and the Mediterranean.

LEPAS ANSERIFERA Linné. (p. 382.)

Systema Naturæ, 1767, (teste Darwin;) Darwin, op. cit., p. 81, Pl. 1, fig. 4. *Anatifa striata* Gould, op. cit., p. 20.

This species probably occurs in the same way as the last. It has the same range.

CONCHODERMA AURITA Olfers. (p. 392.)

Darwin, op. cit., p. 141, Pl. 3, fig. 4. *Lepas aurita* Linné, Systema Naturæ, 1767, (teste Darwin.) *Otion Cuvieri* Gould, op. cit., p. 23.

On ships' bottoms, &c. It ranges through all the seas.

CONCHODERMA VIRGATA Olfers. (p. 392.)

Darwin, op. cit., p. 146, Pl. 3, fig. 2. *Lepas virgata* Spengler, 1790, (teste Darwin.) *Cineras vittata* Gould, op. cit., p. 22.

Occurs in the same way, and has the same range as the last species.

XIPHOSURA.

LIMULUS POLYPHEMUS Latreille. (p. 340.)

Hist. des Crust., (teste Edwards,) Hist. nat. des Crust., tome iii, p. 549; Say, loc. cit., p. 433; Gould, op. cit., p. 339; Packard, Memoirs Boston Soc. Nat. Hist., vol. ii, p. 155, Pl. 3–5, 1872, (on the development;) A. Milne Edwards, Annales des Sci. nat., 5e sér., tome xvii, nos. 1 et 2, Dec., 1872, Pl. 5–16, (on the anatomy.) *Monoculus Polyphemus* Linné, Systema Naturæ; *Polyphemus occidentalis* Lamark, Hist. des Anim. sans vert.; De Kay, op. cit., p. 55, Pl. 11, fig. 50. *Limulus australis* Say, loc. cit., p. 436. *Xiphosura Polyphemus* White, List of Crust. in British Mus., p. 121, 1847.

Casco Bay, on the coast of Maine, to Florida.

ANNELIDA.

POLYCHÆTA.

APHRODITA ACULEATA Linn. (p. 507.)

Systema Naturæ, ed. xii, vol. i, p. 1084, 1767; Malmgren, Öfvers. af Kong. Vet.-Akad. Förhandlingar, 1865, p. 52; Johnston, Catalogue of British Non-Parasitical Worms, p. 101, Pl. 9, 1865; Quatrefages, Histoire naturelle des Annelés, vol. i, p. 191, 1865.

Off Gay Head in 15 to 19 fathoms, mud; Bay of Fundy, 10 to 106 fathoms, mud; St. George's Bank, 50 fathoms; northward to Labrador. Northern coasts of Europe to Great Britain and Mediterranean.

LEPIDONOTUS SQUAMATUS Leach. Plate X, figs. 40, 41. (p. 320.)

Aphrodita squamata Linn., Syst. Nat., ed. x, p. 665; ed. xii, p. 1084. *Polynöe squamata* Savigny, Syst. Annel., 20 (t. Quatr.): Quatr., op. cit., p. 218. *Aphrodita punctata* Müll., Zoöl. Dan. Prod., p. 218 (t. Malmgren). *Lepidonotus squamatus* Malmgren, op. cit., p. 56; Johnston, op. cit., p. 109, Pl. 7, fig. 1. *Lepidonote armadillo* Leidy, Marine Invert. of Rhode Island and New Jersey, p. 16, Pl. 11, fig. 54. *Polynöe dasypus* Quatr., op. cit., vol. i, p. 226.

Great Egg Harbor, New Jersey; New Haven; Watch Hill, Rhode Island; Vineyard Sound, &c. Very common north of Cape Cod to Labrador and Iceland; northern coasts of Europe; Great Britain; France.

In the Bay of Fundy it occurs abundantly from above low-water mark to the depth of 80 fathoms.

LEPIDONOTUS SUBLEVIS Verrill, sp. nov. Plate X, fig. 42. (p. 320.)

Body oblong, somewhat narrowed toward each end, entirely covered by twelve pairs of large scales, or "elytra," which, with the exception of the first and last pairs, are broad oval, evenly rounded posteriorly, the outer lateral edge with a fine fringe; the posterior margin smooth. Their surface is iridescent and nearly smooth throughout, and destitute of tubercles, but has minute rounded granules, and appears punctate under a lens. The scales of the last pair are elongated, with the inner edge curved inward, but without a distinct emargination, such as is seen in the preceding species. Setæ numerous, slender but stiff, amber-yellow. Scales usually reddish or greenish brown, finely specked with dark brown. Length up to 30^{mm}; breadth, 8^{mm}.

This species is easily distinguished from the last by its nearly smooth scales, the form of the last pair, and the lighter-colored and more slender setæ.

Savin Rock, near New Haven; Vineyard Sound.

LEPIDONOTUS ANGUSTUS Verrill, sp. nov. (p. 494.)

Body elongated, narrow, of nearly uniform width throughout, convex above. Twelve pairs of elytra, which are only slightly imbricated and hardly cover the back completely, there being often a narrow naked dorsal space, but when the elytra are closely appressed the back is nearly covered. The elytra are rather small, regularly oval, except those of the terminal pairs; outer edge irregularly fringed; surface covered with small, slightly prominent, roundish granules. Posterior elytra with a deep emargination on the inner margin. Head larger and relatively broader than in *L. squamatus*, convex, with well-rounded sides, eyes larger and farther apart. Antennæ rather short. Setæ shorter than in either of the preceding species, of nearly uniform length, rather rigid, light amber-colored, forming short dense fascicles. Color variable; in one specimen the scales were yellowish gray and brownish, varied with dark specks, and with a central subcircular or somewhat crescent-shaped white spot, surrounded by a circle of dark brown specks.

which form an irregular dark spot on the inner border of the pale central spot.

Reefs off Watch Hill, Rhode Island, in 4 or 5 fathoms, among rocks and algæ.

HARMOTHÖE IMBRICATA Malmgren. (p. 321.)

Nordiska Hafs-Annulater, op. cit., p. 67, 1865, Pl. 9, fig. 8, A–E. *Aphrodita imbricata* Linn., Syst. Nat., ed. xii, p. 1084, 1767. *Aphrodita cirrata* Müller, Prodr. Zoöl. Dan., No. 2644 (t. Malmgren); Fabricius, Fauna Grœnlandica, p. 308, Pl. 1, fig. 70. *Lepidonote cirrata* Œrsted, Grön. Ann. Dorsib., 1843, p. 14, Pl. 1, figs. 1, 5, 6, 11, 14, 15; Stimpson, Invertebrata of Grand Manan, p. 36, 1853. *Polynöe cirrata* Sars, Arch. für. Naturg., vol. xi, 1845, p. 11, Pl. 1, figs. 12–21 (embryology).

New Haven; Watch Hill, Rhode Island; Vineyard Sound; Massachusetts Bay; Bay of Fundy and northward to Greenland; Iceland; and Spitzbergen. Northern coasts of Europe; Scotland. In the Bay of Fundy it is common from above low-water mark to 60 fathoms; in Vineyard Sound, from low-water mark to 15 fathoms; 25 fathoms off Buzzard's Bay.

STHENELAIS PICTA Verrill, sp. nov. (p. 348.)

(?) *Sigalion Mathildæ* Leidy, Marine Invert. Fauna of the Coasts of Rhode Island and New Jersey, p. 16, Pl. 11, f. 53, from Journal Philadelphia Acad., series ii, vol. iii, 1855 (*non* Aud. and Edw.) (?) *Sthenelais Leidyi* Quatr., op. cit., vol. i, p. 278 (no description).

Body depressed, much elongated, nearly uniform in breadth throughout; back convex; ventral surface flat. The whole dorsal surface is closely covered by the imbricated scales, of which there are more than 150 pairs. These, with the exception of the anterior and posterior pairs, are broadly lunate, with a deep emargination in the center of the anterior edge; the posterior and lateral margins are broadly rounded; the outer lateral edge is laciniately fringed; the posterior edge is smooth; the whole surface of the anterior scales is covered with minute, slightly elevated granules; farther back, the exposed portion of the surface of the scales is smooth, and the microscopic granules are restricted to the anterior and inner portions. The scales of the anterior pair are oval, and have their entire outer and anterior margins minutely but irregularly denticulate.

The head is small, rounded, contracted behind the posterior eyes and in front of the anterior ones; the eyes are near together, in a quadrangle; those in the anterior pair are a little farther apart, and lateral. The head is prolonged anteriorly into a narrow elliptical or oval portion, which forms the base of the median antennæ; close to and below each of the anterior eyes a prominent, membranous, ciliated process arises. The feet of the first pair, which are directed forward, are elongated, and bear a pair of slender, elongated, dorsal cirri, which are nearly as long as the antennæ; a much shorter, slender cirrus from the lower lobe, with a small, thin, membraneous process below; and a large fascicle of long, slender setæ, as long as the median antennæ. The palpi are slender, longer than the antennæ; lateral feet prominent, projecting beyond the scales; setæ light yellow.

Color variable, generally light gray, with a dark brown median dorsal band, each scale often bordered on the posterior and inner edges with brown, which is connected with a blackish angular spot near the anterior margin, the rest of the scale being transparent and whitish; head dark brown, with a red central spot and a round whitish spot on each side. Length up to 150^{mm}; breadth usually about 4^{mm}.

Vineyard Sound, low-water mark to 14 fathoms; off Martha's Vineyard, 21 fathoms, sand; off New Haven, 4 to 5 fathoms, shelly. Great Egg Harbor (Leidy).

This species differs considerably in the form of the head, antennæ, &c., from the figure given by Leidy. His description is insufficient to determine whether he observed the same species.

NEPHTHYS INGENS Stimpson. Plate XII, figs. 59, 60. (p. 431.)

Marine Invertebrata of Grand Manan, p. 33, in Smithsonian Contributions, 1853.

Long Island Sound, off New Haven, 3 to 8 fathoms, mud, common; off Block Island, in 29 fathoms; Bay of Fundy, 10 to 60 fathoms.

This species is readily distinguished by the form of the head and position of the small antennæ; by the large median dorsal papilla on the proboscis, and the smaller ventral one; by the very prominent and widely separated rami of the posterior feet; and the dark color of the setæ. It grows to the length of 130^{mm} or more.

NEPHTHYS PICTA Ehlers. Plate XII, fig. 57. (p. 348.)

Die Borstenwürmer, vol. i, p. 632, Pl. 23, figs. 9, 35, 1868.

Vineyard Sound, low-water mark to 8 fathoms, muddy and shelly. Nahant; Charleston (Ehlers).

NEPHTHYS BUCERA Ehlers. Plate XII, fig. 58. (p. 416.)

Die Borstenwürmer, vol. i, p. 617, Pl. 23, fig. 8.

Vineyard Sound, 8 to 10 fathoms, shelly; Watch Hill, Rhode Island, 4 to 5 fathoms, among rocks and sand. Massachusetts Bay (Ehlers).

This species is remarkable both for the form of the head and the length of the setæ, which often exceed the diameter of the body.

NEPHTHYS CILIATA Rathke.

Beiträge zur Fauna Norwegens, p. 170, 1843; Malmgren, op. cit., p. 104, Pl. 12, figs. 17, A–C, 1865; Quatrefages, op. cit., p. 429 (*Nephtys*); Ehlers, Borstenwürmer, vol. i, p. 629, Pl. 23, fig. 36, 1868. *Nereis ciliata* Müller, Zoölog. Danica, vol. iii, p. 17, Pl. 89, figs. 1–4 (t. Ehlers). *Nephthys borealis* Œrsted, Annulat. Danicor. consp., p. 32, 1843 (t. Malmgren).

Ehlers gives Edgartown as a locality for this species. It is a northern form, found at Iceland, Greenland, Spitzbergen, and along the northern coasts of Europe and Great Britain. Stimpson records it from the

Bay of Fundy, in 40 fathoms, mud. It was dredged near St. George's Bank in 85, 110, and 150 fathoms, mud, by Dr. A. S. Packard, on the "Bache," 1872.

EUMIDIA AMERICANA Verrill, sp. nov. (p. 494.)

Body long and slender. Head triangular, subcordate, broad and slightly emarginate posteriorly, the sides rapidly converging, the front end narrow and rounded, with four slender antennæ, which are as long as the head; odd median antenna long and slender, tapering, as long as or longer than the head. Eyes moderately large, round, convex, near the posterior margin of the head. Tentacular cirri long and slender; crowded. Proboscis elongated, subclavate, enlarging to the end, which is surrounded by about fourteen triangular papillæ; the basal two-thirds covered with small, slender, prominent papillæ, which are not crowded, but arranged in longitudinal rows; this part of the proboscis is, in the preserved specimens, longitudinally ridged and transversely wrinkled; the terminal third is nearly smooth, but usually minutely granulous. The lateral lamellæ, or branchiæ, are ovate-lanceolate, leaf-like, with curved tips; posteriorly they are larger and more acute. Length up to 50^{mm}; breadth, 1.5^{mm}.

Vineyard Sound, 8 to 12 fathoms, among compound ascidians.

EUMIDIA VIVIDA Verrill, sp. nov.

Head relatively a little longer than in the preceding species, with the sides more convex, and the front rounded; antennæ long and slender. Eyes brownish, very large, about twice as large as in the preceding species. Proboscis long, slender, clavate, nearly smooth, but with a few minute, distant papillæ; the terminal orifice surrounded by about eighteen very small papilliform denticulations. Branchiæ of the anterior segments long and narrow lanceolate; of the middle segments ovate. Length up to 45^{mm}; breadth, 1.5^{mm}.

Vineyard Sound, 8 to 12 fathoms, among ascidians.

EUMIDIA PAPILLOSA Verrill, sp. nov.

Head short, rounded, convex, emarginate posteriorly, the sides convex; antennæ not very slender; median odd one stout, tapering, acute, as long as the head. Eyes large; brown. Tentacular cirri rather stout, those of the two posterior pairs more than twice as long as the others. Proboscis long, clavate, densely covered with short, rounded papillæ, and with a circle of minute papillæ at the orifice.

Length up to 40^{mm}; breadth, 2^{mm}.

Vineyard Sound, 6 to 10 fathoms, among compound ascidians.

EULALIA PISTACIA Verrill, sp. nov.

Body moderately slender, depressed. Head convex, shorter than broad; in preserved specimens, sides well rounded, posterior margin slightly emarginate; median odd antenna small, slender, considerably shorter than the head. Eyes large, brown. Tentacular cirri moderately long; the four posterior ones considerably longer than the others. Branchiæ narrow lanceolate anteriorly; ovate and leaf-like on the middle segments; longer and lanceolate posteriorly. Proboscis long, more or less clavate, smooth, but often showing longitudinal striations, and sometimes with a few very minute scattered papillæ toward the end; the orifice surrounded by a circle of numerous minute papillæ. Color bright yellowish green (epidote-green or pistachio-green), often with obscure darker markings posteriorly, and at the base of the appendages. Length up to 40^{mm}; breadth, 1.5^{mm}.

Vineyard Sound, 6 to 12 fathoms, among compound ascidians; off New Haven, 4 to 5 fathoms, among hydroids.

EULALIA GRANULOSA Verrill, sp. nov.

Body not very slender, considerably stouter than in the preceding species, and less tapering anteriorly. Head short cordate, decidedly emarginate behind, broader than long; sides prominently rounded; front small, rounded. Antenæ short; odd one slender, originating between the eyes, more than half the length of the head. Eyes large, round, convex, dark brown. Proboscis long, clavate, thickly covered throughout with round, scarcely prominent, crowded, rather large granules, each of which has a dark central spot; orifice surrounded by a circle of small papillæ. Tentacular cirri slender, acute, the two posterior pairs long, reaching the eighth segment. Lateral appendages large and prominent for the genus. Branchiæ of upper ramus rather large, ovate, leaf-like anteriorly; larger and obliquely ovate, with acuminate tips, farther back; branchiæ of lower ramus similar in form and nearly as large. Color bright grass-green. Length 55^{mm}, or more; breadth, 2^{mm}; length of proboscis, 6^{mm}.

Off New Haven, 4 to 5 fathoms, among hydroids.

EULALIA ANNULATA Verrill, sp. nov.

Body moderately slender, convex, tapering to both ends. Head longer than broad, somewhat oblong, truncate behind, the sides but little convex, narrowing but little to the obtusely rounded front. Proboscis covered with small prominent papillæ. Eyes two, large, dark brown or blackish, rather near together. Odd median antenna slender, more than half as long as the head, placed far in advance of the eyes; frontal antennæ rather large, about the same in length, but much stouter than the median one, with slender tips. Tentacular cirri very unequal, the two upper pairs much longer than the others, not very slender, reaching to the seventh or eighth segment in preserved specimens; the two lower pairs not more than one-third as long. Dorsal branchiæ narrow and acute throughout; the anterior ones are narrow lanceolate, with subacute tips; those farther back become still more elongated, narrow lanceolate, or almost linear lanceolate, with acuminate tips, and in length equal to half the diameter of the body; posteriorly they become somewhat wider, with acute, curved tips. Caudal cirri small, narrow lanceolate, about as long as the posterior lateral lamellæ, or branchiæ. Color of preserved specimens pale greenish or bluish gray, with narrow annulations of golden brown, and iridescent. Length 50^{mm}, or more; breadth about 1.25^{mm}.

Vineyard Sound, 4 to 12 fathoms, among ascidians.

EULALIA GRACILIS Verrill, sp. nov.

Body very long and slender, with the segments deeply incised; posterior segments elongated. Head small, elongated, truncate behind; posterior angles not prominent, oblong, tapering but little toward the front, which is obtusely rounded; sides not swollen. Eyes of moderate size, brown, situated close to the posterior margin of the head. The four frontal antennæ are more than half as large as the head, rather stout, tapering, and the head is slightly constricted behind them; odd median one, small, slender, inconspicuous, about one-third the length of the head, placed considerably in advance of the eyes. Tentacular cirri rather stout, the two upper ones longest, rather more than twice as long as the head; the posterior pair, when extended backward, reaches the fifth setigerous segment in preserved specimens; the two lower ones are considerably stouter and smaller, nearly equal, and are somewhat longer than the head in alcoholic specimens. Branchiæ of the anterior segments short, oval, obtuse at the tip; posteriorly larger, elongated oval, leaf-like. Color light greenish brown or olive, with a row of dark brown spots along each side of the dorsal surface of the body.

Length up to 65^{mm}; breadth about 1^{mm}.

Vineyard Sound, 6 to 14 fathoms, among ascidians and hydroids.

This species is very active in its motions. In general appearance it resembles certain species of *Phyllodoce*, for which it might easily be mistaken, owing to the small size and translucency of the odd median antenna, which is not easily observed, especially with living specimens. The position of the tentacular cirri is, however, sufficient to distinguish the genus from *Phyllodoce* and *Eumidia*. The form of the head is quite peculiar, but somewhat resembles that of *Phyllodoce gracilis*, and also the preceding species.

One specimen of the *Eulalia gracilis* was found in which fissiparity was apparently about to take place. In this, one of the segments was larger than the rest, and had developed a distinct pair of eyes. The specimen unfortunately died before the separation took place.

PHYLLODOCE GRACILIS Verrill, sp. nov. Pl. XI, fig. 56. (p. 494.)

(?) *Phyllodoce maculata* A. Agassiz, Annals Lyceum New York, vol. viii, p. 333, fig. 53, 1866 (*non* Müller, *nec* Œrsted).

Body very long and slender. Head longer than broad, decidedly cordate behind, with the posterior angles well rounded; the sides swelling out opposite the eyes, then narrowing to near the antennæ, where there is a slight constriction, and expanding slightly at the end, which is obtusely rounded. Eyes very large, brown, wide apart, and sub-lateral, connected by a curved band of brown specks; antennæ rather large and long, about one-third as long as the head. Tentacular cirri large, the two posterior much the longest, reaching to about the eighth setigerous segment. Branchiæ of anterior segments broad oval or sub-circular, rounded at the end; posterior ones larger, broad oval, narrowed to the end. Proboscis with a large, swollen, basal portion, on which are twelve longitudinal rows of large, prominent, obtuse papillæ, about seven in each row; and a terminal smooth portion, which is somewhat longer, and about as broad at the end as the basal portion, but considerably narrower at its commencement; the orifice is surrounded by a circle of large, rounded papillæ. Color greenish, with a median dorsal row of dark brown spots, and another less conspicuous row along each side of the back, at the base of the lateral appendages.

Length up to 75^{mm}; breadth, 1 to 1.25^{mm}.

Watch Hill, Rhode Island, in 4 or 5 fathoms, rocky bottom.

The figure (56) copied from one of those given by Mr. Agassiz does not agree perfectly with the specimens described, but probably represents the same species. The head, as figured, is more oblong and the eyes nearer together than in my specimens; the tentacular cirri are less crowded. The anterior ones, in the preserved specimens at least, appear to arise from beneath the base of the head. Some of these differences may be due to the different states of extension and contraction; for the species in this family are all quite changeable in form during life, and usually contract very much in alcohol.

PHYLLODOCE CATENULA Verrill, sp. nov. (p. 494.)

Head somewhat longer than broad, slightly cordate posteriorly, with the posterior angles well rounded, and the sides full and convex; front broadly rounded, and with a slight emargination in the middle. Eyes large, dark brown, placed on the dorsal surface of the head; antennæ rather long, slender. Tentacular cirri long and slender, the two posterior much longer than the others. Branchiæ of anterior segments broad ovate, with rounded tips; farther back larger and longer, ovate, leaf-like, with acuminate tips. Proboscis with twelve rows of papillæ on the basal portion, which are prominent, somewhat elongated, obtuse, seven or eight in the lateral rows, those in each row close together. Color of body and branchiæ pale green, with a median dorsal row of dark brown spots, one to each segment; and two lateral rows, in which there is a spot at the base of each "foot;" head pale, or greenish white.

Length up to 75^{mm}; breadth about 1.5^{mm}.

Watch Hill, Rhode Island, in 4 to 6 fathoms, among rocks and algæ, and in tide-pools; Wood's Hole, at surface, evening, July 3. Very common in the Bay of Fundy, from low-water to 50 fathoms.

This species is closely allied to *P. pulchella* Malmgren, from Northern Europe, but differs somewhat in the form of the head, which is shorter and rounder in the latter; the branchiæ also differ in form. It is a very active species, and secretes a large quantity of mucus.

ETEONE ROBUSTA Verrill, sp. nov. (p. 488.)

Body large, stout, depressed, broadest in the middle, tapering gradually to each end. Head small, about as long as wide, convex, with a median depression; the sides rounded; front obtusely rounded. The four frontal antennæ are very small, short, obtuse, less than half the diameter of the head. Eyes very small, black. Tentacles very small and short, tapering, their length about one-half the diameter of the head, the two pairs about equal. Branchiæ small, sessile, anteriorly very small, oval, obtuse; in the middle region rounded, sub-oval. Color dark green, with the anterior portion somewhat paler, and with light green transverse bands between the segments; lateral appendages pale green.

Length, 125^{mm}; breadth in middle, 5^{mm}; length of head, 0.6^{mm}.

Watch Hill, Rhode Island, under stones, between tides, April 12, 1873.

ETEONE LIMICOLA Verrill, sp. nov. (p. 349.)

Body very long and slender, tapering gradually to both ends; depressed, and with deeply incised, elongated segments posteriorly; less depressed and with shorter and less distinct segments anteriorly. Head small, about as broad as long, the posterior angles well rounded, the sides with a slight constriction in advance of the eyes, narrowing rapidly; front narrow, convex; antennæ slender, about half the length of the head. Eyes minute, inconspicuous. Tentacular cirri about equal to the length of the head. Lateral appendages small on the anterior segments, becoming much more prominent farther back; anterior branchiæ very small, ovate, sessile; those farther back much larger, and narrow ovate. Color, when living, light green throughout.

Length about 80^{mm}; breadth, including appendages, 1.5^{mm}.

Great Egg Harbor, New Jersey, in mud at low-water.

ETEONE SETOSA Verrill, sp. nov.

Body long and slender, resembling the preceding in form, but somewhat less slender. Head shorter and broader, the posterior angles prominently rounded; two slight notches or emarginations on the posterior margin, the middle portion extending farther back than the lateral; sides rapidly tapering; front narrow. Antennæ less than half the length of the head. Eyes small, but quite distinct. Tentacular cirri scarcely as long as the head. Lateral appendages a little prominent on the anterior segments, but much less so than farther back; setæ numerous. The branchiæ are small, sessile, and inconspicuous anteriorly; larger and ovate farther back.

Length up to 75^{mm}; breadth about 2^{mm}.

Vineyard Sound, 6 to 12 fathoms, among ascidians.

ETEONE, species undetermined.

A small and slender species was dredged off Gay Head, in 19 fathoms, soft mud.

Another very peculiar species of *Eteone* was obtained at Great Egg Harbor, New Jersey. In this the head is depressed and elongated, tapering, with short antennæ. The anterior part of the body is round and with the lateral appendages very small, closely appressed, and not at all prominent, giving to this part of the body a smooth appearance; on this part of the body the branchiæ are very small, lunate, sessile, closely appressed; farther back they become much larger, and rounded or ovate, while the setigerous lobe becomes prominent, and the setæ much longer and more numerous.

PODARKE OBSCURA Verrill, sp. nov. Pl. XII, fig. 61. (p. 319.)

Body convex above, flat below, with the segments deeply incised at the sides, moderately slender in full extension, but capable of great contraction, tapering gradually to the caudal extremity, and less toward the head. Head small, broader than long, emarginate in front, sides forming rounded angles; posterior margin nearly straight. Antennæ five, subequal, the outer pair articulated upon a short, thick basal segment; the odd median one is somewhat shorter, articulated upon a small basal segment, which arises in front of the anterior pair of eyes. Tentacular cirri long, slender, six on each side, two arising from each of the first three annulations, on each side; those on the middle are longest, those on the first shortest. Eyes four, small, red; those on each side close together, but those of the anterior pair are farthest apart. Proboscis with a large, swollen basal portion, and a smaller cylindrical terminal portion, the surface nearly smooth. Lateral appendages, or "feet," elongated, biramous. The upper branch is short, conical, bearing at its extremity a long, slender dorsal cirrus, nearly as long as the breadth of the body, or even exceeding it, and having a short basal joint; the setæ of the upper ramus are very few and small. The lower branch is much larger and longer, thick at base, tapering somewhat to the obtuse end, from which a small, terminal, obtuse, papilliform process arises; the short, acute, ventral cirrus arises from about the terminal third, and is less than half as long as the dorsal cirrus; the setæ are numerous and long, forming a broad, fan-shaped fascicle, in which the middle setæ are considerably longer than the upper and lower ones, and in length about equal to the setigerous lobe; these setæ are all compound, the middle ones having a very long, slender, acute terminal joint, and the shorter ones beneath having a much shorter terminal joint. Last segment small, rounded, bearing two long, slender anal cirri, much longer than the dorsal cirri. Color variable, most commonly very dark brown or blackish; sometimes dark brown with transverse bands of light flesh-color between the segments, and two intermediate transverse whitish lines on each segment.

Length up to 40mm when extended; breadth, including setæ, 3mm.

Wood's Hole, among eel-grass and at the surface, very abundant, especially at night, in July and August; also under stones, between tides.

AUTOLYTUS CORNUTUS A. Agassiz. Pl. XIII, figs. 65, 66. (p. 397.)

Journal Boston Society of Natural History, vol. vii, p. 392, Plates 9–11, 1863.

Great Egg Harbor, New Jersey; New Haven; Watch Hill; Vineyard Sound; Massachusetts Bay; Eastport, Maine. Low-water mark to 15 fathoms.

AUTOLYTUS, species undetermined. (p. 398.)

Off New Haven, 4 to 6 fathoms, shelly, among hydroids.

AUTOLYTUS, species undetermined.

Females, filled with eggs, of a large species of this genus were taken at the surface of Vineyard Sound, April 30, by Mr. V. N. Edwards. These were about 40mm in length, as preserved in alcohol, and rather stout, tapering to each end. The head is small, short, rounded in front. The eyes are small, and the two pairs are near together. The odd median antenna is more than twice as long as the breadth of the head; the lateral ones are about half as long; the first six setigerous segments have short setæ; the following ones have a fascicle of long, slender ones, equal to the breadth of the body.

SYLLIS, species undetermined. (p. 453.)

A single specimen from Vineyard Sound. The body is about 12mm long; the antennæ are not very long; the palpi short; the dorsal cirri are rather long, and, like the antennæ, regularly beaded; the ventral cirri are small, tapering; the setæ are numerous, rather short.

GATTIOLA, species undetermined. (p. 453.)

Young specimens were taken several times in Vineyard Sound, at the surface. Adult specimens of a fine species of this genus were dredged in the Bay of Fundy in 1872, in 80 fathoms.

NEREIS VIRENS Sars. Pl. XI, figs. 47–50. (p. 317.)

Beskrivelser og Iakttagelser, etc., p. 58, Pl. 10, fig. 27, a, b, c, 1835 (t. Malmgren). *Nereis grandis* Stimpson, Invertebrata of Grand Manan, p. 34, fig. 24, 1853. *Nereis Yankiana* Quatrefages, Hist. des Annelés, i, p. 553, Pl. 17, figs. 7, 8 1865; *Alitta virens* Malmgren, op. cit., p. 183; Annulata polychæta, p. 56, Pl. 3, figs. 19, A–E, 1867.

New Haven, at low water; Watch Hill; Vineyard Sound; Massachusetts Bay; Eastport, Maine; northward to Labrador. Northern coasts of Europe to Great Britain.

NEREIS LIMBATA Ehlers. Pl. XI, fig. 51. (p. 318.)

Die Borstenwürmer, vol. i, p. 567, 1868.

Charleston, South Carolina, to Massachusetts Bay; half-tide mark to 4 to 6 fathoms in Long Island Sound.

NEREIS PELAGICA Linn. Pl. XI, figs. 52–55. (p. 319.)

Systema naturæ, ed. x, p. 654; ed. xii, p. 1086; Malmgren, Annulata polychæta p. 47, Pl. 5, figs. 35, A–D, 1867; Ehlers, op. cit., p. 511, Pl. 20, figs. 11–20, 1868. *Heteronereis grandifolia* Malmgren, Nordiska Hafs-Annulater, p. 108, Pl. 11, figs. 15, 16, B, B[1], C; Ann. polychæta, p. 60, Pl. 5, figs. 31, A–D; *Heteronereis arctica* Œrsted, Grœnland's Annul. dorsibr., p. 27, Pl. 4, figs. 50*, 51, 60, Pl. 5, figs. 65, 68 70*, male (t. Ehlers); *Heteronereis assimilis* Œrsted, op. cit., p. 28, Pl. 4, figs. 54, 61, Pl. 5, fig. 72, female (t. Ehlers).

Off New Haven; Watch Hill; Vineyard Sound; northward to Labrador. Greenland; Iceland; Spitzbergen; northern coasts of Europe to Great Britain. In the Bay of Fundy from low-water mark to 106 fathoms, common.

NEREIS FUCATA Aud. and Edwards. (p. 494.)

Histoire nat. litt. de la France, vol. ii, p. 188 (teste Malmgren); *Lycoris fucata* Savigny, Syst. des Annélides, p. 31, 1820 (t. Ehlers); Descr. de l'Égypte, éd. 2, xxi, p. 357 (t. Malmgren); *Nereilepas fucata* Malmgren, Annulata polychæta, p. 53, Pl. 3, figs. 18–18 E; Johnston, Catalogue, p. 158, fig. 30, 1865. *Heteronereis glaucopis* Malmgren, Nordiska Hafs-Annulater, Öfvers. af Kongl. Vet. Akad. Förh., 1865, p. 181, Pl. 11, figs. 16, 16 A; Annulata polychæta, p. 60, Pl. 4, figs. 26, 27, 1867. *Nereis fucata* Ehlers, Borstenwürmer, vol. i, p. 546, Pl. 21, figs. 41–44.

A specimen was dredged at Watch Hill, Rhode Island, in 4 to 6 fathoms, among rocks and algæ, which agrees well with Malmgren's description and figure of *Heteronereis glaucopis*. Ehlers regards the latter as the heteronereis-form of *N. fucata*.

NEREIS, species undetermined.

Head sub-conical; antennæ small, slender; palpi small, shorter, and thicker; two upper pairs of tentacular cirri moderately elongated, subequal, lower ones very small. Posterior eyes elongated and on the upper side of the head; anterior pair small, lateral. Feet terminated by four small papillæ; dorsal and ventral cirri small, slender.

The only specimen observed is preserved in alcohol; it is a female filled with eggs. Vineyard Sound, 6 to 8 fathoms.

NECTONEREIS Verrill, genus nov.

Head prominent, depressed, oval, rounded in front, bearing two pairs of large eyes on the upper and lateral surfaces, and a pair of small antennæ beneath; palpi small or rudimentary. Tentacular cirri four on each side, as in *Nereis*. Proboscis small, similar to that of *Nereis*, but more simple; furnished with a pair of terminal hooks; with two anterior clusters of denticles on the upper side, and with five small clusters below, in a ring extending nearly half-way around it. Anterior part of body fusiform, consisting of about fourteen segments, on which the feet are divided into small, rounded lobes, with small ventral cirri; and with long dorsal cirri, those on the first seven segments swollen and gibbous toward the end, with a small acute terminal portion. Posterior part of the body composed of numerous short segments, on which the feet are furnished with lamelliform appendages.

This remarkable annelid bears some resemblance, in the structure of the body and "feet," to *Heteronereis*, and there is probably another form to which it bears the same relation that *Heteronereis* bears to *Nereis*; but the structure of the head is very unlike that of any known genus, and, indeed, would not allow it to be placed in the family of *Nereidæ* without modifying the family-characters. There are are no large palpi, corresponding to those of *Nereis*, and nothing to represent them, unless two small lobes close to the mouth be considered rudimentary palpi.

NECTONEREIS MEGALOPS Verrill, sp. nov. Plate XII, figs. 62, 63. (p. 440.)

Body slender, consisting of two parts; the anterior portion, containing fourteen setigerous segments, is broadest in the middle, tapering both ways, and separated from the posterior portion by a distinct constriction; the posterior portion is much longer and more slender, tapering gradually to the end, and consists of very numerous short segments, which are furnished with complex lateral appendages, with thin lamellæ and compound bladed setæ. Head broad oval, somewhat convex, and very smooth above; the lateral margins a little convex; the front obtusely rounded. Eyes very large, convex; the anterior ones largest, lateral and partially dorsal, oval; in contact with the posterior ones, which are somewhat smaller and more dorsal. Two small decurved antennæ, with swollen bases, are on the ventral side of the head; two small, rounded processes in front of the mouth. Tentacular cirri slender, the upper pair much the longest; the rather short lower pair arising near the mouth; the two intermediate pairs arise behind and close to the anterior eyes; all are slightly annulated. The "feet" on the first seven segments have a large dorsal cirrus, increasing in length from the first to the seventh, narrow at base, swollen and gibbous toward the end, with a slender, oblique, terminal portion; on the seven following segments the dorsal cirri are smaller, slender, tapering; the ventral cirri are small, with swollen bases on the first five segments, slender and tapering on the rest; the intermediate lobes of the feet are small and rounded, but more elongated on the first five segments. Setæ of different forms, many of them with a slender, often curved, acute terminal piece.

The lateral appendages of the posterior region have, on the upper ramus, a long, slender dorsal cirrus, strongly crenulate-lobed on the lower side; a small, rounded lamelliform process above its base; and a long, lanceolate process arising just below it, and in length equaling the cirrus; an ovate setigerous lobe, bearing a broad fan-shaped fascicle of compound setæ, extending about to the end of the dorsal cirrus; and a lower ovate-lanceolate lamelliform process, with the base expanded and extending backward, the tip reaching to about the outer third of the cirrus; a single strong black spine supports the setigerous lobe. The lower ramus has a rounded setigerous lobe, and a large broadly-rounded lamelliform process, nearly as long as the longest one of the upper ramus and much broader; the setigerous lobe bears a broad fan-shaped fascicle of compound setæ, similar to those of the upper ramus, but a little shorter, and a single black basal spine; the ventral cirrus is slender, and there is a broad, rounded ventral lamella at its base. The setæ are rather stout, with a broad, thin, blade-like, terminal piece, which is generally lanceolate, with a rounded point, and often somewhat curved, but more commonly straight. A few setæ have a slender acute terminal piece. Anal segment with numerous small slender papilliform processes on each side, forming a circle.

Length up to 35^{mm}; breadth about 2.5^{mm}.

Vineyard Sound, swimming actively at the surface, both in the evening and in the brightest sunshine, in the middle of the day; July 3 to August 11.

DIOPATRA CUPREA Claparède. Plate XIII, figs. 67, 68. (p. 346.)

Annélides chétopodes du golfe de Naples, in Mémoires de la Société de Physiques et d'Hist. Nat. de Genève, vol. xix, p. 432, 1868. *Nereis cuprea* Bosc, Hist. nat. des Vers, vol. i, p. 143 (t. Claparède).

Charleston, South Carolina, to Long Island Sound and Vineyard Sound.

MARPHYSA LEIDYI Quatrefages. Plate XII, fig. 64. (p. 319.)

Histoire nat. des Annelés, vol. i, p. 337, 1865 (*M. Leidii*). *Eunice sanguinea* Leidy, Mar. Inv. Fauna of Rhode Island and New Jersey, p. 15, 1855 (*non* Montagu).

Great Egg Harbor, New Jersey, to Long Island Sound and Vineyard Sound. Low-water mark to 10 fathoms.

LYCIDICE AMERICANA Verrill, sp. nov. (p. 508.)

Body depressed, slender, narrowed toward each end; segments well-marked. Head much depressed, oblong, narrowed somewhat toward the front, which is truncate and somewhat emarginate in the middle; lower side bilobed, the lobes well rounded. The two eyes are lateral, just outside the bases of the lateral antennæ. The three antennæ are subequal, nearly as long as the diameter of the head; the odd median one is apparently a little longer than the lateral, and placed slightly farther back. The dorsal cirri are long and slender, exceeding the diameter of the body in living specimens; they have a small lobe near the base. Anal cirri four; the two lower exceeding the diameter of the body; the two upper ones less than half as long. Color light red, with a bright red dorsal vessel and dark brown intestines, showing through in the middle; eyes dark red.

Length, while living, about 40^{mm}; greatest diameter, 1.5^{mm}.

Off Gay Head, in 19 fathoms, soft mud.

NEMATONEREIS, species undetermined. (p. 508.)

A species, apparently belonging to this genus, was dredged in 29 fathoms, east of Block Island. The specimens have been lost or mislaid. In life the head was small, rounded, with one median dorsal antenna, about as long as the diameter of the head. Eyes two, small but conspicuous, dark brown. Dorsal cirri slender.

LUMBRICONEREIS FRAGILIS Œrsted. (p. 507.)

Conspec. Ann. Dan., p. 15, figs. 1, 2, 1843 (t. Malmgren). *Lumbricus fragilis* Müller, Prod. Zool. Dan., p. 216; Zool. Dan., vol. i, p. 22, Pl. 22, figs. 1–3, 1788, (t. Malmgren). *Lumbrinereis fragilis* Malmgren, Annulata polychæta, p. 63, Pl. 14, figs. 83–83, D.

Mouth of Vineyard Sound and deeper waters outside; northward to Nova Scotia and Gulf of Saint Lawrence. Northern coasts of Europe. From low-water mark, in the Bay of Fundy, to 430 fathoms, off Saint George's Bank.

LUMBRICONEREIS OPALINA Verrill, sp. nov. Plate XIII, figs. 69, 70. (p. 342.)

Lumbriconereis splendida Leidy., op. cit., p. 15 (*non* Blainville).

Body cylindrical, much elongated, largest in the middle, tapering gradually toward the head, which is comparatively small; segments well marked. Head conoidal, obtuse, changing much in form during life; in extension considerably longer than broad, and more acute than in the figure. Eyes four, in a transverse row, the two middle ones larger and a little in advance of the others. The lateral appendages, or "feet," consist of a short, obtusely-rounded basal papilla, which bears the setæ; from the posterior and ventral end of this a prominent elongated lobe arises, which is somewhot curved and obtuse. These appendages are longer in the middle of the body than anteriorly. Setæ five to nine in each fascicle, and of several forms; one or two in each fascicle usually have a long, slender, flexible capillary point. Color reddish or brownish, with brilliant iridescence.

Length up to 400^{mm}; diameter in middle, 3^{mm}.

New Haven to Vineyard Sound; low-water mark to 14 fathoms.

LUMBRICONEREIS TENUIS Verrill, sp. nov. (p. 342.)

Body very long, slender, filiform, of nearly uniform diameter throughout, capable of great extension; segments very numerous, well marked. Head a little narrower than buccal segment, depressed, obtusely pointed or rounded in front, without eyes. In the first to ninth pairs the lateral appendages have about six slender lanceolate setæ; those of the ninth pair have two slender spatulate setæ, with about six or seven lanceolate ones; at the sixteenth pair they begin to have recurved spatulate setæ, with two or three hook-like denticles at the end, while two or three lanceolate ones remain; posterior to the twenty-third or twenty-fourth pair only one of the long, slender, acute setæ remains, accompanied by two or three of the spatulate hooks; the latter are about half as long as the former, slender toward the base, but gradually becoming broader toward the end, which is twice as broad, obtusely rounded, and curved back from about the middle; the hooks are nearly terminal on one side, the thin margin projecting beyond them. The basal lobe of the "feet" is very small; the posterior lobe is small but prominent. Color light red to dark red, somewhat iridescent.

Length up to 350^{mm}; diameter, 0.05^{mm} to 1^{mm}.

Great Egg Harbor, New Jersey, to New Haven and Vineyard Sound.

NINOË NIGRIPES Verrill, sp. nov. (p. 508.)

Body elongated, slender, broadest a short distance behind the head, at the middle of the branchiferous segments. Head depressed, elongated, conical, blunt at end, about twice as long as broad. The branchiæ are represented on the first two setigerous segments by a short, flattened lobe, arising from the outer and posterior face of the setigerous lobe. On the two following segments the lobe is divided into two or three parts; on the fifth there are usually three, more elongated, round, and more slender branchiæ, which increase in number and length on the succeeding segments until there are five, six, or more long, slender branchial filaments, which arise from the posterior face of the setigerous lobe, and diverge, forming a somewhat fan-shaped or digitate group; about the twenty-fourth segment the number rapidly diminishes, and after the twenty-seventh or twenty-eighth there remains but one small branchial process. The setigerous lobe is prominent, obtuse, turned forward. The setæ are numerous on the branchial segments, and rather long, of various shapes, but mostly bent, with an acute lanceolate point; posteriorly they are shorter and fewer, and mostly slender, margined setæ, with hooks at the spatulate end. Body flesh-color; the setæ dark, often blackish; branchiæ bright red.

Length of broken specimens, 20^{mm}; breadth anteriorly, 2^{mm}.

Vineyard Sound and Buzzard's Bay, and waters outside; in 8 to 29 fathoms, mud.

STAUROCEPHALUS PALLIDUS Verrill, sp. nov. (p. 348.)

Body rather slender, convex above, flattened below, largest in the middle, tapering slightly toward each end, composed of about seventy segments. Head small, depressed, rounded in front; antennæ four, slender, longer than the breadth of body, the two upper ones longer and more slender than the lower ones, strongly annulated or beaded; lower ones stouter, smooth, tapering. Eyes four, dark red; the posterior pair very small, placed between the bases of the upper antennæ; the anterior pair farther apart, placed between the bases of the upper and lower antennæ. Anal cirri four, the upper pair slender and about twice as long as the lower ones. Dorsal cirri elongated, slender, more than twice as long as the setigerous lobe, absent on the first setigerous segment, very small on the second, but well developed on the third. Setæ rather long and slender. Color pale yellow, with red blood-vessels showing through anteriorly.

Length, 50^{mm}; breadth, 2^{mm}. This species moves like a *Nereis*.

Near New Haven light-house, in sand, at low-water mark.

RHYNCHOBOLUS AMERICANUS Verrill. Plate X, figs. 45, 46. (p. 342.)

Glycera Americana Leidy, op. cit., p. 15, Pl. 11, figs. 49, 50, 1855; Ehlers, Borstenwürmer, vol. i, p. 668, Pl. 23, figs. 43–46, 1868.

Charleston, South Carolina, to Long Island Sound and Vineyard Sound. Low-water mark to 10 fathoms.

I follow Claparède in adopting *Rhynchobolus* for those species of the old genus *Glycera* which have the proboscis armed at the end with four hooks or fangs.

RHYNCHOBOLUS DIBRANCHIATUS Verrill. Plate X, figs. 43, 44. (p. 341.)

Glycera dibranchiata Ehlers, op. cit., pp. 670–702, Pl. 24, figs. 10–28, 1868.

Great Egg Harbor, New Jersey, to Long Island Sound; Vineyard Sound; and Massachusetts Bay. Low-water mark to 8 fathoms.

Ehlers has given a very full anatomical description of this species.

EONE GRACILIS Verrill, sp. nov. (p. 508.)

Body very slender, terete; surface iridescent. Head elongated, acutely conical, composed of eight distinct, rounded annulations, the basal one with a pair of minute reddish eyes; antennæ four, slender. Feet prominent, elongated, more than equal to half the diameter of the body; they are uniramous on about thirty-two segments of the anterior part of the body, and bilobed, with a small obtuse dorsal cirrus; the upper lobe is prominent, more elongated than the lower one, both cylindrical, obtusely pointed; setæ compound, in two small fascicles, long, the free part exceeding the entire length of the foot. On the posterior half of the body there is a small, slightly elevated, mammilliform upper ramus, above the base of the lower ramus, and entirely separate from it, containing two or more small, acute, dark setæ, which project but slightly; the lower ramus is deeply bilobed, the lobes elongated, round, the upper one longest, the lower one acute; on the posterior side of the base of the upper lobe there is a minute, rounded setigerous lobe, and at the junction of the two lobes, on the posterior face, there is another small setigerous lobe; the setæ are long and slender, acute, many of them curved, arranged in small fascicles.

Length, 20^{mm}; diameter less than 1^{mm}.

Off Gay Head, 19 fathoms, in soft mud.

ARICIA ORNATA Verrill, sp. nov. (p. 344.)

Body rather stout, composed of numerous very short segments, much depressed and flattened anteriorly, strongly convex beneath in the middle region, flattened above throughout; breadth nearly the same through a large part of the length, narrowed slightly and gradually toward the posterior end, and abruptly narrowed anteriorly close to the head, which is very small, short, conical, and acute at the tip. On the anterior thirty-two setigerous segments the feet consist of a small upper ramus, having a small, tapering dorsal cirrus and a minute setigerous lobe, bearing a small fascicle of slender and short setæ, and a lower ramus, separated by a narrow space, and consisting of a small upper papilla, and a long transverse row of minute, rounded papillæ, which surmount a narrow, somewhat elevated, crest-like ridge; the first twelve or thirteen segments having shorter rows, so as to leave a broad, naked ventral space, but those farther back having rows of papillæ that nearly meet beneath, and thus entirely covering the sides and ventral surface for a short distance; these crest-like ridges bear close rows of minute, hooked setæ. The branchiæ commence on the upper surface of the fifth setigerous segment, in the form of elongated papillæ, which become more elongated and narrow ligulate farther back. Posterior to the thirty-second segment the papilliform crests of the lower ramus disappear, and the lower ramus consists of an elongated papilliform, and finally cirriform, upper process, with a minute setigerous lobe at its base, bearing fine inconspicuous setæ; and an elongated membranous basal portion, decurrent down on the lateral surface of the segment; the upper ramus is connected at the base by a membranous web with the lower one, and consists of an elongated dorsal cirrus, similar in size and shape to the branchia, and a very small setigerous lobe, bearing a small fascicle of fine setæ. The branchiæ are connected by a slight web-like basal ridge with the dorsal cirri. Thus there are three parallel rows of cirriform or slender ligulate processes along each side of the back, leaving a broad, central, naked space all along the back.

Length up to 60^{mm} or more; breadth, 4^{mm}.

Savin Rock, burrowing in sand at low-water mark, May, 1872.

ANTHOSTOMA ROBUSTUM Verrill, sp. nov. Plate XIV, fig. 76. (p. 343.)

Body large, long, stout, thickest and rounded, or but slightly depressed, anteriorly; tapering rapidly to the head; posterior portion very long, narrowing gradually to the posterior end, flatter or concave above, well rounded below, higher than wide, with three rows of long, erect, ligulate, or narrow lanceolate processes along each side of the back, the four inner rows largest; and a pair of foliaceous processes on the sides of each segment. Head short, conical, acute. Proboscis large, broad, divided into about eighteen long, narrow, digitate, and sulcated lobes, with convoluted margins, broadest at the end, and free for a large part of their length, but united at the base by a membranous web; or it might be described as divided into a lower, two lateral, and two upper main lobes, each of which is again divided into three or four digitations. During life these are all continually changing in form and length, and generally only a few of the processes are protruded at one time. Branchiæ commence on the twenty-sixth setigerous segment as minute papillæ; on the twenty-eighth they become prominent and acute-conical; farther back they become long, lanceolate, thin, foliaceous, as long as the diameter of the body.

On the twenty-three anterior setigerous segments the "feet" are represented by two short, dense, fan-shaped fascicles of setæ on each side. On the twenty-fourth segment a small papilliform lobe, or ventral cirrus, appears below the lower ramus, which rapidly becomes larger on the succeeding segments, becoming quite conspicuous on the twenty-ninth segment; at about the twenty-eighth it becomes broader, and divided into three small lobes, the lowest broadest and thinnest, and a bilobed setigerous lobe is developed. At the thirtieth the ventral lobe becomes broader, somewhat foliaceous, with a rounded outline; farther back this becomes still larger and more foliaceous, with a broadly-rounded flexuous outer border, and the upper branch of the setigerous lobe becomes an elongated ligulate process, directed upward, and similar in form to the branchiæ, though smaller and more slender, but the lower branch remains small and rounded; a small fascicle of long, slender setæ arises from between them. On the twenty-seventh segment an upper cirrus appears on both the upper and lower rami, in the form of a small papilla, which becomes somewhat elongated and tapering at the twenty-ninth; that of the lower ramus continues small throughout, and much shorter than the setigerous or ventral lobes, but that of the upper ramus becomes rapidly larger, longer, and more ligulate, corresponding nearly with the branchiæ in size, form, and rate of increase. On the middle and posterior regions the upper ramus consists of this long, thin, lanceolate cirrus and a fascicle of long, slender setæ, arising from the anterior face of its base, and in length considerably exceeding the cirrus; the setæ are pale yellow. Those of the upper ramus are short anteriorly, and become decidedly longer at the twenty-eighth segment, and on the thirty-second and subsequent segments they form a long, divergent, fan-shaped fascicle; color, when living, ocher-yellow, orange-yellow, to yellowish brown, generally brighter yellow posteriorly. Usually there are two rows of brown spots along the back, and posteriorly there is a dorsal red or reddish brown line; branchiæ blood-red.

Length of large specimens up to 375^{mm} or more; breadth, 10^{mm}; ordinary specimens are about 300^{mm} long and 7^{mm} broad. Owing to the facility with which it breaks up when disturbed, it is difficult to obtain entire specimens of large size.

Great Egg Harbor, New Jersey; New Haven; Wood's Hole; in sand, at low-water.

ANTHOSTOMA FRAGILE Verrill, sp. nov. (p. 344.)

Body long and slender, composed of very numerous segments, very fragile, and prone to divide spontaneously when disturbed; thickest and sub-cylindrical anteriorly, tapering rapidly to the head; posterior part very long and slender, tapering gradually, flattened dorsally. Head distinctly annulated, elongated conical, very acute, with the tip slender and translucent; proboscis short and broad, not extending far beyond the tip of the head, with six or more broad, convoluted, changeable lobes, which are united at the base by a broad membranous expansion. The dorsal branchiæ first appear on the sixteenth setigerous segment as small papillæ; they become well developed and long ligulate at about the twentieth, increasing somewhat in length on the segments farther back. On the first thirteen segments behind the buccal the "feet" are represented by a very small, slightly-elevated lobe, above and below, each bearing a dense fascicle, that of the lower ramus widest, but the length of the setæ about equal in both. On the fourteenth segment a small tubercle appears on both rami; on the sixteenth these become elongated and somewhat cirriform, and the setæ become considerably longer on the fifteenth segment. At about the seventeenth segment the lower ramus becomes distinctly tri-lobed, and at the twentieth four-lobed, with the setigerous lobe bifid, and the two lower lateral lobes conical, acute, and swollen at the base; while the upper ramus is long and ligulate, like the branchiæ, and the setæ are long and slender, the lower fascicle smallest. Farther back the lobes of the lower ramus become still more developed, but keep their acute conical form, and the upper ramus and setæ continue to elongate until, on the posterior part of the body, they exceed in length the diameter of the body. Anal segment oblong, sub-cylindrical, smooth, with two long filiform cirri on the upper side; color, when living, brownish orange, dull yellow, ocher, light reddish, or flesh-color, with a red median dorsal line, and sometimes with the dorsal surface tinged with red posteriorly; a narrow, light ventral line, bordered with reddish. Sometimes the upper surface is maculate with fine polygonal, whitish spots, due, perhaps, to ova contained within the body; there are sometimes two obscure brownish spots on the upper side of the head.

Length up to 125^{mm}; diameter, 3^{mm}.

Great Egg Harbor, New Jersey; New Haven; Watch Hill; Wood's Hole; in sand, between tides, and gregarious.

ANTHOSTOMA ACUTUM Verrill, sp. nov. (p. 501.)

Body long and quite slender, tapering most toward the head, and very gradually posteriorly. Head very acutely pointed, with two rather indistinct reddish spots above, resembling imperfect ocelli. The branchiæ commence at the eleventh setigerous segment as small dorsal papillæ, and become prominent on the thirteenth; on the succeeding segments they become long and ligulate. Anteriorly the feet are represented by an upper ramus, consisting of a very small tuft of setæ, with a very small papilliform lobe above it, and a lower ramus, consisting of a small prominent papilla, with a fascicle of slender setæ, much larger than the upper one. On the fourteenth and succeeding segments the dorsal cirrus of the upper ramus becomes longer, more slender, and ligulate. On the fifteenth segment a small, short, rounded ventral cirrus appears on the lower ramus, and farther back it becomes larger and more prominent, and the setigerous lobe becomes bilobed. Anal segment rounded, obtuse; cirri long and slender. Color light red.

Length up to 40^{mm}; diameter, 2.5^{mm}.

Off Gay Head, 19 fathoms, soft mud; also from the deeper parts of Vineyard Sound.

ANTHOSTOMA, species undetermined. (p. 508.)

Another species, not well studied, was dredged in the deeper waters off Gay Head and Buzzard's Bay. It differs from all the preceding in having eighteen anterior segments without branchiæ.

NERINE AGILIS Verrill, sp. nov. (p. 346.)

Body long and rather slender, anteriorly flattened, posteriorly more rounded. Head long conical, with a slender acute tip; mouth a transverse fissure beneath; eyes four, placed in front of the bases of the two large antennæ, small, black, the anterior ones a little farther apart; antennæ long, slender, with thickened bases, placed on the dorsal surface of the head, with their bases contiguous.

The branchiæ are slender, ligulate, and exist on all the segments except the first. On the first segment the "feet" are represented on each side by two small rounded lobes, bearing very small setæ, and placed just below the bases of the antennæ; on the succeeding twenty segments the lower ramus consists of a larger, somewhat semicircular lobe, bearing a broad cluster of slender, acute setæ, and separate from the upper ramus, which consists of a thin foliaceous process joined to the branchial cirrus, but with a free terminal portion, and bearing a broad, comb-like cluster of long acute setæ, nearly as long as the branchiæ, and much longer than those of the ventral ramus. On the twenty-first setigerous segment a small papilliform ventral cirrus appears on the lower ramus, and farther back it becomes more prominent and separate from the setigerous lobe. In the middle and posterior region the free portion of the cirriform lobe of the upper ramus is longer.

Color reddish or brownish green anteriorly, light green on the sides; branchiæ bright red. Length up to 60^{mm}; breadth, 2^{mm}; length of antennæ, 12^{mm}.

Great Egg Harbor, New Jersey, on the outer beach, burrowing in sand, at low-water mark.

SCOLECOLEPIS VIRIDIS Verrill, sp. nov. (p. 345.)

Body long, slender, depressed; both the upper and lower surfaces flattened, of nearly uniform breadth throughout most of the length, abruptly narrowed at each end, and somewhat tapering and more rounded posteriorly. Head with the central plate longer than broad, forming an acute angle behind, anteriorly suddenly expanding into a wide transverse frontal lobe, broadly rounded in front, with a slight emargination in the middle, the lateral angles prominent and slightly auriculate or recurved. Eyes four, distant, the two pairs nearly parallel. Proboscis small, smooth, rounded. Antennæ slender, twice as long as the breadth of the body. The branchiæ are slender and ligulate anteriorly, and meet over the middle of the back; but farther back they gradually decrease in length, and disappear at about the anterior third. The upper ramus of the feet consists of a broad, thin, foliaceous upper ramus, rounded outwardly, connected, for most of its length, with the branchia, the upper end a little prominent; and a broad cluster of setæ, consisting of a small upper fascicle of slender aciculæ, scarcely as long as the branchia, and a comb-like group of shorter and somewhat stouter bent and acute setæ. The lower ramus consists of a small, thin, rounded process, bearing a transverse row of acute bent setæ, and a ventral tuft of longer and more slender ones. Posteriorly the slender setæ in the dorsal and ventral tufts are considerably longer; and several stouter, recurved, two-hooked, uncinate setæ appear in the transverse rows of acute setæ, both in the upper and lower rami. Anal segment short, truncate or suburceolate, somewhat bilobed; the margin of the orifice crenulated with small rounded lobes, and with four small conical papillæ on the upper side. Color olive-green or bright green, darker posteriorly; branchiæ bright red; antennæ light green, with a row of black specks.

Length up to 100^{mm}; breadth, 3^{mm}.

Great Egg Harbor; New Haven; Watch Hill; Wood's Hole; burrowing in sand, at low-water.

SCOLECOLEPIS TENUIS Verrill, sp. nov. (p. 345.)

Body very long and slender, depressed, especially anteriorly, gradually tapering posteriorly. Head short and broad, slightly three-lobed in front, the central lobe broadly rounded, the lateral ones also rounded, somewhat smaller. Antennæ long and slender. The branchiæ are small, ligulate, and exist only on the anterior segments. The setæ of the dorsal fascicle are long and slender; but those of the first three segments are longer than the others, forming large fan-shaped fascicles directed upward and forward; those of the first segment longest, about twice as long as the breadth of the head. Farther back the setæ of the upper ramus become shorter, the upper ones slender, capillary, the lower ones stouter, somewhat bent, mostly acute, some uncinate. Those of the lower ramus are shorter, setiform, forming large fascicles anteriorly. Farther back the upper ones are partly stouter, somewhat bent, and acute, and partly uncinate, while a small ventral fascicle of slender ones still remains. Posteriorly the setigerous lobes of the feet become very small. Color light green; branchiæ red, tinged with green; antennæ whitish, with a red central line.

Length, 80^{mm}; breadth, 1.25^{mm}.

Great Egg Harbor, New Jersey; burrowing in sand, at low-water.

SCOLECOLEPIS CIRRATA Malmgren. (p. 501.)

Annulata polychæta, p. 91, Pl. 9, figs. 54 A–54 D. *Nerine cirrata* Sars, Nyt. Mag., vol. vi, p. 207 (teste Malmgren).

This is a larger and stouter species than either of the preceding. The front of the head is broadly rounded, with prominent, rounded, lateral angles; the foliaceous lateral appendages are larger and much wider.

Off Block Island, in 29 fathoms, and in the deepest parts of Vineyard Sound, near the mouth; off Saint George's Bank, in 110 and 150 fathoms. Northern coasts of Europe; Spitzbergen; Greenland. In 20–250 fathoms. (Malmgren).

SPIO SETOSA Verrill, sp. nov. Plate XIV, fig. 77. (p. 344.)

Nerine coniocephala? A. Agassiz, Annals Lyceum of Nat. Hist. of New York, vol. viii, p. 333, Pl. x, figs. 39–45, 1866, (*non* Johnston.)

Body long, moderately slender, flattened dorsally, convex below, obtuse anteriorly, slightly tapered toward the posterior end. Head with a prominent median lobe, which is sub-truncate and a little turned up at the front end, with the corners a little prominent and rounded; lateral lobes shorter than the median; on the posterior part of the vertex there is a small median, conical prominence. Eyes four, on the vertex, the posterior pair nearest together; antennæ long. Branchiæ moderately long, slender, ligulate, largest on the anterior segments. On the first three or four segments the upper ramus of the feet has a slender dorsal cirrus, which disappears farther back. The setæ of the upper ramus are long, acute, and form a broad fascicle, in which the upper ones are much longer and more slender, divergent; the lower stouter and more or less bent; they are longest on the first four or five segments, the upper ones considerably exceeding the branchiæ. The lower ramus is small and but slightly elevated; on the anterior segments it bears a small fascicle of short, acute, bent setæ, much shorter than those of the upper ramus, and closely crowded together in two or more rows, with a small ventral tuft of longer and more slender setæ; farther back the acute bent setæ begin to be replaced by uncinate setæ, which, at about the tenth segment, form a complete transverse row, parallel with a row of slightly longer, pointed setæ, while the small ventral tuft of longer acute setæ still remains, and all the setæ in the broad fascicle of the upper ramus are acute and much longer. In the middle region of the body, the uncini of the lower ramus form a close row, containing fifteen to twenty; they are strongly recurved near the end and margined.

Length up to 80^{mm}; diameter about 2.5^{mm}.

New Haven; Wood's Hole; and Naushon Island; in sand, at low-water.

This species appears to be the same as the one studied by Mr. Agassiz, though it differs slightly from his figures, one of which I have copied.

SPIO ROBUSTA Verrill, sp. nov. (p. 345.)

Body stout, broadest anteriorly, tapering posteriorly, but little depressed except anteriorly, very convex beneath, flattened above. Head broad, somewhat angular; the median lobe truncated and slightly emarginate in front; lateral lobes a little shorter, wide, obtuse in front, slightly angulated laterally; a small median, conical elevation on the posterior part of the head. Antennæ long, rather stout. Branchiæ long, narrow, tapering. Upper ramus of the feet with a small, obtuse setigerous lobe, bearing a small fascicle of short setæ, considerably shorter than the branchiæ, even on the anterior segments, and a foliaceous process arising behind the setigerous lobe, broadly rounded on its thin outer edge; the upper end free and obtusely pointed; farther back the setæ are shorter and the foliaceous process smaller and less prominent. The lower ramus on the anterior segments has a small, prominent, semicircular foliaceous process and a small, dense fascicle of short setæ, crowded in several transverse rows; on the eighth and subsequent segments the foliaceous processes become larger and wider, and the setæ more numerous, crowded, and partly uncinate; still farther back the setæ are nearly all uncinate, except a very small ventral tuft of slender ones, and form long, double, transverse rows, projecting but little beyond the surface. Color greenish.

Length, 50^{mm}, or more; breadth, 3^{mm} to 3.5^{mm}.

Wood's Hole and Naushon Island; in sand, at low-water mark.

POLYDORA CILIATUM Claparède (?). Plate XIV, fig. 78. (p. 345.)

A. Agassiz, On the Young Stages of a Few Annelids, in Annals Lyceum Nat. Hist. of New York, vol. viii, pp. 323–330, figs. 26–38, 1866 (embryology).

Naushon Island and Massachusetts Bay; in muddy sand, at about half-tide (A. Agassiz).

The adults of this species were not found by us. The young were frequently taken in the towing-nets.

A young *Polydora*, belonging perhaps to a different species, was dredged off New Haven, in 4 to 6 fathoms, shelly bottom. It was about 12^{mm} long. The color was pale yellow, with small black spots along the sides between the fascicles of setæ; a red dorsal vessel; antennæ white.

OPHELIA SIMPLEX Leidy. (p. 319.)

Marine Invert. Fauna of Rhode Island and New Jersey, p. 16, 1855.

Body short, smooth, iridescent, well rounded above, flat below; usually found coiled up, so that the extremities meet, or nearly so, and resembling in general form the larvæ of certain beetles and flies. Head very acute conical; the buccal segment suddenly enlarges; mouth beneath, with thick evertile lips, the lower one generally protruded as a large rounded lobe. Posterior end terminated by about ten unequal, round, blunt, fleshy, simple papillæ, of which the two ventral ones are considerably longest. The setæ commence opposite the mouth and extend to the posterior end; they form two fan-shaped fascicles on each side of each segment, closely approximate at their origin, but strongly divergent, the upper ones directed upward, the lower ones downward; the setæ are very long and slender on the middle segments, those of the upper fascicles longest, and exceeding half the diameter of the body; anteriorly they are considerably shorter; they are somewhat expanded toward the base, but have long and very slender tips. Dorsal cirri rather long and stout, transparent and wrinkled, blunt at tip, thickened at base; in length nearly equaling a third of the diameter of the body. Color yellowish white, tinged with brownish on the sides.

Length, 8^{mm} to 10^{mm}; diameter, 1.5^{mm}.

Savin Rock, at half-tide. Point Judith, Rhode Island, below low-water mark (Leidy).

The specimen above described was found under stones at Savin Rock, near New Haven, May 5. Its body was completely filled, from one end to the other, with comparatively large yellowish white eggs, which show through the transparent integument of the dorsal side very distinctly.

TRAVISIA CARNEA Verill, sp. nov. (p. 508.)

Body with twenty-four setigerous segments, oblong or fusiform, very changeable, round, usually tapering abruptly to each end. Head small, conical, acute; posterior end terminated by a small, bluntly rounded, or slightly clavate papilla; setæ small and slender. Branchiæ short, slender, commencing on the third setigerous segment and ceasing at the twentieth; longest about one-fourth as long as the diameter of the body. Segments of middle region tri-annulated. Color light red or deep flesh-color; branchiæ bright red.

Length, in extension, about 25^{mm}; 3^{mm} to 4^{mm} in diameter. It can contract to 12^{mm} or less in length.

Off Gay Head, Martha's Vineyard, in 19 fathoms, soft mud.

AMMOTRYPANE FIMBRIATA Verrill, sp. nov. Plate XV, fig. 79. (p. 508.)

Body elongated, slender, smooth, thickest in advance of the middle, tapering gradually to both ends, convex, and well rounded above; lower surface with a median sulcus and rounded margins, separated from the upper surface by a deep groove. Head very acute. Eyes two, small, black. Proboscis small, sub-globular, smooth. Branchiæ long and slender. Caudal appendage spoon-shaped, deeply concave, transversely striated; the outer margin fringed with a row of small, slender papillæ; a pair of slender cirriform processes, about half its length, arises at its ventral base, and a longer single median one is generally concealed in its cavity. Setæ of the anterior segments long and slender, more than half the diameter of the body, shorter farther back. Color, when living, purplish flesh-color, shining and iridescent on the dorsal surface; a row of elongated dark spots on each side between the fascicles of setæ; the setæ dark gray.

Length, 75mm; diameter, 3mm.

Off Buzzard's Bay, in 25 fathoms, mud; Bay of Fundy, 10 to 90 fathoms, mud; near Saint George's Bank, 110 and 150 fathoms, mud.

SCALIBREGMA BREVICAUDA Verrill, sp. nov. (p. 416.)

Body rather short, with a narrow, tapering anterior portion; a swollen middle region; and a narrow, tapering caudal portion; lower surface with a very narrow, smooth median area, divided transversely into a series of small rounded prominences by slight depressions. Head small, transverse, truncate or slightly concave in front, the angles produced and prominent. On the anterior region four segments bear short, tufted branchiæ, close to the base of the upper fascicles of setæ, which are rather long and slender; each of these segments also has a dorsal transverse row of rather large and conspicuous blackish granules on its posterior margin, and also a black spot on the sides below the branchiæ. The surface of all the anterior segments is regularly and rather finely granulous, the granules in transverse rows. The middle region, composed of about ten segments, is thicker, and sometimes much swollen, and the feet are represented only by small fascicles of slender setæ. The caudal region is less than one-half the entire length in preserved specimens, and is rather slender and tapering, composed of about sixteen segments; the rami of the feet consist of a prominent, obtuse papilla, both above and below, with a blackish spot at the end, and bearing a fascicle of slender setæ, in length rather exceeding half the diameter of this part of the body. Color, when living, dark brownish red, tinged with yellow at both ends.

Length, 32mm; diameter, 2.5mm.

Off New Haven, 4 to 6 fathoms, shelly bottom.

TROPHONIA AFFINIS Verrill. Pl. XIV, fig. 75. (p. 507.)

Siphonostomum affine Leidy, op. cit., p. 16 (148), 1855.

Body rather slender and elongated for the genus; skin irregularly rugose, granulous, anteriorly covered with small papillæ. The eight branchiæ are cylindrical, thick, blunt, unequal; two tentacles stouter than the branchiæ, sulcate beneath. On the four anterior segments the upper and lower fascicles of setæ are much elongated and directed forward. On the fifth and following segments those in the upper fascicles are capillary, divergent, six to ten in each fascicle; in the lower fascicles there are about three stout, slightly curved, acute, deep yellow setæ. On the third and fourth segments the setæ of the upper fascicles are longer and larger than those in the lower ones; posteriorly the lower setæ become longer, stouter, and more curved at the tip, the lowest one becoming hook-like.

Length, 60mm; diameter, 3.5mm.

Off Block Island, 29 fathoms; off Buzzard's Bay, 25 fathoms, mud. Great Egg Harbor (Leidy).

BRADA SETOSA Verrill, sp. nov. (p. 508.)

Body short, oblong, sub-cylindrical, flattened below, tapering a little toward both ends, which are obtuse; composed of seventeen setigerous segments. Skin covered with small, prominent, acute papillæ. Upper fascicles of setæ long, slender, light colored; lower fascicles larger, composed of stouter, long, dark colored setæ, surrounded at base by small cirriform appendages. Ventral cirrus small.

Length of preserved specimen, 10^{mm}; diameter, 2.5^{mm}.

Off Gay Head, 8 to 10 fathoms, among muscles, &c.

STERNASPIS FOSSOR Stimpson, Plate XIV, fig. 74. (p. 507.)

Marine Invertebrata of Grand Manan, p. 29, fig. 19, 1853.

Off Gay Head, 19 fathoms, soft mud; common in the Bay of Fundy in 10 to 90 fathoms, mud; near Saint George's Bank, 110 fathoms, sandy mud; Casco Bay, 20 fathoms.

CIRRATULUS GRANDIS Verrill, sp. nov. Plate XV, figs. 80, 81. (p. 319).

Body large and stout, anteriorly subcylindrical, somewhat flattened and tapering slightly posteriorly, and rather abruptly tapered anteriorly. Head small, acute, with obscure brownish spots above, but apparently without distinct ocelli. Posterior end obtuse, the orifice surrounded by a thickened, slightly crenulated border. Posterior to the mouth there are about seven rather indistinct annuli (perhaps four biannulated segments) destitute of appendages; the two next segments bear two fascicles of small setæ on each side, and two crowded dorsal clusters of long slender branchial cirri; these clusters nearly meet on the dorsal line, leaving only a narrow naked space, and contain a large number of cirri, usually of various lengths, closely crowded together. Farther back the "feet" consist of small and slightly prominent upper and lower rami, connected by a slightly raised, transverse ridge; each ramus bears a small fascicle of short, slender, acute setæ, in a transverse row; and a few stouter curved spinules, which project but little from the surface; posteriorly the spinules are more numerous and the slender setæ fewer and a little longer, but they are scarcely equal to one-tenth of the diameter of the body. Along nearly the whole length of the body long slender branchial cirri arise from above most of the upper rami, but many of these are generally broken off in preserved specimens. In alcohol the lower surface of the body is generally flat or concave; the "feet" occupy an elevated lateral ridge, often separated from both the ventral and dorsal surface by a deep groove; and the dorsal surface is moderately convex. The annulations are short, very numerous, and distinct. Color, when living, dull yellow, yellowish green, yellowish orange, greenish orange to orange-brown, darkest anteriorly, and often iridescent beneath; sides often with dark brown specks; anterior branchial cirri usually bright orange, with a red central line; lateral ones darker yellow or orange, generally with a central line of bright red, due to the blood-vessels showing through.

Length up to 150^{mm}; diameter, 5^{mm} to 7^{mm}; length of branchial cirri, 60^{mm} to 100^{mm}.

New Haven to Vineyard Sound; low-water to 6 fathoms, in sand and gravel; common.

CIRRATULUS TENUIS Verrill, sp. nov. (p. 416.)

Body slender, elongated, strongly annulated. Head conical, depressed, acute. The first four rings behind the mouth are longer than the rest, and destitute of appendages. The branchiæ and setæ commence at the fifth segment; the branchiæ form a cluster on each side, and are long and filiform; farther back and on the middle region there is usually a pair of branchial cirri on each segment, but posteriorly they become distant and irregular. Setæ long and slender in each ramus, the upper ones exceeding in length the diameter of the body on the anterior and middle regions, but becoming much shorter posteriorly. In alcohol the integument is iridescent. No eyes were detected.

Length, 40^{mm}; diameter, 1.25^{mm}.

Vineyard Sound, 6 to 12 fathoms, among compound ascidians; 23 fathoms off Martha's Vineyard.

CIRRHINEREIS FRAGILIS Quatrefages. (p. 397.)

Histoire naturelle des Annelés, vol. i, p. 464. *Cirrhatulus fragilis* Leidy, op. cit., p. 147 (15), Plate 11, figs. 39–43, 1855.

Point Judith, Rhode Island, under stones at low water (Leidy). Specimens, apparently of this species, were dredged in Vineyard Sound.

NARAGANSETA CORALII Leidy. (p. 494.)

Marine Invertebrate Fauna of Rhode Island and New Jersey, p. 12 (144), Pl. 11, figs. 46–48, 1855; Quatrefages, op. cit., vol. i, p. 468.

New Haven; Watch Hill; Point Judith; in *Astrangia Danæ.*

Our largest specimen had ten pairs of cirri; the first three pairs originate from one segment, the lowest being stouter and lighter colored than the rest.

DODECACEREA, species undetermined. (p. 422.)

A species, belonging apparently to this genus, was dredged off New Haven Harbor, in shallow water, but the specimens are too young for accurate determination.

CLYMENELLA Verrill, gen. nov.

Body elongated, composed of about twenty-two segments exclusive of the cephalic and anal segments. All the segments, except the buccal and three anteanal, setigerous; they bear fascicles of slender setæ above and series of hooks below. The anterior margin of the fourth setigerous segment is prolonged into a thin membranous collar. Proboscis swollen, longitudinally ribbed. Head with a prominent convex median plate, and with a raised border on each side and behind, the lateral and posterior lobes separated by notches. Anal segment funnel-shaped, the edge surrounded by papillæ.

CLYMENELLA TORQUATA Verrill. Plate XIV, figs. 71–73. (p. 343).

Clymene torquatus Leidy, op. cit., p. 14 (146), 1855.

Great Egg Harbor, New Jersey; New Haven; Vineyard Sound; Bay of Fundy; Saint George's Bank, &c. Low-water to 60 fathoms.

NICOMACHE DISPAR Verrill, sp. nov. (p. 512.)

Body elongated, with eighteen setigerous segments. Head elongated, sub-conical, with a small central plate, and a depressed point in front, and with low, narrow, lateral and posterior marginal lobes, separated by slight notches; on the anterior part of each lateral border there is a cluster of small, reddish brown, ocelli-like specks. Buccal lobe coalescent with the cephalic above. Proboscis swollen and plicate. The first two setigerous segments have small fascicles of slender, short setæ above, and a single uncinate seta or hook below on each side. The third segment has much longer setæ in the upper fascicles and two hooks in the lower ones. The fourth has still longer, slender setæ in the upper fascicles, and about eight hooks in each of the lower ones. In the following segments the hooks become much more numerous. There is one short, biannulated, anteanal segment, destitute of setæ. Anal segment suburceolate, as long as broad, cylindrical toward its border, which is furnished on the ventral side with one long, slender cirrus, often as long as the diameter of the anal segment, and two short lateral ones; the rest of the border has a few, mostly very small, distant, unequal, obtuse papillæ or denticulations. The anal orifice is situated at the summit of a small cone, which rises from the bottom of the funnel. The last setigerous segment is longer than the anteanal, and a little longer than any of the ten that precede it, which are all short and subequal, broader than long, those toward the posterior end deeply incised at the intervals between them. The three anterior setigerous segments are shorter than broad; the fourth is twice as long; the fifth is three times as long; the sixth is five times as long. The color, when living, was light red, translucent, with conspicuous bright red blood-vessels, and with a bright red band at about the anterior third. The largest specimen obtained was 50^{mm} long and 2.5^{mm} in diameter after preservation in alcohol. In this specimen the anal segment is long, funnel-shaped, flaring but little toward the margin, and with four or five slight transverse annulations. The buccal segment has two transverse reddish lines on each side.

Off Buzzard's Bay in 25 fathoms; fifteen miles east of Block Island in 29 fathoms, sandy mud. It forms rough tubes of sand, which are not very firm.

MALDANE ELONGATA Verrill, sp. nov. (p. 343.)

Body large and much elongated, cylindrical, obliquely truncated at both ends; with nineteen setigerous segments, those of the middle region elongated; head depressed, with its dorsal surface very oblique; median lobe low, convex, obtusely rounded in front; lateral marginal lobes, or folds, low, rounded, thickened, separated by a shallow emargination from the posterior transverse fold, which is also thickened, little elevated, and divided into two parts by a slight sulcus; from the notch between the lateral and posterior lobes of the head, a lateral oblique sulcus curves downward and backward, and joins the first of the two transverse sulci, which are strongly marked on the ventral side of the buccal segment. Anterior setigerous segments strongly biannulated; the first two are short, the length about equal to the diameter; the next two are considerably longer; and those farther back become very much elongated; the last setigerous segment is short. The segments are considerably swollen where the setæ arise, especially in the middle region. The upper setæ are long and slender, mostly about half the diameter of the body, and form rather large fascicles on most of the segments. The last segment is obliquely truncated, its posterior border surrounding the base of the large anal process, which is obliquely placed, foliaceous, obovate, with the posterior edge broadly rounded, the upper surface concave, and the margin entire. Color dark umber-brown, or reddish brown, iridescent; the swollen parts of the rings are lighter yellowish brown, or grayish brown, the dark red blood-vessels often showing through; near the bases of the setæ there are usually small dark colored specks; head and buccal lobe thickly specked with dark brown or blackish.

Length of largest specimens, 300^{mm}; diameter, 4^{mm} to 5^{mm}; more frequently about half this size.

Savin Rock, near New Haven; in sandy mud at low-water mark, forming thick tubes composed of fine mud.

RHODINE ATTENUATA Verrill, sp. nov. (p. 508.)

Body slender, elongated, with the segments strongly marked, and the first setigerous segment very long. Head elongated, depressed, obtusely rounded in front; median lobe, or ridge, broad and but little elevated, except near the front of the head, where it becomes suddenly narrowed, more convex, with well marked foveæ on each side; lateral lobes rudimentary, scarcely apparent; on the posterior part of the head there is a prominent transverse elevation. Buccal lobe confluent with the cephalic. First setigerous segment swollen anteriorly and about as broad as the head at its anterior end where the setæ arise, but narrowed and gradually attenuated backward, its total length being about eight times its diameter; second and third setigerous segments about equal, nearly twice as long as broad, swollen in the middle, the front margin of each prolonged into a sheath-like collar; the three next segments are short and rounded, about as long as broad, much narrowed at each end, and swollen in the middle; next two about twice as long as broad; succeeding segments more elongated. Anal segment wanting in the specimens examined.

Length about 50^{mm}; diameter about 1^{mm}.

Off Gay Head, 6 to 8 fathoms; fifteen miles east of Block Island, in 29 fathoms, sandy mud.

The *Clymene urceolata* Leidy, from Great Egg Harbor, will probably be found on the New England coast, but we have not met with it. It is peculiar in having an urceolate anal segment, with a smooth margin.

AMMOCHARES, species undetermined. (p. 508.)

A species which constructs slender, flexible tubes, covered with grains of sand, regularly and curiously attached by one end in an imbricated manner, was dredged fifteen miles east of Block Island, in 29 fathoms sandy mud, and in 23 fathoms off Martha's Vineyard. The worm is very slender, flesh-color, with a red dorsal vessel, and two small, red, ocelli-like spots.

NOTOMASTUS LURIDUS Verrill, sp. nov. (p. 342.)

Body long and rather large, composed of numerous segments, nearly cylindrical when living, and tapering but little, except close to the ends. In preserved specimens the anterior region, including about ten segments, is often a little swollen and slightly larger than the rest of the body; at other times it is even more slender than the posterior region. Head small, acute. Proboscis short and broad, swollen; in full expansion nearly twice the diameter of the body, nearly smooth, dark blood-red. The segments of the anterior region are longer than broad, in extension nearly twice as long, biannulated, and each of the annuli is again annulated with several transverse, more or less irregular sulci or furrows; ten of these segments bear fascicles of slender setæ both above and below, the fascicles on the first two setigerous segments being very small, and containing few setæ. The segments following the tenth setigerous one have a small transverse row of slender uncinate setæ above, and a longer lateral transverse row of the same kind of setæ on each side; the "feet," or setigerous lobes, are but little prominent, the upper ones being dorsal and much smaller than the lateral ones. The surface of the body is transversely wrinkled, and covered with minute, irregular reticulations, giving it a slightly granulous appearance. Color, when living, dark purplish brown, with a bluish iridescence anteriorly, and a darker median dorsal line posteriorly; minute, white, raised spots, or slight papillæ, are scattered over the surface.

Length, 150^{mm} or more; diameter, 2^{mm}.

Savin Rock, near New Haven; in muddy sand, at low-water mark.

NOTOMASTUS FILIFORMIS Verrill, sp. nov. (p. 342.)

Body very long and slender, filiform, composed of very numerous short segments. Head very changeable in form, usually long, conical, and very acutely pointed. Proboscis smooth, obovate, or trumpet-shaped, when extended, and bright red. In the anterior region there are eleven setigerous segments, which bear small fascicles of slender setæ in both rami, those in the first five longer and acutely pointed; these segments are short, biannulate; the lower fascicles of setæ are largest and fan-shaped. In the middle region the segments are about as long as broad. Color, pale red to bright red, often mottled with whitish, and more or less yellowish posteriorly.

Length, 100^{mm}; diameter, 1^{mm}.

Great Egg Harbor, low-water to one fathom, in sandy mud; New Haven; Watch Hill; Vineyard Sound.

SABELLARIA VULGARIS Verrill, sp. nov. Plate XVII, figs. 88, 88*a*. (p. 321.)

Body rather stout, thickest anteriorly, tapering backward to the base of the long, slender caudal appendage. Two slender, red, oral tentacles arise near the mouth, between the bases of the operculigerous lobes, and, when extended, reach beyond the bases of the opercula. A single median lanceolate process also arises between the operculigerous lobes. A deep emargination exists on the ventral side, back of the mouth; on each side of this the front margin of the segment is prolonged into a tridentate lobe, the teeth or lobes being unequal, the inner ones largest, the middle ones more slender and acute, the outer one smallest and shortest; beyond these, toward the sides, there is another small acute process; two conical processes also project forward from the lateral margins, and also a fascicle of setæ. The ciliated prehensile cirri, or tentacles, are long and slender when extended, and reach considerably beyond the opercula. The setæ composing the opercula are golden yellow; the outer circle white at base. A row of small conical papillæ surrounds the bases of the opercula. Branchiæ long, lanceolate, acute, longer than the diameter of the body. Color of body yellowish flesh-color, or pale reddish, often with two rows of brown spots along the ventral surface; operculigerous lobes whitish or grayish, specked with blackish; branchiæ reddish or yellowish, with a red central line, often with a greenish tinge, or red centered with green; tentacles pale flesh-color, sometimes purplish; opercula blackish or grayish on the anterior surface, golden yellow on the sides, white at base; caudal process pale red or flesh-color.

Length about 25^{mm}, exclusive of caudal process; 2^{mm} to 2.5^{mm} in diameter.

Great Egg Harbor, New Jersey, to New Haven and Vineyard Sound; low-water to ten fathoms; very common. Eggs are laid in May and June.

CISTENIDES GOULDII Verrill, sp. nov. Plate XVII, figs. 87, 87*a*. (p. 323).

Pectinaria Belgica Gould, Invertebrata of Massachusetts, 1st ed., p. 7, Plate 1, fig. 1 (tube), 1841 (not of European writers). *Pectinaria auricoma* Leidy, op. cit., p. 14 (146), 1855 (not of European writers).

Body rather stout, little curved. Head with the dorsal surface obliquely truncated, its posterior marginal fold with a smooth border. Antennæ long, tapering, acute; frontal membrane or veil semicircular, its edge divided into rather long, slender, acute papillæ, about twenty-eight in number. Cephalic setæ in two broad groups, each containing about fifteen light golden setæ, which are somewhat curved upward, with long, slender, very acute tips, those in the middle of each group much the longest. Tentacles stout, obtuse, flattened, and folded up so as to form a groove beneath. Color light red or flesh-color, handsomely mottled with dark red and blue.

Length up to 40^{mm}; diameter, 7^{mm}.

Great Egg Harbor to New Haven and Cape Cod; low-water to 10 fathoms.

This species can easily be distinguished from *C. granulatus*, which is common in the Bay of Fundy, by the cephalic setæ or spines, which are fewer, much stouter, obtuse, and darker colored in the latter.

AMPHARETE GRACILIS Malmgren. Plate XVI, fig. 83. (p. 508).

Nordiska Hafs-Annulater, Ofvers. af kongl. vet. Akad. Förh., 1865, p. 365, Plate 26, figs. 75–75D.

Body flesh-colored, greenish posteriorly, with a conspicuous red median vessel; branchiæ light sea-green.

Length, 25^{mm} to 35^{mm}; diameter, 2.5^{mm} to 3^{mm}; length of branchiæ, 6^{mm} to 9^{mm}.

Off Gay Head, 10 fathoms; off Martha's Vineyard, 23 fathoms; east of Block Island in 29 fathoms; Bay of Fundy, 10 to 90 fathoms; northern coasts of Europe, Bahusia, at Koster Island, in 130 fathoms. Our specimens differ slightly from the description and figures of Dr. Malmgren, especially in usually having but twelve uncigerous segments in the posterior region, instead of thirteen, found by him in the European specimens. This may be due to difference of age or sex. There are, however, thirteen in one of our specimens.

AMPHARETE SETOSA Verrill, sp. nov. (p. 416.)

Body rather thick anteriorly, tapering rapidly backward. Cephalic lobe acute, with a much shorter, small, lateral lobe on each side. Branchiæ eight, transversely wrinkled, rather short; in preserved specimens about equal to the breadth of the body. Palmulæ, or cephalic fascicles of setæ, short and broad, rounded, fan-shaped, the setæ being nearly equal, the ventral ones a little longer than the lateral. Fourteen segments bear small fascicles of long setæ, supported by prominent lobes at the base. The posterior region consists of about ten uncigerous segments. Anal segments small, with two long slender cirri. Color of body translucent, light yellowish green; the anterior part of the body tinged with bright blood-red, due to the circulating fluid, showing through the integument; branchiæ greenish, with a central series of white spots; setæ of the palmulæ, deep yellow.

Length about 20^{mm}; diameter, 2.5^{mm} to 3^{mm}.

Off New Haven, low-water mark to 6 fathoms, shelly. It makes rough tubes about an inch long, covered with coarse sand and mud.

AMAGE PUSILLA Verrill, sp. nov.

Body rather slender. Head obtusely rounded in front; the middle lobe small, and but little larger than the lateral. Eight slender branchiæ, about twice as long as the diameter of the body, arranged in a crowded group; two farther back than the rest; and with no apparent naked median space. Twelve of the setigerous segments bear long fascicles of slender setæ. No "palmulæ," or cephalic setæ. Tentacles numerous and slender. Two small, slender anal cirri.

Length, 12^{mm}; diameter, 1.5^{mm}.

Off New Haven, 5 to 6 fathoms; shelly bottom.

MELINNA CRISTATA Malmgren. (p. 432.)

Nordiska Hafs-Annulater, loc. cit., p. 371, Plate 20, figs. 50–50D. *Sabellides cristata* Sars, Fauna littoralis Norvegiæ, vol. ii, pp. 19, 24, Pl. 2, figs. 1–7, 1856.

Mouth of Vineyard Sound, on muddy bottoms, in the deepest water; Bay of Fundy, on muddy bottoms, in 10 to 90 fathoms; near Saint George's Bank, in 110 and 150 fathoms, mud. Off the Scandinavian coast in 40 to 200 fathoms; Greenland; Spitzbergen.

The tube is soft, flexible, slender, and covered with fine mud.

TEREBELLIDES STROËMI Sars. (p. 507.)

Beskriv. og Iakttag., p. 48, Plate 13, figs. 31, *a–d* (teste Malmgren); Malmgren, Nordiska Hafs-Annulater, loc. cit., p. 396, Plate 43–43D, 1865.

East of Block Island, in 29 fathoms, sandy mud; Bay of Fundy, 10 to 90 fathoms, muddy; near Saint George's Bank, 85 to 150 fathoms. Greenland, 10 to 250 fathoms; Iceland; Spitzbergen; northern coasts of Europe; Adriatic Sea.

AMPHITRITE ORNATA Verrill. Pl. XVI, fig. 82. (p. 320).

Terebella ornata Leidy, Marine Invertebrate Fauna of Rhode Island and New Jersey, loc. cit., p. 14 (146), Plate 11, figs. 44, 45 (setæ), 1855.

Great Egg Harbor, New Jersey, to New Haven and Vineyard Sound; common in sand and gravel at low-water mark.

NICOLEA SIMPLEX Verrill, sp. nov. (p. 321.)

Body elongated, swollen anteriorly, especially above, attenuated posteriorly. Head with a rather large, well rounded, or nearly circular frontal membrane, which has a smooth margin; mouth with a small posterior fold. Tentacles very numerous, crowded, long, and slender. Branchiæ four, rather small; those of the anterior pair somewhat the larger; those of both pairs are repeatedly dichotomously divided from close to the base. The divisions are short and not very numerous, and diverge at a wide angle. Fifteen segments bear small fascicles of slender setæ, commencing at the next behind the last branchiferous segment. The third and fourth setigerous segments of the male bear small, slender lateral cirri. Ventral shields about thirteen; the first six transversely oblong, and nearly equal in width; the last seven narrowing rapidly to the last, which is acutely triangular. Color, when living, light red, or flesh-color.

Length, 35^{mm}; diameter, 3^{mm} to 4^{mm}.

New Haven to Vineyard Sound, from low-water to 6 fathoms; off Watch Hill, 4 to 6 fathoms, in tubes composed of bits of shells and grains of sand, attached to *Laminariæ*.

SCIONOPSIS Verrill, gen. nov.

Body composed of numerous segments, of which 17, following the third, bear fascicles of slender setæ, and the following ones have only small uncigerous lobes; second and third segments bear branchiæ, and have their anterior margins prolonged into membranous, collar-like expansions; that of the second forming broad, lateral lobes behind the tentacles; that of the third forming behind the branchiæ a dorsal collar or sheath, beneath which they can be retracted. Branchiæ typically four. Those of the first pair usually larger, but generally one or more are absent, and frequently the anterior ones are smallest, or those of the same pair may be unequal, owing probably to the facility with which they may break off and be reproduced; they are palmately branched and supported on elongated pedicels. Tentacles numerous and crowded.

This genus is allied more closely to *Pista* than to any other yet described, but differs in the structure of the branchiæ and character of the collar formed by the third segment.

SCIONOPSIS PALMATA Verrill, sp. nov. (p. 321.)

Body elongated; rather slender; thickened but not distinctly swollen anteriorly, tapering gradually to the posterior end. The setigerous feet commence at the fourth segment, or next behind the branchial collar, and are all quite prominent, the first three or four being a little smaller than the rest; the setæ are rather long. The uncigerous feet commence on the second setigerous segment. Behind the last setigerous segment the uncigerous feet are smaller, somewhat prominent, and extend to the anal segment. Ventral shields about 20; the most anterior ones are transversely oblong; the succeeding ones squarish, gradually tapering to the last, which are very narrow. Anal segment tapering; its orifice with a crenulated margin. Branchiæ large, with numerous palmate divisions arising from the summit of the stout and rather long pedicels.* There are usually five or more main divisions in good-sized specimens, these spread outward from one point, are recurved at the ends, and flexuous and bipinnately branched, the lower pinnæ being longest each time, and the ultimate divisions very numerous, fine, slender, and acute. The branchiæ of the posterior pair, in normal specimens, are considerably smaller, with the divisions less numerous, and the ramuli longer and more delicate. The pedicels of the anterior branchiæ are about as long as the diameter of the body, and are very contractile, as well as the branches, so that the gills can be contracted into a small compass and withdrawn under the dorsal collar, beneath which the pedicels arise. This branchial collar is formed by the prolongation of the margin of the third segment; on each side of the median line above, it is divided into two narrow, lanceolate processes directed forward; exterior to these there are two other wider and usually less prominent angles or lobes; laterally, the collar is prominent, with a broadly rounded, thin margin, which forms another angle on each side beneath; on the ventral side its edge recedes and is but little raised. The tentacular collar, formed by the second segment, expands into a broad, rounded, prominent lobe on each side; and on the ventral surface becomes narrower, though still prominent, and recedes in a broad, rounded sinus behind the posterior lobe of the mouth. The cephalic segment is bordered by a rather broad frontal membrane, emarginate above, and broadly rounded laterally. Tentacles very numerous, long, and slender. Color, light red, brownish red to dark reddish brown; the annulations often darker; the upper surface is usually more or less specked with flake-white; along each side, below, there is usually a row of squarish spots, brighter red than the rest of the body, each pair connected by a narrow, transverse line of red between the ventral shields, which are dull yellowish red; the segments along the sides are often bordered with red; branchiæ usually green, specked on the outer sides of the branches with flake-white, and with internal blood-red vessels, showing distinctly in all the divisions; the pedicel is usually bright red; tentacles, flesh-color.

Length up to 70^{mm}; diameter, 3^{mm}.

Great Egg Harbor to New Haven and Vineyard Sound; low-water mark to one fathom.

LEPRÆA RUBRA Verrill, sp. nov. (p. 382.)

Body elongated, somewhat swollen anteriorly, rapidly tapering to the very long, slender, posterior portion. All the segments posterior to the branchiæ bear small fascicles of slender setæ, as well as uncini; posterior to the twenty-fifth setigerous segment the uncigerous feet become

* In mentioning this species, on page 321, it was stated that it has but three gills, and, in fact, this is the most frequent number. Among the numerous examples examined, I have only recently found a specimen with both pairs of gills in their normal condition.

much narrower and more prominent; anteriorly they are very broad. Ventral plates rather broad anteriorly, those posterior to the seventh or eighth suddenly narrowed. Branchiæ in three pairs, small, finely arborescently divided, the divisions numerous; posterior pair considerably smaller than the others. Cephalic lobe with a somewhat prolonged frontal border, broadly rounded in front, with an entire margin. Color bright red; tentacles flesh-color.

Length, 50^{mm} or more; diameter, 2.5^{mm} to 3^{mm}.

Vineyard Sound; Wood's Hole on piles of wharves just below low-water mark.

POLYCIRRUS EXIMIUS Verrill. Plate XVI, fig. 85. (p. 320).

Torquea eximia Leidy, op. cit, p. 14 (146), Plate 11, figs. 51, 52 (setæ), 1855.

In this species there are twenty-five setigerous segments, bearing small fascicles of long, slender setæ; about seventy posterior segments bear uncini only; anteriorly the uncini commence on the eighth setigerous segment. There are nine ventral shields, divided by a median ventral sulcus. The frontal lobe of the head is large, elongated oval or elliptical. The posterior lobe of the mouth is large, rounded. Body and tentacles bright blood-red; the body is often more or less yellowish posteriorly.

Great Egg Harbor to New Haven and Vineyard Sound; low-water to 10 fathoms.

A species of this genus was also dredged in 19 fathoms off Gay Head, but its identity with the above is uncertain. Another species, remarkable for its brilliant blue phosphorescence, is common in the Bay of Fundy. The *P. eximius* does not appear to be phosphorescent.

CHÆTOBRANCHUS Verrill, genus nov.

Allied to *Polycirrus* and, like the latter, destitute of blood-vessels. Body much elongated, composed of very numerous segments, nearly all of which bear fascicles of setæ. Segments of the middle region bear simple, or more or less branched, branchial cirri, each of their divisions tipped with slender setæ; these cirri are wanting on the anterior and posterior segments, the first and last ones being smaller and more simple than the rest. The cephalic segment expands into a broad, tentacular or frontal lobe, which is rounded or emarginate anteriorly, and often more or less scolloped laterally. Tentacles crowded, very numerous, long and slender in extension, capable of being distended by the blood, as in *Polycirrus*, &c.

CHÆTOBRANCHUS SANGUINEUS Verrill, sp. nov. (p. 320.)

Body greatly elongated, much attenuated posteriorly, more or less swollen anteriorly, but narrowed toward the head, the thickest portion being usually between the tenth and fifteenth segments. The branchial cirri commence at about the ninth segment, those of the first pair being short, simple cirri; those on the next segment are once forked; those on the next have three or four branches; farther back they divide dichotomously above the base into numerous branches, all of which are supported upon a short basal pedicel, which may be a little elongated in expansion, the total length of the branchiæ being then greater than the diameter of the body; the branches are clustered, slender, delicate, and elongated, and each one is terminated by a small fascicle of slender, sharp, serrate setæ two to four or more in a group, so that the entire appendage may be regarded as a very remarkable enlargement and modification of the setigerous lobes of the "feet."

On the segments anterior to the ninth the setigerous lobes of the feet are short, conical, swollen at base, and bear a small fascicle of setæ; the ventral surface of the anterior segment is somewhat raised, and divided by a series of sulci or wrinkles into several lobes or crenulations, which are somewhat prominent and papilliform at the posterior margin of each segment, and have a granulous surface. There is a distinct median ventral sulcus. Between the adjacent branchial cirri anteriorly there are, on each side, four or more thickened, somewhat raised, squarish organs, with a granulous and apparently glandular structure; farther back these are reduced to two, then to one, and finally disappear on the segments of the posterior region, which is very long, slender, attenuated, composed of very numerous short segments, with only rudimentary appendages; after the branchial cirri become reduced to simple processes they still continue, on about forty segments, gradually decreasing in length and size; beyond this small setæ still exist on the segments, till near the end of the body. Anal segment small and simple, the orifice with slightly crenulated margins. Frontal membrane large and broad, versatile in form, often with a deep emargination in front, each lateral lobe divided into two or three subordinate lobes, or unequal scollops, the edges undulated; at other times the front edge and sides are broadly rounded and entire. The mouth is furnished with a large elongated ovate lobe, which is rounded, free, and prominent posteriorly. Tentacles very long, much crowded, and very numerous; in extension usually as long as the body. Color of body, anteriorly, deep blood-red; posteriorly, more or less mottled or centered with yellow, owing to the internal organs showing through the integument; tentacles and branchial cirri bright blood-red.

Length up to 350^{mm}; diameter 5^{mm} to 7^{mm} or more anteriorly; length of tentacles, in extension, 400^{mm} or more.

Great Egg Harbor to New Haven and Vineyard Sound; common at low-water mark, in mud.

POTAMILLA OCULIFERA Verrill. Plate XVII, fig. 86. (p. 322).

Sabella oculifera Leidy, op. cit., p. 13 (145), Plate 11, figs. 55–61, 1855.

Great Egg Harbor to New Haven; Vineyard Sound, low-water mark to 25 fathoms, off Buzzard's Bay. In the Bay of Fundy from low-water mark to 60 fathoms.

Closely related to *P. reniformis* of Northern Europe, and possibly identical with it.

SABELLA MICROPHTHALMA Verrill, sp. nov. (p. 323.)

Body rather short and stout, narrowed slightly anteriorly, tapering rapidly close to the posterior end, composed of about sixty segment, depressed, moderately convex above, flat below, especially when preserved in alcohol; anterior region composed of eight setigerous segments, having moderately long fascicles of setæ; posterior region composed of about fifty short segments, bearing very small fascicles of setæ; anal segment small, simple, with two very small ocelli-like spots; ventral shields of the anterior segments short, transversely narrow, oblong; median sulcus very distinct in the posterior region, dividing the ventral shields into two nearly rectangular parts, which are broader than long. Branchiæ numerous and long, often half as long as the body, connected by a slight web close to the base; the stalks smooth, with numerous minute ocelli, in two irregular rows; pinnæ numerous, long and slender; tips of the branchiæ without pinnæ. Collar broadly interrupted above, flaring and reflexed at the sides, with rounded upper angles, erect and sinuous at the latero-ventral margins, reflexed below, forming two short, rounded lobes, separated by a narrow but deep central sinus, within which there is a short bilobed organ. Tentacles thin, lanceolate, acute, in preserved specimens not so long as the diameter of the body. The anterior segment is divided by a deep dorsal sulcus, which is not conspicuous on the succeeding segments. Color of body greenish yellow, dull olive-green, or greenish brown; branchiæ pale yellowish, greenish, or flesh-color, often with numerous transverse bands of lighter and darker green, which extend to the pinnæ, and sometimes blotched with brown; collar translucent, specked with flake-white; ocelli dark reddish brown. Specimens, apparently belonging to this species, were taken from wood bored by *Teredo*, near New Haven. These had the body olive-green, specked with flake-white anteriorly, on the ventral side, especially on the first two segments; branchiæ mottled with greenish brown and white and specked with flake-white; ocelli brown, numerous.

Length, 30^{mm}; diameter, 2.5^{mm} to 3^{mm}. Preserved specimens are about 20^{mm} long, 2.5^{mm} broad.

New Haven to Vineyard Sound; low-water mark to 5 fathoms.

EUCHONE ELEGANS Verrill, sp. nov. Plate XVI, fig. 84. (p. 432).

Body rounded, slender, gradually tapered backward; the anterior region, which forms about one-half of the entire length, consists of eight setigerous segments; these are biannulated and divided by a dorsal, longitudinal sulcus, and by a lateral sulcus on each side below the uncigerous lobes. The middle region consists of thirteen shorter biannulated segments, which bear small fascicles of setæ on the lower rami; these are divided by a ventral sulcus, and also by the lateral ones. The caudal region consists of about ten very short segments; all of which, except the last, bear small fascicles of setæ. These segments are margined by a rather broad membrane, wider and rounded anteriorly, narrowing to the end. Collar broad, with a nearly even margin, often somewhat sinuous at the sides, divided above and below, the lobes rounded at the angles. The collar is a little broader below than above. Branchiæ long, slender, recurved in expansion, connected by a broad and very thin membrane, continued as thin borders of the branchiæ to their tips, which are destitute of pinnæ for some distance. Body pale flesh-color, with a darker median line, reddish anteriorly, darker greenish or brownish, posteriorly; branchiæ pale yellowish or greenish, each with a flake-white spot near the base outside. Other specimens were greenish gray, with green branchiæ. Some were flesh-color, with a bright-red dorsal vessel; the branchiæ flesh-color, without the white spots at the base.

Length, in extension, about 20^{mm}; diameter of body, 1.5^{mm}.

Deep water off the mouth of Vineyard Sound; off Martha's Vineyard, in 21 and 23 fathoms; off Block Island, in 29 fathoms, sandy mud, abundant. Cosco Bay, 7 to 20 fathoms.

This species makes slender tubes, covered with fine sand.

FABRICIA LEIDYI Verrill, sp. nov. (p. 323.)

Body very small and slender, tapering a little to both ends, in extension considerably exsert from the slender tube; eleven segments bear fascicles of setæ; the segments are about as long as broad, slightly constricted at the articulations, with the anterior margin a little prominent; anal segment small, tapered to a blunt point, bearing two small, dark ocelli. Branchiæ six, subequal, forming three symmetrical pairs, each one with five to seven slender pinnæ on each side; the basal pinnæ are about as long as the main stem, the others successively shorter, so that all reach to about the same level. Tentacles short, thick, bluntly rounded at the end, strongly ciliated. At the base of the branchiæ, on each side, is a red, pulsating vesicle, the pulsations alternating in the two; just back of these, on the first segment, are two brown ocelli; a little farther back, and near together, on the dorsal side, are two auditory vesicles, each with a round central corpuscle. The fourth and eleven succeeding segments bear small fascicles of acute, bent setæ, about as long as half the diameter of the body; on the middle segment there are about four or five setæ in a fascicle; on the ninth, three; on the tenth, two; on the eleventh, one or two, in the specimens examined. Intestine rather wide, but narrowed at the eighth setigerous segment, and after that slender, bordered by a red blood-vessel on each side. In the fourth setigerous segment there are three globular granulated organs. color, yellowish white, tinged with red by the circulating fluid.

Length about 3^{mm}; diameter about 0.25^{mm}; expanse of branchiæ, 0.8^{mm}. The specimens measured may be immature.

New Haven to Vineyard Sound, common at and below low-water mark; Cisco Bay.

SERPULA DIANTHUS Verrill, sp. nov. (p. 322.)

Body elongated, gradually attenuated to the posterior end; the posterior region considerably flattened; dorsal surface covered with minute papillæ and having a finely pubescent appearance under a lens. Collar broad and long, in living specimens sometimes one-third as long as the body; the posterior portion free dorsally, and in expansion about as long as the attached portion, extending backward and gradually narrowing to the end; the margins thin and undulated; the anterior border is divided into a broad revolute dorsal lobe, with an undulated margin, and two narrower lateral lobes, which are broadly revolute laterally, with the margin rounded and nearly even. Seven segments bear rather large fascicles of long, acute setæ. The first fascicle is remote from the next, and directed downward and forward, with the setæ longer than in the others; the six following fascicles are broad, and are directed downward and backward. The uncinate setæ form long transverse rows anteriorly, but toward the posterior end they form short rows. Operculum funnel-shaped, longitudinally striated externally, with a long, slender pedicel; the upper surface is concave, with about thirty small, acute denticles around the margin; an inner circle of about twelve long, slender papillæ, incurved at tips and united at base, arises from the upper surface of the operculum. On the left side is a small rudimentary operculum, club-shaped at the end, with a short pedicel. Branchiæ are long rather slender, united close to the base, about eighteen on each side, in mature specimens, those toward the ventral border considerably longer, than the upper ones; tips naked for a short distance, slender, and acute; pinnæ very numerous, slender. Colors quite variable, especially those of the branchiæ; the branchiæ are frequently purplish brown, transversely banded with flake-white, alternating with yellowish green, the pinnæ usually having the same color as the portion from which they arise; on the exterior of the branchiæ the purple bands are often divided by a narrow longitudinal line of whitish; operculum brownish green on the outer surface, purplish on the sides, with white longitudinal lines toward the margin, greenish white at base; pedicel purplish, banded with white; collar pale translucent greenish, veined with darker green; body deep greenish yellow, the dorsal surface light yellow. Many other styles of coloration occur, some of which are described on page 322.

Length up to 75^{mm}; diameter about 3^{mm}.

Great Egg Harbor to New Haven and Cape Cod; low-water mark to 8 fathoms.

The tubes are long, variously crooked, and often contorted, sometimes solitary, frequently aggregated into masses four or five inches in diameter. They are nearly cylindrical, with irregular lines of growth, and sometimes with faint carinations.

SERPULA DIANTHUS, var. CITRINA Verrill. (p. 322.)

I have applied this name to a very marked color-variety, in which the branchiæ are lemon-yellow or orange-yellow, without bands, but usually with a reddish central line; the operculum is usually yellow; collar and base of branchiæ bright yellow; body light yellow.

Found with the preceding, and often in the same cluster of tubes.

VERMILIA (?), species undetermined. (p. 416.)

The species thus indicated forms slender, more or less crooked, angular tubes, with two distinct carinations on the upper surface; they are about half an inch long, attached firmly by one side along their whole length. The branchiæ form a wreath, with about six on each side; pinnæ long and slender; two or more of the branchiæ bear pink, sack-like appendages. The branchiæ are reddish brown, annulated with narrow bands of white.

Diameter of tubes, about 1.25^{mm}; of expanded branchiæ, 4^{mm}. The specimens have been lost, and no observations were recorded concerning the operculum, so that the genus is still uncertain.

Long Island Sound, off New Haven, in 4 to 6 fathoms, on shells.

SPIRORBIS BOREALIS Daudin (?).

Rec. des mém. de mollusques, 1800. *Serpula spirorbis* Linné, Systema Naturæ, ed. xii, p. 1265. (?) *Spirorbis spirillum* Gould, Invertebrata of Mass., ed. i, p. 8, 1841; A. Agassiz, Annals Lyceum Nat. History of New York, vol. viii, p. 318, Plate 7, figs. 20–25 (embryology), 1866 (not of Linné and other European writers).

New Haven to Cape Cod, the Bay of Fundy, and northward; abundant on *Fucus*, *Chondrus crispus*, and other algæ, at low-water mark.

Whether this, our most common species, be identical with the European species known by this name is still uncertain.

The animals of the various species of *Spirorbis* are still very imperfectly known, and many species have been described from the tubes alone. Accurate descriptions or figures of the animals are necessary before the species can be determined satisfactorily.

This species has nine branchiæ, five on one side and four on the other, with the operculum. The branchiæ are large and broad with long pinnæ, the basal ones shorter, the distal ones increasing in length to near the end, so that each branchial plume is somewhat obovate in outline; the tips are naked only for a short distance. The branchial wreath, in full expansion, is about as broad as the entire shell. The operculum is oblique and one-sided, and supported on a long clavate pedicel, which is transversely wrinkled, and expands gradually into the operculum at the end, the enlargement being chiefly on one side; the outer surface is roughly granulous and usually covered with adhering dirt. The collar is broad, and has three fascicles of setæ on each side. The branchiæ are pale greenish white, centered with brighter green, due to the circulating fluid.

This is the species mentioned in the early part of this report (p. 332) under the name of *S. spirillum*. The true *spirillum* of Linné as a translucent tube, and is found in deeper water, on hydroids, &c.

SPIRORBIS LUCIDUS Fleming.

Edinburgh Encyclop., vol. vii, p. 68; Johnston, Catalogue of British Non-Parasitical Worms, p. 349; Malmgren, Annulata polychæta, p. 123. *Serpula lucida* Montagu, Test. Brit., p. 506 (t. Johnston). *Serpula porrecta* Fabricius, Fauna Grœnlandica, p. 378 (*non* Müller). *Spirorbis sinistrorsa* Montagu, op. cit., p. 504; Gould, Invertebrata of Massachusetts, ed. i, p. 9, Plate 1, fig. 4, 1841.

Deeper parts of Vineyard Sound, near the mouth, in 10 to 12 fathoms, on hydroids and bryozoa; off Gay Head, 10 fathoms; off Buzzard's Bay, in 25 fathoms, on *Caberea Ellisii;* off Block Island, in 29 fathoms, on *Caberea;* Casco Bay, 6 to 20 fathoms, on algæ, &c.; Bay of Fundy, 10 to 80 fathoms, on hydroids; Saint George's Bank, 30 to 60 fathoms. Greenland; northern coasts of Europe.

This species forms small, translucent, glossy, reversed spiral tubes, coiled in an elevated spire, the last whorls usually turned up, or even erect and free.

There are six branchiæ, which are large and broad, with long, slender pinnæ, which do not decrease in length till near the end; the naked tips are short and acute. The operculum is sub-circular, somewhat obliquely attached to the slender pedicel, which is about half as long as the extended branchiæ, and enlarges rather suddenly close to the operculum; the outer surface of the operculum appears nearly flat, and is covered with adherent dirt. The collar is broad, with undulated and revolute edges. The three fascicles of setæ are long and slender. Ocelli two, conspicuous. The animal, in expansion, is usually much exsert from the tube. Anterior part of the body bright red; branchiæ pale greenish; their bases and posterior part of the body bright epidote-green.

It is the species catalogued as *S. porrecta (?)* on pages 498 and 504.

OLIGOCHÆTA.

CLITELLIO IRRORATA Verrill, sp. nov. (p. 324.)

Body very slender, the largest about 60^{mm} long, 0.75^{mm} in diameter, distinctly annulated. Head conical, a little elongated, subacute; setæ commencing on the first segment; those on the anterior segments in fascicles of two or three, very short, small, in length not one-third the diameter of the body, more or less curved like an italic *f*, obtusely pointed at the end; some of them are but slightly bent at the tip, others are strongly hooked; farther back there are three or four setæ in the fascicles, and they are somewhat longer, and two or more in many of the fascicles are forked, the others simple, spinous, more or less curved; in the upper fascicles posteriorly, and sometimes throughout the whole length, there are two or three much longer, very slender, hair-like, flexible bristles, but these are often absent from most of the segments, perhaps accidentally. The intestine is voluminous, slightly constricted at the articulations; two bright red blood-vessels, distinctly visible through the integuments, run along the intestine, one above and one below, following its flexures, without contractile lacunæ.

New Haven to Wood's Hole and Casco Bay, under stones in the upper part of the fucus-zone, and nearly up to high-water mark.

The above description was made from living specimens taken at Savin Rock, near New Haven.

Some of the specimens obtained at Wood's Hole appear to differ somewhat from this description, but the differences may be chiefly due to their being taken in the breeding season. In these the anterior fascicles consist of two short setæ, which are slightly curved in the form of an italic *f*, and are subacute, not bifid at tips. At the ninth to twelfth setigerous segments a thickening occurs, forming a clitellus; on the ninth segment the setæ are replaced by a small mammiform, bilobed organ; on the tenth there is a pair of prominent obtuse papillæ, swollen at base. On the posterior segments only two setæ were observed in each of the four fascicles, but they were longer, more slender, and more curved at the tip than the anterior ones. In each of the segments slender cæcal tubes, forming about two loops on each side, were noticed. Length, about 35^{mm}.

LUMBRICULUS TENUIS Leidy.

Marine Invertebrate Fauna of Rhode Island and New Jersey, p. 16 (148), Plate 11, fig. 64, 1855.

Point Judith, Rhode Island, abundant about the roots of grasses on the shore of a sound (Leidy). We did not obtain this species.

HALODRILLUS Verrill, genus nov.

Body long and slender. Blood white or colorless. Setæ small, acute, in four fan-shaped fascicles on each segment. The alimentary canal consists of a pyriform pharynx, followed by a portion from which several (five to seven) rounded or pyriform cæcal lobes, of different sizes, arise on each side and project forward and outward; these are followed by a large two-lobed portion, beyond which the intestine is constricted, then thickened and convoluted, and covered with polygonal, greenish, glandular cells, which become fewer farther back, where the intestine becomes a long, narrow, convoluted tube. In the anterior part of the body, around the stomach and cæcal lobes, there are numerous convolutions of slender tubes. The blood-vessels running along the intestine contain a colorless fluid.

HALODRILLUS LITTORALIS Verrill, sp. nov. (p. 324.)

Body round, slender, moderately long, tapering to both ends, but thickest toward the anterior end, tapering more gradually posteriorly. Head small, conical, moderately acute, or obtuse, according to the state of contraction; mouth a transverse, slightly sinuous slit beneath. The setæ commence with four fascicles on the first segment behind the buccal; the setæ are slightly curved, forming rounded, fan-shaped fascicles of four to six setæ, the middle setæ being longer than the upper and lower ones; posteriorly the setæ are less numerous. Caudal segment tapered, obtuse, or slightly emarginate at the end, with a simple orifice. The blood contains minute, oblong corpuscles. Color milk-white. Length, 25^{mm} to 40^{mm}; diameter, 0.5^{mm} to 1^{mm}.

New Haven; Wood's Hole; Casco Bay, Maine; very common under dead sea-weeds and stones near high-water mark.

ENCHYTRÆUS TRIVENTRALOPECTINATUS Minor.

American Journal of Science, vol. xxxv, p. 36, 1863.

In this species, according to Minor, there are three pairs of ventral fascicles of setæ before the dorsal ones commence; the pharynx extends to the fourth pair of ventral fascicles, from which a narrow œsophagus extends to a little back of the sixth pair; here a gradual enlargement of the alimentary canal occurs, ending abruptly just back of the eighth in a narrow, twisted tube, and this gradually enlarges at the ninth ventral fascicle into a moderate sized alimentary canal. No eyes. Length, about 10^{mm}.

New Haven, near high-water mark (Minor).

BDELLODEA.

Comparatively few leeches have hitherto been met with in this region. Many additional species, parasitic on fishes, undoubtedly remain to be discovered.

BRANCHIOBDELLA RAVENELII Diesing. Plate XVIII, fig. 89. (p. 458.)

Sitzungsberichte der kais. Akad. der Wissenschaften, Wien, xxxiii, p. 482, 1859. *Phyllobranchus Ravenelii* Girard, Proceedings of the American Association for the Advancement of Science for 1850, vol. iv, p. 124, 1851. (?) *Branchellion Orbiniensis* Quatrefages, Annals des sci. natur., sér. 3, vol. xviii, pp. 279–325, Plate 6, figs. 1–13, Pl. 7–8, 1852 (anatomy).

In describing this species Mr. Girard mistook the anterior for the posterior end, and described the large posterior sucker, or acetabulum, as the head. The color is dark brown, purplish, or dark violaceous, specked with white.

Vineyard Sound, on a stingray (*Myliobatis Freminvillei*), in several instances; a number usually occurred together. Charleston, South Carolina, on a "skate," species unknown (Girard). Atlantic Ocean, on a torpedo (Quatrefages).

CYSTOBRANCHUS VIVIDUS Verrill. (p. 458.)

American Journal of Science and Arts, ser. 3, vol. iii, p. 126, fig. 1, 1872.

New Haven, on the minnow (*Fundulus pisculentus*), both in fresh and brackish water; November and December.

ICHTHYOBDELLA FUNDULI Verrill. (p. 458.)

American Journal of Science and Arts, loc. cit., p. 126.

New Haven, on *Fundulus pisculentus*, with the last.

PONTOBDELLA RAPAX Verrill, sp. nov. Plate XVIII, fig. 91. (p. 458.)

Body, in extension, long and slender, rounded, thickest behind the middle, attenuated anteriorly. Acetabulum nearly circular, not much wider than the body. Head small, obliquely truncated, rounded. Color dark olive, with a row of square or oblong white spots along each side; head and acetabulum whitish, tinged with green. The young are reddish brown.

Length, 30^{mm} to 40^{mm}; diameter, 1.5^{mm} to 2^{mm}.

Vineyard Sound, on the ocellated flounder, (*Chænopsetta ocellaris*).

PONTOBDELLA, species undetermined. (p. 458.)

Body slender, cylindrical, strongly annulated; the largest seen was about 12^{mm} long and 0.75^{mm} in diameter when extended. Head obliquely campanulate, attached by a narrow pedicel-like neck. Acetabulum oblique, round, only a little wider than the body. Color pale greenish or greenish white, with scattered microscopic specks of blackish. No distinct ocelli, but there are several dark stellate pigment-spots on the head, similar to those on the body. Perhaps all the specimens are immature.

Savin Rock, New Haven, on *Mysis Americanus*, below low-water mark.

MYZOBDELLA LUGUBRIS Leidy. (p. 458.)

Proceedings of the Academy of Natural Sciences of Philadelphia, vol. v, p. 243, 1851; Diesing, op. cit., p. 489.

Parasitic on the edible crab (*Callinectes hastatus*), attached about the bases of the legs. We have not obtained this species on the coast of New England, but it may be expected to occur here.

MALACOBDELLA OBESA Verrill, sp. nov. Plate XVIII, fig. 90. (p. 458.)

Body stout, broad, thick, convex above, flat below, broadest near the posterior end, narrowing somewhat anteriorly; the front broadly rounded, with a median vertical slit, in which the mouth is situated. Acetabulum large, rounded, about as broad as the body. Intestine convoluted posteriorly, visible throug the integument. Between the intestine and lateral margins, especially posteriorly, the skin is covered with small stellate spots, looking like openings, within and around which are large numbers of small round bodies, like ova. Color yellowish white. Length, 30^{mm} to 40^{mm}; breadth, 12^{mm} to 15^{mm}.

Salem, Massachusetts; Long Island Sound; parasitic in the branchial cavity of the long clam (*Mya arenaria*).

MALACOBDELLA MERCENARIA Verrill, sp. nov. (p. 458.)

Malacobdella grossa Leidy, Proceedings Academy Natural Sciences of Philadelphia, vol. v, p. 209 (*non* Blainville).

Body, in extension, elongated, oblong, with nearly parallel sides, or tapering slightly anteriorly; anterior end broad, obtusely rounded, emarginate in the center, but not deeply fissured. In contraction the body is broader posteriorly. Dorsal surface a little convex; lower side side flat. Acetabulum round, rather small, about half the diameter of the body in the contracted state, but nearly as broad when the body is fully extended. The intestine shows through the integument distinctly; it is slender, and makes about seven turns or folds. Color pale yellow, with minute white specks beneath and on the upper surface anteriorly, giving it a hoary appearance; middle of the dorsal surface irregularly marked with flake-white; laterally reticulated with fine white lines.

Length in extension, 25^{mm}; breadth, 4^{mm}; in partial contraction, 18^{mm} long; 5^{mm} to 6^{mm} wide.

New Haven, parasitic in the branchial cavity of the round clam (*Venus mercenaria*), October, 1871. Philadelphia, in the same clam (Leidy).

GYMNOCOPA.

TOMOPTERIS, species undetermined. (p. 453.)

Young specimens of a species of this genus were taken in the evening in Vineyard Sound. They are too immature for accurate identification.

A large and fine species of *Tomopteris* was taken by Mr. S. I. Smith, in Eastport harbor, in July, 1872. This was about 40^{mm} in length. An excellent drawing of it was made by Mr. Emerton from the living specimens. It is, perhaps, the adult state of the Vineyard Sound species.

CHÆTOGNATHA.

SAGITTA ELEGANS Verrill, sp. nov. (p. 440.)

Body slender, thickest in the middle, tapering slightly toward both ends. Head somewhat broader than the neck, and about equal to the body where thickest, slightly oblong, a little longer than broad, obtuse, rounded in front or sub-truncate, sometimes with a slightly prominent small central lobe or papilla; the anterior part of the head rises into a crest-like median lobe considerably higher than the posterior part; ocelli two, minute, widely separated, on the posterior half of the head; the anterior lateral borders of the head are slightly crenulated. The fascicles of setæ or spinules on the sides of the head each contain about eight setæ, which are considerably curved, with acute tips, and reach as far as the anterior border of the head. Caudal fin ovate; its posterior edge broadly rounded. The posterior lateral fins commence just in advance of the ovaries, and extend back considerably beyond them, so as to leave a naked space somewhat less than their length between their posterior ends and the caudal fin; on this naked part, just in advance of the caudal fin, are two small, low, lateral papillæ connected with the male organs; two other smaller papillæ are situated at about the posterior third of the lateral fins. The median lateral fins are about equal in length to the posterior ones, and separated from them by a naked space less than their own length; the distance from the anterior end of the middle fins to the anterior border of the head is equal to twice the length of the fins; the length of the latter is about one-sixth of the entire length of the body. The color is translucent whitish, nearly diaphanous.

Length, about 16^{mm}; diameter, about 0.9^{mm}.

Wood's Hole and Vineyard Sound, at surface, July 1; off Gay Head, among *Salpæ*, September 8, in the day-time.

SAGITTA, species undetermined. (p. 440.)

A much larger and stouter species than the preceding was taken in abundance by Mr. Vinal N. Edwards, in Vineyard Sound, at various dates, from January to May.

Its length is generally 25^{mm} to 30^{mm}. I have not seen it living.

GEPHYREA or SIPUNCULOIDS.

PHASCOLOSOMA CÆMENTARIUM. Verrill Plate XVIII, fig. 92. (p. 416.)

Sipunculus cæmentarius Quatrefages, op. cit., vol. ii, p. 628, 1865. *Phascolosoma Bernhardus* Pourtales, Proceedings American Association for Advancement of Science for 1851, p. 41, 1852. *Sipunculus Bernhardus* Stimpson, Invertebrata of Grand Manan, p. 28 (*non* Forbes.)

Deeper parts of Vineyard Sound, 10 to 15 fathoms; off Block Island, 29 fathoms; Bay of Fundy, 2 to 90 fathoms, abundant; near Saint George's Bank, 45 to 430 fathoms.

PHASCOLOSOMA, species undetermined. (p. 353.)

A species similar to the last in size and form, with a thick integument, thickly covered throughout with small rounded papillæ or granules, but without the dark chitinous hooks seen on the posterior part of the latter.

Vineyard Sound.

PHASCOLOSOMA GOULDII Diesing. Plate XVIII, fig. 93. (p. 353.)

Revision der Rhyngodeen, op. cit., p. 764, 1859. *Sipunculus Gouldii* Pourtales, Proceedings of American Association for the Advancement of Science for 1851, vol. v, p. 40, 1852; Keferstein, Zeitschrift für wissenschaftliche Zoologie, vol. xv, p. 434, Plate 33, fig. 32, 1865, and vol. xvii, p. 54, 1867.

New Haven to Massachusetts Bay, at Chelsea Beach; common in sand and gravel at low-water mark.

SCOLECIDA.

TURBELLARIA.

RHABDOCŒLA or NEMERTEANS.

BALANOGLOSSUS AURANTIACUS Verrill. (p. 351.)

Stimpsonia aurantiaca Girard, Proceedings Academy of Natural Sciences of Philadelphia, vol. vi, p. 367, 1854. *Balanoglossus Kowalevskii* A. Agassiz, Memoirs American Academy of Arts and Sciences, vol. ix, p. 421, Plates 1–3, 1873.

Fort Macon, North Carolina, to Naushon Island. Charleston, South

Carolina (Girard). Newport, Rhode Island, to Beverly, Massachusetts (A. Agassiz). In sand between tides.

A reexamination of living specimens of the southern form will be necessary before their identity with the northern one can be positively established. I am unable to separate them with preserved specimens. See page 351; also American Journal of Science, ser. 3, vol. v, p. 235.)

NEMERTES SOCIALIS Leidy. (p. 324.)

Marine Invert. Fauna of Rhode Island and New Jersey, p. 11 (143), 1855.

Great Egg Harbor to New Haven and Vineyard Sound. Very common under stones, between tides.

NEMERTES VIRIDIS Diesing.

Sitzungsberichte der kais. Akad. der Wissenschaften, vol. xlv, p. 305, 1862. *Planaria viridis* Müller, Zoöl. Dan. Prodromus, 2684, 1776 (t. Fab.); Fabricius, Fauna Grœnlandica, p. 324, 1780. *Notospermus viridis* Diesing, Syst. Helminth, vol. i, p. 260, 1850. *Nemertes olivacea* Johnston, Mag. of Zoology and Botany, vol. i, p. 536, Pl. 18, fig. 1. *Borlasia olivacea* Johnston, Catalogue British Non-parasitical Worms, p. 21, Pl. 2^b, fig. 1, 1865. *Nemertes obscura* Desor, Boston Journal of Natural History, vol. vi, pp. 1 to 12, Plates 1 and 2, 1848. *Polia obscura* Girard in Stimpson's Marine Invertebrata of Grand Manan, p. 28, 1853.

Body very changeable in form; in full extension long and slender, sub-terete, tapering toward both ends, the length being sometimes 150^{mm} to 200^{mm}, while the diameter is 2^{mm} to 3^{mm}; in contraction the body becomes much shorter and stouter, more or less flattened, and obtuse at the ends, large specimens often being only 30^{mm} or 40^{mm} long and 4^{mm} to 5^{mm} broad. The head is flattened, more or less bluntly rounded, and is furnished with a row of small dark ocelli on each side, which vary in number and size according to the age, the large specimens often having six or eight on each side, while the small ones have but three or four, and the very young ones have only a single pair. The lateral fossæ of the head are long and deep, in the form of slits, and extend well forward to near the terminal pore. The latter in some states of contraction appears like a slight vertical slit or notch, but at other times appears circular; the proboscis is long, slender toward the base, clavate toward the end, the terminal portion transversely wrinkled. The ventral opening or mouth is situated opposite to or a little behind the posterior ends of the lateral fossæ; it is ordinarily small and elliptical, with a distinct lighter colored border, but is capable of great dilation when the creature is engaged in swallowing some annelid nearly as large as itself.

In alcoholic specimens the body is usually thickened and rounded anteriorly, more slender and somewhat flattened farther back, often acute at the posterior end; head obtusely rounded or sub-truncate, with a small terminal pore and two lateral fossæ, which are short and extend forward very near to the terminal pore; ventral opening or mouth small and round, situated slightly behind the posterior ends of the lateral fossæ; ocelli not apparent. The color, when living, is very variable, most commonly dark olive-green or blackish green above, and somewhat lighter below, the head margined with lighter; frequently the color is dark liver-brown or reddish brown, and the back is usually crossed by faint pale lines, placed at unequal distances.

Buzzard's Bay and Vineyard Sound, under stones, between tides, and in 4 to 6 fathoms, rocky bottoms, very common; Casco Bay and Bay of Fundy; and northward to Labrador and Greenland. Also on the northern coasts of Europe to Great Britain. Abundant under stones between tides, and in shallow water.

The specimens referred to on page 324 as probably belonging to *Cerebratulus*, were most likely identical with this species.

NEMERTES (?) species undetermined (*a*). (p. 498.)

Body elongated, moderately stout; head not distinct from the body. Color uniform bright brownish red.

Length, 25^{mm}.

Off Watch Hill, Rhode Island, among rocks, in 4 to 6 fathoms. A species, apparently the same, also occurred in 25 fathoms off Buzzard's Bay.

This was red with two dark red spots anteriorly. No ocelli were detected.

NEMERTES, (?), species undetermined (*b*).

Body slender, sub-terete; head not distinct from body. Ocelli inconspicuous, apparently about three in a row on each side of front of head. Color of head and body, above, brownish red, with a whitish ring around the neck, which recedes in the middle, above.

Length, 8^{mm}.

Off Watch Hill, with the preceding.

This is, perhaps, a species of *Cosmocephala*.

NEMERTES, species undetermined (*c*).

Body slender; head not separated by a constriction. Ocelli very numerous, arranged in a long cluster on each side of the head. Color uniform olive-green above and below.

Length, 35^{mm}; breadth, 1.3^{mm} to 2^{mm}.

New Haven Harbor, on the piles of a wharf, in brackish water.

TETRASTEMMA ARENICOLA Verrill, sp. nov. Plate XIX, fig. 98. (p. 351.)

Body sub-terete, long, slender, slightly depressed, of nearly uniform width; the head is very versatile, usually sub-conical or lanceolate, flattened, occasionally becoming partially distinct from the body by a slight constriction at the neck. Ocelli four, those in the anterior pair nearer together. The lateral fossæ are long and deep slits on the sides of the head; mouth or ventral pore small, often sub-triangular, situated just back of the posterior ends of the lateral fossæ. Body deep flesh-color or pale purplish. Length, about 100^{mm}, in extension.

Savin Rock, near New Haven, in sand at low-water mark.

This species is, perhaps, not a true *Tetrastemma*. It is here only provisionally referred to that genus.

MECKELIA INGENS Leidy. Plate XIX, figs. 96, 96*a*. (p. 349.)

Marine Invertebrate Fauna of Rhode Island and New Jersey, p. 11 (143), 1855. (?) *Meckelia Pocohontas* Girard, Proceedings of Academy of Natural Sciences of Philadelphia, vol. vi, p. 366, 1854.

Fort Macon, North Carolina; Great Egg Harbor to New Haven and Vineyard Sound. Low-water mark to 8 fathoms. Charleston, South Carolina (Girard).

MECKELIA LACTEA Leidy. (p. 350.)

Proceedings of Academy of Natural Sciences of Philadelphia, vol. v, p. 243, 1851.

Great Egg Harbor to New Haven and Vineyard Sound. Low-water mark to 10 fathoms. Perhaps the young of the preceding species.

MECKELIA ROSEA Leidy. (p. 350.)

Proceedings Academy Natural Sciences of Philadelphia, vol. v, p. 244, 1851.

Great Egg Harbor to New Haven and Vineyard Sound. Common in sand at low-water mark.

MECKELIA LURIDA Verrill, sp. nov. (p. 508.)

Body long, large, stout, much depressed throughout, and thin posteriorly, somewhat thickened anteriorly. Head changeable in form, often acute; lateral fossæ long. Ventral opening large, elongated. Proboscis long, slender, emitted from a terminal pore. In some specimens there was a slender, acute, caudal papilla. Color deep chocolate-brown, with lighter margins. Length, 150^{mm} to 250^{mm}; breadth up to 10^{mm} or more.

Off Gay Head, 19 fathoms, soft mud; off Buzzard's Bay, 25 fathoms; off Block Island, 29 fathoms, sandy mud; Casco Bay, 10 to 68 fathoms.

CEREBRATULUS (?), species undetermined (*a*). (p. 508.)

This is a dark olive-green species, with paler margins, the anterior part darkest.

Off Block Island, in 29 fathoms; off Gay Head, in 19 fathoms, soft mud.

COSMOCEPHALA OCHRACEA Verrill, sp. nov. Plate XIX, figs. 95, 95*a*. (p. 325.)

Body elongated, moderately slender, somewhat flattened but thick, and with the margins rounded, obtuse at both ends or subacute posteriorly; broadest and often swollen anteriorly; gradually and slightly tapering posteriorly; the integument is translucent and the internal median organs show quite distinctly; lateral organs voluminous, extending the whole length of the body along each side, and showing through as dull yellowish white mottlings. Head continuous with the body, obtuse; a slight groove, usually appearing as a whitish line on each side, runs obliquely across the ventral and lateral surface of the head, diverging from the mouth and curving somewhat forward at the sides; terminal pore small and inconspicuous; mouth, or ventral pore, small. Ocelli numerous, arranged as in the figure, but varying somewhat in number. (See p. 325.) Color dull yellowish, or yellowish white, often tinged with deeper yellow or orange anteriorly, with the median line lighter; a reddish internal organ shows through as an elongated red spot between the posterior ocelli.

Length, 50^{mm} to 70^{mm}; breadth, 2.5^{mm} to 3^{mm}.

New Haven to Vineyard Sound; under stones, between tides.

POLINA GLUTINOSA Verrill, sp. nov. Plate XIX, fig. 97. (p. 324.)

Body rather slender and elongated in extension, usually broadest in the middle and tapering to both ends, but quite versatile in form; head not distinct, usually obtuse; posterior end narrower, usually obtuse or slightly emarginate; integument soft, secreting a large quantity of mucus; the lateral organs extend to the head. Ocelli numerous, variable in number, usually eight or ten on each side, arranged in three pairs of short, oblique, divergent rows, two to four in each; terminal pore of the head moderately large; no lateral fossæ could be detected. There appears to be a terminal opening at the posterior end. Color dull yellow or pale orange yellow, sometimes brighter orange, especially anteriorly; posteriorly usually lighter, with a faintly marked dusky or greenish median line.

Length, 25^{mm} to 30^{mm} in extension; breadth, 1.3^{mm} to 2^{mm}.

Great Egg Harbor to New Haven and Vineyard Sound; low-water mark to 6 fathoms.

MONOCELIS AGILIS Leidy. (p. 325.)

Marine Invert. Fauna of Rhode Island and New Jersey, p. 11 (143), 1855. *Monops* (?) *agilis* Diesing, Sitzungsberichte der kais, Akad. der Wissenschaften, vol. xlv, p. 232, 1862 (*non Monops agilis* Schultze, sp.)

New Haven; Point Judith, Rhode Island, at low-water, creeping on *Mytilus edulis* (Leidy).

ACELIS CRENULATA Diesing.

Op. cit. p. 206. *Acmostomum crenulatum* Schmarda, Neue wirbell. Th., vol. i, p. 1, 3, Pl. 1, fig. 2 (t. Diesing).

Hoboken, New Jersey, in brackish water (Schmarda).

GENUS UNDETERMINED.

Body very long and slender, almost filiform, slightly flattened, with rounded sides; the flat sides are longitudinally striated, the narrower rounded sides are marked with numerous short, distinct, separate, transverse lines or depressions, corresponding to opaque internal organs. In one of the smaller specimens one end is acute conical, terminated by a slender incurved point; the other end is obtusely rounded, depressed and translucent at the end, apparently with a transverse orifice beneath. The largest specimen, and one of the smaller, has one end corresponding in form to that last described; the other is rounded, a little enlarged, subtruncate, apparently with a terminal orifice. A yellowish internal organ, with transverse divisions, runs along each side internally. In life the color was grayish white, with four very slender double longitudinal lines of dark slate-color.

Length of largest specimens, in alcohol, 80^{mm}; diameter, 0.7^{mm}; smallest ones, 40^{mm}; diameter, 0.5^{mm}.

Wood's Hole, swimming very actively at the surface in the evening, June 29 and July 13, 1871.

This species was taken by Mr. S. I. Smith, who recorded the color. I did not observe it myself in the living state. The above description was made from preserved specimens. Its characters cannot all be made out satisfactorily with alcoholic specimens, and its generic and family affinities are uncertain. In general appearance, when living and moving, it resembles *Gordius* and *Rhamphogordius*.

DENDROCŒLA or PLANARIANS.

STYLOCHOPSIS LITTORALIS Verrill, sp. nov. Plate XIX, fig. 99. (p. 325.)

Body flat with thin margins, very changeable in form, broad oval, elliptical or oblong, rounded or sub-truncate at the ends, often with the margins undulated. The tentacles are small, round, obtuse, translucent, each containing an elongated group of about ten or twelve minute black ocelli on the anterior surface. The tentacles are situated at about the anterior fourth of the body, and are separated by about one-fourth of its breadth. Dorsal ocelli about eight, forming four groups of two each, in advance of the tentacles; marginal ocelli numerous, small, black, most conspicuous beneath, and most numerous on the anterior portion, arranged in two or more irregular rows near the margin, extending back to the middle of the sides or beyond. Color pale greenish or brownish yellow, veined or reticulated with lighter, and with a light median stripe posteriorly; beneath flesh-color, with a median elongated light spot, narrowest in the middle, due to internal organs.

Length, 8^{mm}; breadth, about 6^{mm}.

New Haven to Vineyard Sound; under stones, between tides.

PLANOCERA NEBULOSA Girard. Plate XIX, fig. 100. (p. 325.)

Proceedings of the Academy of Natural Sciences of Philadelphia for 1853, vol. vi, p. 367, 1854.

Savin Rock near New Haven, under stones at low-water. Charleston, S. C. (Girard).

LEPTOPLANA FOLIUM Verrill, sp. nov. (p. 487.)

Body very flat, with the margin thin and undulated; outline versatile, usually cordate or leaf-like, broadest and emarginate posteriorly, the posterior borders well rounded, and the side a little convex, narrowing to an obtuse point at the anterior end; sometimes oblong or elliptical, and but little narrowed anteriorly; the posterior emargination is usually very distinct, often deep, and sometimes in contraction has a small projecting angular point in the middle, but at times the emargination nearly disappears. Ocelli in four groups, near the anterior end; the two posterior clusters are smaller than the anterior and wider apart; the anterior clusters are very near the others, and close together, almost blending on the median line, and are composed of numerous very minute crowded ocelli, less distinct than those of the other clusters. Color pale yellowish flesh-color, veined with dentritic lines of darker flesh-color, or with whitish; an indistinct pale reddish spot behind the anterior ocelli; an interrupted longitudinal whitish stripe in the middle, due to the internal organs, and a small median whitish stripe posteriorly.

Length, 20^{mm} to 25^{mm}; breadth, 10^{mm} to 15^{mm}.

Off Watch Hill, 4 to 6 fathoms, among rocks and algæ; off Block Island, in 29 fathoms; off Buzzard's Bay, in 25 fathoms.

PLANARIA GRISEA Verrill, sp. nov. (p. 487.)

Body elongated and usually oblong in extension, often long oval or somewhat elliptical, obtusely pointed or rounded posteriorly; head subtruncate in front, often a little prominent in the middle; the angles are somewhat prominent, but not elongated. Ocelli two, black, each surrounded by a reniform, white spot. Color yellowish green or grayish, with a central whitish stripe in the middle of the back, surrounded by darker; head margined with whitish.

Length, in extension, 12^{mm}; breadth, 3^{mm}.

Watch Hill, Rhode Island, under stones, between tides.

PROCERODES WHEATLANDII Girard. (p. 325.)

Proceedings Boston Soc. Natural History, vol. iii, p. 251, 1851; Stimpson, op. cit., p. 6, 1857. *Planaria frequens* Leidy, Marine Invert. Fauna of Rhode Island and New Jersey, p. 11, 1855. *Procerodes frequens* Stimpson, op. cit., p. 6; this Report, p. 325.

New Haven to Casco Bay. Point Judith (Leidy). Manchester, Massachusetts (Girard). Abundant under stones, between tides.

FOVIA WARRENII Girard. (p. 480.)

Proceedings of the Boston Society of Natural History, vol. iv, p. 211, 1852; Stimpson, Prodromus, p. 6, 1857. *Vortex Warrenii* Girard, op. cit., vol. iii, pp. 264 and 363, 1851; Diesing, op. cit., vol. xiv, p. 229, 1862.

A small, narrow, oblong, red Planarian, apparently belonging to this species, was collected at Wood's Hole, among eel-grass, and also in Casco Bay. Chelsea, Massachusetts (Girard).

BDELLOURA CANDIDA Girard. (p. 460.)

Proceedings Boston Society Natural History, vol. iv, p. 211, 1852. *Vortex candida* Girard, op. cit., vol. iii, p. 264, (for 1850), 1851. *Bdelloura parasitica* Leidy, Proceedings Academy Natural Sciences of Philadelphia for 1851, vol. v, p. 242, 1852; Stimpson, Prodromus, p. 6, 1857.

Great Egg Harbor; New Haven; Massachusetts Bay. Parasitic on the gills of the "horseshoe-crab" (*Limulus Polyphemus*).

BDELLOURA RUSTICA Leidy.

Proceedings Acad. Natural Sciences of Philadelphia, vol. v, p. 242, 1852; Stimpson, Prodromus, p. 6, 1857.

Great Egg Harbor, on *Ulva latissima* (Leidy).

NEMATODES.

PONTONEMA MARINUM Leidy. Plate XVIII, fig. 94. (p. 325.)

Marine Invertebrate Fauna of Rhode Island and New Jersey, p. 12 (144), 1855.

Great Egg Harbor to New Haven and Vineyard Sound; very abundant from above low-water mark to 10 fathoms.

PONTONEMA VACILLATUM Leidy. (p. 326.)

Marine Invertebrate Fauna of Rhode Island and New Jersey, p. 12 (144), 1855.

Great Egg Harbor to Vineyard Sound, with the preceding.

Various other small, free Nematodes are frequently met with, but they have not been carefully examined.

Numerous species are also parasitic in the stomach, intestine, muscles and other organs of fishes, crustacea, worms, &c. (See page 456.)

MOLLUSCA.

CEPHALOPODA.

DIBRANCHIATA.

OMMASTREPHES ILLECEBROSA. (p. 441.)

Loligo illecebrosa Lesueur, Journal Acad. Natural Sciences, Philadelphia, vol. ii, p. 95, Plate 10, 1821; Gould, Invertebrata of Massachusetts, ed. i, p. 318, 1841; Dekay, Natural History of New York, Mollusca, p. 4, 1843. *Ommastrephes sagittatus* Binney,* in Gould's Invertebrata of Mass., ed. ii, p. 510, 1870, but *not* Plate 25, fig. 339 (*non* Lamarck, sp.)

A large specimen, taken at Eastport, Maine, was ten inches long, exclusive of the arms. When preserved in alcohol the caudal-fin was rather more than one-third of the length of the head and body together; its width was equal to about three-fourths of its length. The colors of this specimen were described on page 442. A small specimen from Newport, R. I., agrees in color and most other respects with the larger specimens, but differs somewhat in the proportions, especially of the caudal fin, probably owing to its immaturity. This specimen, in alcohol,

* Binney's, Plate xxvi, Figs. 341–344, erroneously referred to *Loligopsis pavo*, apparently represents this species.

is 84mm long, exclusive of the arms; the body is 72mm long, 15mm broad; the caudal fin is 25mm long and 36mm broad.

A fresh specimen, caught in Casco Bay, had the following proportions: Length of head and body, not including the arms, 221mm; length of caudal fin, 86mm; breadth of fin, 90mm; diameter of body, 35mm; length of upper arms, 80mm; of second pair, 100mm; of third pair, 100mm; of extensile arms, 182mm; of the ventral pair, 90mm.

Greenport, Long Island, (Sanderson Smith); Newport, Rhode Island; Provincetown, Massachusetts; Casco Bay; Mount Desert, Maine; Bay of Fundy.

Ommastrephes Bartramii (Lesueur, sp.) is found in the Gulf Stream off our coasts, and may sometimes occur accidentally on our shores. It is a more slender and elongated species than the preceding, with a relatively shorter caudal fin. It is also darker colored. The figure given by Binney in the last edition of Gould's Invertebrata of Massachusetts (Plate 25, fig. 340) does not represent this species.

LOLIGO PEALII Lesueur. Plate XX, figs. 102–105. (p. 440.)

Journal Acad. Natural Sciences, Philadelphia, vol. ii, p. 92, Pl. 8, 1821; Dekay, Natural History of New York, Mollusca, p. 4, Pl. 38, fig. 354 (copied from Lesueur); Binney, in Gould's Invertebrata of Mass., ed. ii, p. 514 (Pl. 25, fig. 340,) probably represents this species, certainly not *O. Bartramii.*)

South Carolina to Massachusetts Bay. Very common in Long Island Sound and Vineyard Sound.

The young, from an inch to two inches in length, were taken from the middle of July to the last of August in great numbers, at the surface, in Vineyard Sound, by Mr. Vinal N. Edwards.

LOLIGO PUNCTATA Dekay.

Natural History of New York, Mollusca, p. 3, Pl. I, fig. 1, 1843; Binney, in Gould's Invertebrata of Mass., ed. ii, p. 513.

This is probably identical with the preceding species. The slight differences noticed are probably sexual, but as I have not been able to fully satisfy myself in regard to this, I have not thought it proper to unite them at this time.

Long Island Sound.

LOLIGO PALLIDA Verrill, sp. nov. Plate XX, figs. 101, 101*a*. (p. 441.)

Body stout, tapering rapidly backward. Anterior border of mantle with a prominent, obtusely rounded, median dorsal lobe, from which the margin recedes on each side; on the lower side the margin is concave in the middle, with a projecting angle on each side. Caudal fin large, about as broad as long, more than half as long as the body. Siphon large and stout; upper pair of arms considerably smaller and shorter than the others, slender at tips, margined along the inner dorsal ridge with a thin membrane. Second pair of arms stouter and longer, triquetral, slightly margined on the outer angle. Third pair much stouter and considerably longer, with a membranous fold along the middle of the outer surface, which expands into a thin membrane toward the end. Tentacular arms long and slender, in extension longer than the body, the portion that bears suckers forming about one-third the whole length; in the female the larger suckers on the middle of this portion are not so large as the largest on the other arms, and are arranged in about four rows; those near the tips of the arms are very small and crowded. In the male the principal suckers of the tentacular arms are very much larger than in the female, and considerably exceed those of the other arms; they form two alternating rows along the middle of the arm, and external to them there is a row of smaller suckers on each side, alternating with them; the suckers toward the tips are very numerous, small, and crowded; outside of the suckers, on each side, there is a marginal membrane with a scolloped edge; another membranous fold runs along the outer surface and expands into a broad membrane near the end; the arms of the ventral pair are intermediate in length between those of the second and third pairs. Ground-color of body, head, arms, and fins pale, translucent, yellowish white; entire ventral surface pale, with small, distant, brownish circular spots, which are nearly obsolete on the siphon and arms; the upper surface is covered with pale brown, unequal, circular spots which are not crowded, having spaces of whitish between them; the spots are more sparse on the head and arms, but somewhat clustered above the eyes. The general appearance of the animal when fresh is unusually pale and gelatinous. The "pen" is broad, quill-shaped, translucent, and amber-colored. A medium-sized male specimen preserved in alcohol measures 145^{mm} from the base of the dorsal arms to the posterior end of the body; length of body, 120^{mm}; length of caudal fin, 70^{mm}; breadth of fin, 75^{mm}; length of first pair of arms, 42^{mm}; of second pair, 50^{mm}; of third, 60^{mm}; of tentacular arms, 150^{mm}; of ventral pair, 53^{mm}.

Long Island Sound.

The *Spirula Peronii* Lamarck, (*Spirula fragilis* in Binney's Gould, p. 516, fig. 755), is occasionally cast up, on the outer beaches of Nantucket, but it probably does not occur alive in our waters.

GASTROPODA.

PECTINIBRANCHIATA.

BELA HARPULARIA Adams. Plate XXI, fig. 108. (p. 508.)

H. and A. Adams, Genera of Recent Mollusca, vol. i, p. 92, 1858; Gould's Invertebrata of Mass., ed. ii, p. 352, fig. 191. *Fusus harpularius* Couthouy, Boston Journal Natural History, vol. ii, p. 106, Pl. 1, fig. 10, 1838; Gould's Invertebrata of Mass., ed. i, p. 291, fig. 191, 1841. *Mangelia harpularia* Stimpson, Shells of New England, page 48, 1851.

Massachusetts Bay to Labrador and Greenland. Off Gay Head, 10 to 19 fathoms; in the Bay of Fundy frequent in from 1 to 80 fathoms. Fossil in the Post-Pliocene "Leda-clays" of Labrador (Packard); and Canada (Dawson).

BELA PLEUROTOMARIA Adams.

H. and A. Adams, Genera of Recent Mollusca, vol. i, p. 92, 1858; Gould, Invert. of Mass., ed. ii, p. 355, fig. 625. *Fusus pleurotomarius* Couthouy, Boston Journal of Natural History, vol. ii, p. 107, Plate 1, fig. 9, 1838. *Fusus rufus* Gould, Invert. of Mass., ed. i, p. 190, fig. 192 (*non* Montagu). *Buccinum pyramidale* Ström, N. A. Dan. iii, p. 296, fig. 22 (t. Loven). *Defrancia Vahlii* (Beck) Möller, 1842 (t. Loven). *Mangelia pryamidalis* Stimpson, Shells of New England, p. 49.

Off the coast of Long Island, in 46 fathoms (Stimpson). Massachusetts Bay to Labrador; in Casco Bay and the Bay of Fundy not uncommon in 18 to 60 fathoms. Greenland (Möller). Finmark (Lovén). Fossil in the Post-Pliocene deposits of Canada, Labrador, Great Britain, and Scandinavia.

The identification of this species with the *Buccinum pyramidale* Ström, is somewhat uncertain; if correct, the latter name has priority.

BELA PLICATA Adams. Plate XXI, fig. 107. (p. 383.)

H. and A. Adams, Genera of Recent Mollusca, vol. i, p. 92, 1858. *Pleurotoma plicata* C. B. Adams, Boston Journal of Natural History, vol. iii, p. 318, Plate 3, fig. 6; Gould, Invert. of Mass., ed. i, p. 282, fig. 187; ed. ii, p. 350, fig. 612. *Pleurotoma plicosa* C. B. Adams, Contributions to Conchology, vol. i, p. 54, 1850; Jay, Catalogue, ed. iv, p. 327. *Pleurotoma brunnea* Perkins, Proc. Boston Soc. Nat. History, vol. xiii, p. 121, 1869.

Near New Haven, rare. Huntington and Greenport, Long Island (Sanderson Smith). New York (Dekay). Dartmouth, Massachusetts, and New Bedford Harbor, in mud, (C. B. Adams). Beaufort, N. C. (Dr. E. Coues). Indian Pass, Florida (E. Jewett).

MANGELIA CERINA. (p. 432.)

Verrill, American Journal of Science, vol. iii, p. 210, 1872. *Pleurotoma cerinum* Kurtz and Stimpson, Proceedings of the Boston Society of Natural History, vol. iv, p. 115, 1851; Stimpson, Shells of New England, p. 49, Pl. 2, fig. 2, 1851.

Shell elongated, fusiform, rather acute at apex, composed of about seven whorls; apical whorls smooth, the others angulated in the middle and decidedly flattened just below the suture; suture distinct, but shallow, undulated; the body whorl has about eleven prominent, longitudinal, sub-acute plications or ribs, separated by wide, concave interspaces. The ribs are most prominent at the angulation above the middle of the lower whorl, and do not extend on the flattened sub-sutural band. The whole surface is covered by fine, raised, revolving lines, often alternately larger and smaller, separated by wider striæ, and crossed by fine, distinct lines of growth, rendering them slightly nodulous. The revolving lines are most distinct on the sub-sutural band, and are often nearly obsolete over the summits of the ribs. Outer lip acute, with a decided angle at about the posterior fourth, where it recedes to form a decided, rounded notch, at and just above the angle; middle portion nearly straight, gradually curving and receding toward the anterior end; canal short, straight, and somewhat contracted. Color whitish, or slightly yellow; inner surface light wax-yellow. Length, 6.5^{mm}; breadth, 3^{mm}; length of aperture, 3^{mm}.

Vineyard Sound, 3 to 10 fathoms; near New Haven. New Bedford, Mass., and Charleston, S. C. (Stimpson). Staten Island; Greenport and Huntington, Long Island, low water to 3 fathoms, (S. Smith). Beaufort, N. C. (Coues). Fossil in the Post-Pliocene of South Carolina.

PLEUROTOMA BICARINATUM Couthouy. Plate XXI, fig. 106. (p. 418.)

Boston Journal of Natural History, vol. ii, p. 104, Plate 1, fig. 11, 1838; Gould, Invert. of Mass., ed. i, p. 281, fig. 186; ed. ii, p. 349, fig. 618. *Mangelia bicarinata* Stimpson, Shells of New England, p. 49. *Defrancia bicarinata* H. and A. Adams, Genera of Mollusca, vol. i, p. 95.

Stonington, Conn. (Linsley). Vineyard Sound, 6 to 12 fathoms, rare; Massachusetts Bay; Bay of Fundy. This is a rare and imperfectly known species. I have never had opportunities to examine the living animal.

The generic relations of this and the two preceding shells are still doubtful.

BUCCINUM UNDATUM Linné. Plate XXI, fig. 121. (p. 494.)

Systema Naturæ, ed. xii, p. 1204. Gould, Invertebrata of Massachusetts, ed. i, p. 305; ed. ii, p. 366, fig. 634. *Buccinum undulatum* Möller, in Kroyer's Tidsskrift, vol. iv, p. 84, 1842 (t. Stimpson). Stimpson, Review of the Northern Buccinums, in Canadian Naturalist, October, 1865. *Buccinum Labradorense* Reeve, Conch. Icon., vol. iii, Buc. i, 5, 1846 (t. Stimpson).

Mouth of Vineyard Sound and off Gay Head, 6 to 19 fathoms. Off New Jersey, north latitude 40°, west longitude 73°, in 32 fathoms, sandy bottom, (Captain Gedney).

Near Stonington, Conn. (Linsley); Montauk Point, Long Island, and Little Gull Island (S. Smith). Not common south of Cape Cod, except on the outer islands and in deep water; common in Massachusetts Bay; and very abundant on the coast of Maine, and northward to Greenland. On the European coast it occurs from Iceland and the North Cape to France, and from low water to 650 fathoms. In the Bay of Fundy it is abundant from above low-water mark to 100 fathoms.

As a fossil it is common in the Post-Pliocene deposits of Maine, Canada, Labrador, and Great Britain. Mr. Desor obtained it from the Post-Pliocene formation of Nantucket Island.

The ordinary American specimens from shallow water differ considerably in form from the typical European specimens, but the species is quite variable on both coasts, and I have examined large specimens from Saint George's Bank and La Have Bank, dredged by Mr. S. I. Smith, which differ very little from the common European form, and it is easy to form series connecting these with our common shore specimens. I am, therefore, unable to agree with Dr. Stimpson, who considered our shell distinct from the European, and adopted the name *undulatum* for it.

NEPTUNEA CURTA Verrill.

Fusus corneus Say, Amer. Conch., iii, Plate 29, 1831 (*non* Linné, Pennant, etc.). *Fusus Islandicus* Gould, Invert. of Mass., ed. i, p. 284; ed. ii, p. 371, fig. 638 (*non* Chemnitz, Gmelin, etc.). *Fusus curtus* Jeffreys, British Conchology, vol. iv, p. 336, 1867.

Massachusetts Bay to Labrador. Casco Bay, 6 to 50 fathoms; common in the Bay of Fundy from low-water mark to 80 fathoms. Linsley reports it, as *F. corneus*, from fish-stomachs at Stonington, Connecticut. In the Yale Museum are dead shells of this species, which have been occupied by *Eupaguri*, found on Fire Island Beach, on the south side of Long Island, by Mr. S. I. Smith. It probably inhabits the deep water off Block Island.

The dentition of this species is decidedly buccinoid. The central plates are transversely oblong, deeply concave above, with the lateral angles produced; below armed with three small, nearly equal, short teeth, the central one largest, beyond which, on each side, it is concave, the outer angles being a little prominent. The lateral plates are large, with an outer, very strong, curved tooth, and two much smaller, slightly curved ones near the inner end, the innermost being slightly the largest.

The dentition agrees very closely with that of *N. antiqua*, the type both of the genus *Neptunea*, Bolton, 1798, and *Chrysodomus*, Swainson, 1840, but it is very different from that of *Sipho Berniciensis* (*S. Islandicus* Trosch.), which Troschel refers to the Faciolaridæ. The latter is evidently the type of a genus (*Sipho*) very distinct from *Neptunea;* but among the European species, *gracilis*, *propinqua*, *buccinata*, and the true *Islandica* (as described by Jeffreys) are closely related to *curta*, and belong to the genus *Neptunea*, in the family Buccinidæ.

NEPTUNEA (*Neptunella*) PYGMÆA. Plate XXI, fig. 115. (p. 508.)

Fusus Islandicus, var. pygmæus, Gould, Invert. of Mass., ed. i, p. 284, fig. 199, 1841. *Tritonium pygmæum* Stimpson, Shells of New England, p. 46, 1851. *Fusus Trumbullii* Linsley, Amer. Journal Science, ser. i, vol. xlviii, p. 28, fig. 1, 2, 1845 (*non* Gould, 1848). *Fusus pygmæus* Gould, Invert. of Mass., ed. ii, p. 372, fig. 639. *Neptunea* (*Sipho*) *pygmæa* H. and A. Adams, Genera Recent Mollusca, vol. i, p. 81, 1858. *Chrysodomus pygmæus* Dall, Proc. Boston Soc. Nat. Hist., vol. xiii, p. 242, 1870.

Deep water off New London and Stonington, Connecticut, northward to the Gulf of Saint Lawrence. East of Block Island, 29 fathoms, sandy mud; off Buzzard's Bay, 25 fathoms; off Gay Head, 19 fathoms, mud, abundant and large; off Edgarton, 18 to 20 fathoms; Casco Bay, 10 to 40 fathoms, common; Eastport, Maine, and Bay of Fundy, low water to 100 fathoms (A. E. V.). Near Saint George's Bank, 40 to 150 fathoms; east of Saint George's Bank, 430 fathoms; and off Halifax (S. I. Smith).

The odontophore in this species is long and slender; the dentition is buccinoid. The middle plate is small, transversely oblong, concave above, below convex, with one very small central tooth; lateral plates relatively large and strong, with a large, curved outer tooth, and a smaller bifid inner tooth, widely separated from the outer one.

The peculiarities in the dentition of this species, in connection with the singular wooly or velvety epidermis, indicate that this species should form the type of a sub-genus, or perhaps even a distinct genus. For the group I would propose the name *Neptunella*.

FULGUR CARICA Conrad. Pl. XXII, fig. 127. (p. 355.)

Proceedings of the Academy of Nat. Sciences, Philadelphia, vol. vi, p. 319, 1853; Gill, on the Genus Fulgur and its Allies, in American Journal of Conchology, vol. iii, p. 145, 1867. *Murex carica* Gmelin, Syst. Nat., p. 3545, 1788. *Fulgur eliceans* (*pars*) Montfort, Conch. Syst., vol. ii, p. 503, 1810, fig. (t. Gill). *Pyrula carica* Lamarck, Anim. sans Vert., ed. i, vol. vii, p. 138, 1822; Gould, Invert. of Mass., ed. i, p. 296. *Busycon carica* Gould, op. cit., ed. ii, p. 383, fig. 646; Stimpson, in American Journal of Conchology, vol. i, p. 61, 1865.

Eastern coast of the United States; northward to Cape Cod; southward to northern Florida, and west Florida. Abundant in Vineyard Sound, in 1 to 10 fathoms; also in Long Island Sound, near New Haven. Nantucket (Adams); St. Augustine, Florida (H. S. Williams); west Florida (E. Jewett.) It occurs in the Miocene formation of Maryland and Virginia, and in the Post-Pliocene deposits of Virginia, North Carolina, South Carolina, and Florida.

SYCOTYPUS CANALICULATUS Gill. (p. 355.)

American Journal of Conchology, vol. iii, p. 149, 1867. *Murex canaliculatus* Linné, Syst. Nat., ed. xii, p. 1222. *Pyrula canaliculata* Lamarck, Anim. sans Vert., vol. vii, p. 137, 1822; Gould, Invert. of Mass., ed. i, p. 294, fig. 206. *Busycon canaliculatum* H. and A. Adams, Genera of Recent Mollusca, vol. i, p. 151, 1858; Gould, Invert. of Mass., ed. ii, p. 380, fig. 645. *Fulgur canaliculata* Say, Journal Acad. Nat. Sciences, Philadelphia, vol. ii, 1822; Conrad, Proc. Phil. Acad., vol. vi, p. 219, 1853.

Eastern coast of the United States; northward to Cape Cod and Nantucket; southward to Georgia and Northern Florida, Western Florida, and northern shores of Gulf of Mexico. Abundant in Vineyard Sound, Long Island Sound, &c., in 1 to 8 fathoms. St. Augustine, Florida (H. S. Williams). Found fossil in the Post-Pliocene of Virginia, North and South Carolina, and Northern Florida; in the Pliocene of South Carolina; and Miocene of Maryland.

NASSA VIBEX Say. Plate XXI, fig. 114. (p. 371).

Journal Academy Nat. Sciences, Philadelphia, vol. ii, p. 231, 1822; Gould, Invertebrata of Mass., ed. ii, p. 365, fig. 633. *Nassa fretensis* Perkins, Proceedings Boston Soc. Nat. History, vol. xiii, p. 117, figure, 1869 (variety).

Eastern coast of the United States; northward to Vineyard Sound; southward to Florida, and the Gulf of Mexico; not abundant north of Cape Hatteras. In Vineyard Sound and Long Island Sound, found sparingly in shallow water among eel-grass. New Bedford (Adams). Lloyd's Harbor, Huntington, and Northport, Long Island (S. Smith); Egmont Key, Florida (Jewett). It has been found in the Pliocene and Post-Pliocene of South Carolina.

Some of Say's original specimens were from South Carolina, others from Great Egg Harbor, New Jersey. At the latter locality I have also collected among eel-grass, in shallow water, the variety described by Dr. Perkins as *N. fretensis*, which is the most common form in all the more northern localities. Specimens intermediate between these and the ordinary southern forms are, however, of frequent occurrence, and the typical form also occurred in Vineyard Sound, with the variety.

TRITIA TRIVITTATA Adams. Plate XXI, fig. 112. (p. 354.)

H. and A. Adams, Genera of Recent Mollusca, vol. i, p. 122, 1858. *Nassa trivittata* Say, Journal Acad. Natural Sciences, Philadelphia, vol. ii, p. 231; Gould, Invert. of Mass., ed. ii, p. 364, fig. 632. *Buccinum trivittatum* Adams, Boston Journal of Nat. Hist., vol. ii, p. 265; Gould, op. cit., ed. i, p. 309, fig. 211.

Gulf of Saint Lawrence to Northern Florida. Eastport, Maine, and Bay of Fundy, 3 to 30 fathoms, not abundant; Casco Bay, 1 to 40 fathoms, abundant; Vineyard Sound and Buzzard's Bay, 0 to 14 fathoms, abundant; off Block Island, 29 fathoms; Long Island Sound, common. Gaspé, Canada (Dawson). Fossil in the Post-Pliocene of Point Shirley, Mass., Nantucket (Desor), Gull Island (Smith), Virginia, South Carolina, and North Carolina; in the Pliocene of South Carolina; and in the Miocene of Maryland, Virginia, and South Carolina.

ILYANASSA OBSOLETA Stimpson. Plate XXI, fig. 113. (p. 468.)

American Journal of Conchology, vol. i, p. 61, Plate 9, figs. 11, 12, 1865. *Nassa obsoleta* Say, Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 232, 1822; Binney's Say, p. 77, 1858; Gould, Invertebrata of Mass., ed. ii, p. 362, fig. 631; *Buccinum obsoletum* Gould, Invert. of Mass., ed. i, p. 308, fig. 210; *Tritia obsoleta* H. and A. Adams, Genera, p. 122, 1858.

Eastern and southern coasts of the United States; northward to Casco Bay, Maine, and the mouth of the Kennebeck River, and local in the southern part of the Gulf of Saint Lawrence; southward to Florida and the northern shores of the Gulf of Mexico. Extremely abundant on the whole coast south of Cape Cod; more local farther north, and mostly restricted to sheltered bays and harbors. It has not been found on the eastern part of the coast of Maine nor in the Bay of Fundy. An isolated colony of this species is found on the western and southern shores of the Gulf of Saint Lawrence and Prince Edward's Island (Bell, Dawson).

As a fossil it has been found in the Post-Pliocene deposits at Point Shirley, in Chelsea, Massachusetts (Stimpson); at Nantucket Island (Desor); Virginia; and South Carolina. It is also reported from the Pliocene of South Carolina.

UROSALPINX CINEREA Stimpson. Plate XXI, fig. 116. (p. 306.)

American Journal of Conchology, vol. i, p. 58, Plate 8, figs. 6 and 7, 1865. *Fusus cinereus* Say, Journal Academy Nat. Science, Philadelphia, vol. ii, p. 236, 1822; American Conchology, Plate 29, 1831. *Buccinum plicosum* Menke, Syn., ed. ii, p. 69, 1830, (t. Gould); Gould, Invertebrata of Mass., ed. i, p. 303, fig. 213. *Buccinum cinereum* Gould, op. cit., ed. ii, p. 370, fig. 637.

Eastern coast of the United States; northward to Massachusetts Bay, and local farther north, to the Gulf of Saint Lawrence; southward to Georgia and Northern Florida, and on the west coast of Florida, at Tampa Bay. Abundant in Vineyard Sound, Buzzard's Bay, Long Island Sound, and along the coast of the Middle States, especially on oyster-beds. In Vineyard Sound it occurs from above low-water mark to 8 fathoms. It occurs in some of the shallow and sheltered branches of Casco Bay, especially at the upper end of Quahog Bay, but has not been found on the islands, nor farther eastward along the coast of Maine, nor in the Bay of Fundy. A colony exists, however, in the southern part of the Gulf of Saint Lawrence, associated with the preceding and other southern species. It is found fossil in the Post-Pliocene of Point Shirley, Massachusetts, Nantucket, Gardiner's Island, Virginia, North Carolina, and South Carolina; in the Pliocene of South Carolina; and in the Miocene of Maryland.

EUPLEURA CAUDATA H. and A. Adams. Plate XXI, fig. 117. (p. 371.)

Genera of Recent Mollusca, vol. i, p. 107, 1858; Stimpson, Amer. Journal of Conchology, vol. i, p. 58, Plate 8, fig. 5 (dentition), 1865. *Ranella caudata* Say, Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 236, 1822; Gould, Invert. of Mass., ed. i, p. 297, fig. 176; ed. ii, p. 386, fig. 648.

Eastern coast of the United States; northward to Nantucket and Cape Cod; southward to northern Florida, and western Florida, at Tampa Bay. At Vineyard Sound it occurred living in considerable numbers in the shallow ditches on the marshes, as well as in the sound itself, in 1 to 8 fathoms; off New Haven, in 1 to 5 fathoms, not abundant; Great Egg Harbor, frequent among eel-grass in shallow water. Egmont Key, Florida (Jewett).

In the fossil state this species has been found in the Post-Pliocene of Virginia, North and South Carolina, and Florida; in the Pliocene of South Carolina; and in the Miocene of Maryland and South Carolina.

PURPURA LAPILLUS Lamarck. Plate XXI, figs. 118 to 120. (p. 306.)

Anim. sans Vert., ed. i, vol. vi, 1822; ed. ii, vol. x, p. 79; Gould, Invert. of Mass., ed. i, p. 301; ed. ii, p. 360, fig. 630. *Buccinum lapillus* Linné, Syst. Naturæ, ed. xii, p. 1202, 1767.

Watch Hill, Rhode Island; Montauk Point, Long Island; Cuttyhunk Island; shores of Vineyard Sound, at Nobsca Point; northward to the Arctic Ocean. On the European coast southward to Portugal. Northeastern coast of Asia. Sitka (Middendorff). This species is local south of Cape Cod, and has not been found to the eastward of Stonington, Connecticut, in Long Island Sound. It is extremely abundant along the northern coasts of New England and Nova Scotia, often nearly covering the surface of the rocks toward low-water mark, where they are encrusted by *Balanus balanoides*, upon which it chiefly feeds, inserting its proboscis between the opercular valves of the barnacle.

This shell has been found in the Post-Pliocene deposits at Waterville, Maine, and at Gardiner's Island, but is not a common fossil in this country. In England it is found in the Red-Crag and all later formations; it also occurs in the Post-Pliocene deposits of Scandinavia. The fossils show the same variations that are seen in the recent shells.

PTYCHATRACTUS LIGATUS Stimpson.

American Journal of Conchology, vol. i, p. 59, plate 8, fig. 8 (dentition), 1865. *Fasciolaria ligata* Mighels and Adams, Boston Journal of Nat. History, vol. iv, p. 51, Plate 4, fig. 17, 1842; Gould, Invert. of Mass., ed. ii, p. 385, fig. 647.

Casco Bay, Maine, to Labrador. Stonington, Connecticut (Linsley).

Casco Bay, 20 to 40 fathoms; Bay of Fundy, 15 to 60 fathoms. Halifax (Willis); Gaspé (Whiteaves); Murray Bay (Dawson); Mingan (Foote). This shell occurs sparingly at all these localities. It has not been recorded from south of Cape Cod by any one except Linsley, and it must be regarded as a very doubtful member of the fauna of Southern New England until rediscovered.

Dr. Dawson records one broken specimen from the Post-Pliocene of Montreal.

ANACHIS AVARA Perkins. (p. 306.)

Proceedings, Boston Soc. Nat. History, vol. xiii, p. 113, 1869 (in part). *Columbella avara* Say, Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 230, 1822; (in part) Gould, Invert. of Mass., ed. i, p. 313; ed. ii, p. 356 (in part).

Cape Cod to Northern Florida; Western Florida and the northern shores of the Gulf of Mexico. Vineyard Sound, from 0 to 10 fathoms; Long Island Sound; Great Egg Harbor, New Jersey; Nantucket (Adams); Fort Macon (Coues); South Carolina (Gibbes); Georgia (Couper); Western Florida (Jewett). North of Cape Cod, it is local and rare; Massachusetts Bay (Stimpson).

Fossil in the Post-Pliocene of North and South Carolina, and in the Pliocene of South Carolina.

Among the shells usually referred to this species there are great variations in form and sculpture, and the color is quite inconstant. The numerous specimens that I have examined from various localities can, however, be arranged in two groups, between which I have found no specimens that can be regarded as truly intermediate, although most of their distinctive characters are variable in each series. For the present, therefore, I have with some hesitation followed Mr. Ravenel in regarding these two principal forms as distinct species. As these species (or varieties) have not been distinguished by most writers, it is probable that some of the northern localities given above should properly go under the next species, which is far more abundant in Vineyard Sound and Long Island Sound than the typical *avara*, while the latter predominates in the collections from Fort Macon, North Carolina, and southward. The figures given by Dr. Gould represent the ordinary northern form of the following species. In the first part of this report both forms are included under *avara*.

From Fort Macon I have specimens that agree perfectly with Say's original description of *avara*. These are less elongated than the next species, and rather fusiform, the thickest part being but little below the middle, with the spire acute. The mature shells have ten flattened whorls; the first three or nuclear whorls are smooth; some of the succeeding ones usually have numerous vertical costæ; the last whorl has 10 to 13 more or less prominent, smooth obtusely rounded, somewhat curved costæ, separated by wider concave intervals, and gradually disappearing below the middle; below the costæ are numerous, well impressed revolving grooves, of which 8 or 10 are wider and deeper than the rest; similar but finer grooves cross the spaces between the costæ, but are mostly obsolete on the costæ; the middle whorls usually have a similar number of costæ, which are less prominent, and often more or less obsolete, while the spaces between are crossed by numerous fine revolving striæ. The canal is short, broad, and nearly straight; the outer lip well rounded, not incurved anteriorly, but with a decided emargination posteriorly. Length of mature shells, 13^{mm}; diameter, 6^{mm}, often smaller.

Specimens of the same size and form from Vineyard Sound and New Haven agree closely with the above description in most respects, but have 14 or 15 costæ on the last whorl, and about 20 on the preceding ones, where the costæ are so crowded that the spaces between are often narrower than the costæ.

ANACHIS SIMILIS Verrill. Plate XXI, fig. 109.

Columbella similis Ravenel, Proc. Acad. Nat. Sci., Philad., 1861, p. 41. *Columbella translirata* Ravenel, op. cit., p. 42. *Columbella avara* (in part) Gould, Invert., ed. i, p. 313, fig. 197; ed. ii, p. 356, fig. 726.

Massachusetts Bay to Georgia. Abundant in Vineyard Sound and Long Island Sound; Great Egg Harbor. Fort Macon (Dr. Yarrow.) This species is usually much more elongated than the preceding, with a more elevated spire, the broadest place being a little above the lower third of the length. Whorls, 10; flattened; the nuclear whorls smooth The canal is longer, and usually distinctly excurved; the outer lip is more or less incurved anteriorly, so as to slightly narrow the canal; the body-whorl has 18 to 20 or more rather regular, obtuse costæ, separated by spaces of about the same width, generally slightly nodular close to the suture; at some distance below the middle of the whorl they gradually disappear, but sometimes there are also smaller intermediate costæ below the middle of the whorl (var. *translirata*); the lower part of the whorl is covered with numerous well-impressed, revolving grooves, which cross the lower ends of the costæ, rendering them nodulous; on the upper part of the whorls the revolving grooves are larger and more distinct than in the preceding species, and usually continue over the costæ; the one next below the suture is usually larger than the rest, and thus produces the subsutural nodules; the grooves are generally least distinct in the middle of the lower whorl, which is sometimes slightly angulated. On the middle whorls there are numerous (usually more than 25) regular costæ, like those of the last one, and crossed by about 5 distinct revolving grooves, more conspicuous in the spaces between; the upper one largest, usually producing a distinct series of nodules on each whorl. Color exceedingly variable, generally dark reddish brown, chestnut, or light yellowish brown, more or less mottled and specked with whitish; there is often a subsutural band of white, or the nodules are white, and also a band of white around the middle of the last whorl, but these are frequently absent. Length of a rather large specimen, 17^{mm}; breadth, 7^{mm}; length of an average specimen, 13^{mm}; breadth, 5^{mm}; length of a slender specimen, 15^{mm}; breadth, 5^{mm}.

ASTYRIS LUNATA Dall. Plate XXI, fig. 110. (p. 306.)

Proceedings Boston Soc. Natural History, vol. xiii, p. 242, 1870. *Nassa lunata* Say, Journal Acad. Nat. Sciences, Philadelphia, vol. v, p. 213, 1826. *Buccinum lunatum* Adams, Boston Journ. Nat. Hist., vol. ii, p. 226; Gould, Invert. of Mass., ed i., p. 312, fig. 196. *Columbella lunata* Gould, op. cit., ed. ii, p. 359, fig. 629. *Fusus Trumbulli* Gould, Amer. Journ. Science, vol. vi, p. 235, fig. 7, 1848, (*non* Linsley). *Buccinum Wheatleyi* Dekay, Nat. Hist. of New York, Mollusca, p. 132, Plate 7, fig. 162, 1843. *Columbella Gouldiana* Ag. MSS.; Stimpson, Shells of New England, p. 48, 1851; Smith, Annals Lyceum Nat. Hist. of New York, vol. viii, p. 398, fig. 5, 1865. *Astyris* "*limata* Say" and *A.* "*Turnbullii* Linsl.," H. and A. Adams, Genera, vol. i, p. 187 (typographical errors).

Massachusetts Bay to Northern Florida and the northern shores of the Gulf of Mexico; local and not abundant north of Cape Cod, at Prov, incetown, Nahant, and Swampscott, Massachusetts. Very abundant in Vineyard Sound, from low-water to 10 fathoms; and in Long Island Sound; Great South Bay, Long Island; and Great Egg Harbor, New Jersey; Fort Macon, North Carolina, and southward. Estella Pass, Florida (Jewett); Georgia (Couper).

Fossil in the Post-Pliocene deposits of South Carolina; and at Gardiner's Island, New York (S. Smith); and in the Pliocene of South Carolina.

The color-variety, separated by several writers as *C. Gouldiana*, is identical with the *Wheatleyi* of Dekay.

ASTYRIS ZONALIS Verrill. Plate XXI, fig. 111. (p. 399.)

Buccinum zonalis Linsley, American Journal of Science, ser. i, vol. xlviii, p. 285, 1845 (no description); Gould, Amer. Journ. Science, series ii, vol. vi, p. 236, fig. 8, 1848. *Columbella dissimilis* Stimpson, Proceedings Boston Soc. Nat. History, vol. iv, p. 114, 1851; Shells of New England, p. 47, 1851; Gould, Invert. of Mass., ed. ii, p. 358, fig. 628.

Long Island Sound, near New Haven; Vineyard Sound; Casco Bay; Eastport, Maine, 10 to 60 fathoms. Grand Menan, New Brunswick, in 8 fathoms, sand, (Stimpson). Stonington (Linsley).

ASTYRIS ROSACEA H. and A. Adams. (p. 508.)

Genera of Recent Mollusca, vol. i, p. 187, 1858. *Buccinum rosaceum* Gould, American Journal of Science, xxxviii, p. 197, 1840; Invert. of Mass., ed. i, p. 311, fig. 195, 1841. *Columbella rosacea* Stimpson, Shells of New England, p. 47, 1851; Gould, Invert. of Mass., ed. ii, p. 257, fig. 627. (?)*Fusus Holböllii* Möller, Naturhistorisk Tidsskrift, vol. iv, p. 88, 1842.

East of Block Island, 29 fathoms, fine sandy mud; Stonington, Connecticut (Linsley); Massachusetts Bay to Gulf of Saint Lawrence; Isles of Shoals, 20 fathoms, and West Isles, 10 fathoms (Stimpson); Casco Bay, 10 to 20 fathoms; Bay of Fundy, 8 to 60 fathoms; Sable Island, Nova Scotia (Willis); Grand Menan, in deep water, (Stimpson).

The identity of *A. Holböllii*, from Greenland, with this species, is very doubtful, for it was described as smooth, with a firm corneus, fusco-luteus epidermis.

LUNATIA HEROS Adams. Plate XXIII, figs. 133 to 136. (p. 353.)

H. and A. Adams, Genera of Recent Mollusca, vol. i, p. 207, 1858; Gould, Invert. of Mass., ed. ii, p. 338, figs. 608, 609. *Natica heros* Say, Jour. Acad. Nat. Sci., Philadelphia, vol. ii, p. 248, 1822; Gould, Invert., ed. i, p. 231. *Natica triseriata* Say, op. cit., vol. v. p. 209 (color-variety); Gould, Invert., ed. i, p. 233. *Lunatia triseriata* Gould, op. cit., ed. ii, p. 340, fig. 610.

Georgia to Gulf of Saint Lawrence and southern coast of Labrador. Coast of New Jersey, near Great Egg Harbor, abundant and large, (A. E. V.) ;southern side of Long Island, at Fire Island beach, abundant, (S. I. Smith); Long Island Sound, at New Haven, not common; Vineyard Sound, abundant from low-water to 10 fathoms; Casco Bay, common; Bay of Fundy, common from low-water to 40 fathoms; Saint George's Bank, common, (S. I. Smith); Gaspé (Dawson); Georgia (Couper). The variety *triseriata* has the same distribution, and is the more common form in the deeper waters, but is also found on the sand-flats at low-water. It is common in Casco Bay and Bay of Fundy, in 1 to 40 fathoms; off Martha's Vineyard, 10 to 20 fathoms; and off New London, Connecticut, 10 fathoms.

This species has been found fossil in the Miocene of Maryland, Virginia, and South Carolina; in the Pliocene of South Carolina; and in the Post-Pliocene of Canada and South Carolina.

LUNATIA IMMACULATA Adams. Plate XXIII, fig. 131. (p. 508.)

H. and A. Adams, Genera of Recent Mollusca, vol. i, p. 207. *Natica immaculata* Totten, American Journal of Science, ser. i, vol. xxviii, p. 351, fig. 6, 1835; Gould, Invertebrata, ed. i, p. 234, fig. 168, 1841. *Mamma (?) immaculata* Gould, ed. ii, p. 344, fig. 614.

Stonington, Connecticut, and eastern end of Long Island, to Gulf of Saint Lawrence. Off Martha's Vineyard, 20 fathoms; east of Block Island, 29 fathoms. Stonington (Linsley); Off Napeague Point, Long Island (S. Smith); Newport, R. I. (Totten). Massachusetts Bay, Casco Bay, and Bay of Fundy, 5 to 80 fathoms, common; often found living at low-water mark in the Bay of Fundy.

NEVERITA DUPLICATA Stimpson. Plate XXIII, fig. 130. (p. 354.)

Smithsonian Check-List, p. 5, 1860; Gould, Invert. of Mass., ed. ii, p. 345, fig. 615. *Natica duplicata* Say, Jour. Acad. Nat. Sciences, Philadelphia, vol. ii, p. 247, 1822; Gould, Invert., ed. i, p. 236, fig. 164, 1841. *Lunatia duplicata* H. and A. Adams, Genera Recent Mollusca, vol. i, p. 207, 1858.

Massachusetts Bay to Northern Florida; northwestern Florida to Yucatan. Local and not common north of Cape Cod. Abundant at Nantucket; Vineyard Sound; Long Island Sound; southern coast of Long Island; New Jersey; and southward. Saint Augustine, Florida (Williams). Tampa Bay, Florida, and Egmont Key, abundant, (Jewett). Texas (Schott). Near Vera Cruz, Mexico (coll. T. Salt).

Fossil in the Miocene of Maryland, Virginia, North and South Carolina; Pliocene of South Carolina; and Post-Pliocene of Virginia, North Carolina, South Carolina, Saint John's River, and Tampa Bay, Florida.

NATICA PUSILLA Say. Plate XXIII, fig. 132. (p. 417.)

Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 257, 1822; Stimpson, Shells of New England, p. 43, 1851; Gould, Invert. of Mass., ed. ii, p. 344, fig. 613, (*not* of ed. i); Sanderson Smith, in Annals Lyc. Nat. History, New York, vol. ix, p. 396, fig. 4, 1870.

Vineyard Sound to Northern Florida. In Vineyard Sound and Buzzard's Bay this species is common in 2 to 10 fathoms. Huntington and Gardiner's Bay, Long Island, 4 to 5 fathoms, (S. Smith). South Carolina (Kurtz). Fort Macon, North Carolina (Coues). Georgia (Couper).

Acrybia flava H. and A. Adams, = *Natica flava* Gould, Invert., ed. i, p. 239, fig. 162; *Bulbus flavus* Gould, op. cit., ed. ii, p. 347, fig. 616. This species was catalogued by Linsley (1845) as from the stomachs of haddock taken off Stonington, Connecticut. It has not been subsequently recorded from south of Cape Cod by any one. It is not improbable that there was some mistake, either in respect to the locality or the identity of the specimens referred to by Linsley. It is an arctic species, found in the Bay of Fundy and at Saint George's Bank; northward to Greenland (Möller, as *N. nana*).

Natica clausa Brod. and Sowerby, was erroneously given by Mr. Perkins (Proc. Boston Soc. Nat. Hist., vol. xiii, p. 162) as from "Stonington, Connecticut, Linsley." It does not occur in Mr. Linsley's list, nor has it been found living, to my knowledge, south of Cape Cod. It occurs in Massachusetts Bay and northward to the Arctic Ocean. It is not uncommon in the Bay of Fundy from 6 to 109 fathoms; and in Casco Bay from 9 to 60 fathoms. One small dead specimen was dredged by us in 19 fathoms, off Gay Head.

CERITHIOPSIS GREENII Verrill. Plate XXIV, fig. 153. (p. 383.)

Cerithium Greenii C. B. Adams, Boston Journal of Natural History, vol. ii, p. 287, Plate 4, fig. 12, 1838; Gould, Invert., ed. i, p. 579, fig. 184. *Bittium Greenii* H. and A. Adams, Genera, vol. i, p. 287, 1858; Gould, Invert., ed. ii, p. 322, fig. 591.

Massachusetts Bay to South Carolina. Vineyard Sound and Buzzard's Bay, 3 to 10 fathoms; Long Island Sound, near New Haven. Dartmouth Harbor (Adams); Boston Harbor (Stimpson); Long Island (S. Smith); Fort Macon, North Carolina (Coues). Also reported from Bermuda.

Jeffreys (in Annals and Mag. Nat. Hist., Oct., 1872, p. 244) regards this as identical with the European *C. tubercularis*, and gives it a northern distribution. Both opinions appear to be incorrect.

CERITHIOPSIS EMERSONII Adams. Plate XXIV, fig. 151. (p. 417.)

H. and A. Adams, Genera, p. 240, 1858; Gould, Invert., ed. ii, p. 387, fig. 649 *Cerithium Emersonii* C. B. Adams, op. cit., p. 284, Plate 4, fig. 10, 1838; Gould, Invert., ed. i, p. 275, fig. 180.

Cape Cod to South Carolina. Vineyard Sound and Buzzard's Bay, 3 to 10 fathoms, shelly. Nantucket (Adams); Huntington and Greenport, Long Island (S. Smith). Fossil in the Miocene of North Carolina, (Conrad). Jeffreys (in British Conchology, vol. iv, p. 257) regards this species as identical with *Cerithium metula* Lovén, 1846, on the authority of Danielssen. This appears to be an erroneous identification.

CERITHIOPSIS TEREBRALIS Adams. Plate XXIV, fig. 150. (p. 417.)

H. and A. Adams, Genera, vol. i, p. 241, 1858; Gould, Invert., ed. ii, p. 389, fig. 650. *Cerithium terebrale* C. B. Adams, Boston Journal Nat. Hist., vol. iii, p, 320, Plate 3, fig. 7, 1840; Gould, Invert., ed. i, p. 276, fig. 181. *Cerithium terebellum* C. B. Adams, Catalogue Genera and Species of Recent Shells in Collection of C. B. A., p. 13, 1847.

Cape Cod to South Carolina. Vineyard Sound and Buzzard's Bay, 2 to 12 fathoms, not uncommon. New Bedford, Massachusetts (Adams). Greenport and Huntington, Long Island (S. Smith). Fort Macon, North Carolina (Coues).

TRIFORIS NIGROCINCTUS Stimpson. Plate XXIV, fig. 152. (p. 305.)

Smithsonian Check-List, p. 5, 1860; Gould, Invert., ed. ii, p. 323, fig. 592. *Cerithium nigrocinctum* C. B. Adams, Boston Jour. Nat. Hist., vol. ii, p. 286, Plate 4, fig. 11, 1838; Gould, Invert., ed. i, p. 277, fig. 182.

Cape Cod to South Carolina. Vineyard Sound and Buzzard's Bay, low-water to 10 fathoms, not uncommon; near New Haven; and Great Egg Harbor, New Jersey. Dartmouth, Massachusetts (Adams). Huntington and Greenport, Long Island (S. Smith). Fort Macon (Coues).

BITTIUM NIGRUM Stimpson. Plate XXIV, fig. 154. (p. 305.)

Smithsonian Check-List, p. 5, 1860; Gould, Invert., ed. ii, p. 321, fig. 590. *Pasithea nigra* Totten, American Jour. of Science, vol. xxvi, p. 369, Plate 1, fig. 7, 1834. *Cerithium reticulatum* Totten, op. cit., vol. xxviii, p. 352, fig. 8, 1835 (*non* Da Costa). *Cerithium Sayi* Menke (t. Gould); Gould, Invert., ed. i, p. 278, fig. 183.

Massachusetts Bay to South Carolina; local north of Cape Cod, in Boston Harbor (Totten), and in the Gulf of Saint Lawrence, at Pictou and Prince Edward's Island (Dawson). It is not found on the coast of Maine nor in the Bay of Fundy. Vineyard Sound and Buzzard's Bay, abundant, low-water to 8 fathoms, among algæ and eel-grass; Long Island Sound; and Great Egg Harbor, New Jersey, abundant. Fort Macon (Coues).

The *Bittium alternatum* (*Turritella alternata* Say, 1822) is a very closely related species, and probably identical with this.

Turritella erosa Couthouy, recorded, with a mark of doubt, by Linley, as from the stomach of a cod, off Stonington, Conn., was perhaps incorrectly identified. It may have been a worn *Cerithiopsis terebralis*. The true *T. erosa* is a decidedly northern species, common in Casco Bay and the Bay of Fundy, and extending northward to the Arctic Ocean, and southward on the northern coasts of Europe, and on the North Pacific coast of America. It has not been recorded from south of Cape Cod by any one except Linsley.

VERMETUS RADICULA Stimpson. Plate XXIV, fig. 157. (p. 417.)

Shells of New England, p. 37, 1851; Gould, Invert., ed ii, p. 316, fig. 584. *Vermetus lumbricalis* Gould, ed. i, p. 246, and various other American authors, (*non* Lamarck).

Cape Cod to Florida. Vineyard Sound and Buzzard's Bay, 3 to 10 fathoms, not uncommon; Long Island Sound. Fort Macon, North Carolina, common, (Coues).

Fossil in the Post-Pliocene of North Carolina.

CÆCUM PULCHELLUM Stimpson. Plate XXIV, fig. 158. (p. 417.)

Proceedings Boston Society of Natural History, vol. iv, p. 112, 1851; Shells of New England, p. 36, Plate 2, fig. 3, 1851; Gould, Invert., ed. ii, p. 315, fig. 583.

Vineyard Sound, 1 to 4 fathoms, and dead on shore at Nobsca Beach. New Bedford (Stimpson). Greenport, Long Island, 10 fathoms, sand, (S. Smith).

Dead shells of this species readily lose the outer layer, in which the annulations are formed; they then become white and smooth, without any trace of annulations, and might be mistaken for a different species.

CÆCUM COOPERI Smith.

Sanderson Smith, Annals Lyceum Nat. Hist., New York, vol. vii, p. 154, 1860; op. cit., vol. ix, p. 393, fig. 3, 1870, (*non* Carpenter, 1864). *Cæcum costatum* Verrill, American Journal of Science, vol. iii, p. 283, 1872; this Report, p. 417.

Vineyard Sound, 8 to 10 fathoms. Gardiner's Bay, Long Island, 4 to 5 fathoms, sand, (Smith).

The first description of this species was formerly overlooked by me; as it antedates the description of the Californian species to which Dr. Carpenter gave the same name, the present species must be called *Cooperi*.

In the adolescent stage of growth this species enlarges rather rapidly, and has 12 or 13, distinct, elevated, rounded costæ, narrower than the intervals between; the circular grooves are numerous, unequal, interrupted over the costæ, and broader toward the aperture. The aperture is rounded within; its margin is stellated externally by the costæ.

CREPIDULA FORNICATA Lamarck. Plate XXIII, fig. 129. (p. 417.)

Animaux sans Vert., vol. vii, p. 641; Say, Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 225, 1822; Gould, Invert., ed. i, p. 158, fig. 17; ed. ii, p. 271, fig. 532(?). *Patella fornicata* Linné, Syst. Nat., ed. xii, p. 1257.

Casco Bay, Maine, to Florida, and the northern shores of the Gulf of Mexico. Local north of Massachusetts Bay; in the southern part of the Gulf of Saint Lawrence, at Prince Edward's Island, &c. Halifax (Willis). Saint George's Bank (S. I. Smith). It is common in the shallow and sheltered parts of Casco Bay, but has not been found east of the Kennebeck River, on the coast of Maine, nor in the Bay of Fundy. Very abundant in Vineyard Sound and Buzzard's Bay, from low-water to 12 fathoms; in Long Island Sound, near New Haven, low-water to 6 fathoms; Great Egg Harbor, New Jersey; and everywhere southward. Egmont Key and Tampa Bay, Florida (E. Jewett).

Fossil in the Miocene of Maryland, North and South Carolina; Pliocene of South Carolina; and Post-Pliocene of North and South Carolina, Gardiner's Island, New York, and Nantucket Island.

The *fornicata* of Linné was described as a Mediterranean species, and may not be identical with the American shell.

CREPIDULA PLANA Say. Plate XXIII, fig. 127.

Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 226, 1822; Gould, Invert., ed. i, p. 159, fig. 16; ed. ii, p. 272, fig. 533. *Crepidula unguiformis* Stimpson, Shells of New England, p. 30, 1851; this Report, pp. 355, 417 (*non* Lamarck, 1822).

Massachusetts Bay to Florida and the northern shores of the Gulf of Mexico. Local and less abundant farther north, in Casco Bay, Maine; Nova Scotia (Willis); Gulf of Saint Lawrence (Bell, Dawson); and Saint George's Bank (S. I. Smith). Not found on the eastern part of the coast of Maine, nor in the Bay of Fundy. Very common in Vineyard Sound, Buzzard's Bay, and Long Island Sound, from low-water mark to 12 fathoms, on the *outside* of oysters, *Limuli*, and various dead shells, as well as on the *inside* of various dead univalve shells; in all these situations frequently associated with the preceding species, but no intermediate forms have been observed.

Fossil in the Miocene of North and South Carolina; Pliocene of South Carolina; and in the Post-Pliocene of Gardiner's Island, New York, North Carolina, South Carolina, and Florida.

The Mediterranean shell, *C. unguiformis* Lamarck, is a distinct species.

CREPIDULA CONVEXA Say. Plate XXIII, fig. 128. (p. 355.)

Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 227, 1822; Gould, Invert., ed. i, p. 160, fig. 15; ed. ii, p. 273, fig. 534. *Crepidula glauca* Say, op. cit., p. 226; Gould, Invert., ed. ii, p. 274, fig. 535; ed. i, p. 151, fig. 14. *Crepidula acuta* H. C. Lea, American Jour. Science, ser. i, vol. xlii, p. 108, Plate 1, fig. 4, 1842.

Massachusetts Bay to Florida. Less abundant and local farther north; at Quahog Bay, Maine; Nova Scotia (Willis); and Gulf of Saint Lawrence. Very common in Vineyard Sound, Buzzard's Bay, Long Island Sound, shores of Long Island, and Great Egg Harbor, New Jersey. Fort Macon, North Carolina (Coues). Georgia (Couper).

Fossil in the Post-Pliocene of Virginia and South Carolina.

The distribution of this species is probably identical with that of *Eupagurus longicarpus* and *Ilyanassa obsoleta*, with which it is nearly always associated. At Quahog Bay, Maine, this species occurs on the back of the dead shells of *I. obsoleta*, which are occupied by the hermit-crab, just as in the waters of Southern New England; and these, with numerous other southern forms associated with them, constitute a genuine southern colony, occupying a warm, sheltered bay, surrounded on all sides by the northern fauna.

The depressed variety (*glauca*) is found chiefly on broad and nearly flat surfaces of large bivalve shells, stones, &c. The very convex varieties adhere mainly to the surfaces of small convex univalves.

CRUCIBULUM STRIATUM Adams. Plate XXIII, figs. 125, 126. (p. 417.)

H. and A. Adams, Genera of Recent Mollusca, vol. i, p. 366; Gould, Invert., ed. ii, p. 275, fig. 536. *Calyptræa (Dispotæa) striata* Say, Journ. Acad. Nat. Sciences Philadelphia, vol. v, p. 216, 1836. *Crucibulum (Dispotæa) striata* H. and A. Adams, Genera, vol. i, p. 366, 1858.

Bay of Fundy to New Jersey. Eastport Harbor and Bay of Fundy, low-water mark to 30 fathoms, common; Frenchman's Bay and Mount Desert, Maine, 3 to 10 fathoms, common; Casco Bay, Maine, 6 to 40 fathoms; Vineyard Sound and Buzzard's Bay, 3 to 12 fathoms, not uncommon. Gardiner's Bay and Montauk Point, Long Island (S. Smith). Off New London, Conn. (coll. T. M. Prudden). Saint George's Bank (S. I. Smith). Northern New Jersey (Say).

LITTORINA IRRORATA Gray. (p. 372.)

Zoology of Captain Beechey's Voyage, p. 138, Plate 38, fig. 1, 1839. Gould, Invert., ed. ii, p. 311, fig. 579. *Turbo irroratus* Say, Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 239, July, 1822; Binney's Say, p. 81. *Phasianella sulcata* Lamarck, Animaux sans Vert., ed. i, vol. vii, p. 54, Aug., 1822; ed. ii, vol. ix, p. 244. *Littorina sulcata* Deshayes, in Lamarck, op. cit., vol. ix, p. 203, 1843.

Vineyard Sound to Florida and the northern shores of the Gulf of Mexico. Vineyard Sound, sparingly; Long Island Sound, near New Haven, rare. Stratford, Connecticut, on high sedge (Linsley). Huntington, Long Island (S. Smith). Comparatively rare and local north of Maryland; very abundant farther south.

Many of the shells of this species found on our shores have undoubtedly been brought from Virginia and Maryland with the southern oysters planted in our waters, but it is probably indigenous in certain localities.

LITTORINA RUDIS. Plate XXIV, fig. 137. (p. 305.)

Gould, Invert., ed. i, p. 257, fig. 165, 1841; ed. ii, p. 304, fig. 575. *Turbo rudis* Maton, Nat. Hist. and Antiq. West. Count., vol. i, p. 277, 1797, (t. Jeffreys); Donovan, British Shells, vol. i, Plate 33, fig. 3, 1800, (t. Gould.) *Turbo obligatus* Say, Jour. Acad. Nat. Sci., Philad., vol. ii, p. 241, 1822. *Turbo vestitus* Say, op. cit., p. 241, 1822 (variety *tenebrosa*). *Littorina Grönlandica* Möller, in Kroyer's Tidsskrift, vol. iv, p. 82, 1842. *Turbo tenebrosus* Montagu, Test. Brit., p. 303, Plate 20, fig. 4, 1803 (variety). *Littorina tenebrosa* Gould, ed. i, p. 259, fig. 166; ed. ii, p. 306, fig. 576.

Among the additional names that appear to have been applied to the various states of this variable species are: *L. saxatilis* Johnson; *Turbo sulcatus* Leach; *Turbo jugosus* Montagu; *L. patula* (*var.*) Jeffreys; *L. neglecta* Bean; *T. ventricosus* Brown; *L. marmorata* Pfeiffer; *Nerita littorea* Fabricius (*non* Linné); *L. Grönlandica* Möller, Lovén, Mörch; *L. rudissima* Bean; *L. zonaria* Bean; *L. neglecta* Bean, etc.

Great Egg Harbor, New Jersey, northward to the Arctic Ocean; Greenland; Iceland; Spitzbergen. Northern coasts of Europe to Great Britain and Spain. Local south of Long Island Sound; abundant on all the rocky shores of Southern New England, from New York to Cape Cod, and at the eastern end of Long Island; local at Great Egg Harbor, among *Fucus*, on the stones of an old pier. Extremely abundant on all the northern shores of New England and northward. Fossil in the Post-Pliocene of Canada, Great Britain, and Scandinavia.

LITTORINA PALLIATA. Plate XXIV, fig. 138. (p. 305.)

Gould, Invert. of Mass., ed. i, p. 260, fig. 167, 1841; ed. ii, p. 309, fig. 578. *Turbo palliatus* Say, op. cit., p. 240, 1822. *Littorina neritoidea* Dekay, Mollusca New York, p. 105, Plate 6, figs. 109–111 (*non Turbo neritoidea* Linné). *Littorina littoralis* Stimpson, Shells of New England, p. 33, (*non* Forbes and Hanley; *non Nerita littoralis* Linné). *Turbo littoralis* Fabricius, Fauna Grœnlandica, p. 402, 1780 (*non* Linné). *Littorina arctica* Möller, Kroyer's Tidsskrift, vol. iv, p. 82, 1842. (?) *Littorina limata* Lovén, Ofversigt af Kongl. Vet.-Akad. Förhandlingar, vol. iii, p. 154, 1846. *Littorina Peconica* S. Smith, Annals Lyceum Nat. Hist., New York, vol. vii, p. 155, 1860.

Great Egg Harbor, New Jersey, to the Arctic Ocean; Greenland, Spitzbergen, Finmark, and Norway. Very abundant from New York to Cape Cod and northward, wherever *Fuci* grow on rocks between tides; local and less abundant south of Long Island Sound.

Fossil in the Post-Pliocene of Great Britain and Scandinavia.

Should this species prove to be identical with *L. obtusata* (Linné, sp.) of Europe, as there is reason to anticipate, its range will be nearly coincident with that of *L. rudis*, with which it is always found associated on our coast. Several writers have already united the two forms, but no satisfactory comparisons of large series of specimens, from many localities on both coasts, have been made.

LACUNA VINCTA Turton. Plate XXIV, fig. 139. (p. 305.)

Gould, Invert., ed. i, p. 262, figs. 169, 178*, 1841; ed. ii, p. 302, fig. 573. *Turbo vincta* Montagu, Test. Brit., p. 307, Plate 20, fig. 3, (t. Gould). *Trochus divaricatus* Fabricius, Fauna Grönlandica, p. 392, 1780 (*non* Linné). *Lacuna divaricata* Lovén, op. cit., p. 155, 1846; Jeffreys, British Conchology, vol. iii, p. 346.

According to Jeffreys, the following are among the synonyms or varieties of this species: *Turbo canalis* Montagu; *T. quadrifasciata* Mont.; *Phasianella fasciata*, *P. bifasciata*, *P. cornea*, and *P. striata* Brown; *Lacuna solidula* Lovén; *L. labiosa* Lovén; *L. frigida* Lovén.

New York to the Arctic Ocean; Greenland, Iceland, Lapland, Scandinavia, Great Britain, France; on the Pacific coast of America southward to Puget Sound. Long Island Sound, common, but rather local; Watch Hill, Rhode Island, among algæ, in 4 to 5 fathoms; Vineyard

Sound; Buzzard's Bay. Very abundant north of Massachusetts Bay, in Casco Bay, Bay of Fundy, Labrador, etc. Staten Island and Long Island (S. Smith).

Fossil in the Post-Pliocene of northern Great Britain and Scandinavia.

Lacuna neritoidea Gould.

American Journ. of Science, vol. xxxviii, p. 197, 1840; Invert., ed. i, p. 263, fig. 170; ed. ii, p. 303, fig. 574.

This species is a very doubtful inhabitant of this region, having been recorded by no one except Linsley, 1845, who reports it from Long Island Sound (Oyster River and Long Beach, Stratford, Connecticut). I have never been able to find it in the same region, nor has any one else had better success. Linsley's specimens may have been incorrectly named. It occurs in Massachusetts Bay; at Cape Elizabeth, Casco Bay; Grand Menan Island, etc.; northward to Greenland; and on the northern shore of Europe.

LITTORINELLA MINUTA Stimpson. Plate XXIV, fig. 140. (p. 469.)

Researches upon the Hydrobiinæ and Allied Forms, p. 42, May, 1865, in the Smithsonian Miscellaneous Collections. *Turbo minutus* Totten, American Journ. Science, ser. i, vol. xxvi, p. 369, fig. 6, 1834. *Cingula minuta* Gould, Invert., ed. i, p. 265, fig. 171. *Rissoa minuta* Gould, op. cit., ed. ii, p. 298, fig. 566. *Ecrobia minuta* (provisional name) Stimpson, op. cit., p. 42, 1865. *? Cingula modesta* Lea, Boston Journal of Natural History, vol. v, p. 288, Plate 24, fig. 5.

The tentacles in this species are rather short, scarcely exceeding the breadth of the head, slightly tapering, blunt; the eyes are on low prominences on the outer side of the bases of the tentacles; rostrum large, stout, transversely wrinkled, longer than the tentacles, tapering somewhat, but divided at the end by a deep emargination into two rounded lobes, which are often somewhat expanded. Foot short and broad, subtruncate anteriorly, with the angles broad and but little produced, posterior end broadly rounded.

New Jersey to Nova Scotia and Gulf of Saint Lawrence. Abundant along the brackish and muddy shores of Long Island Sound, Buzzard's Bay, Vineyard Sound, Massachusetts Bay, Casco Bay, and Bay of Fundy.

It is not confined to brackish waters, but often occurs also on the ocean shores, under stones between tides.

LITTORINELLA LÆVIS Verrill.

Cingula lævis Dekay, Natural History of New York, Mollusca, p. 111, Plate 6, fig. 118 (poor), 1843. *Odostomia limnoidea* (Dekay, MSS.), Linsley, Amer. Journ. Science, ser. i, vol. xlviii, p. 284, 1845 (no description). (?)*Rissoa Stimpsoni* S. Smith, Annals Lyceum Nat. Hist., New York, vol. ix, p. 393, fig. 2, 1870.

Long Island Sound, near New Haven. Stratford, Connecticut (Linsley); near New York (Dekay); Greenport, Long Island (S. Smith).

RISSOA ACULEUS Stimpson. Plate XXIV, fig. 141. (p. 306.)

Proc. Boston Soc. Nat. Hist., vol. iv, p. 15, 1851; Shells of New England, p. 34; Gould, Invert., ed. ii, p. 299, fig. 568. *Cingula aculeus* Gould, Invert., ed. i, p. 266, fig. 172, 1841. *Trochus striatellus* Fabricius, Fauna Grönl., p. 393, (*non* Linné). (?)*Rissoa saxatilis* Möller, Index Mollusca Grönl., in Kroyer's Tidsskrift, vol. iv, p. 82, 1843. (?)*Rissoa arctica* Lovén, Ofversigt af Kongl., Vet.-Akad. Förhandlingar, vol. iii, p. 156, 1846.

Long Island Sound to Greenland. New Haven, Connecticut, and vicinity, common. Watch Hill, Rhode Island; Vineyard Sound; Stratford, Connecticut (Linsley); Gull Island (Smith). Common on the shores of Massachusetts Bay, Casco Bay, and Bay of Fundy.

Lovén's *R. arctica* was from Finmark, and, to judge from the descriptions, may not be identical with our species. Mr. Jeffreys regards it as a variety of *R. striata* of Europe. He also unites the American shell with *R. striata*, thus: "The variety *arctica* (under the specific name *aculeus* given to it by Professor Stimpson) inhabits the northern sea-board of the United States." (See British Conchology, vol. iv, p. 38). It is natural to infer that a writer who does not appear to have seen the accurate description and figure of this species published in the well-known work of Dr. Gould, ten years previous to Dr. Stimpson's earliest publications, cannot have devoted much time or attention to the American shells, and therefore his opinions should not have too much weight in such cases.

In reality, our shell differs widely from *R. striata*. It agrees more nearly with the English *R. proxima* (Alder, Forbes and Hanley), but apparently differs from it in the soft parts. The foot in our shell is broadly and slightly rounded anteriorly, with the angles only slightly produced, and tapers backward to a bluntly-rounded posterior end. The tentacles are long, slender, slightly tapering, with blunt tips. The eyes are situated near their bases on the dorso-lateral aspect, and are scarcely elevated above the general surface. The snout is rather long, often a little expanded at the end, and divided by a deep emargination into two lobes, which often, in a dorsal view, show a slight emargination on their outer surface. No opercular cirrus was observed. This species belongs to the genus *Onoba* of H. and A. Adams. The *R. saxatilis* was described by Möller as having the whorls *smooth*, but he refers to *T. striatellus* of Fabricius, which had spiral striations, as in our species.

RISSOA EXARATA Stimpson. (p. 495.)

Proceedings Boston Soc. Nat. Hist., vol. iv, p. 15, 1851; Shells of New England, p. 34, Plate 1, fig. 3, 1851; Gould, Invert., ed. ii, p. 301, fig. 571. *Cingula arenaria* Mighels and Adams, Boston Jour. Nat. Hist., vol. iv, p. 49, Plate 4, fig. 24, 1842 (*non* Montagu, sp.). *Rissoa Mighelsii* Stimpson, Proc. Bost. Soc. Nat. Hist., vol. iv, p. 15, 1851; Shells of New England, p. 34; Gould, Invert., ed. ii, p. 301, (but not figure 570, which is probably *R. sulcosa*).

Stonington, Connecticut, to Gulf of Saint Lawrence. Watch Hill, Rhode Island, 4 to 5 fathoms, among rocks and algæ (white variety); Casco Bay, 6 to 25 fathoms; Bay of Fundy, 4 to 20 fathoms. Fossil in the Post-Pliocene of Canada. This species is usually brownish or chestnut-color, but is also frequently white.

Rissoa eburnea Stimpson, has been recorded (as *Rissoella* (?) *eburnea*) by Dr. G. H. Perkins, from Long Island Sound, near New Haven, but I have seen no undoubted shells of this species from any locality south of Massachusetts Bay. The shell referred to by Dr. Perkins was beach-worn, and may have been some other species. The figure given in the second edition of Gould's Invertebrata (fig. 564, p. 297), does not represent this species. See the figure in Stimpson's Shells of New England, Plate 1, figs. 1, 1*a*. This shell appears to be a *Jeffreysia*.

From Huntington, Long Island, I have seen a shell closely resembling *Rissoa latior* Stimpson, (M. and Adams, sp.), if not identical with it.

SKENEA PLANORBIS. Plate XXIV, fig. 142. (p. 383.)

Forbes and Hanley, British Mollusca, vol iii, p. 156, Plate 74, figs. 1–3, and Plate G, G, figs. 1 and 1*a* (animal); Stimpson, Shells of New England, p. 35; Gould, Invert., ed. ii, p. 296, fig. 563. *Turbo planorbis* Fabricius, Fauna Grönl., p. 394, 1780. *Skenea serpuloides* Gould, Invert., ed. i, 247, fig. 189.

Long Island Sound to Greenland, Iceland, Spitzbergen, Scandinavia; and northern and eastern coasts of Europe generally, to England and France. Near New Haven, Connecticut, common; Watch Hill, Rhode Island; Cuttyhunk Island. Very common on all rocky shores in Massachusetts Bay, Casco Bay, and Bay of Fundy. Fossil in the Post-Pliocene of Scotland and Scandinavia.

STYLIFER STIMPSONII Verrill. (p. 460.)

American Journal of Science, vol. iii, pp. 210 and 283, 1872.

Shell white, short, swollen, broad oval; spire short, rapidly enlarging. Whorls four or five, the last one forming a large part of the shell; convex, rounded, with the suture impressed, surface smooth, or with very faint striæ of growth; a slightly impressed revolving line just below the suture. Aperture large and broad. Length about .15 of an inch; breadth, .12.

Parasitic on the dorsal surface of *Strongylocentrotus Dröbachiensis*, from off New Jersey, in 35 fathoms (Captain Gedney); and Saint George's Bank, north latitude 41° 25′, west longitude 65° 50′, 3″, in 60 fathoms, (S. I. Smith).

EULIMA OLEACEA Kurtz and Stimpson. Plate XXIV, fig. 149. (p. 418.)

Proceedings Boston Soc. Nat. Hist., vol. iv, p. 115, 1851; Stimpson, Shells of New England, p. 39, Plate 1, fig 6, 1851; Gould, Invert., ed. ii, p. 332, fig. 603.

Vineyard Sound to Beaufort, North Carolina. In Vineyard Sound it is not uncommon on *Thyone Briareus*, in 4 to 10 fathoms. Buzzard's Bay (Stimpson).

ODOSTOMIA PRODUCTA Gould. Plate XXIV, fig. 143. (p. 418.)

Invert., ed. i, p. 270, fig. 175, 1841; ed. ii, p. 325, fig. 593. *Jaminia producta* Adams, Boston Journal Nat. Hist., vol. iii, p. 322, Plate 3, fig. 8, 1840.

Vineyard Sound to New Jersey.

ODOSTOMIA FUSCA Gould. Plate XXIV, fig. 144. (p. 307.)

Invert., ed. i, p. 270, fig. 176; ed. ii, p. 325, fig. 594. *Pyramis fusca* Adams, op. cit., vol ii, p. 282, Plate 4, fig. 9, 1839.

Cape Cod to New Jersey.

This species is referred both to *Turbonilla* and *Odostomia* by H. and A. Adams, in the same work (Genera Moll., pp. 231, 232).

ODOSTOMIA DEALBATA Stimpson.

Smithsonian Check-List, p. 5, 1860; Gould, Invert., ed. ii, p. 327, fig. 595. *Chemnitzia dealbata* Stimpson, Proc., Boston Soc. Nat. Hist., vol. iv, p. 114, 1851; Shells of New England, p. 41.

Long Island Sound to Boston Harbor. New Haven, Connecticut (Perkins). Boston (Stimpson).

ODOSTOMIA BISUTURALIS Gould. (p. 307.)

Invert., ed. ii, p. 327, (not fig. 597). *Turritella bisuturalis* Say, Journ. Acad. Nat. Sci., Philadelphia, vol. ii, p. 244, 1822. *Chemnitzia bisuturalis* Stimpson, Shells of New England, p. 42. *Jaminia exigua* Couthouy, Boston Journ. Nat. Hist., vol. ii, Plate 1, fig. 7, 1838. *Odostomia exigua* Gould, Invert., ed. i, p. 272, fig. 177.

New Jersey to Massachusetts Bay. Boston (Say); Chelsea (Couthouy); Staten Island; Greenport, and Huntington, Long Island (S. Smith). Not uncommon in Long Island Sound, Vineyard Sound, and Buzzard's Bay.

The figure (597) in the second edition of Gould's Invertebrata does not represent this species, but apparently a variety of *O. trifida*.

ODOSTOMIA TRIFIDA Gould. Plate XXIV, figs. 145, 146. (p. 307.)

Invert., ed. i, p. 274, fig. 179, 1841; ed. ii, p. 328, fig. 598. *Actæon trifidus* Totten, Amer. Journ. Science, ser. i, vol. xxvi, p. 368, Plate 1, figs. 4, *a*, *b*, 1834.

New Jersey to Massachusetts Bay. Staten Island (S. Smith); Lynn, Massachusetts (Haskell). Common in Long Island Sound, Vineyard Sound, and Buzzard's Bay.

ODOSTOMIA IMPRESSA Stimpson. Plate XXIV, fig. 147. (p. 418.)

American Journ. Science, vol. xxiv, p. 444, 1860; Gould, Invert., ed. ii, p. 330, fig. 600. *Odostomia insculpta* Dekay, Nat. Hist. N. Y., Mollusca, p. 115, Plate 31, fig. 297, 1843. *Turritella impressa* Say, Journ. Acad. Nat. Sci., Philadelphia, vol. ii, p. 244, 1822; Binney's Say, p. 84. *Chemnitzia impressa* Stimpson, Shells of New England, p. 42, 1851.

Long Island Sound to South Carolina. Near New Haven, Connecticut, rare. East River (Dekay); Maryland (Say); Beaufort, North Carolina (Stimpson, Coues).

ODOSTOMIA SEMINUDA Gould. Plate XXIV, fig. 148. (p. 418.)

Invert., ed. i, p. 273, fig. 178, 1841; ed. ii, p. 329, fig. 599. *Jaminia seminuda* C. B. Adams, Boston Journal Nat. Hist. vol. ii, p. 280, Plate 4, fig. 13, 1839. *Chemnitzia seminuda* Stimpson, Shells of New England, p. 42, 1851. *Turbonilla seminuda* H. and A. Adams, Genera Moll., vol. i, p. 231.

Massachusetts Bay to South Carolina. Common in Vineyard Sound and Buzzard's Bay, in 2 to 10 fathoms; Long Island Sound, less common. Massachusetts Bay (Stimpson). Greenport and Huntington, Long Island (S. Smith). Fort Macon, North Carolina (Coues).

TURBONILLA INTERRUPTA Adams. (p. 418.)

H. and A. Adams, Genera, vol. i, p. 231, 1858; Gould, Invert., ed. ii, p. 231, fig. 601 (bad figure). *Turritella interrupta* Totten, Amer. Jour. Science, ser. i, vol. xxviii, p. 352, fig. 7, 1835; Gould, Invert., ed. i, p. 268, fig. 173 (incorrect).

Cape Cod to South Carolina. Quite common in Vineyard Sound and Buzzard's Bay, in 3 to 10 fathoms; Long Island Sound, off Thimble Islands and New Haven, 3 to 5 fathoms, rather rare. Huntington and Greenport (S. Smith). Dartmouth, Massachusetts (Adams). Newport, Rhode Island (Totten). Fort Macon, North Carolina (Coues).

I have received from Prof. E. S. Morse specimens of this shell obtained from mud in the harbor of Portland, Maine, but they are dead and bleached. I am not aware that it has been found living so far north on our coast. Fossil in the Post-Pliocene of South Carolina.

Lovén records this species as from the coast of Norway, but possibly his shell is a different species, or else a variety of *T. rufa* of Southern Europe, which is certainly very closely related to our species, and is considered the same by Jeffreys. If so, the name given by Totten has precedence of *rufa* (Philippi, 1836). Farther and more extensive comparisons must be made before the identity of the two forms can be established.

The figure given in the first edition of Gould's Invertebrata, and copied in the second edition, does not correctly represent this shell, and was, perhaps, drawn from some other species, for it does not agree with Gould's description, which is accurate. The spire, as represented, is too acute and too rapidly tapered; the last or body whorl is too large; the aperture has not the right form; and the peculiar sculpture is not brought out at all. Totten's figure, though somewhat coarse, is characteristic.

TURBONILLA ELEGANS Verrill. Plate XXIV, fig. 155. (p. 418.)

American Journal of Science, ser. iii, vol. iii, pp. 210, 282, Plate 6, fig. 4, 1872.

Shell light yellowish, elongated, moderately slender, acute. Whorls ten or more, well rounded, not distinctly flattened; suture rather deeply impressed; surface somewhat lustrous, with numerous rounded vertical costæ, narrower than the concave interspaces, fading out below the middle of the last whorl; and with numerous fine revolving grooves, which are interrupted on the costæ, but distinct in the intervals; on the upper whorls there are about five; and on the lower half of the last whorl usually five or six distinct and continuous ones. Aperture broad oval, anteriorly rounded and slightly effuse; outer lip thin, sharp; columella nearly straight at base within, slightly revolute outwardly, regularly curved anteriorly where it joins the outer lip, and not forming an angle with it. The epidermis is thin, light yellow, sometimes with a darker, yellowish, revolving band on the middle of the last whorls, and also with the revolving striæ darker.

Vineyard Sound, 6 to 10 fathoms; Long Island Sound, near New Haven, 5 fathoms.

TURBONILLA AREOLATA Verrill, sp. nov.

Shell small, slender, with eight or more whorls, slightly obelisk-shaped, owing to the more rapid narrowing of the upper whorls; apical or nuclear whorl very small, reversed; the other whorls are moderately convex, somewhat flattened in the middle, and crossed by numerous rather crowded, narrow, transverse costæ, of which there are twenty-five or more on the lower whorls; interstices interrupted by numerous rather conspicuous, revolving, impressed lines, of which there are about six on the upper whorls; these divide the interstices into series of pretty regular, small, squarish pits, but do not cross the costæ; the body-whorl is subangulated below the middle, where the costæ disappear, below which the base is marked only by fine revolving lines; suture impressed. Aperture oval, acute posteriorly, rounded and slightly spreading anteriorly; outer lip sharp, thin, slightly angulated below the middle, rounded and slightly effuse anteriorly; columella smooth, somewhat curved, scarcely forming an angle at its junction with the outer lip. Length, 4^{mm}; breadth, 1.5^{mm}.

Long Island Sound, near New Haven.

The crowded costæ and numerous spiral lines produce a closely cancellated appearance, which is sufficient to distinguish this from the two preceding species. From the following it differs much in sculpture, form, shape of aperture, and columella, and especially in the minute size of the apical whorl.

TURBONILLA COSTULATA Verrill, sp. nov.

Shell small, long conical, translucent, glossy white, banded faintly with pale brown, subacute, with a relatively large, smooth, reversed apical whorl; the other whorls are six or more, flattened, and but slightly convex, enlarging regularly, crossed by numerous straight, smooth, rounded, transverse costæ, of which there are upward of twenty on the lower whorls; interstices rather narrower than the costæ, deep, and interrupted by numerous very minute revolving lines, which are scarcely visible under an ordinary pocket-lens, and do not cross the costæ; suture impressed. The body-whorl is subangulated below the middle, the costæ vanishing at the angulation; the base is covered with numerous microscopic revolving lines; on the body-whorl there are two revolving bands of pale brown, one above and one below the angulation. Aperture long ovate, acute posteriorly, a little angulated on the outer side, rounded and slightly prolonged anteriorly. Outer lip thin and sharp, round and slightly effuse anteriorly; columella smooth, nearly straight, but scarcely forming an angle where it joins the outer lip. Length, 4^{mm}; breadth, 1.5^{mm}.

Somewhat resembles *T. interrupta*, but the costæ are more crowded, the spiral lines are very much finer and more numerous, and the nuclear-whorl is much larger.

Long Island Sound, near New Haven, Conn.

TURBONILLA STRICTA Verrill, sp. nov.

Shell white, subulate, very acute, with a very minute reversed apical whorl; whorls ten, besides the nucleus, gradually and regularly enlarging, flattened or only very slightly convex, crossed by straight, obtuse, transverse costæ, of which there are about sixteen or eighteen on the lower whorls; the two upper whorls are nearly smooth; suture impressed. Aperture irregularly oblong-ovate, acute posteriorly, rounded anteriorly; outer lip flattened, thickened internally, in mature shells, and minutely crenulate within; columella smooth, nearly straight, thickened, forming an angle where it joins the outer lip. Length, 4.5^{mm}; breadth, 1^{mm}.

Long Island Sound, off New Haven, Connecticut.

This is probably the shell recorded from this region as *T. nivea* (Stimpson, sp.) by Dr. G. H. Perkins. It differs from the *nivea* in the form of the aperture and lip, and in being smaller and much more acute, though having the same number of whorls.

TURBONILLA EQUALIS Verrill.

Turritella æqualis Say, Journal Acad. Nat. Sciences, vol. v, p. 208, 1826; Binney's Say, p. 119.

"Shell subulate, white; volutions ten, each with about twenty-two, transverse, elevated, obtuse, equal lines, with interstitial grooves of the same diameter; suture distinct, impressed; aperture rounded at base, and destitute of any distinct emargination. Length one-fifth of an inch." (Say.)

My specimens agree well with the above description. The shell is very slender and acute, with a small distinctly reversed apical whorl; the remaining nine whorls are somewhat flattened, and all are crossed by obtuse, transverse costæ, which are a little oblique, especially at the upper ends, close to the sutures; on the body-whorl there are about twenty, but fewer on the upper ones; at the base of the body-whorl they vanish, leaving it smooth; the interstices between the costæ are deep and apparently smooth. The aperture is round ovate, well rounded or sub-circular anteriorly; the inner lip having a raised and thin margin. Length, 4.5mm; breadth, 1.25mm. Vineyard Sound, 6 to 8 fathoms.

Menestho albula Möller (Fabricius, sp.), was recorded by Linsley (as *Pyramis striatula* Couth.) from the stomachs of ducks at Bridgeport, Connecticut. It has not been found south of Cape Cod by any one else, and as it is a rare deep-water shell on our northern coast, it is not likely to have been obtained by ducks. It is found in Massachusetts Bay, Casco Bay, Bay of Fundy, and northward to Greenland. Linsley's shell may have been *Odostomia impressa*.

SCALARIA LINEATA Say. Plate XXI, fig. 123. (p. 418.)

Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 242, 1822; Binney's Say, pp. 83, 180, Plate 27, lower left figure; Gould, Invert., ed. i, p. 250; ed. ii, p. 312, fig. 580.

Vineyard Sound, Buzzard's Bay, and Long Island Sound; southward to South Carolina and Georgia. Fossil in the Post-Pliocene of North and South Carolina.

SCALARIA MULTISTRIATA Say. Plate XXI, fig. 122. (p. 418.)

Journ. Acad. Nat. Sciences, Philadelphia, vol. v, p. 208, 1826; Amer. Conchology, iii, Plate 27; Binney's Say, pp. 119, 180, Plate 27, lower right figure; Gould, Invert., ed. ii, p. 313, fig. 581.

Vineyard Sound, Buzzard's Bay and Long Island Sound; southward to Florida. Fossil in the Post-Pliocene of South Carolina.

SCALARIA ANGULATA Say.

American Conchology, iii, Plate 27, upper figures, 1831, as a variety of *S. clathrus*; Sowerby, Thes. Conch., part iv, p. 86, Plate 32, fig. 5, 1844. *Scalaria Humphreysii* Kiener, Iconographie des Coquilles Viv., p. 15, Plate 5, fig. 16, 1838–9.

Connecticut to Florida. Stonington (Linsley); Greenport, Long Island (S. Smith). Outer beach at Great Egg Harbor, New Jersey (A. E. V.); Fort Macon and Beaufort, North Carolina, common, (Stimpson, Coues); South Carolina (Kiener). Rare and perhaps accidental north of New Jersey.

SCALARIA GRŒNLANDICA Perry.

Conch., 1811, (t. Mörch); Sowerby, Thesaurus Conch., part iv, p. 101, Plate 34. figs. 105, 106, 1844; Gould, Invert., ed. i, p. 249, fig. 170*; ed. ii, p. 314, fig, 582. *Turbo clathrus Grœnlandicus* Chemnitz, Conch., xi, t. 1878, 1879 (t. Gould). *Scalaria subulata* Couthouy, Boston Jour. Nat. Hist., vol. ii, p. 93, Plate 3, fig. 4, 1838.

Cape Cod to the Arctic Ocean, and northern coasts of Europe, southward to Bergen. South Shoals, off Nantucket (Agassiz, t. Stimpson). Common in Casco Bay and Bay of Fundy, from 10 to 109 fathoms. Fossil in the Post-Plicoene of Nantucket, rare, (Desor); and in the Red-Crag, Norwich-Crag, and later deposits in Great Britain.

Janthina fragilis Lamarck; Gould, Invert., ed. i, p. 240; ed. ii, p. 277. This has been found cast ashore at Nantucket, but probably does not occur living so far north. It inhabits the Gulf Stream farther south.

RHIPIDOGLOSSA.

MARGARITA OBSCURA Gould. Plate XXIV, fig. 156. (p. 508.)

Invert., ed. i, p. 253, fig. 171*, 1841; ed. ii, p. 283, fig. 545. *Turbo obscurus* Couthouy, Boston Journ. Nat. Hist., vol. ii, p. 100, Plate 3, fig. 2, 1838.

Stonington, Connecticut, to Labrador. Rare and confined to the outer waters south of Cape Cod; off Martha's Vineyard, 20 to 25 fathoms. Stonington, from haddock's stomach, (Linsley). Common in Massachusetts Bay, Casco Bay, and in the Bay of Fundy, from extreme low-water mark to 100 fathoms. East of Saint George's Bank, in 430 fathoms, (S. I. Smith).

Margarita ornata Dekay, N. Y. Mollusca, p. 107, Plate 6, fig. 104, 1843, was described as occurring in the vicinity of New York, but I have not met with it in Long Island Sound.

DOCOGLOSSA.

ACMÆA TESTUDINALIS Forbes and Hanley. Plate XXIV, figs. 159, 159*a*. (p. 307.)

British Mollusca, vol. ii, p. 434, Plate 62, figs. 8, 9, and Plate A A, fig. 2; Carpenter, Report of British Association for 1856, pp. 219, 366, 1857; Dall (subgenus, *Collisella* Dall), American Journal of Conchology, vol. vi, p. 249, 1871. *Lottia testudinalis* Gould, Invert., ed. i, p. 153, fig. 12. *Tectura testudinalis* Gould, Invert., ed. ii, p. 267, fig. 529. *Patella testudinalis* Müller, Prodromus Zool. Danica, p. 227, 1776.

Variety *alveus*, (fig. 159 *a*). *Patella alveus* Conrad, Journal Acad. Nat. Sciences, Philadelphia, vol. vi, Plate 11, fig. 20, 1831. *Lottia alveus* Gould, Invert., ed. i, p. 154, fig. 13. *Tectura alveus* Gould, Invert., ed. ii, p. 269, fig. 530.

Long Island Sound to the Arctic Ocean; circumpolar. It extends southward on the European coasts to Southern Sweden, England, and Ireland; in the North Pacific, southward to Sitka and the Island of Jesso, Japan. It is comparatively rare and local south of Cape Cod; at New Haven, very rare; Watch Hill, Rhode Island; Martha's Vineyard, Cuttyhunk, and adjacent islands. Huntington and Greenport, Long Island (S. Smith). Fossil in the Post-Pliocene of Labrador (Packard); Greenland, Scandinavia, and Great Britain.

POLYPLACOPHORA.

CHÆTOPLEURA APICULATA Carpenter. Plate XXV, fig. 167.

Chiton apiculatus Say, Amer. Conch., part vii, appendix, (?) 1834; Binney's Say, p. 231; Gould, Invert., ed. i, p. 146, fig. 20; ed. ii, p. 258, fig. 522. *Leptochiton apiculatus*, this Report, p. 399.

Cape Cod to Eastern and Western Florida. Common in Vineyard Sound and Buzzard's Bay, in 3 to 12 fathoms, shelly. Off New London, Connecticut (coll. T. M. Prudden).

Dr. P. P. Carpenter informs me that this species belongs to the genus *Chætopleura* of Gray (*non* Adams).

TRACHYDERMON RUBER Carpenter. Plate XXV, fig. 166.

Chiton ruber Lowe, Zoöl. Journ., vol. ii, p. 101, Plate 5, fig. 2 (t. Gould); Gould, Invert., ed. i, p. 149, fig. 24; ed. ii, p. 260, fig. 523. *Leptochiton ruber* H. and A. Adams, Genera, vol i, p. 473; this Report, p. 399.

Off New London, Connecticut, to the Arctic Ocean and northern coasts of Europe. Rare and local in the colder outer waters south of Cape Cod. Off New London, 8 fathoms; off Watch Hill, 5 fathoms. Stonington (Linsley). Very common in Casco Bay and Bay of Fundy, from low-water mark to 40 fathoms.

Dr. Carpenter assures me that this species should be referred to *Trachydermon*.

Linsley records "*Chiton fulminatus* Couth." (= *C. marmoreus* Gould, Invert., ed. ii, p. 261, fig. 524) as from cod-fish taken off Stonington, Connecticut, but as it has not been confirmed from south of Cape Cod, this must be regarded as a doubtful identification. This species is found from Massachusetts Bay northward to the Arctic Ocean and northern coasts of Europe. It is common in the Bay of Fundy, from low-water mark to 40 fathoms, on "nullipore" (*Lithothamnion*).

"*Chiton albus*" (= *Trachydermon albus*, t. Carpenter) has been mentioned as from this region, but probably erroneously. White specimens of *C. apiculata* are often mistaken for it, when superficially examined. The genuine *albus* is a northern species, with about the same distribution as the preceding. It is abundant in the Bay of Fundy, from low-water to 80 fathoms.

PULMONATA.

MELAMPUS BIDENTATUS Say. Plate XXV, figs. 169, 169*a*. (p. 463.)

Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 245, 1822; Gould, Invert., ed. ii, p. 467, fig. 721. *Auricula bidentata* Gould, Invert., ed. i, p. 117, fig. 131. *Melampus corneus* Stimpson, Shells of New England, p. 51, 1851.

Massachusetts Bay to Florida, and along the northern shores of the Gulf of Mexico to Texas. Very common on the shores of Vineyard Sound, Buzzard's Bay, Long Island, and Long Island Sound. Fossil in the Post-Pliocene of South Carolina.

ALEXIA MYOSOTIS Pfeiffer. Plate XXV, fig. 168. (p. 383.)

Pfeiffer, Mon. Auric. Viv., p. 148, (t. Binney); Gould, Invert., ed. ii, p. 463, figs. 718, 719. *Auricula myosotis* Draparnaud, Tabl. Moll. Fr., p. 53. *Auricula denticulata* Gould, Invert., ed. i, p. 199, fig. 129 (*non* Montfort).

New Jersey to Nova Scotia; also on the Atlantic and Mediterranean coasts of Europe. It is common at Eastport, Maine; Portland, Maine; and at the mouth of West River, near New Haven, Connecticut; also near New York City.

TECTIBRANCHIATA.

BULLA SOLITARIA Say. Plate XXV, fig. 161. (p. 371.)

Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 245, 1822; Binney's Say, p. 84; Gould, Invert., ed. i, p. 162, fig. 92; ed. ii, p. 222, fig. 513. *Bulla insculpta* Totten, American Journ. Science, vol. xxviii, p. 350, fig. 4, 1835.

Massachusetts Bay to South Carolina. Common in the muddy lagoons and salt-ponds along the shores of Vineyard Sound, Buzzard's Bay, and Long Island Sound. Abundant in a small pond near Holmes' Hole; in New Haven Harbor, in ditches near Fort Hale.

CYLICHNA ORYZA Stimpson. Plate XXV, fig. 164. (p. 432.)

Smithsonian Check-List, p. 4, 1860; Gould, Invert., ed. ii, p. 221, fig. 512. *Bulla oryza* Totten, Amer. Jour. Science, vol. xxviii, p. 350, fig. 5, 1835; Gould, Invert., ed. i, p. 168, fig. 93.

Cape Cod to South Carolina. Not uncommon in Vineyard Sound, Buzzard's Bay, and Long Island Sound. This species was recorded as from Casco Bay by Dr. Mighels, but as this habitat has not been confirmed subsequently, it was probably based on an erroneous identification. Fossil in the Post-Pliocene of Canada (Dawson).

CYLICHNA ALBA Lovén. Plate XXV, fig. 163. (p. 508.)

Ofversigt af Kongl. Vet.-Akad. Förhandlingar, vol. iii, p. 142, 1846; Gould, Invert., ed. ii, p. 220, fig. 511. *Volvaria alba* Brown, Ill. Conch. G. B., iii, p. 3, figs. 43, 44. *Bulla triticea* Couthouy, Boston Jour. Nat. Hist., vol. ii, p. 88, Plate 2, fig. 8, 1838; Gould, Invert., ed. i, p. 165, fig. 98.

Near Block Island, northward to the Arctic Ocean; northern coasts of Europe to Bergen; and on the northwest coast of America, south to Sitka. Fossil in the Post-Pliocene of Canada and Great Britain.

Most of the specimens of this shell dredged in the Bay of Fundy are opaque, yellowish brown or chestnut color, but those from Casco Bay are nearly all clear white and translucent, although of equal size.

UTRICULUS CANALICULATUS. Plate XXV, fig. 160. (p. 432.)

Stimpson, Smithsonian Check-List, p. 4, 1860; Gould, Invert., ed. ii, p. 219, fig. 510. *Volvaria canaliculata* Say, Jour. Acad. Nat. Sciences, Philadelphia, vol. v, p. 211, 1826; Binney's Say, p. 121. *Bulla canaliculata* Gould, Invert., ed. i, p. 166, fig. 97. *Tornatina canaliculata* H. and A. Adams, Genera, vol. ii, p. 13.

Massachusetts Bay to South Carolina. Common in Buzzard's Bay and Vineyard Sound, in 2 to 8 fathoms; less common in Long Island Sound. Fort Macon, North Carolina, abundant, (Dr. Yarrow). Fossil in the Post-Pliocene of North and South Carolina; and the Pliocene of South Carolina.

AMPHISPHYRA DEBILIS Verrill. Plate XXV, fig. 162. (p. 432.)

Bulla debilis Gould, Amer. Journ. Science, ser. i, vol. xxxviii, p. 196, 1840; Invert., ed. i, p. 164, fig. 95, 1841. *Diaphana debilis* Gould, Invert., ed. ii, p. 216, fig. 507. *Bulla pellucida* Brown, 1844. *Amphisphyra pellucida* Lovén, op. cit., p. 143, 1846. *Bulla hyalina* Turton, Mag. Nat. Hist., vol. vii, p. 353, 1834, (t. Jeffreys), (*non* Gmelin).

Cape Cod to the Arctic Ocean; and on the northern coasts of Europe, southward to Great Britain, Madeira, etc. Stonington, Connecticut, from stomach of cod (Linsley). Not uncommon in Casco Bay and Bay of Fundy, and northward, in 6 to 50 fathoms. Very rare south of Cape Cod. Fossil in the Post-Pliocene of Canada, Great Britain, Norway, and Sweden.

ACTÆON PUNCTO-STRIATA Stimpson. Plate XXV, fig. 165.

Shells of New England, p. 51, 1851; H. and A. Adams, Genera, vol. ii, p. 5. *Tornatella puncto-striata* C. B. Adams, Boston Jour. Nat. Hist., vol. iii, p. 323, Plate 3, fig. 9, 1840; Gould, Invert., ed. i, p. 245, fig. 188; ed. ii, p. 224, fig. 515.

Cape Cod to South Carolina. Vineyard Sound, and Buzzard's Bay, not uncommon; Long Island Sound, rare; Huntington and Greenport, Long Island (S. Smith).

DORIDELLA Verrill.

Body smooth, oval, convex. Dorsal tentacles retractile, without sheaths. Head prominent, the lateral angles prolonged anteriorly as short oral palpi or tentacles. Foot broad, cordate. Branchiæ tufted, situated near the posterior end, on the right side, in the groove between the mantle and foot.

DORIDELLA OBSCURA Verrill. Plate XXV, figs. 173 *a*, *b*. (p. 400.)

American Journal of Science, vol. 1, p. 408, figs. 2, 3, November, 1870.

Body broad oval, 7.5^{mm} long and 5^{mm} broad; back convex, smooth. Foot broad, cordate in front. Oral disk broad, emarginate or with concave outline in front; the angles somewhat produced, forming short, obtusely pointed, tentacle-like organs, which in extension project beyond the front edge of the mantle. Dorsal tentacles small, stout, retractile. The branchiæ consist of a tuft of slender filaments, usually concealed by the edge of the foot. Color of body dark brown, lighter toward the edge, as if covered with nearly confluent blackish or brown spots, the whitish ground-color showing between them; foot, oral disk, and dorsal tentacles white; the central part of the body, beneath, with a three-lobed yellow spot due to the internal organs. Young specimens are flesh-color or yellowish brown above, specked with darker brown.

Vineyard Sound and Long Island Sound to Great Egg Harbor, New Jersey. Savin Rock, at low-water, under stones; off South End, 4 to 5 fathoms, shelly.

NUDIBRANCHIATA.

DORIS BIFIDA Verrill. Plate XXV, fig. 176. (page 307.)

American Journal of Science, vol. 1, p. 406, 1870.

Outline broad oval, widest anteriorly, about 25^{mm} long by 12^{mm} broad, in extension; back very convex, mantle covered with numerous, scattered, small but prominent, pointed papillæ. Tentacles rather long, thickest in the middle, the outer half strongly plicated with about twenty folds, but with a smooth tip, the base surrounded by small papillæ. Gills retractile into a single cavity, united together by a partial web, deeply frilled, much subdivided, bipinnate, the subdivisions fine and slender. Foot very broad, in extension projecting back beyond the mantle about a quarter of an inch, slightly tapering, rounded and slightly notched at the end. Oral disk or veil crescent-shaped, the front a little prominent, the sides extended backward, and forming a curve continuous with that of the foot.

Color purplish brown, sprinkled with white specks; tentacles deep brown, specked with white, tips yellowish; gills purplish at base, the edges and tips usually yellow; foot similar in color to mantle, but lighter.

Long Island Sound, at Savin Rock, near New Haven, to Eastport, Maine, under stones, at low-water mark.

ONCHIDORIS PALLIDA Verrill. (p. 495.)

American Journal of Science, vol. l, p. 408, 1870; vol. iii, p. 212, 1872. *Doris pallida* Ag. MSS.; Stimpson, Invert. of Grand Manan, p. 26, 1853; Gould, Invert., ed. ii, p. 229, Plate 20, figs. 284, 287, 288, 291.

Off Cuttyhunk Island; Massachusetts Bay; Casco Bay; Bay of Fundy. In Eastport Harbor, not uncommon, from low-water mark to 30 fathoms.

POLYCERA LESSONII D'Orbigny. (p. 400.)

Magazine de Zoöl., vol. vii, p. 5, Plate 105 (t. Gould); Alder and Hancock, Brit. Nud. Moll., Fam. 1, Plate 24; Gould, Invert., ed. ii, p. 226, Plate 17, figs. 242--248. *Doris illuminata* Gould, Invert., ed. i, p. 4, 1841.

Long Island Sound to Labrador; European coasts, from Sweden to France and Great Britain. Savin Rock, near New Haven, Connecticut, at low-water, and off South End in 4 to 5 fathoms; Watch Hill, Rhode Island, 3 to 6 fathoms. Common in Casco Bay and Bay of Fundy, from low-water mark to 20 fathoms.

DENDRONOTUS ARBORESCENS Ald. and Hancock. (p. 495.)

British Nud. Moll., Fam. 3, Plate 3, 1850; Gould, Invert., ed. ii, p. 234, Plate 22, figs. 311–313. *Doris arborescens* Müller, Zoöl. Dan. Prod., p. 229, 1776; Fabricius, Fauna Grönl., p. 346, 1780. *Tritonia arborescens* Cuvier; Gould, Invert., ed. i, p. 5. *Tritonia Reynoldsii* Couthouy, Boston Journ. Nat. Hist., vol. ii, p. 74, Plate 2, figs. 1–4, 1838.

Watch Hill, Rhode Island, in 4 to 5 fathoms, common on *Laminaria* among *Obeliæ;* northward to Greenland; on the European coasts south to Great Britain and France; Sitka (Middendorff). Very common in the Bay of Fundy and Casco Bay, from above low-water mark to 60 fathoms. Rare and local south of Massachusetts Bay.

DOTO CORONATA Lovén. Plate XXV, fig. 170. (p. 400.)

Arch. Scand. Nat., p. 151 (t. Stimpson); Öfvers. af Kongl. Vet.-Akad. Förhandlingar, vol. iii, p. 139, 1846; Alder and Hancock, Brit. Nud. Moll., Fam. 3, Plate 6; Gould, Invert., ed. ii, p. 236, Plate 16, figs. 233–237. *Doris coronata* Gmelin, Syst. Nat., p. 3105, 1790.

New Jersey to Labrador; on the northern European coasts, southward to Great Britain, Holland, and France. Great Egg Harbor, New Jersey, 1 fathom, (A. E. V. and S. I. Smith); Long Island Sound, near New Haven; off Gay Head, Martha's Vineyard; off Watch Hill, Rhode Island, 4 to 5 fathoms, on *Obelia.* Common in Massachusetts Bay, Casco Bay, and Bay of Fundy, from low-water mark to 15 fathoms.

ÆOLIS PAPILLOSA Lovén. (p. 495.)

Öfvers. af Kongl. Vet.-Akad. Förh., vol. iii, p. 139, 1846; Gould, Invert., ed. ii, p. 238, fig. 518, and Plate 18, figs. 257–263. *Limax papillosus* Linné, Syst. Nat., ed. xii, vol. i, p. 1082, 1767. *Æolis farinacea* Gould, MSS.; Stimpson, Invert. Grand Manan, p. 25, 1853.

Rhode Island to the Arctic Ocean; northern coasts of Europe to Great Britain. Rare south of Cape Cod; Watch Hill, among roots of *Laminariæ*; very common in Casco Bay and Bay of Fundy, from above low-water mark to 20 fathoms.

ÆOLIS, OR MONTAGUA. Species undetermined. (p. 495.)

A species about an inch long, with bright red, fusiform branchiæ, arranged in seven or eight transverse clusters on each side. Foot with prominent and acute auricles anteriorly.

Off Gay Head, 4 to 5 fathoms, rocks.

MONTAGUA PILATA Verrill. (p. 383.)

Æolis pilata Gould, Invert., ed. ii, p. 243, Plate 19, figs. 270, 277, 279, 231, 1870. *Æolidia pilata*, this Report, p. 383. (See errata.)

Long Island Sound to Massachusetts Bay. Abundant in New Haven Harbor, on piles of Long Wharf.

MONTAGUA VERMIFERA Verrill.

Æolis vermiferus S. Smith, Annals Lyc. Nat. Hist., N. Y., vol. ix, p. 391, 1870.

Greenport, Long Island (Smith). Long Island Sound, off Thimble Islands, 4 to 5 fathoms, among rocks.

The specimens from Thimble Islands differ somewhat from the original description. They were about half an inch long; moderately stout; the foot lanceolate, rapidly tapered posteriorly to a point, but not produced far beyond the branchiæ, nor slender-pointed; anteriorly the angles are somewhat produced, triangular, and pointed, their length equal to about half the breadth of the foot. Head rounded; tentacles rather stout, obtuse; the oral longer than the dorsal ones; the latter are transversely wrinkled. The branchial papillæ are fusiform, moderately stout, obtuse, arranged in about twelve transverse rows on each side, forming six clusters, the two rows forming each cluster separated by a narrow elliptical naked space, narrower than the spaces between the clusters; in each anterior row there are six or seven papillæ, the upper ones larger, the lowest short and blunt. Foot translucent, white, with a flake-white streak on the upper side posteriorly; body pale yellowish, minutely specked with greenish and flake-white; back of the dorsal tentacles there is, on each side, an orange patch, and there are others along the back; papillæ dark brown internally, irregularly specked with flake-white externally, forming toward the end an ill-defined white ring; the extreme tips are white; tentacles similar in color to the body.

MONTAGUA GOULDII Verrill, sp. nov.

Body elongated, rather slender; foot with the anterior angles only slightly prominent, and obtusely rounded; posteriorly it tapers gradually to an elongated slender point. Tentacles long, slender, not serrate, the dorsal ones a little longer than the oral; eyes small, black; branchial papillæ fusiform, moderately stout, grouped in eight or more tranverse rows on each side, the rows being grouped two by two, so as to form transverse clusters, with two rows each, the rows of the clusters being separated by spaces narrower than those between the clusters. Color of body light yellow or tinged with pale orange; tentacles pale orange, with a flake-white stripe on the posterior surface; branchial papillæ dark brown or reddish brown internally, with a ring of opaque white close to the tips.

Length about 20^{mm}.

Off Thimble Island, in 4 to 5 fathoms, with the preceding species.

This is nearly allied to *M. Mananensis* Stimpson, but the angles of the foot are less produced and not acute, and the proportions of the tentacles are different. Dr. Gould seems to have confounded this species with *M. diversa* (*Æolis diversa* Couth.), and one of his figures (Plate 19, fig. 280) apparently represents this species; but certainly does not represent *M. diversa*, which was originally described and figured as having the oral tentacles longer than the dorsals (See Gould's figs. 267, 268, copied from Couthouy.)

CORYPHELLA GYMNOTA Verrill.

Eolis (*Tergipes*) *gymnota* Couthouy, Boston Jour. Nat. Hist., vol. ii, p. 69, Plate 1, fig. 3, 1838; Gould, Invert., ed. i, p. 7; ed. ii, p. 249, Plate 16, figs. 238–241. *Montagua gymnota* H. and A. Adams, Genera, vol. ii, p. 74. *Cavolina gymnota*, this Report, p. 383. (See errata.)

Wood's Hole to Boston, Massachusetts.

TERGIPES DESPECTUS Adams. (p. 495.)

H. and A. Adams, Genera, vol. ii, p. 76, 1858. *Eolidia despecta* Johnston, Loud. Mag. Nat. Hist., vol. viii, p. 378, fig. 35^e. *Eolis despecta* Alder and Hancock, Brit. Nud. Moll., Fam. 3, Plate 37. *Æolis* (*Tergipes*) *despecta* Gould, Invert., ed. ii, p. 248, Plate 16, figs. 222–225.

Stonington, Connecticut, to Bay of Fundy and northward; northern coasts of Europe to Great Britain. Off Watch Hill, 4 to 5 fathoms, on *Laminaria*, among hydroids, abundant; Casco Bay; Eastport Harbor.

HERMÆA CRUCIATA A. Agassiz, MSS. Plate 25., fig. 175.

Gould, Invert., ed. ii, p. 253, Plate 17, fig. 256.

Naushon Island (A. Agassiz).

ELYSIA CHLOROTICA Gould. Plate XXV, fig. 172. (p. 480.)

Invert., ed. ii, p. 255, Plate 17, figs. 251–255, 1870.

Great Egg Harbor, New Jersey, in pools on salt-marsh at low-water (A. E. V. and S. I. Smith). Cambridge, Massachusetts (Agassiz).

ELYSIELLA CATULUS Verrill. Plate XXV, fig. 171. (p. 480.)

American Journ. Science, vol. iii, p. 284, Plate 7, figs. 5, 5[a], 1872. *Placobranchus catulus* Agassiz, MSS.; Gould, Invert., ed. ii, p. 256, Plate 17, figs. 249, 250, 1870.

Great Egg Harbor, New Jersey, to Massachusetts Bay. New Haven Harbor and Wood's Hole, among eel-grass, common.

PTEROPODA.

GYMNOSOMATA.

CLIONE PAPILLONACEA Pallas. (p. 444.)

Spicil. Zoöl., x, p. 37, Plate 1, figs. 18, 19, (?) 1774. *Clio limacina* Phipps, Voyage to North Pole, p. 195, 1774 (t. Gould). *Clio retusa* Müller, Prod. Zoöl. Dan., 2742, 1776 (*non* Linné); Fabricius, Fauna Grönlandica, p. 334, 1780 (description excellent). *Clio borealis* Brugiere, Encyc. Meth., Vers., i, p. 502, 1792 (t. Gould). *Clione borealis* Gray, Brit. Mus. Pteropoda, p. 36, 1850; Stimpson, Shells of New England, p. 27, 1851; H. and A. Adams, Genera, vol. i, p. 62, Plate 7, fig. 7. *Clione limacina* Stimpson, Smithsonian Check-Lists, p. 4, 1860; Binney in Gould, Invert., ed. ii, p. 507, fig. 754 (poor). *Clio Miquelonensis* Rang, Ann. Sci. Nat., ser. i, vol. v, p. 285, Plate 7, fig. 2, 1825.

New York to the Arctic Ocean; on the northern coasts of Europe south to Great Britain. Off Stonington, Connecticut (A. E. V. and D. C. Eaton); Vineyard Sound (V. N. Edwards); Portland, Maine (C. B. Fuller).

The synonymy of this species has been greatly and unnecessarily confused. The *Clio retusa* of Linné was a southern Pteropod, having a triquetral shell. In a foot-note on page 1094 of the twelfth edition of the Systema Naturæ, he states that he had not seen the genus *Clio*, but adopts it from Brown. He gives three species mentioned by Brown, all having shells.

THECOSOMATA.

STYLIOLA VITREA Verrill. Plate XXV, fig. 178. (p. 443.)

American Journ. Science, vol. iii, p. 284, Plate 6, fig. 7, 1872.

Shell smooth, polished, diaphanous, almost glassy, long conical, rather slender, slightly curved toward the acute apex; animal white; locomotive organs obovate, with the end broadly rounded, and bearing slender tapering tentacle-like processes near the middle of the anterior edge; intermediate lobe short, rounded in front.

Length of shell, 11.5^{mm}; diameter, 2^{mm}.

Taken among *Salpæ*, off Gay Head, Martha's Vineyard, in the afternoon, September 9, 1871.

Several other species of this and other related genera were taken by Messrs. S. I. Smith and Oscar Harger, off Saint George's Bank, in 1872, on the United States steamer Bache. These may occasionally occur also in the vicinity of Nantucket and Martha's Vineyard.

CAVOLINA TRIDENTATA. Plate XXV, fig. 177. (p. 444.)

H. and A. Adams, Genera, vol. i, p. 51, Plate 6, figs. 1, 1[a]; Verrill, op. cit., p. 284. *Anomia tridentata* Forskal, Fauna Arab., p. 124, 1775; Icon., Plate 40, fig. b, (t. Lamarck). *Hyalæa cornea* Lamarck, Syst. des Anim., p. 140, 1801. *Hyalæa tridentata* Lamarck, Anim. sans Vert., ed. ii, vol. vii, p. 415.

Mediterranean Sea and the warmer parts of the Atlantic. The shells were dredged off Martha's Vineyard, at two localities, in 19 and 22 fathoms.

DIACRIA TRISPINOSA Gray. (p. 444.)

British Museum Pteropoda; H. and A. Adams, Genera, i, p. 52, Plate 6, fig. 2[a]; Gould, Invert., ed. ii, p. 504. *Hyalæa trispinosa* Lesueur, in Blainville, Dict. des Sci. Nat., vol. xxii, p. 82, 1824; Forbes and Hanley, Brit. Moll., vol. ii, p. 380, Plate 5, fig. 3; Stimpson, Shells of New England, p. 27.

Gulf Stream and warmer parts of the Atlantic generally. Occasionally cast ashore at Nantucket (Stimpson).

SPIRIALIS GOULDII Stimpson. (p. 443.)

Proc. Boston Soc. Nat. Hist., vol. iv, p. 8, 1851; Shells of New England, p. 27, Plate 1, fig. 4. *Heterofusus balea* and *H. retroversus* Binney, in Gould, Invert., ed. ii, p. 505, Plate 27, figs. 345–349, (not of European writers). *Spirialis Flemingii* A. Agassiz, Proc. Boston Soc. Nat. Hist., vol. x, p. 14, 1865, (not of Forbes). *Heterofusus Alexandri* Verrill, Amer. Jour. Science, vol. iii, p. 281, 1872 (young).

Near Naushon Island and Nahant, Massachusetts (A. Agassiz). Twenty miles off No Man's Land, in stomach of herring, (S. I. Smith). Off Saint George's Bank, in Gulf Stream, (S. I. Smith and O. Harger). The identity of this species with the *Limacina balea* Möller, of Greenland, is very questionable. The description of the latter is brief, and no mention is made of the spiral sculpture, which is an important character of *S. Gouldii.*

LAMELLIBRANCHIATA.

DIMYARIA.

TEREDO NAVALIS Linné. Plate XXVI, fig. 183. Plate XXVII, fig. 186. (pp. 384, 482.)

Systema Naturæ, ed. xii, p. 1267, 1767; Tryon, Proc. Acad. Nat. Sciences, vol. xiv, p. 468, 1862; Gould, Invert., ed. ii, p. 28, fig. 355; Jeffreys, Brit. Conch., vol. iii, p. 171.

Coast of United States, from Florida to Vineyard Sound; coasts of Europe, from Sweden (Christiania) and Great Britain to Sicily; Algeria and the Black Sea (Jeffreys); Senegal. Great Egg Harbor, New Jersey; New Haven Harbor, in piles of wharves; Wood's Hole, in piles of wharf; Vineyard Sound and Buzzard's Bay, in cedar buoys.

This is the most abundant species on our Atlantic coast, south of Massachusetts Bay, where it also probably occurs.

TEREDO MEGOTARA Hanley. Plate XXVII, fig. 188. (p. 387.)

Forbes and Hanley, Brit. Conch., vol. i, p. 77, Plate 1, figs. 1, 2; Plate 18, figs. 1, 2; vol. iv, p. 247; Tryon, op. cit., p. 466, 1862; Jeffreys op. cit., p. 176; Gould, Invert., ed. ii, p. 30, fig. 357.

Massachusetts Bay to South Carolina. Common in floating drift-wood, in the North Atlantic; north to Greenland, Iceland, and Spitzbergen; coasts of Scandinavia and Great Britain. Fossil in the Post-Pliocene of Scandinavia.

TEREDO THOMSONII Tryon. Plate XXVII, fig. 187. (p. 387.)

Proc. Acad. Nat. Sci., Philadelphia, vol. xv, p. 28, Plate 2, figs. 3, 4, 5, 1863; Gould, Invert., ed. ii, p. 31, fig. 358.

New Bedford, Massachusetts, in cedar buoys (Tryon). Provincetown, Massachusetts, in whale-ship (Atwood).

TEREDO DILATATA Stimpson.

Proc. Boston Soc. Nat. Hist., vol. iv, p. 113, 1851; Shells of New England, p. 26; Tryon, op. cit., p. 464, 1862; Gould, Invert., ed. ii, p. 32, fig. 359.

Massachusetts to South Carolina (Tryon). Cape Ann, in buoys, (Stimpson). Provincetown, Massachusetts (Gould). Greenport, Long Island (S. Smith). I have not met with this species south of Cape Cod.

XYLOTRYA FIMBRIATA Jeffreys. Plate XXVII, fig. 189. (p. 387.)

Annals and Mag. Nat. Hist., ser. iii, vol. vi, p. 126, 1860; Tryon, op. cit., p. 478, 1862; Gould, Invert., ed. ii, p. 34, fig. 361. *Teredo palmulata* Forbes and Hanley, Brit. Moll., vol. i. p. 86, Plate 2, figs. 9–11, (*non* Lamarck). *Xylotrya palmulata* Stimpson, Check-List, p. 3, 1860; Perkins, Proc. Boston Soc. Nat. Hist., vol. xii, p. 141, 1869.

Long Island Sound to Florida; Pacific coast, at the Straits of Fuca; Europe. In an old submerged wreck near New Haven. From the hull of the "Peterhoff," used in the blockade of the southern coast during the late war. Frequent in vessels from foreign ports.

PHOLAS TRUNCATA Say. Plate XXVII. fig. 200. (p. 372.)

Journal Acad. Nat. Sciences, Philadelphia, ser. i, vol. ii, p. 321, 1822; Binney's Say, p. 107; Hanley, Recent Shells, p. 6, Plate 9, fig. 26; Tryon, op. cit., p. 202; Gould, Invert., ed. ii, p. 38, fig. 364.

Vineyard Sound to Florida. Payta, Peru (Tryon). Common on the shores of Long Island Sound, near New Haven. The large specimens from Sable Island (Gould), mentioned by Tryon, were not this species, but *Z. crispata.*

PHOLAS COSTATA Linné. (p. 433.)

Systema Naturæ, ed. xii, p. 1111, 1762; Tryon, Proc. Acad. Nat. Sciences, Philadelphia, xiv, p. 201, 1862; Gould, Invert., ed. ii, p. 37, fig. 363.

Caribbean Sea to Buzzard's Bay. Southern Europe (Linné). New Bedford Harbor, living, (Gould); Wood's Hole, Massachusetts, dead shells dredged, (A. E. V.); Long Island Sound. Atlantic City, New Jersey (Tyron). Specimens from the east and west coasts of Florida; and from near Vera Cruz, Mexico (coll., Mr. Salt), are also in the museum of Yale College.

ZIRPHÆA CRISPATA Mörch, 1853. (p. 433.)

H. and A. Adams, Genera, vol. ii, p. 327, Plate 89, figs. 5, 5*a*, 1858; Tryon, op. cit., p. 211, 1862. *Pholas crispata* Linné, Syst. Nat., ed. xii, p. 1111, 1767; Gould, Invert., ed. i, p. 27. *Zirfæa crispata* Gray, Figures of Moll. Anim., Plate 338, fig. 5, and 339, fig. 5, 1857; Ann. and Mag. Nat. Hist., ser. ii, vol. viii, p. 385, 1851; Gould, Invert., ed. ii, p. 39, fig. 365.

Stonington, Connecticut, to Gulf of Saint Lawrence; Iceland; northern coasts of Europe, south to France, and the southern coasts of Great Britain; west coast of North America, south to California. Charleston, South Carolina (Stimpson, t. Gould). New Jersey (t. Gould). Wood's Hole, dead shells dredged, (A. E. V.). Common in Casco Bay, in 10 to 20 fathoms, perforating hard clay and sunken but sound wood; also in the Bay of Fundy, in 8 to 70 fathoms, in hard clay. Mr. C. B. Fuller has obtained fine large specimens in submerged tree-stumps at extreme low-water mark on Jewell's Island, Casco Bay. Fossil in the Post-Pliocene of Maine, Scandinavia; and in the Coralline and Red Crags of Great Britain. Its occurrence at Charleston, South Carolina, needs confirmation.

Martesia cuneiformis Gray, 1851; Tryon, op. cit., p. 219. *Pholas cuneiformis* Say, Jour. Acad. Nat. Sci., Philad., vol. ii, p. 322, 1822.

This species was found by Mr. Perkins in oyster-shells, near New Haven, but it was probably brought from farther south (Maryland or Virginia) in the oysters. It inhabits the coasts of Florida and the West Indies.

Diplothyra Smithii Tryon, op. cit., p. 450, 1862.

This species was described from specimens found in oyster-shells at Staten Island, where they were supposed to have lived. If really indigenous there, it may be expected to occur in Long Island Sound.

SAXICAVA ARCTICA Deshays. Plate XXVII, fig. 192. (p. 309.)

Elem. Conch., Plate xii, figs. 8, 9 (t. Gould); Forbes and Hanley, Brit. Moll., vol. i, p. 141, Plate 6, figs. 4–6; Gould, Invert., ed. ii, p. 89, fig. 397. *Mya arctica* Linné, Syst. Nat., ed. xii, p. 1113, 1767. *Mytilus rugosus* Linné, Syst. Nat., ed. xii, p. 1156. *Saxicava rugosa* Lamarck, Anim. sans Vert., ed. ii, vol. vi, p. 152; Gould, Invert., ed. ii, p. 87; Jeffreys, Brit. Conch., vol. iii, p. 81. *Mytilus pholadis* Linné, Mant. Plant., p. 548. *Saxicava pholadis* Lamarck, op. cit., vol. vi, p. 152. (?) *Saxicava distorta* Say, Jour. Acad. Nat. Sci., Philad., vol. ii, p. 318, 1822; Gould, ed. i, p. 62.

Georgia and South Carolina to the Arctic Ocean; northern coasts of Europe to the Mediterranean; Pacific Coast of America, south to Santa Barbara, California. Various other parts of the world are given as localities by different authors. On our coast this shell is very common from Massachusetts Bay to Labrador, occurring from low-water mark to 50 fathoms or more. In Casco Bay it is extremely abundant in rocky, cavernous pools, among the ledges at low-water mark, and mostly attached by a byssus, associated with *Modiola modiolus*. I also found specimens in 10 to 15 fathoms, perforating recent and sound shells of *Cyprina Islandica*. In the Gulf of Saint Lawrence, near Anticosti Island, where limestone abounds, I have found it burrowing in the limestone in large numbers. South of Cape Cod it is far less abundant, though not uncommon in Long Island Sound. Var. *distorta* (Say) is common from Fort Macon to Georgia, and is possibly a distinct species. Fossil in the Post-Pliocene of Maine, New Brunswick, Canada, Anticosti, Labrador, Scandinavia, and Great Britain; in the Coralline and Red Crags of England, etc. Var. *distorta* is found in the Miocene of Maryland.

MYA ARENARIA Linné. Plate XXVI, fig. 179. (pp. 357, 463.)

Systema Naturæ, ed. xii, p. 1112, 1767; Gould, Invert., ed. i, pp. 40, 359; ed. ii, p. 55, fig. 375. *Mya mercenaria* and *M. acuta* Say, Journal Acad. Nat. Sci., Philadelphia, vol. ii, p. 313, 1822.

South Carolina to the Arctic Ocean; northern coasts of Europe, south to England and France; northeastern coast of Asia, south to China and Japan (Hakodadi). Sitka (Middendorff). South Carolina (Gibbs). Fort Macon, North Carolina (Dr. Yarrow). Comparatively scarce south of Cape Hatteras. Very abundant from New Jersey northward, both in brackish estuaries and on the open coasts. Particularly large and fine in Long Island Sound (see p. 463). Casco Bay and Bay of Fundy, from half-tide mark to 40 fathoms, those dredged being all young. Fossil in the Post-Pliocene of Scandinavia, Greenland, Labrador, Canada, New England, Virginia, South Carolina, etc.; in the Red-Crag and all later formations in Great Britain; and in the Miocene of Virginia.

CORBULA CONTRACTA Say. Plate XXVII, fig. 191. (p. 418.)

Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 312, 1822; Gould, Invert., ed. i, p. 43, fig. 37; ed. ii, p. 60, fig. 377.

Cape Cod to Florida. Common, living, in Vineyard Sound and Buzzard's Bay, in 5 to 19 fathoms; Long Island Sound, near New Haven, not uncommon in shallow water. Georgia (Couper). Fossil in the Post-Pliocene of Virginia, North and South Carolina; and in the Pliocene of South Carolina. A closely related species occurs in the Miocene of Maryland.

LYONSIA HYALINA Conrad. Plate XXVII, fig. 194. (p. 358.)

American Marine Conchology, p. 51, Plate 11, fig. 2, 1831; Gould, Invert., ed. ii, p. 64, fig. 380. *Mya hyalina* Conrad, Jour. Acad. Nat. Sci., Philadelphia, vol. vi, p. 261, Plate 11, fig. 12, 1831. *Osteodesma hyalina* Couthouy, Boston Jour. Nat. Hist., vol. ii, p. 166, 1839; Gould, Invert., ed. i, p. 46, fig. 31.

Florida to Gulf of Saint Lawrence. Common in Long Island Sound, Buzzard's Bay, Vineyard Sound, Massachusetts Bay, Casco Bay, and Bay of Fundy; low-water mark to 30 fathoms; Beaufort, North Carolina (Coues).

CLIDIOPHORA TRILINEATA Carpenter. Plate XXVII, fig. 193. (p. 418.)

Proc. Zoöl. Soc., London, 1864, p. 597; Mollusks of W. N. America, p. 226. *Pandora trilineata* Say, Journ. Acad. Nat. Sciences, Philadelphia, vol. ii, p. 261, 1822; Gould, Invert., ed. i, p. 44; ed. ii, p. 62, fig. 379.

Florida to Gulf of Saint Lawrence. Common in Long Island Sound; off Block Island, 29 fathoms; Buzzard's Bay; Vineyard Sound; Casco Bay; and Bay of Fundy; low water mark to 30 fathoms; Great Egg Harbor, New Jersey, 1 fathom. Beaufort, North Carolina (Coues, Yarrow). Fossil in the Post-Pliocene of Virginia and South Carolina; and in the Pliocene of South Carolina. A closely-related form, *C. crassidens* (Conrad, sp.), occurs in the Miocene of Virginia.

PERIPLOMA PAPYRACEA Verrill. Plate XXVII, fig. 197. (p. 509.)

Amer. Journal Science, vol. iii, pp. 213, 285, Plate 7, figs. 1, 1^a, 1^b (animal and hinge), 1872. *Anatina papyratia* Say, op. cit., p. 314, 1822. *Anatina papyracea* Gould, Invert., ed. i, p. 47, fig. 28; ed. ii, p. 66, fig. 382. *Anatina fragilis* Totten (name provisional), Amer. Jour. Science, vol. xxviii, p. 347, fig. 1, 1835.

New Jersey to Labrador. Anticosti Island (A. E. V.); not uncommon in Massachusetts Bay, Casco Bay, and Bay of Fundy, 10 to 100 fathoms. Less frequent south of Cape Cod; off Block Island, in 29 fathoms, (A. S. Packard); Newport, Rhode Island (Totten); Greenport, Long Island (S. Smith). Chateau Bay, Labrador (Packard).

This species, when young, is liable to be confounded with *Thracia myopsis* Beck = *T. Couthouyi* Stimpson (see Plate XXVII, fig. 196), but they are easily distinguished by the structure of the hinge. The latter occurs in Massachusetts Bay, Bay of Fundy, etc., northward to Greenland, but has not been recorded from south of Cape Cod.

COCHLODESMA LEANUM Couthouy. Plate XXVII, fig. 198. (p. 418.)

Boston Jour. Nat. Hist., vol. ii, p. 170, 1839; Stimpson, Shells of New England, p. 22; Gould, Invert., ed. i, p. 49, figs. 29, 30; ed. ii, p. 68, fig. 383. *Anatina Leana* Conrad, Jour. Acad. Nat. Sciences, vol. vi, p. 263, Plate 11, fig. 11, 1831.

North Carolina to the Gulf of Saint Lawrence. Vineyard Sound and Long Island Sound, not uncommon in 3 to 10 fathoms; Casco Bay and Eastport, Maine, rarely obtained alive; banks off Nova Scotia (Willis); Saint George's Bank (S. I. Smith and O. Harger). A related species, *C. antiquatum* (*Periploma antiquata* Conrad), occurs in the Miocene of Virginia.

THRACIA CONRADI Couthouy. (p. 426.)

Boston Jour. Nat. Hist., vol. ii, p. 153, Plate 4, fig. 2, 1839; Gould, Invert., ed. i, p. 50; ed. ii, p. 69, fig. 384. *Thracia declivis* Conrad, Amer. Mar. Conch., p. 44, Plate 9, fig. 2, 1831 (not of Pennant).

Long Island to Gulf of Saint Lawrence. Vineyard Sound, 6 to 8 fathoms; Casco Bay, 6 to 15 fathoms; Frenchman's Bay, near Mount Desert, Maine, 3 to 8 fathoms. Eastport, Maine, in 6 fathoms, and Grand Menan (Stimpson); Nahant, Massachusetts (Haskell); Rhode Island

and Buzzard's Bay (Gould); Labrador (Packard). Fossil in the Post-Pliocene (Leda-clay) at Saco, Maine (Fuller).

This species burrows so deeply in the mud or sand that it is seldom taken alive with the dredge.

THRACIA TRUNCATA Mighels and Adams. Plate XXVII, fig. 195. (p. 509.)

Boston Jour. Nat. Hist., vol. iv, p. 38, Plate 4, fig. 1, 1842; Gould, Invert., ed. ii, p. 72, fig. 386.

Long Island to Greenland. Off Block Island, 29 fathoms; Casco Bay, 10 to 20 fathoms; Bay of Fundy. Off Long Island, 37 fathoms, (Gould). Greenland, in 60 fathoms, (Mörch).

ENSATELLA AMERICANA Verrill. Plate XXVI, fig. 182; Plate XXXII, fig. 245. (p. 356.)

American Jour. Science, vol. iii, pp. 212, 284, 1872. *Solen Americanus* Gould, Invert., ed. ii, p. 42, 1870 (provisional name). *Solen ensis* Gould, op. cit., ed. i, p. 28; and ed. ii, p. 40 (*non* Linné); Dekay, Nat. Hist. New York, Moll., p. 242, Plate 33, fig. 313. *Ensis Americana* H. and A. Adams, Genera, vol ii, p. 342.

Florida to Labrador. Common at Great Egg Harbor, New Jersey; Long Island Sound; Buzzard's Bay; Vineyard Sound; Massachusetts Bay; Casco Bay; Bay of Fundy; Gulf of Saint Lawrence; low-water mark to 20 fathoms, sandy. Fort Macon, North Carolina, abundant, (Coues). Georgia (Couper). Labrador, rare (Packard). Saint George's Bank (S. I. Smith).

Fossil in the Post-Pliocene of Portland, Maine; Point Shirley, Massachusetts; Nantucket; Virginia; and South Carolina; in the Pliocene of South Carolina; and Miocene of Maryland; North and South Carolina.

In this species the siphonal tubes, in mature shells, protrude about 35^{mm}, and are united together for about half their length, beyond which they are round and divergent, subequal. Both orifices are surrounded by a similar circle of numerous papillæ, of three sizes; the larger ones are enlarged in the middle, acute at tips, with a large black spot on each side of the base; alternate with these are somewhat smaller ones of the same form and with similar basal spots; alternating with the primary and secondary ones are small tapering papillæ, less than half the length of the longest; numerous slender tapering papillæ are also scattered irregularly over the sides of the free portions of both tubes, in some cases in irregular rows of four to six, while on the ventral side of the branchial tube two rows of alternating papillæ extend along the whole length of the siphon. The mantle is closed ventrally for most of its length; there is a posterior opening for the protrusion of the foot, and a small opening just in advance of it, and another opening near the middle of the ventral border; the latter is fringed with small conical papillæ. Foot long; the end bulbous, obliquely truncated and beveled laterally.

Solen viridis Say. This species has been recorded from the southern coast of New England by several writers (Stonington, Connecticut, Linsley; Rhode Island, Conrad), but I have myself met with no authentic New England specimens. It may, however, occur rarely and perhaps accidentally. It is not uncommon on the outer beach at Great Egg Harbor, New Jersey, and farther south, to Florida.

SILIQUA COSTATA Adams. Plate XXXII, fig. 244. (p. 358.)

H. and A. Adams, Genera, vol. ii, p. 345, 1858. *Solen costatus* Say, Jour. Acad. Nat. Sci., Philad., vol. ii, p. 315, 1822; Hanley, Recent Shells, p. 15, Plate 9, fig. 28 (*non Leguminaria costata* Schum., 1817 = *Siliqua radiata* Linné, sp.). *Solen Sayii* Gray, Griffith's Cuvier, xii, Plate 31, fig. 3 (t. Gould). *Machæra costata* Gould, Invert., ed. i, p. 34, and fig. on p. 24, 1841; ed. ii, p. 47, fig. 370.

Cape Hatteras to Gulf of Saint Lawrence. Rare or local north of Casco Bay. Not observed in the Bay of Fundy. Common in Massachusetts Bay; Vineyard Sound; Great Egg Harbor, New Jersey. Comparatively rare in Long Island Sound, near New Haven; Fire Island Beach, Long Island (S. I. Smith). Coney Island, etc. (S. Smith). Rimouski, Gulf of Saint Lawrence, common, (Bell). Banks off Nova Scotia (Willis). The earliest name for this genus appears to be *Siliqua* Muhlfeldt, 1811. It was named *Leguminaria* by Schumacher in 1817, and *Machæra* by Gould, in 1841. The latter name is, moreover, preoccupied by *Machæra* Cuvier, 1832.

TAGELUS GIBBUS Gray. Plate XXVI, fig. 181; Plate XXX, fig. 217. (p. 373.)

Proc. Zoöl. Soc., London, xv, 1847; Dall, Proc. Boston Soc. Nat. Hist., vol. xiii, p. 251, 1870. *Solen gibbus* Spengler, Skrivt. Nat. Selks., vol. iii, p. 104, 1794 (t. Gould). *Solen Guineensis* Chemnitz, Conch., xi, p. 202, Plate 198, fig. 1937, 1799. *Solen Caribæus* Lamarck, Anim. sans Vert., ed. ii, vol. vi, p. 58. *Solecurtus Caribæus* Gould, Invert., ed. i, p. 30. *Solecurtus gibbus* Forbes and Hanley, Brit. Moll., vol. i, p. 267; Gould, Invert., ed. ii, p. 43, fig. 367. *Siliquaria notata* Schumacher, Essai d'un Nouv. Syst. des Habit. des Vers test., p. 129, Plate 7, figs. 2, 3, 1817 (not the genus *Siliquaria* Brug.; Lamarck, 1801). *Siliquaria gibba* H. and A. Adams, Genera, p. 347, Plate 93, figs. 5, 5*a*, 1858.

Caribbean Sea, West Indies, and Gulf of Mexico to Cape Cod. Similar if not identical species are found on the Pacific coast of Central America, and on the west coast of Africa. Vineyard Sound and Buzzard's Bay, not uncommon; Great Egg Harbor, New Jersey, abundant. Fort Macon, North Carolina, very common (Coues). Alabama (Mighels). Fossil in the Post-Pliocene of Virginia, South Carolina, and Florida; in the Pliocene of South Carolina; and in the Miocene of North and South Carolina.

The name, *Siliquaria* Schumacher, 1817, adopted for this genus by several recent writers cannot be retained, because preoccupied by Brugiere, 1791, and by Lamarck (see Syst. des Anim., 1801, p. 98) for a genus of *Vermetidæ*.

This genus is widely different from the restricted genus *Solecurtus*

Blainv., 1824,=*Macha* Oken, 1835, and undoubtedly belongs to the *Tellinidæ*, near *Psammobia*, as shown by the structure of the soft parts. (See page 373 and Plate xxvi, fig. 181).

TAGELUS DIVISUS. Plate XXX, fig. 218. (p. 435.)

Dall, op. cit., p. 251, 1870. *Solen divisus* Spengler, op. cit., p. 96, 1794 (t. Gould). *Solen bidens* Chemnitz, op. cit., p. 203, Plate 198, fig. 1939, 1799. *Solen fragilis* Pulteney, Dorset Catal., p. 28, Plate 4, fig. 5, 1799 (t. Gould). *Solen centralis* Say, Journ. Acad. Nat. Sci., Philad., vol. ii, p. 316, 1822. *Solecurtus bidens* Forbes and Hanley, op. cit., vol. i, p. 266; Stimpson, Shells of New England, p. 22. *Solecurtus divisus* Gould, Invert., ed. ii, p. 44, fig. 368. *Macha divisa* Gray, Catal. Brit. Moll., p. 160. *Leguminaria Floridana* Conrad, Proc. Acad. Nat. Sci., Philad., vol. iv, p. 121, 1848. *Mesopleura bidentata* Conrad, Catal. Solenidæ, Amer. Jour. Conch., vol. iii, Appendix, p. 23, 1867.

Gulf of Mexico and West Indies to Cape Cod. Vineyard Sound and Buzzard's Bay, not common. Rhode Island, rather common, (Gould). Fort Macon, North Carolina, common, (Coues). Tampa Bay, Florida, (Conrad, Jewett).

MACOMA FRAGILIS Adams. Plate XXX, fig. 222.

H. and A. Adams, Genera, vol. ii, p. 400, 1858.

Var. fusca = *Macoma fusca* Adams. (p. 359.)

Genera, vol. ii, p. 400; Gould, Invert., ed. ii, p. 93, fig. 400. *Psammobia fusca* Say, Jour. Acad. Nat. Sci., Philad., vol. v, p. 220, 1826. *Sanguinolaria fusca* Conrad, Amer. Mar. Conch., p. 34, Plate 7, fig. 1, 1831; Gould, Invert., ed. i, p. 66, fig. 42.

Var. fragilis.

Venus fragilis O. Fabricius, Fauna Grönlandica, p. 413, 1780. *Tellina Grönlandica* Beck, Lyell, in Trans. Geol. Soc., London, vol. v, p. 137, Plate 16, fig. 8, 1841. *Macoma Grönlandica* Packard, Mem. Boston Soc., vol. i, pp. 235, 243, etc., 1866; Dawson, Notes on Post-Pliocene Geology of Canada, p. 72, from Canadian Naturalist, vol. vi, 1872. *Tellina Fabricii* Hanley; Sowerby, Thesaurus, p. 112, (t. Mörch).

Georgia to Greenland. Var. *fusca* is abundant on the entire coast of New England, Long Island, and New Jersey. Georgia (Say, Couper). Var. *fragilis* is abundant from Long Island Sound and Massachusetts Bay to Labrador. The two forms grade into one another insensibly.

A closely related but apparently distinct species, *M. Balthica* (Linné, sp.), is abundant in the Baltic and elsewhere on the northern coasts of Europe, and has been regarded as identical by several writers. Another similar form, *inconspicua* (Sowerby), occurs on the northwest coast of America, but is regarded as distinct by Dr. P. P. Carpenter and others.

As a fossil, *var. fragilis* is abundant in the Post-Pliocene deposits of New England, New Brunswick, Canada, Labrador, and Greenland; *var. fusca* occurs in the Post-Pliocene of New England, Virginia, North Carolina, and South Carolina.

MACOMA SABULOSA Mörch.

Tellina (*Macoma*) *sabulosa* Mörch, in Naturh. Bidrag til Beskr. af Grönland, p. 90, 1857. *Tellina sabulosa* Spengler, Skrivt. Nat., vol. iv, part 2, 1798. *Tellina proxima* Gray, Zoöl. Beechey's Voyage, p. 154, Plate 44, fig. 4, 1839. *Tellina sordida* Couthouy, Boston Jour. Nat. Hist., vol. ii, p. 59, Plate 3, fig. 11, 1839. *Sanguinolaria sordida* Gould, Invert., ed. i, p. 67, 1841. *Tellina lata* Lovén, Öfvers. af Kongl. Vet.-Akad., Förhand., vol. xi, p. 195, 1846 (not *Tellina lata* Gmelin, 1790, which is a *Thracia*, t. Mörch). *Tellina calcarea* Lyell, Phil. Trans., 1833 (not Chemnitz, 1782 = a *Mactra*, t. Mörch). *Macoma proxima* Gould, ed. ii, p. 95, fig. 401; this Report, p. 508. *Macoma calcarea* Adams; Dawson, op. cit., p. 73.

Connecticut to the Arctic Ocean; northern coasts of Europe; North Pacific; south on the coast of Asia to Hakodadi, Japan; and, perhaps (as *M. expansa*, a doubtful variety), on the west coast of America south to Puget Sound. Off Block Island, in 29 fathoms, rare; Casco Bay, 3 to 60 fathoms, not uncommon; Quahog Bay, Maine, 3 to 5 fathoms, soft mud, large and abundant; Bay of Fundy, 4 to 80 fathoms. Stonington and Stratford, Connecticut (Linsley); Saint George's Bank (S. I. Smith). Fossil in the Post-Pliocene of Maine, New Brunswick, Canada, Labrador, Scandinavia, and Great Britain.

The *Tellina tenera* Leach, 1818 (*non* Say), has been regarded as a synonym of this species by most writers; Mörch considers it identical with *M. fragilis*.

ANGULUS TENER. Plate XXVI, fig. 180; Plate XXX, fig. 223. (p. 358.)

Tellina (*Angulus*) *tenera* H. and A. Adams, Genera, vol. ii, p. 398, 1858. *Angulus tener* Verrill, Amer. Jour. Science, vol. iii, p. 290, Plate 6, figs. 1, 1*a*, 1872. *Tellina tenera* Say, Jour. Acad. Nat. Sci., Philad., vol. ii, p. 303, 1822; Hanley, Recent Shells, p. 65, Plate 9, fig. 38; Gould, Invert., ed. i, p. 68, fig. 44; ed. ii, p. 97, fig. 403.

Florida to Gulf of Saint Lawrence. Common on the coast of New Jersey, Long Island, Long Island Sound, Buzzard's Bay, Vineyard Sound, Massachusetts Bay; less common in Casco Bay and Bay of Fundy. Gaspé, Canada (Dawson). Fort Macon, North Carolina (Coues). A closely-allied form (*A declivis* = *Tellina declivis* Conrad, Journ. Acad. N. Sc., Phil., vol. vii, p. 131) occurs in the Miocene of Virginia.

ANGULUS TENELLUS Verrill. Plate XXX, fig. 224.

Angulus modestus Verrill, Amer. Jour. Science, vol. iii, pp. 210, 285, Plate 6, figs. 2, 2*a*, 1872; this Report, p. 418, (*non* Carpenter, 1864).

Shell smooth, shining, more or less iridescent, with very fine concentric striæ. Form similar to that of *A. tener*, but more oblong, and with the anterior dorsal margin nearly straight, or even slightly concave; the beaks are at about the posterior third, and scarcely prominent; the posterior end slopes rapidly, and is subtruncate at the end; the ventral margin is but slightly convex in the middle, and sub-parallel with the dorsal margin. The shell is often a little thickened, and firmer than in *A. tener*, but is sometimes as thin. Color, pink, light straw-color, or white; often banded concentrically with these colors. The hinge-margin is stouter and the teeth stronger than in *A. tener*, and different in relative size and proportions; the ligament-plate is also longer.

Long Island Sound and Vineyard Sound; 4 to 10 fathoms, mud and sand.

TELLINA TENTA Say. Plate XXX, fig. 223. (p. 432.)

American Conchology, Part vii, Plate 65, fig. 3, 1837; Binney's Say, p. 228; Hanley, Recent Shells, p. 65, Plate 14, fig. 10; Gould, Invert., ed. i, p. 68, fig. 43; ed. ii, p. 96, fig. 402. *Tellina* (*Peronæa*) *tenta* H. and A. Adams, Genera, vol. ii, p. 499, 1858.

Cape Cod to South Carolina. Vineyard Sound and Buzzard's Bay, 2 to 10 fathoms, mud, common; Long Island Sound; Great Egg Harbor. Greenport, Long Island (S. Smith); Fort Macon, North Carolina (Coues); South Carolina (Say).

Fossil in the Post-Pliocene of South Carolina.

Tellina versicolor Cozzens.

Jay, Catalogue Shells, ed. ii, p. 12, 1836; Dekay, Nat. Hist. New York, Moll., p. 208, Plate 26, fig. 272.

Glass House Point, near New York (Cozzens); Stratford, Connecticut (Linsley).

I have met with no shells corresponding precisely with the description of this species.

GASTRANELLA Verrill.

American Journal of Science, vol. iii, p. 286, 1872.

"Shell oblong, more or less irregular, and sometimes with the ventral margin inflexed; pallial sinus large; ligament external, elongated. Right valve with two small cardinal teeth; the posterior one thin, directed obliquely backward. Left valve with two cardinal teeth; the posterior one stout, bilobed; the anterior one smaller. No distinct lateral teeth. Animal with long, slender, separate siphonal tubes, with a simple circle of papillæ at the ends; mantle well open anteriorly; foot ligulate. The curious little shell for which this genus is constituted apparently resembles *Gastrana* more than any other described genus."

GASTRANELLA TUMIDA Verrill. Plate XXVII, fig. 190. (p. 418.)

American Jour. Sci., vol. iii, pp. 210, 286, Plate 6, figs. 3, 3*a*, 1872.

Shell small, variable in form, swollen above, more or less elongated oval, or oblong, with rounded ends, compressed posteriorly. The beaks are rounded, somewhat prominent, incurved but not approximate, and directed somewhat forward; the anterior dorsal margin is deeply concave in front of the beaks, but without a distinct lunule, at the anterior end regularly rounded or a little prolonged, compressed; ventral margin slightly convex, or nearly straight and sub-parallel with the dorsal margin, or incurved, in the different specimens; posterior end broadly rounded in some, decidedly prolonged in others; dorsal posterior margin usually nearly straight for at least half its length, sometimes a little convex and gradually sloping throughout. Surface with fine, somewhat irregular, concentric striæ, slightly iridescent. Color white, with the umbos purple. Length, 4^{mm}; height, 2.5^{mm}.

Long Island Sound, near New Haven, 4 to 6 fathoms, shelly and gravelly bottom, among hydroids and sponges (A. E. V.).

Abra æqualis Say.

American Conch., Part iii, Plate 28; outer figures, 1831; Binney's Say, p. 182, same plate; Stimpson, Check-List, p. 3, 1860. *Amphidesma æqualis* Say, Journ. Acad. Nat. Sci., Philadelphia, vol. ii, p. 307, 1822; American Conch., Part iii, Plate 28; Binney's Say, pp. 100, 182. *Semele equalis* Verrill, Amer. Jour. Science, vol. iii, p. 210, 1872.

Florida and Gulf of Mexico to Cape Hatteras; rare and local farther north. Stonington, Connecticut, from cod-stomachs (Linsley). Fort Macon, North Carolina, abundant (Coues, Yarrow). Texas (Rœmer). Charleston, South Carolina (Say).

The occurrence of this southern species at Stonington needs confirmation. I have seen no specimens from north of Cape Hatteras.

Fossil in the Miocene of North and South Carolina.

CUMINGIA TELLINOIDES Conrad. Plate XXX, fig. 221. (p. 418.)

Journ. Acad. Nat. Sci., Philad., vol. vii, p. 234, 1837; Gould, Invert., ed. i, p. 56, fig. 36; ed. ii, p. 79, fig. 390. *Mactra tellinoides* Conrad, Journ. Acad. Nat. Sci., Philad., vol. vi, p. 258, Plate 9, figs. 2, 3, 1831.

Cape Cod to Florida. Common in Vineyard Sound and Buzzard's Bay, 3 to 12 fathoms; Long Island Sound, less common. Fort Macon, North Carolina (Coues, Yarrow). Florida (Conrad). Fossil in the Post-Pliocene of Nantucket Island, South Carolina, and North Carolina; in the Pliocene of South Carolina; and in the Miocene of Virginia and South Carolina.

CERONIA ARCTATA Adams. (p. 426.)

H. and A. Adams, Genera, vol. ii, p. 414, 1858; Gould, Invert., ed. ii, p. 80, fig. 391. *Mactra arctata* Conrad, Journ. Acad. Nat. Sci., Philad., vol. vi, p. 257, Plate 11, fig. 1, 1831. *Mesodesma arctata* Gould, Invert., ed. i, p. 57, fig. 39.

Long Island to River Saint Lawrence. Stonington, Connecticut (Linsley). East Hampton and Montauk, Long Island (S. Smith). Nantucket (Gould). Common in Massachusetts Bay; Casco Bay, and Eastport, Maine, rare. Nova Scotia (Willis).

Donax fossor Say.

Journal Acad. Nat. Sciences, Philadelphia, vol. ii, p. 306, 1822; Binney's Say, pp. 99, 226, Plate 61, fig. 2.

This species may possibly occur occasionally on the Southern New England coast, but I am not aware of any authentic instances. I have found it quite common living on the outer beach at Great Egg Harbor, New Jersey, and it has been found as far north as the southern side of Long Island.

MACTRA SOLIDISSIMA Chemnitz. Plate XXVIII, fig. 202. (p. 358.)

Conch., x, p. 350, Plate 170, fig. 1656, 1788; Gould, Invert., ed. i, p. 51; ed. ii, p. 73, fig. 387. *Mactra gigantea* Lam., Anim. sans Vert., ed. ii, vol. vi, p. 97. *Mactra similis* Say, Journ. Acad. Nat. Sci., Philadelphia, vol. ii, p. 309, 1822; Binney's Say, p. 101. *Spisula solidissima* Gray, Charlesworth's Mag. Nat. Hist., vol. i, p. 373, 1837; H. and A. Adams, vol. xi, p. 378. *Hemimactra solidissima* Conrad, Amer. Journ. Conch., vol. iii, appendix, p. 32; Perkins, Proc. Bost. Soc. Nat. Hist., vol. xiii, p. 346, 1869. *Spisula Sayi* Gray, op. cit., p. 373.

Florida and Gulf of Mexico to Labrador. Very abundant on the outer beach at Great Egg Harbor, New Jersey; Long Island; Long Island Sound; Vineyard Sound; Cape Cod; Massachusetts Bay; Casco Bay; Bay of Fundy, low water-mark to 10 fathoms, sandy. Fort Macon, North Carolina (Coues); Labrador (Packard); St. George's Bank (S. I. Smith); West Florida (Jewett); Texas (Rœmer).

Fossil in the Post-Pliocene at Point Shirley, Chelsea, Massachusetts (Stimpson); and apparently in the Miocene of North and South Carolina (Conrad, as "*M. similis ?*").

MULINIA LATERALIS Gray. Plate XXVI, fig. 185, B. (p. 373.)

Charlesworth's Mag. of Nat. Hist., vol. i, p. 376, 1837; Meek, Smithsonian Check-Lists, Miocene, p. 11, 1864. *Mactra lateralis* Say, Journ. Acad. Nat. Sci., Philad., vol. ii, p. 309, 1822; Gould, Invert., ed. i, p. 54, figs. 34, 35; ed. ii, p. 77, fig. 389. *Standella lateralis* H. and A. Adams, Genera, vol. ii, p. 382, 1858; Conrad, Proc. Philad. Acad., vol. xiv, p. 573, 1862.

Massachusetts Bay to Florida, and on the northern shores of the Gulf of Mexico to Galveston, Texas. Very abundant in Long Island Sound; common in Buzzard's Bay and Vineyard Sound, 1 to 15 fathoms, mud. Boston and near Lynn, Massachusetts (Gould). Fort Macon, North Carolina (Coues). Georgia (Couper). Texas (Rœmer).

Fossil in the Post-Pliocene of Virginia, North Carolina, South Carolina, and Florida (Saint John's River); in the Pliocene of South Carolina; and in the Miocene of Virginia, North and South Carolina.

PETRICOLA PHOLADIFORMIS Lamarck. Plate XXVII, fig. 199. (p. 372.)

Anim. sans Vert., ed. i, vol. v., p. 505, 1818; ed. ii, vol. vi, p. 159; Say, Amer. Conch., Part vi, Plate 60, fig. 1, 1834; Binney's Say, p. 222 (same plate); Hanley, Recent Shells, p. 52, Plate 13, fig. 49; Gould, Invert., ed. i, p. 63; ed. ii, p. 90, figs. 398, 399. *Petricola fornicata* Say, Journ. Acad. Nat. Sci., Philadelphia, vol. ii, p. 319, 1822. *Petricola dactylus* Say, Amer. Conch., Part vi, Plate 60, fig. 2 (*non* Sowerby, Hanley, etc.); Gould, Invert., ed. i, p. 65; ed. ii, p. 92, fig. 41.

Florida and Gulf of Mexico to Massachusetts Bay; local and more rare farther north, at Quahog Bay, Maine; and in the southern part of the Gulf of Saint Lawrence, as at Prince Edward's Island (Dawson); Nova Scotia (Willis). Very common in Long Island Sound, near New Haven; Buzzard's Bay; Vineyard Sound (Lackey's Bay, etc.); and Massachusetts Bay (Chelsea, Nahant, etc.). Fort Macon (Coues);

Florida (Conrad); Texas (Rœmer); Cuba (D'Orbigny). Fossil in the Post-Pliocene of Virginia, South Carolina, and Florida; and in the Pliocene of South Carolina. A similar form, if not identical (*P. Carolinensis* Conrad), occurs in the Miocene of South Carolina.

A species scarcely to be distinguished from this was sent to me in large numbers from La Paz, Gulf of California, by Captain Pedersen.

VENUS MERCENARIA Linné. Plate XXVI, fig. 184 (animal). (p. 359.)

Systema Naturæ, ed. xii, p. 1131, 1767; Gould, Invert., ed. i, p. 85, fig. 67; ed. ii, p. 133, fig. 445. *Mercenaria violacea* Schumacher, Essai d'un Nouveau Syst., p. 135, Plate 10, fig. 3, 1817; Adams, Genera, vol. ii, p. 419. *Mercenaria mercenaria* Chenu, Man. Conch., vol. ii, p. 82, figs. 356–358, 1862. *Crassivenus mercenaria* Perkins, Proc. Boston Soc. Nat. Hist., vol. xiii, p. 147, 1869. *Venus notata* Say, Journ. Acad. Nat. Sci., Philadelphia, vol. ii, p. 271, 1822 (variety); Gould, Invert., ed. i, p. 87, fig. 67; ed. ii, p. 135, fig. 446. *Venus præparca* Say, op. cit., p. 271, 1822; Binney's Say, p. 95.

Florida to Massachusetts Bay; more rare and local farther north, at Quahog Bay, Maine; Nova Scotia (Willis); and in the southern part of the Gulf of Saint Lawrence, to the Bay of Chaleur. It is not found on the coast of Maine, east of Kennebeck River, nor in the Bay of Fundy. Very common in Vineyard Sound, Buzzard's Bay, Long Island Sound, and southward. Fort Macon (Coues); South Carolina (Gibbes); Georgia (Couper); Texas (Rœmer). Fossil in the Post-Pliocene of Point Shirley, Nantucket Island, Gardiner's Island, Virginia, and South Carolina; in the Pliocene of South Carolina; and in the Miocene of Maryland, Virginia, North and South Carolina.

CALLISTA CONVEXA Adams. Plate XXX, fig. 219. (p. 432.)

H. and A. Adams, Genera, vol. ii, p. 425, 1858. *Cytherea convexa* Say, Journ. Acad. Nat. Sci., Phil., vol. iv, p. 149, Plate 12, fig. 3, 1824 (fossil); Gould, Invert., ed. i, p. 84, fig. 49; ed. ii, p. 131, fig. 444 (recent). *Dione convexa* Deshayes, Catal. Conch. Biv., British Museum, p. 71, 1853. *Cytherea morrhuana* Linsley, Amer. Jour. Sci., vol. xlviii, p. 276, 1845 (no description); Gould, op. cit., ser. ii, vol. vi, p. 233, 1848 (young). *Cytherea Sayana* Conrad, Amer. Jour. Sci., ser. i, vol. xxiii, p. 345, 1833 (recent); Fossils of the Medial Tertiary of the U. S., p. 13, Plate 7, fig. 3, 1838 (fossil). *Cytherea Sayii* Perkins, Proc., Boston Soc. Nat. Hist., vol. xiii, p. 147, 1869. *Callista (Caryatis) convexa* Römer; Verrill, Amer. Jour. Sci., vol. xlix, p. 277, March, 1870.

New Jersey to Gulf of Saint Lawrence. Fort Macon, North Carolina, dead valves on the beach, plenty, but perhaps fossil, (Coues, Yarrow). Great Egg Harbor, New Jersey; Long Island Sound; Vineyard Sound, and Buzzard's Bay, 2 to 10 fathoms, mud, common; Casco Bay, 3 to 8 fathoms, mud, adult, living; Eastport, Maine, rare. Nova Scotia (Willis); Prince Edward's Island (Dawson).

Fossil in the Post-Pliocene of Virginia and North Carolina; in the Pliocene of South Carolina; and in the Miocene of Maryland, North and South Carolina.

The name *Sayana* given to this species in 1833 (loc. cit.) by Mr. Conrad, was accompanied by a short description of recent specimens from Rhode Island and New Jersey. He gave *C. convexa* Say as a synonym, however, remarking that it "appears not to differ from the *C. convexa* of Say, but I have changed the name because M. Brogniart had previously applied it to a very dissimilar species." More recently, however, he has indicated his belief that the two are distinct (Catal. Miocene Shells, in Proc. Phil. Acad., vol. xiv, p. 575, 1862), although he recognizes the "*Sayana*" as a Miocene shell, but he has not pointed out the differences, if any exist, so far as known to me. Should the recent shell prove to be distinct from the fossil one described by Say, it should therefore bear the name *Callista Sayana*.

In this species the animal is white, or pale salmon-color. The border of the mantle sometimes protrudes considerably beyond the edge of the shell, and is delicately undulated or frilled; the siphon tubes, in full expansion, are smooth and rather longer than the shell, and are united quite to the ends; the orifices are simple, without apparent papillæ, and the branchial is considerably larger than the other; a well-marked groove extends along the whole length of the siphon, indicating the partition between the tubes.

TOTTENIA GEMMA Perkins. Plate XXX, fig. 220. (p. 359.)

Proc. Boston Soc. Nat. Hist., vol. xiii, 1869 (in errata); by error, *Totteniana* (p. 148). *Venus gemma* Totten, Amer. Jour. Science, vol. xxvi, p. 367, figs. 2*a*, *d*, 1834. *Gemma gemma* Deshayes, Catal. Conch. Biv., British Museum, p. 113, 1853; H. and A. Adams, Genera, vol. ii, p. 419, Plate 107, fig. 3. *Gemma Totteni* Stimpson, Check-List, p. 3, 1860.

South Carolina to Labrador. Very abundant in Long Island Sound, Buzzard's Bay, Vineyard Sound, Nantucket, and Massachusetts Bay; common in Casco Bay, and at Grand Menan Island. Nova Scotia (Willis). Prince Edward's Island (Dawson). Indian Harbor, Labrador (Packard). Fort Macon, North Carolina (Coues).

An allied species (*T. sphærica* H. C. Lea, sp.) occurs in the Miocene of Virginia.

TOTTENIA MANHATTENSIS Verrill.

Venus Manhattensis Prime, in Jay's Catalogue of Shells, ed. iv, supplement, p. 466, 1852. *Venus* (*Gemma*) *Manhattensis* Prime, Annals Lyc. Nat. Hist. N. Y., vol. vii, p. 482 (figure), 1862. *Gemma Manhattensis* Gould, Invert., ed. ii, p. 138, fig. 449.

North Carolina to Vineyard Sound. Hell Gate (Prime). Greenport and Huntington, Long Island (S. Smith). Near New Haven, rare. Fort Macon, North Carolina (Yarrow).

I have seen but few specimens of this shell, and am not fully satisfied that it is distinct from the preceding. Its color is not constant, some specimens being pale straw-color, others purplish. Mr. Prime originally described it as white.

CYPRINA ISLANDICA Lamarck. Plate XXVIII, fig. 201. (p. 508.)

Animaux sans Vert., ed. ii, vol. vi, p. 290; Gould, Invert., ed. i, p. 82; ed. ii, p. 443. *Venus Islandica* Linné, Syst. Nat., ed. xii, p. 1131.

Eastern end of Long Island to the Arctic Ocean; on the northern European coasts southward to England. Off Block Island, 29 fathoms, sandy mud; off Gay Head, Martha's Vineyard, 19 fathoms, soft mud; common in Casco Bay, 10 to 80 fathoms; Bay of Fundy, 6 to 90 fathoms; Saint George's Bank, 45 fathoms; and Gulf of Saint Lawrence. Montauk, Long Island (S. Smith). Fossil in the Post-Pliocene of Scandinavia, Scotland, England, Sicily, and other parts of Europe. In North America it appears not to have been found fossil hitherto, and it must, therefore, be rare in our northern Post-Pliocene or glacial deposits, if not altogether absent.

CARDIUM PINNULATUM Conrad. Plate XXIX, fig. 209. (p. 505.)

Journal Acad. Nat. Sciences, Philadelphia, ser. i, vol. vi, p. 260, Plate 11, fig. 8, 1831; Gould, Invert., ed. i, p. 90, fig. 57; ed. ii, p. 141, fig. 452.

Long Island Sound to Southern Labrador. Near New Haven, Connecticut, rare; Buzzard's Bay and Vineyard Sound, 4 to 12 fathoms, common; very common in Massachusetts Bay, Casco Bay, Bay of Fundy, and Gulf of Saint Lawrence, 2 to 80 fathoms. Labrador, south of Straits of Belle Isle (Packard). Huntington, Gardiner's and Peconic Bays, Long Island (S. Smith.) Off New London, Connecticut, (coll. T. M. Prudden).

Fossil in the Post-Pliocene of New Brunswick.

LÆVICARDIUM MORTONI. Plate XXIX, fig. 208. (p. 358.)

Perkins, Proc. Boston Soc. Nat. Hist., vol. xiii, p. 150, 1869. *Cardium Mortoni* Conrad, op. cit., vol. vi, p. 259, Plate 10, figs. 5, 6, 7; Gould, Invert., ed. i, p. 91; *Liocardium Mortoni* Stimpson, Check-List, p. 2, 1860; Gould, Invert., ed. ii, p. 143, fig. 453.

Florida and northern shores of the Gulf of Mexico to Cape Cod; rare and local farther north. Common in Long Island Sound, Buzzard's Bay, Vineyard Sound, and about Nantucket. Dartmouth Lakes, Halifax, Nova Scotia (Willis, t. Gould). West Florida (Jewett). Fort Macon (Coues). Fossil in the Post-Pliocene of South Carolina.

Serripes Grönlandicus Beck (*Aphrodite Grönlandica* Stimpson; Gould, Invert., ed. ii, p. 144, fig. 454). This species was recorded as from Stonington, Connecticut, by Linsley, but has not since been found south of Cape Cod, and must, therefore, be regarded as a doubtful inhabitant of our waters. It occurs from Massachusetts Bay to the Arctic Ocean, but is rare south of the Gulf of Saint Lawrence and Labrador. Casco Bay and Mount Desert, Maine, 8 to 30 fathoms, rare, (A. E. V.).

CYCLOCARDIA BOREALIS Conrad. Plate XXIX, fig. 216. (p. 418.)

Amer. Journ. Conchology, vol. iii, p. 191, 1867. *Cardita borealis* Conrad, Amer. Mar. Conch., p. 39, Plate 8, fig. 1, 1831; Gould, Invert., ed. i, p. 94, fig. 59; ed. ii, p. 146, fig. 455. *Actinobolus borealis* H. and A. Adams, Genera, vol. ii, p. 487, 1858.

(?) *Venericardia cribraria* Say, Amer. Conch., Part v, cover, 1832; Binney's Say, p. 205. (?) *Venericardia granulata* Say, Jour. A. Nat. Sci., Philadelphia, vol. iv, p. 142, Plate 12, fig. 1. *Cardita granulata* Conrad, Fossils of Medial Tert. of U. S., p. 13, Plate 7, fig. 1.

New Jersey to Labrador. Common in the deeper parts of Vineyard Sound, near its mouth, and off Gay Head and Buzzard's Bay, 10 to 25 fathoms; off Block Island, 29 fathoms; very common in Casco Bay, Bay of Fundy, and Gulf of Saint Lawrence, 3 to 80 fathoms. Sandy Hook, and Montauk, Long Island (S. Smith). Off New London, Connecticut (T. M. Prudden). Saint George's Bank, 25 to 65 fathoms, (S. I. Smith). Straits of Belle Isle, 50 fathoms; Chateau Bay, 50 fathoms; Long Island, Labrador, 15 fathoms, (Packard). A species, regarded as identical by Dr. Carpenter, occurs on the North Pacific coast of America as far south as Catalina Island, and on the northeast coast of Asia.

Fossil in the Post-Pliocene of Gardiner's Island; Nantucket and Point Shirley, Massachusetts; and Labrador. The Miocene form, *C. granulata* (Say, sp.) is very closely allied to this, if not identical. It is found in Virginia and Maryland.

CYCLOCARDIA NOVANGLIÆ Morse. Plate XXIX, fig. 215. (p. 418.)

Actinobolus (*Cyclocardia*) *Nova-angliæ* Morse, First Annual Report of Trustees of Peabody Acad. of Science, Salem, p. 76, cut, 1869. *Cyclocardia Novangliæ* Verrill, Amer. Journ. Science, vol. iii, p. 211, 1872.

Connecticut to Gulf of Saint Lawrence. Mouth of Vineyard Sound and off Gay Head, 10 to 25 fathoms; Casco Bay, and Bay of Fundy, 3 to 40 fathoms, not uncommon. Off New London, Connecticut (T. M. Prudden).

ASTARTE UNDATA Gould. Plate XXIX, fig. 203. (p. 508.)

Invert., ed. i, p. 80, fig. 46, 1841 (provisional name); Philippi, Abbildungen und Beschr. neuer oder wenig gek. Conch., vol. ii, p. 1, Plate 1, fig. 1, 1850; Verrill, Amer. Jour. Science, vol. iii, p. 213, 1872. *Crasina latisulca* Hanley, Recent Shells, p. 87, Plate 14, fig. 35, 1843. *Astarte sulcata* Gould, Invert., ed. i, p. 78, fig. 46, 1841 (not of European writers); ed. ii, p. 119, fig. 432 (poor figure, from an old, deformed shell).

Var. *lutea* = *Astarte lutea* Perkins, Proc. Boston Soc. Nat. Hist., vol. xiii, p. 150, figure, 1869.

Long Island Sound to the southern part of the Gulf of Saint Lawrence. Off Gay Head and Buzzard's Bay, and in the deeper parts of Vineyard Sound, 8 to 25 fathoms, common; off Block Island, 29 fathoms; very common in Casco Bay and Bay of Fundy, 5 to 100 fathoms; Saint George's Bank, 20 to 85 fathoms. Off New London, Connecticut, (T. M. Prudden). Southern part of Gulf of Saint Lawrence (Whiteaves). Var. *lutea* occurs rarely near New Haven (Perkins); and more frequently off Gay Head and in Vineyard Sound, 8 to 19 fathoms, with the ordinary varieties. It resembles the European *sulcata* more than the common or typical varieties do, but passes insensibly into the ordinary forms. The shells referred to *undata*, by Dawson and Whiteaves, from

Gaspé, Canada, are not this species, but a short variety of *A. elliptica*. The latter is a much more northern shell, and I have dredged but one specimen on the New England coast (off Casco Bay, 65 fathoms).

Fossil at Point Shirley, Massachusetts, in the Post-Pliocene, (Stimpson, as *A. sulcata*); and at Gardiner's Island (S. Smith).

ASTARTE CASTANEA Say. Plate XXIX, fig. 204. (p. 432.)

American Conchology, Part i, 1830, Plate 1; Binney's Say, p. 150, Plate 1; Gould, Invert., ed. i, p. 76, fig. 45; ed. ii, p. 117, fig. 431. *Venus castanea* Say, Journ. Acad. Nat. Sci., Philad., vol. ii, p. 273, 1822; Binney's Say, p. 96. *Crassina castanea* Lamarck, Anim. sans Vert., ed. ii, vol. vi, p. 258; Hanley, Recent Shells, p. 88, Plate 9, fig. 27.

Great Egg Harbor, New Jersey, to Nova Scotia. Common on the shores of Long Island, Nantucket, Martha's Vineyard, and Cape Cod; Long Island Sound, not very common; Vineyard Sound and Buzzard's Bay, 5 to 20 fathoms, frequent; Casco Bay and Bay of Fundy, 5 to 20 fathoms, not common. Massachusetts Bay, abundant, (t. Gould). Saint George's Bank, 25 to 40 fathoms, (S. I. Smith). Halifax and Sable Island, Nova Scotia (Willis). Off Cape Sable, Nova Scotia (A. E. V.). Off New London, Connecticut (T. M. Prudden). Fossil in the Post-Pliocene at Nantucket and Point Shirley, Massachusetts.

ASTARTE QUADRANS Gould. Plate XXIX, fig. 205. (p. 509.)

Invert., ed. i, p. 81, fig. 48, 1841; ed. ii, p. 123, fig. 434; Verrill, Amer. Journ. Sci., vol. iii, p. 287, 1872. *Astarte Portlandica* Mighels, Boston Journ. Nat. Hist., vol. iv, pp. 320, 345, Plate 16, fig. 2, 1843 (variety); Gould, Invert., ed. ii, p. 127, fig. 441.

Stonington, Connecticut, to Gulf of Saint Lawrence. Mouth of Vineyard Sound, and off Martha's Vineyard, 19 to 25 fathoms, rare; Massachusetts Bay; Casco Bay; Bay of Fundy, in 6 to 40 fathoms, not uncommon. Saint George's Bank (S. I. Smith). Gulf of Saint Lawrence (Whiteaves).

Var. *Portlandica* occurs, with intermediate forms, in Casco Bay and Bay of Fundy, 10 to 25 fathoms, not common.

GOULDIA MACTRACEA Gould. Plate XXIX, figs. 206, 207. (p. 418.)

Invert., ed. ii, p. 128, fig. 442, 1870. *Astarte mactracea* Linsley, Amer. Jour. Sci., vol. xlviii, p. 275 (figure), 1845; Gould, op. cit., ser. ii, vol. vi, p. 233, figs. 1. 2, 1848. (?)*Astarte lunulata* Conrad, Jour. Acad. Nat. Sciences, Philad., vol. vii, p. 151, 1837; Fossils of the Medial Tertiary of the U. S., p. 45, Plate 21, fig. 8, 1840; *Gouldia lunulata* Conrad, Catal. of Miocene Shells, in Proc. Acad. Nat. Sci., Philad., vol. xiv, p. 578, 1862.

Florida and northern shores of the Gulf of Mexico to Cape Cod. Common, living, and of large size, in Vineyard Sound and Buzzard's Bay, especially at Wood's Hole, 3 to 10 fathoms. Stonington, in stomach of cod (Linsley). Huntington and Greenport, Long Island (S. Smith). Off New London, Connecticut (coll. T. M. Prudden). Fort Macon (Coues). South Carolina (Kurtz). West Florida (E. Jewett). Tampa Bay (Conrad).

Fossil (*G. lunulata*) in the Post-Pliocene of North and South Carolina; in the Pliocene of South Carolina; and in the Miocene of Maryland and Virginia. The fossil shell is probably identical with the recent one, but I have not had suitable specimens of the former for comparison; if identical, the species should be called *G. lunulata*.

LUCINA FILOSA Stimpson. Plate XXIX, fig. 212. (p. 509.)

Shells of New England, p. 17, 1851; Gould, Invert., ed. ii, p. 98, fig. 404. *Lucina radula* Gould, Invert., ed. i, p. 69 (*non* Montagu, sp.). ? *Lucina contracta*, Say, Jour. Acad. Nat. Sciences, Philad., vol. iv, p. 145, Plate 10, fig. 8; Conrad, Fossils of the Medial Tertiary of U. S., p. 40, Plate 20, fig. 5, 1840.

Stonington, Connecticut, to Maine. Off Block Island, 29 fathoms, sandy mud; off Gay Head, 19 fathoms, soft mud; Casco Bay and Portland Harbor. Stonington (Linsley). Boston Harbor (Stimpson). Phillip's Beach (Holder). Rhode Island (Conrad, as *L. contracta*).

Fossil in the Post-Pliocene of Gardiner's Island (S. Smith). *L. contracta* occurs in the Miocene of Virginia; it was formerly regarded by Conrad as identical with the recent shell from Rhode Island, but is probably a distinct, though closely-allied species. Mr. Jeffreys identified this species with *L. borealis* (Linné) of Europe; the latter is also found on the Pacific coast at Vancouver Island and Catalina Island (Cooper and P. P. Carpenter).

CYCLAS DENTATA. Plate XXIX, fig. 211. (p. 418.)

Lucina dentata Wood, General Conchology, p. 195, Plate 46, fig. 7, 1815; Gould, Invert., ed. ii, p. 99, fig. 45. *Lucina divaricata* Gould, Invert., ed. i, p. 70, (*non* Linné, sp). *Lucina strigilla* Stimpson, Shells of New England, p. 17, 1851.

Brazil and West Indies to Cape Cod. Not uncommon, dead, but rarely obtained living, in Vineyard Sound, 6 to 14 fathoms. Coney Island (S. Smith). Nantucket (Gould). St. George's Bank (S. I. Smith). Fort Macon, North Carolina, abundant, (Coues, Yarrow). Georgia (Couper).

Fossil in the Post-Pliocene of North Carolina, South Carolina, and Florida; and in the Pliocene of South Carolina. The same, or a closely-related species, (*L. Conradi* D'Orb., Prod., iii, p. 117, 2194, t. Conrad, in Proc. Acad. Nat. Sci., Phil., 1862, p. 577=*L. divaricata* Conrad, Fossils of Med. Tert., p. 38, Plate 20, fig. 3) occurs in the Miocene of Virginia.

CRYPTODON GOULDII Adams. Plate XXIX, fig. 213. (p. 509.)

H. and A. Adams, Genera, vol. ii, p. 470, 1858; Gould, Invert., ed. ii, p. 100, fig. 406. *Lucina Gouldii* Philippi, Zeitsch. f. Malak., 1845, p. 74 (t. Gould). *Thyasira Gouldii* Stimpson, Shells of New Eng., p. 17, 1851. *Lucina flexuosa* Gould, Invert., ed. i, p. 71, fig. 52 (*non* Montagu, sp.).

Stonington, Connecticut, to Gulf of Saint Lawrence. Off Block Island, 29 fathoms; Buzzard's Bay, 6 fathoms, mud; common in Massachusetts Bay, Casco Bay, and Bay of Fundy, 5 to 60 fathoms, muddy and sandy. Nova Scotia (Willis). Gaspé, Canada (Whiteaves). Murray Bay (Dawson). Gulf of Saint Lawrence, 20 to 300 fathoms (Whiteaves). Greenland (Mörch). Labrador, 15 to 50 fathoms, (Packard). Fossil in the Post-Pliocene at Montreal, rare, (Dawson); Brunswick, Maine (Packard).

Possibly some of the Gulf of Saint Lawrence specimens may belong to the following species.

CRYPTODON OBESUS Verrill. Plate XXIX, fig. 214. (p. 509.)

American Journ. Science, vol. iii, pp. 211, 287, Plate 7, fig. 2, 1872.

Shell white, irregularly and rather coarsely concentrically striated, much swollen in the middle; the transverse diameter nearly equal to the length; the height considerably exceeding the length. The beaks are prolonged and turned strongly to the anterior side. The lunular area is rather large and sunken, somewhat flat, in some cases separated by a slight ridge into an inner and an outer portion. Anterior border with a prominent rounded angle; ventral margin prolonged and rounded in the middle; posterior side with two strongly-developed flexures, separated by deep grooves. Interior of shell with radiating grooves, most conspicuous toward the ventral edge.

Length of the largest specimen, 15^{mm}; height, 18^{mm}; thickness, 13^{mm}. The smaller specimens have about the same proportions.

Six single valves, some of them quite fresh, were obtained off No-man's Land at different localities. They were all right valves, and the smallest was 12.5^{mm} of an inch in height. The specimen from Labrador agrees nearly in form and structure, and is only 5.75^{mm} in height and 5^{mm} in length.

This species appears to be more nearly related to *C. flexuosus* of Europe than to *C. Gouldii*. The European species is nearly intermediate between the two American shells in form; but judging from the specimens that I have had opportunities to examine, the three forms ought to be kept distinct. *C. Gouldii* is a thinner and more delicate shell, more rounded, relatively much longer, and is seldom more than 6^{mm} to 7^{mm} in breadth.

Block Island to Labrador. East of Block Island, in 29 fathoms, fine sandy mud; off Gay Head, 19 fathoms, mud; Casco Bay, 60 fathoms, mud. Labrador (Packard). East of Saint George's Bank, 430 fathoms (S. I. Smith).

Turtonia minuta Stimpson.

Shells of New England, p. 16, 1851 (*non* Alder, Forbes and Hanley, etc.); Gould, Invert., ed. ii, p. 85, fig. 395. *Venus minuta* Fabricius, Fauna Grönlandica, p. 412, 1780. *Turtonia nitida* Verrill, Amer. Journ. of Sci. vol. iii, p. 286, Plate 7, figs. 4, 4*a*, 1872.

Massachusetts Bay to Greenland. Common under stones and in rocky pools at low-water, in Massachusetts Bay and Casco Bay. Although this species has not yet been found south of Cape Cod, so far as I am aware, it will probably be found hereafter on the more exposed rocky shores, as at Point Judith, Watch Hill, or on some of the outer islands.

The American specimens of this shell differ so widely in form, and especially in the structure of the hinge, from all the European specimens with which I have compared them, as well as from the descriptions and figures, that I cannot regard them as identical. Dr. Gould has well defined the form and external characters of our shell. I have seen no European specimens so elongated in form as the American examples seen by me invariably are, but depend less on the external form than on the structure of the hinge for distinguishing them. (See the greatly enlarged figure in the Amer. Journal of Science).

Having had opportunities to study northern specimens of this shell, since I gave it the name *nitida*, I have become fully satisfied that the original shell described by Fabricius is identical with the American species, rather than with the European. His description corresponds well with our best specimens. The European species, if, as I believe, distinct from ours, should, therefore, retain the name *T. purpurea* (Montagu, sp.); and *minuta* should be restored to the American form.

KELLIA PLANULATA Stimpson. Plate XXX, fig. 226. (p. 310.)

Shells of New England, p. 17, 1851; Gould, Invert., ed. ii, p. 83, fig, 393. *Kellia rubra* Gould, Invert., ed. i, p. 60, (*non* Montagu, sp.).

Long Island Sound to Greenland. Near New Haven, Connecticut, rare; Vineyard Sound and Buzzard's Bay, 1 to 8 fathoms, not common; Casco Bay; Eastport, Maine, 8 to 15 fathoms; Bay of Fundy. Montauk and Greenport, Long Island, low-water to 6 fathoms, mud; and Gull Island, low-water, under stones, (S. Smith). Boston Harbor, 5 fathoms, shelly, (Stimpson). Sable Island, Nova Scotia (Willis). Greenland (Mörch).

MONTACUTA ELEVATA Stimpson. (p. 418.)

Shells of New England, p. 16, 1851; Gould, Invert., ed. ii. p. 86, fig. 396. *Montacuta bidentata* Gould, Invert., ed. i, p. 59, 1841 (*non* Montagu, sp., 1803).

Long Island Sound to Massachusetts Bay. Savin Rock, near New Haven, rare; Naushon Island, Vineyard Sound, rare. Greenport, Long Island (S. Smith). New Bedford (Gould). Chelsea Beach (Stimpson).

LEPTON FABAGELLA Conrad.

Marine Conchology, p. 53, Plate 11, fig. 3, 1831; Dekay, Nat. History of New York, Mollusca, p. 243, Plate 32, fig. 307, A, B.

Rhode Island (Conrad).

I have not seen specimens of this shell. It seems to be rare and little known.

A closely-related species (*L. mactroides* Conrad, Fossils Medial Tert., p. 19, Plate X, fig. 5, 1839) is found in the Miocene of Maryland.

SOLENOMYA VELUM Say. Plate XXIX, fig. 210. (p. 360.)

Journal Acad. Nat. Sciences, Philad., vol. ii, p. 317, 1822 (*Solemya*); Gould, Invert., ed. i, p. 35; ed. ii, p. 48, fig. 371.

North Carolina to Nova Scotia. Great Egg Harbor, New Jersey; Long Island Sound, near New Haven, low-water to 6 fathoms, not uncommon very common in Buzzard's Bay and Vineyard Sound, 1 to 5 fathoms, especially in soft mud, in coves; Chelsea Beach, etc., Massachusetts Bay, common; Casco Bay, rare. Nova Scotia (Willis). Huntington and Greenport, Long Island, rare, (S. Smith).

SOLENOMYA BOREALIS Totten.

Amer. Jour. Science, vol. xxvi, p. 366, fig. 1, *h, i*, 1834 (*Solemya borealis*); Gould, Invert., ed. i, p. 36; ed. ii, p. 50, fig. 372.

Connecticut to Nova Scotia. Newport, Rhode Island (Totten). Chelsea and Nahant, Massachusetts (Gould). Casco Bay and Portland Harbor rare; Vineyard Sound, at Cuttyhunk Island, rare. Stonington, Connecticut (Linsley).

This species may prove to be only the mature state of the preceding, but I have never seen specimens intermediate in character.

YOLDIA LIMATULA Stimpson. Plate XXX, fig. 232. (p. 432).

Shells of New England, p. 9, 1851; H. and A. Adams, Genera, vol. ii, p. 548, Plate 126, figs. 5, 5*b*, 1858; Gould, Invert., ed. ii, p. 154, fig. 462. *Nucula limatula* Say, Amer. Conch., ii, Plate 12, middle figures, 1831; Gould, Invert., p. 98, fig. 62. *Leda limatula* Stimpson, Shells of New England, p. 10, 1851.

North Carolina to Gulf of Saint Lawrence. Common in Long Island Sound; Buzzard's Bay; Vineyard Sound; Casco Bay, in 2 to 12 fathoms, soft mud; less common in the Bay of Fundy, 4 to 30 fathoms. Beaufort, North Carolina (Stimpson, Coues). Huntington and Greenport, Long Island (S. Smith). Nova Scotia (Willis). The specimens from Long Island Sound are as large and fine as the northern ones.

Fossil in the Post-Pliocene of Canada, Virginia, North and South Carolina; and in the Pliocene of South Carolina. An allied species (*Y. lævis* Say, sp., Conrad) occurs in the Miocene of Maryland and South Carolina.

Yoldia myalis Stimpson; Gould, Invert., ed. ii, p. 160, fig. 467; *Nucula myalis* Couthouy, 1838. This is often confounded with *Y. limatula*, though quite distinct. It is a more arctic species, ranging from Massachusetts Bay to the Arctic Ocean and Spitzbergen, but it has not been found south of Cape Cod, so far as known to me. The shells reported as such, that I have seen, are *Y. limatula*. Gould reports the latter as from Nordland (McAndrew), but we suspect that *Y. myalis* or *Y. sapotilla* may have been, in this case, mistaken for *Y. limatula*.

YOLDIA SAPOTILLA Stimpson, 1851. Plate XXX, fig. 231. (p. 509.)

H. and A. Adams, Genera, vol. ii, p. 548; Gould, Invert., ed. ii, p. 159, fig. 466. *Nucula sapotilla* Gould, Invert., ed. i, p. 100, fig. 61, 1841; Hanley, Recent Shells, p. 170, Plate 20, fig. 3. *Leda* (*Yoldia*) *sapotilla* Stimpson, Shells of New England, p. 10, 1851. *Yoldia arctica* Mörch, op. cit., p. 93, 1857 ;(t. Dawson, from specimen; *non Y. arctica* Sars).

Long Island to the Arctic Ocean, comparatively rare and local, chiefly in deep water, south of Cape Cod. Off Gay Head, 19 fathoms, soft mud; off Buzzard's Bay, 25 fathoms, sand; east of Block Island, 29 fathoms, fine sandy mud; common in Casco Bay and Bay of Fundy, 4 to 100 fathoms, mud. Greenport, Long Island (S. Smith). Massachusetts Bay (Gould). Nova Scotia (Willis). Labrador (Packard). Greenland (Mörch).

This species seems to be unknown among our Post-Pliocene shells. Having examined several hundred specimens from many different localities and depths, I am satisfied that it is perfectly distinct from *Y. limatula*, with which certain writers are inclined to unite it.

Yoldia Gouldii.

Nucula Gouldii DeKay, Nat. Hist. New York, Mollusca, p. 180, Plate 13, fig. 221, 1843.

This was originally described by Dekay as from Long Island Sound. I have seen no specimens corresponding with the description in all respects. It is, perhaps, a short variety of *Y. sapotilla*.

YOLDIA OBESA Stimpson, 1851. (p. 509.)

H. and A. Adams, Genera, vol. ii, p. 548, 1858; Gould, Invert., ed. ii, p, 155, fig. 463. *Leda obesa* Stimpson, Proc. Boston Soc. Nat. Hist., vol. iv, p. 13, 1851; Shells of New England, p. 10, Plate 2, fig. 1, 1851. *Nucula navicularis* Mighels, Boston Journal Nat. History, p. 323, 1843 (*non* Couthouy, Gould).

Block Island to Gulf of Saint Lawrence. East of Block Island, 29 fathoms, rare; Casco Bay and off Cape Elizabeth, 30 to 95 fathoms; Bay of Fundy, 40 to 100 fathoms, rare; near Saint George's Bank, 110 and 150 fathoms (Packard). Massachusetts Bay (Stimpson).

YOLDIA THRACIFORMIS Stimpson, 1851. (p. 509.)

Smithsonian Check-List, p. 2, 1860; H. and A. Adams, Genera, vol. ii, p. 548, 1858 (*thraciæformis*); Gould, Invert., ed. ii, p. 157, fig. 465; Mörch, op. cit., p. 21, 1857. *Nucula thraciæformis* Storer, Boston Jour. Nat. History, vol. ii, p. 122, figure, 1838; Gould, Invert., ed. i, p. 97, fig. 66. *Leda thraciæformis* Stimpson, Shells of New England, p. 9, 1851. *Nucula navicularis* Couthouy, Boston Journ. Nat. History, vol. ii, p. 178, Plate 4, fig. 4, 1839, (young); Gould, Invert., ed. i, p. 103. *Yoldia angularis* Möller, op. cit., p. 92, 1842 (t. Mörch).

Long Island to Greenland. Off Fire Island, south of Long Island, in 10 fathoms; and off Race Point, Cape Cod, in 30 fathoms, (Stimpson). Not uncommon, and of large size, in Casco Bay, 15 to 95 fathoms; and Bay of Fundy, 10 to 100 fathoms; near Saint George's Bank, 85 fathoms (Packard).

LEDA TENUISULCATA Stimpson. (p. 509.)

Shells of New England, p. 10, 1851; Gould, Invert., ed. ii, p. 161, fig. 468. *Nucula tenuisulcata* Couthouy, Boston Journ. Nat. Hist., vol. ii, p. 64, Plate 3, fig. 8, 1838. *Nucula minuta* Gould, Invert., ed. i, p. 101, 1841 (*non* Fabricius, sp).

Rhode Island to Gulf of Saint Lawrence. Common in Massachusetts Bay, Casco Bay, and Bay of Fundy, 6 to 80 fathoms. Nova Scotia (Willis). Newport, Rhode Island (t. S. Smith). Southern part of the Gulf of Saint Lawrence (Whiteaves). Particularly abundant in Eastport Harbor, 10 to 30 fathoms; Saint George's Bank and vicinity, 40 to 150 fathoms (Smith, Packard). Fossil in the Post-Pliocene at Saco and Portland, Maine (Packard); ? Canada (Dawson, as *L. pernula*, var).

NUCULA PROXIMA Say. Plate XXX, fig. 230. (p. 418.)

Journ. Acad. Nat. Sciences, Philad., vol. ii, p. 270, 1822; Gould, Invert., ed. i, p. 103, fig. 63; ed. ii, p. 150, fig. 458.

South Carolina to Gulf of Saint Lawrence. Common in Long Island Sound, Buzzard's Bay, and Vineyard Sound, 2 to 19 fathoms; off Buzzard's Bay and Block Island, 25 to 29 fathoms; common in Massachusetts Bay, Casco Bay, and Bay of Fundy, 4 to 80 fathoms; very abundant in Trenton Bay, Mount Desert, Maine, 10 fathoms, soft mud. Nova Scotia (Willis). Saint George's Bank (S. I. Smith). Fort Macon, North Carolina (Coues). Long Island, abundant, (S. Smith). Fossil in the Post-Pliocene of North and South Carolina; in the Pliocene of South Carolina; and in the Miocene of Maryland and South Carolina.

NUCULA DELPHINODONTA Mighels. Plate XXX, fig. 229. (p. 509.)

Boston Journal Nat. Hist., vol. iv, p. 40, Plate 4, fig. 5, 1842; Gould, Invert., ed. ii, p. 153, fig. 461. *Nucula corticata* Möller, Naturhistorisk Tidsskrift, vol. iv, p. 90, 1842. ? *Nucula radiata* Dekay, Nat. Hist. New York, Moll., p. 179, Plate 12, fig. 216, 1843.

Rhode Island to Greenland. East of Block Island, 29 fathoms; off Gay Head, 19 fathoms, soft mud; Massachusetts Bay, common; Casco Bay, 6 to 95 fathoms, common; Frenchman's Bay, Mount Desert, common; Bay of Fundy and Eastport Harbor, 10 to 100 fathoms, mud, common; Nova Scotia (Willis); Gulf of St. Lawrence (Whiteaves). Greenland (Möller, Mörch). Northern Europe (t. Jeffreys).

Nucula tenuis Turton (Montagu, sp.)

Gould, Invert., ed. i., p. 105, fig. 64; ed. ii, p. 149, fig. 457.

This species was recorded as from cod-stomachs, at Stonington, Connecticut, but was not met with by us. Its occurrence south of Cape Cod needs confirmation. It is an arctic species; common in Casco Bay and the Bay of Fundy, in 10 to 100 fathoms, mud; and northward to the Arctic Ocean. Also on the northern coasts of Europe, south to Great Britain. It is also found in the Post-Pliocene of New England and Canada.

SCAPHARCA TRANSVERSA. Plate XXX, fig. 228. (p. 309.)

H. and A. Adams, Genera, vol. ii, p. 538, 1858. *Arca transversa* Say, Jour. Acad. Nat. Sci., Philad., vol. ii, p. 269, 1822; Gould, Invert., ed. i, p. 96; ed. ii, p. 148, fig. 456*a*.

Florida to Cape Cod. Long Island Sound, near New Haven, low-water to 8 fathoms; Buzzard's Bay and Vineyard Sound, 2 to 10 fathoms; Great Egg Harbor, New Jersey, 1 fathom. Nantucket (Gould). Long Island, abundant; Greenport, 3 to 10 fathoms (S. Smith). Fort Macon, North Carolina (Coues). South Carolina (Kurtz). Georgia (Couper).

Fossil in the Post-Pliocene of Nantucket, Gardiner's Island, Virginia, North and South Carolina; and in the Miocene of Virginia and North Carolina. According to Gould, found fossil at Provincetown, Massachusetts, in an artesian boring, 120 to 200 feet beneath the surface, (Post-Pliocene ?)

ARGINA PEXATA Gray. Plate XXX, fig. 227. (p. 309.)

Proc. Zoöl. Soc., London, 1847; H. and A. Adams, Genera, vol. ii, p. 540, Plate 125, figs. 7, 7*a*, 1858. *Arca pexata* Say, Jour. Acad. Nat. Sciences, Philad., vol. ii, p. 268, 1822; Gould, Invert., ed. i, p. 95, fig. 60; ed. ii, p. 147, fig. 456.

Florida and northern shores of Gulf of Mexico to Cape Cod; rare and local farther north, in Massachusetts Bay. Very common in Long Island Sound, low-water to 10 fathoms; Buzzard's Bay; Vineyard Sound; Great Egg Harbor, New Jersey. On beach at Provincetown, Massachusetts (S. I. Smith). Staten Island and Long Island, abundant (S. Smith). Fort Macon, North Carolina (Yarrow). Georgia (Couper). West Florida (Jewett). Texas (Rœmer).

Fossil in the Post-Pliocene of Gardiner's Island (?) (S. Smith); in the Miocene of South Carolina.

ARCA PONDEROSA Say.

Journ. Acad. Nat. Sciences, Philadelphia, vol. ii, p. 267, 1822; Binney's Say, p. 92.

This species occurs on the beach at Edgartown, Martha's Vineyard, associated with the other common sand-dwelling shells of that region. The valves are apparently tolerably fresh, though worn, and no fossil shells have been found in that vicinity. It occurs in the same way on the southern side of Long Island, near Fire Island (S. I. Smith and S. Smith). But I am not aware that it has been found living north of Cape Hatteras; nevertheless, it may occur locally in shallow water off shore. The specimens found may possibly have been washed out from submerged Post-Pliocene deposits.

It is found living at Fort Macon, North Carolina, and southward to the Gulf of Mexico.

HETEROMYARIA.

MYTILUS EDULIS Linné. Plate XXXI, fig. 234. (pp. 307, 432.)

Systema Naturæ, ed. xii, p. 1157, 1767; Gould, Invert., ed. i, p. 121, fig. 82; ed. ii, p. 183, figs. 483, 484. *Mytilus borealis* Lamarck, Anim. sans Vert., ed. ii, vol. vii, p. 46; Dekay, Nat. Hist. N. Y., Moll., p. 182, Plate 13, fig. 222, Plate 24, fig. 256. *Mytilus pellucidus* Pennant, Brit. Zoöl., vol. iv, p. 237, Plate 66, fig. 3, (t. Gould) = variety *pellucidus* Gould, Invert., ed. ii, p. 184, fig. 484. *Mytilus notatus* Dekay, op. cit., p. 182, Plate 13, fig. 223, 1843.

Circumpolar: Arctic Ocean south to North Carolina, on the American coast; south to Great Britain, France, and the Mediterranean and Black Seas, on the European coast; south to Monterey and San Francisco, on the North Pacific coast; south to China and Japan, on the Asiatic coast. Very abundant in Great Egg Harbor, New Jersey, Long

Island Sound, Buzzard's Bay, Vineyard Sound, Massachusetts Bay, Casco Bay, Bay of Fundy (littoral to 50 fathoms), and northward. Fort Macon, North Carolina (Coues).

Fossil in the Post-Pliocene of Greenland, Labrador, Canada, Lake Champlain, Maine, New Brunswick, Point Shirley, Massachusetts, and Saint John's River, Florida; in the Post-Pliocene of Scandinavia, Russia, and Great Britain; in the Red Crag and all later formations in England.

MODIOLA MODIOLUS Turton. Plate XXXI, fig. 237. (p. 309.)

British Bivalves, p. 199, Plate 15, fig. 3, 1822; Gould, Invert., ed. i, p. 123; ed. ii, p. 186, fig. 485; Dekay, op. cit., p. 185, Plate 24, fig. 257. *Mytilus modiolus* Linné, Syst. Nat., ed. xii, p. 1158. (?)*Modiola papuana* Lamarck, Anim. sans Vert., ed. ii, vol. vii, p. 17; Say, Amer. Conch., Plate 45.

Circumpolar: Greenland southward to New Jersey; on the European coast from Spitzbergen southward to Great Britain and France; in the North Pacific southward to Monterey, California, on the American coast; and southward to Northern Japan on the Asiatic coast. Long Island Sound, not very common; Vineyard Sound and Buzzard's Bay, not abundant; common in Massachusetts Bay; abundant in Casco Bay and Bay of Fundy, low-water to 80 fathoms. Staten Island and Long Island (S. Smith). Fossil in the Post-Pliocene of Point Shirley, Massachusetts, Montreal, Canada, Scotland, Ireland, Sicily, etc.; in the Coraline Crag, Red Crag, and later formations in England.

MODIOLA PLICATULA Lamarck. Plate XXXI, fig. 238. (p. 307.)

Anim. sans Vert., ed. i, 1819; ed. ii, vol. vii, p. 22; Gould, ed. i, p. 125, fig. 81; ed. ii, p. 188, fig. 486; Dekay, op. cit., p. 184, Plate 14, fig. 258; Hanley, Recent Shells, p. 240. *Mytilus plicatus* Deshayes, Encyclop. Meth., Plate 220, fig. 5; Stimpson, Shells of New England, p. 12. *Modiola semicosta* Conrad, Jour. Acad. Nat. Sci., Philad., vol. vii, p. 244, Plate 20, fig. 7, (t. Gould). *Mytilus demissus* Dillyn, Catal. Recent Shells, vol. i, p. 314 (t. Gould). *Brachydontes plicatulus* H. and A. Adams, Genera, vol. ii, p. 517; Perkins, op. cit., p. 156.

Georgia, to Casco Bay, Maine; more rare and local farther north; in the southern part of the Gulf of Saint Lawrence, and on the coast of Nova Scotia; nor observed on the coast of Maine east of the Kennebeck River, nor in the Bay of Fundy. Very abundant at Egg Harbor, New Jersey, Long Island Sound, Buzzard's Bay, and Vineyard Sound; less abundant in Massachusetts Bay, near Salem, Massachusetts, etc.; local in sheltered muddy coves about Casco Bay and Quahog Bay, Maine. Mouth of the Kennebeck River (C. B. Fuller). Prince Edward's Island (Dawson). Nova Scotia (Willis). Fort Macon, North Carolina (Coues). Georgia (Couper).

MODIOLA HAMATUS Verrill. (pp. 374, 475.)

American Journ. Science, vol. iii, p. 211, Plate 7, fig. 3, 1872. *Mytilus hamatus* Say, Journ. Acad. Nat. Sci., Philadelphia, vol. ii, p. 265, 1822; American Conchology, Plate 50; Binney's Say, pp. 91, 204, Plate 50. *Aulacomya hamatus* Adams, Genera, vol. ii, p. 513. *Brachydontes hamatus* Perkins, op. cit., p. 156, 1869.

Long Island Sound to Florida, and the shores of the Gulf of Mexico to Vera Cruz. New Haven, common on oysters, living, but perhaps introduced from Virginia. New York Harbor, on oysters, (S. Smith). Fort Macon, North Carolina (Yarrow). Georgia (Couper). Tampa Bay, Florida (Conrad, Jewett). Texas (Rœmer). Near Vera Cruz (coll. T. Salt, in Yale museum).

MODIOLARIA NIGRA Lovén. Plate XXXI, fig. 236. (p. 433.)

Öfvers. af Kongl. Vet.-Akad., Förhandl., vol. iii, p. 187, 1846; Mörch, Naturhist. Bidrag, Grönland, p. 93, 1857; H. and A. Adams, Genera, vol. ii, p. 515, 1858; Gould, Invert., ed. ii, p. 190, figs. 487, 488. *Modiola nigra* Gray, Appendix to Parry's Voyage, p. 244, 1824; Hanley, Recent Shells, p. 242. *Mytilus discrepans* Stimpson, Shells of New England, p. 12, 1851 (not of European authors). *Modiola nexa* Gould, Invert., ed. i, p. 128, fig. 86 (young).

Circumpolar: Greenland, southward to Long Island; Spitzbergen, southward to Great Britain and Holland; Behring's Straits, southward to Okhotsk. Not uncommon and of good size in Vineyard Sound, 10 to 15 fathoms, off Gay Head, etc.; common in Casco Bay and Bay of Fundy, of large size, low-water to 60 fathoms; Stonington, Connecticut, in stomach of cod, (Linsley).

Fossil in the Post-Pliocene of Maine, Canada, Labrador, and Northern Europe.

MODIOLARIA DISCORS Beck.

Lovén, Öfvers. af Kongl. Vet.-Akad. Förhandl., vol. iii, p. 187, 1846; Gould, Invert., ed. ii, p. 83, figs. 489, 490. *Mytilus discors* Linné, Syst. Nat., ed. xii, p. 1159; Stimpson, Shells of New England, p. 12, (*non* Gould, ed. i). *Mytilus discrepans* Montagu, Test. Brit., p. 169. *Modiola discrepans* Lamarck, Anim. sans Vert., ed. ii, vol. vii, p. 23; Gould, Invert., ed. i, p. 129, fig. 83. *Modiola lævigata* Gray, Appendix to Parry's Second Voyage, p. 245. *Mytilus levigatus* Stimpson, Shells of New England, p. 12. *Modiolaria lævigata* Lovén, op. cit., p. 187, 1846; Stimpson, Check-List, p. 2, 1860; this Report, p. 509.

Circumpolar: Greenland, southward to Long Island; Finmark, southward to Great Britain; Behring's Straits, southward to Puget Sound. Very common in Casco Bay and Bay of Fundy, low-water to 100 fathoms; not uncommon in Massachusetts Bay; rare and local south of Cape Cod. Saint George's Bank and vicinity, common, (S. I. Smith, Packard). Gardiner's Bay, Long Island, rare, (S. Smith). North of Hebrides, in 530 fathoms, (t. Jeffreys).

Fossil in the Post-Pliocene of Canada, Greenland, and Northern Europe. I am unable to separate *M. lævigata*, as a species, from the ordinary New England form, usually referred to *M. discors*, the differences being due chiefly to age. The common European form of *discors* shows more differences, but is probably only a dwarf variety of the same species.

MODIOLARIA CORRUGATA Mörch. Plate XXXI, fig. 235. (p. 509.)

Op. cit., p. 94, 1857; Stimpson, Check-List, Smithsonian Inst., p. 2, 1860; Gould, Invert., ed. ii, p. 193, fig. 491. *Mytilus corrugatus* Stimpson, Shells of New England, p. 12, 1851. *Mytilus discors* Gould, Invert., ed. i, p. 130, fig. 84 (*non* Linné, sp.).

Long Island to Greenland and Northern Europe. Off Martha's Vineyard and Buzzard's Bay, 20 to 25 fathoms, rare; Casco Bay, 15 to 95 fathoms, not common; Bay of Fundy, 10 to 100 fathoms, frequent. Saint George's Bank (S. I. Smith, A. S. Packard). Gardiner's Bay, 5 fathoms, one specimen, (S. Smith). Off New London, Connecticut (T. M. Prudden). Gulf of Saint Lawrence (Whiteaves). Murray Bay (Dawson). Nova Scotia (Willis). Labrador (Packard). Arctic Ocean, near Behring's Straits, 30 fathoms, (Stimpson, N. P. Expl. Exp., t. Gould).

Fossil in the Post-Pliocene of Canada (Dawson).

CRENELLA GLANDULA Adams. Plate XXXI, fig. 233. (p. 418.)

H. and A. Adams, Genera, vol. ii, p. 515, 1858; Gould, Invert., ed. ii, p. 194, fig. 492. *Modiola glandula* Totten, American Journal Science, ser. i, vol. xxvi, p. 367, figs. 3, e, f, g, 1834; Gould, Invert., ed. i, p. 131, fig. 87 (*pars*). *Mytilus decussatus* Stimpson, Shells of New England, p. 11, 1851, (*non* Montagu, sp.); Dekay, op. cit., p. 186, Plate 22, fig. 248.

Connecticut to Gulf of Saint Lawrence. Buzzard's Bay and Vineyard Sound, 5 to 15 fathoms, not uncommon; off Gay Head, 19 fathoms, soft mud; off Block Island, 29 fathoms, sandy mud; common in Massachusetts Bay, Casco Bay, and Bay of Fundy, 3 to 60 fathoms. Halifax (Willis). Gulf of Saint Lawrence, at Gaspé (Whiteaves). Gardiner's Bay, Long Island (S. Smith). Stonington (Linsley). Off New London, Connecticut (T. M. Prudden). Sandy Hook, New Jersey (Ferguson). Fossil in the Post-Pliocene at Montreal, Canada (Dawson). A related species, *C. æquilaterata* Conrad (H. C. Lea, sp.) occurs in the Miocene of Virginia.

This species was undoubtedly confounded with *C. decussata* (Montagu, sp.) by both Gould and Stimpson. The genuine *decussata* is quite common in Casco Bay, Bay of Fundy, and Gulf of Saint Lawrence, and is usually associated in those waters with *C. glandula*. It is a northern, and common European species, and is also recorded from the North Pacific coast of America by Dr. P. P. Carpenter. It also occurs in Greenland (Mörch).

MONOMYARIA.

PECTEN IRRADIANS Lamarck. Plate XXXII, fig. 238. (p. 374.)

Anim. sans Vert., ed. i, 1819; ed. ii, vol. vii, p. 143; Gould, Invert., ed. ii, p. 199, fig. 496. *Pecten concentricus* Say, Journ. Acad. Nat. Sci., Philad., vol. ii, p. 259, 1822; Gould, Invert., ed. i, p. 134, fig. 88; Dekay, op. cit., p. 172, Plate 9, fig. 205.

Florida and the northern shores of the Gulf of Mexico to Cape Cod; rare and local farther north in Massachusetts Bay; and Nova Scotia (Willis). Very common in Vineyard Sound, Buzzard's Bay, shores of Long Island and Connecticut, New Jersey, and southward. Tampa Bay, Florida (Conrad, E. Jewett). Texas (Rœmer).

Fossil in the Post-Pliocene of North Carolina and Tampa Bay, Florida; in the Pliocene of South Carolina; and in the Miocene of

Maryland. Dug up from beneath the mud in the harbor of Portland, Maine, in a semi-fossil state by the mud-dredging machines (Fuller).

PECTEN ISLANDICUS Chemnitz.

Conch., vii, p. 304, Plate 65, figs. 615, 616, 1784, (t. Gould); Lamarck, op. cit., ed. ii, vol. vii, p. 145; Gould, Invert., ed. i, p. 133, fig. 87; ed. ii, p. 198, fig. 495. *Ostrea Islandica* Müller, Zoöl. Dan. Prod., No. 2990, 1776; Fabricius, Fauna, Grönl., p. 415, 1780. *Pecten Pealii* Conrad, Amer. Mar. Conch., p. 12, Plate 2, fig. 2, 1831.

Arctic Ocean south to Cape Cod, local and rare farther south; on the northern European coasts, south to Bergen, Norway, and Great Britain. Not uncommon and of good size in Casco Bay, 20 to 70 fathoms; common in the Bay of Fundy, low-water to 100 fathoms. Saint George's Bank, 40 to 65 fathoms, (S. I. Smith). More common farther north. Stonington, Connecticut, in an eel-pot, (Linsley). I am not aware that any one except Linsley has recorded it from the southern coast of New England.

Fossil in the Post-Pliocene of Maine (abundant), New Brunswick, Canada, Labrador, Greenland, Scandinavia, Denmark, Scotland, etc. Naples (Jeffreys). Mr. Sanderson Smith reports fragments from Gardiner's Island.

PECTEN TENUICOSTATUS Mighels. (p. 509.)

Mighels and Adams, Proceedings Boston Soc. Nat. Hist., vol. i, p. 49, 1841; Boston Journal of Natural History, vol. iv, p. 41, Plate 4, fig. 7, 1842 (young); Gould, Invert., ed. ii, p. 196, fig. 494. *Pecten Magellanicus* Lamarck, Anim. sans Vert., ed. ii, vol. vii, p. 134 (? *non* Gmelin, sp.); Hanley, Recent Shells, p. 274; Gould, Invert., ed. i, p. 132. *Pecten fuscus* Linsley, Amer. Jour. Sci., ser. i, vol. xlviii, p. 278, 1845; Gould, ser. ii, vol. vi, p. 235, fig. 6, 1848 (young). *Pecten brunneus* Stimpson, Shells of New England, in errata, 1851.

New Jersey to Labrador. Rare and local south of Cape Cod. Not uncommon in Massachusetts Bay and Casco Bay, 4 to 80 fathoms; abundant in Frenchman's Bay, Mount Desert, Maine, in 3 to 10 fathoms; common in Passamaquoddy Bay and Bay of Fundy, 1 to 109 fathoms. Saint George's Bank, 45 fathoms, (S. I. Smith). Nova Scotia (Willis). Labrador, 2 to 15 fathoms, (Packard). Off Block Island (Gould). Stonington, Connecticut, in cod stomachs, (Linsley, as *P. fuscus*). Coney Island and Sandy Hook, New York (S. Smith).

Fossil in the Post-Pliocene near Saint John, New Brunswick, and Gardiner's Island, New York. A closely related species occurs in the Miocene of Virginia.

ANOMIA GLABRA Verrill. Plate XXXII, figs. 241, 242, 242[a]. (p. 311.)

American Jour. Science, vol. iii, p. 213, 1872. *Anomia ephippium* (*pars*) Linné, Syst. Nat., ed. xii, p. 1150; Gould, Invert., ed. i, p. 138; ed. ii, p. 204, fig. 497. *Anomia electrica* Gould, Invert., ed. i, p. 140; ed. ii, p. 205, fig. 499, adult, (*non* Linné.) *Anomia squamula* Gould, Invert., ed. i, p. 140; ed. ii, p. 206, young, (*non* Linné.)

Florida to Cape Cod; rare and local farther north, in Massachusetts Bay, Casco Bay, and on the southern coast of Nova Scotia, off Cape

Sable, 8 fathoms. Not observed on the eastern part of the coast of Maine, nor in the Bay of Fundy. Very common in Long Island Sound, Buzzard's Bay, Vineyard Sound; along both shores of Long Island; New Jersey, and southward; low-water to 12 fathoms. Southern part of Saint George's Bank, 20 fathoms, (S. I. Smith).

Fossil in the Post-Pliocene of North and South Carolina; and in the Pliocene of South Carolina.

Linné gave "Pennsylvania" as one of the localities for his *A. ephippium*, and, therefore, probably confounded our shell with the European species, as most subsequent writers have done. Gould has well described our species in its different states, under the names quoted above, figures 499 of the second edition (our figures 241, 242), represent the ordinary adult form, which is everywhere abundant on the southern shores of New England. The specimens from Eastport, Maine, referred to *A. ephippium* by Gould, were undoubtedly the smooth or squamose variety of the following species.

ANOMIA ACULEATA Gmelin. Plate XXXII, figs. 239, 240, 240ᵃ. (p. 495.)

Syst. Nat., p. 3346, 1790; Gould, Invert., ed. i, p. 139, fig. 90; ed. ii, p. 204, fig. 498.

Long Island to Labrador, and northern coasts of Europe. Off Stonington, Connecticut, 4 to 5 fathoms rocky; off Gay Head, 10 fathoms, scarce; very common in Casco Bay, Bay of Fundy, and northward, low-water to 80 fathoms. Greenport and Montauk, Long Island (S. Smith).

Varieties of this species occur frequently in the Bay of Fundy and Casco Bay, in which the aculeate scales are more or less abortive, or even entirely absent, leaving the surface either nearly smooth or irregularly squamose, but such varieties are easily distinguished from the young of the preceding species.

This may possibly be a variety of the true *ephippium* of Europe, as supposed by many writers, but I believe it to be perfectly distinct from *A. glabra*.

OSTREA VIRGINIANA Lister. (pp. 310, 472.)

Favanne, Conch., Plate 41, fig C 2, 1780 (t. Gould); Gould, Invert., ed. i, p. 136; ed. ii, p. 202; Verrill, Amer. Jour. Science, vol. iii, p. 213, 1872. *Ostrea Virginica* Gmelin, Syst. Nat., p. 3336, 1790; Lamarck, Anim. sans Vert., ed. ii, vol. vii, p. 225. *Ostrea borealis* Lamarck, op. cit., p. 220; Gould, Invert., ed. i, p. 137; ed. ii, p. 203; Dekay, op. cit., p. 169, Plate 10, figs. 203, 204. *Ostrea Canadensis* Bruguière, Encycl. Meth., Plate 180, figs. 1–3; Lamarck, op. cit., p. 226; Hanley, Recent Shells, p. 299.

Florida and the northen shores of the Gulf of Mexico to Massachusetts Bay; local farther north, off Damariscotta, Maine, and in the southern part of the Gulf of Saint Lawrence, at Prince Edward Island, in Northumberland Straits, and Bay of Chaleur. Not found along the eastern shores of Maine, nor in the Bay of Fundy. Abundant in the ancient Indian shell-heaps on the coast of Massachusetts, on the islands in Casco Bay, and at Damariscotta. The shells, in a semi-fossil state, have been dug up from deep beneath the mud in the harbor of Portland, Maine, in large quantities, but native oysters appear to be entirely extinct in Casco Bay. Very abundant in Long Island Sound; in the upper part of Buzzard's Bay; rare and local in Vineyard Sound; very abundant on the shores of Maryland and Virginia. Mouth of Saint John's River, and in Tampa Bay, Florida (Conrad). Texas (Rœmer).

Fossil in the Post-Pliocene at Point Shirley, Massachusetts, Nantucket Island (abundant), Gardiner's Island; in the Pliocene of South Carolina; and in the Miocene of Virginia and South Carolina.

The occurrence of large quantities of oyster-shells beneath the harbor mud at Portland, associated with *Venus mercenaria*, *Pecten irradians*, *Turbonilla interrupta*, and other southern species, now extinct in that locality, and the occurrence of the first two species in the ancient Indian shell-heaps, on some of the islands in Casco Bay, though not now found living among the islands, indicates that the temperature of those waters was higher at a former period than at present. These facts also point to the most satisfactory explanation of the existence of numerous southern shells, associated with the oyster and *Venus mercenaria* in the southern part of the Gulf of Saint Lawrence, though not now found in the intermediate waters, along the coast of Maine, nor in the Bay of Fundy.

All the various forms of this species, upon which the several nominal species, united above, have been based by Lamarck and others, often occur together in the same beds in Long Island Sound, and may easily be connected together by all sorts of intermediate forms. Even the same specimen will often have the form of *borealis* in one stage of its growth, and then will suddenly change to the *Virginiana* style, and, perhaps, later still, will return to the form of *borealis*. Or these different forms may be assumed in reverse order. Great variations in the number and size of the costæ and undulations of the lower valve occur, both in different specimens from the same locality, and even in the same specimen, at different stages of growth. All these variations occur in precisely the same way in the shells taken from the ancient Indian shell-heaps along our entire coast, from Florida to Maine.

TUNICATA.

SACCOBRANCHIA.

CIONA TENELLA Verrill. (p. 419.)

American Journal Science, ser. iii, vol. i, p. 99, figs. 12, 13, 1871. *Ascidia tenella* Stimpson, Proc. Bost. Soc. Nat. Hist., iv, p. 228, 1853; Inv. of Grand Manan, p. 20, 1853; Binney, in Gould, Invert., ed. ii, p. 24, 1870. *?Ascidia ocellata* Ag., Proc. Amer. Assoc. for Adv. Sci., ii, p. 159, 1850 (description insufficient); Binney, in Gould, Invert., ed. ii, p. 24, Plate 24, fig. 332, 1870.

Cape Cod to Gulf of Saint Lawrence; rare and local south of Cape

Cod. Common in Casco Bay and Bay of Fundy, low-water to 100 fathoms. New Bedford, Massachusetts (L. Agassiz).

MOLGULA MANHATTENSIS Verrill. Plate XXXIII, fig. 250. (pp. 311, 445.)

Amer. Jour. Science, vol. i, p. 54, Jan., 1871; Tellkampf, Annals Lyc. Nat. Hist., New York, vol. x, p. 83, 1872. *Ascidia Manhattensis* Dekay, Report on the Natural History of New York, Mollusca, p. 259, 1843; Binney, in Gould's Invertebrata of Massachusetts, ed. ii, p. 25, 1870 (copied from Dekay). *Ascidia amphora* Ag., MSS.; Binney, op. cit., p. 25, Plate 24, fig. 333.

North Carolina to Casco Bay, Maine. Very common in Great Egg Harbor, New Jersey, Long Island Sound, Buzzard's Bay, Vineyard Sound, and Massachusetts Bay. Less common in Casco Bay. Great South Bay, Long Island, abundant, (S. I. Smith).

MOLGULA PELLUCIDA Verrill. (p. 426.)

Amer. Jour. Science, vol. iii, p. 289, Plate 8, fig. 2, 1872.

Body subglobular with a smooth, thin, pellucid test. Tubes terminal, contiguous, much swollen at base, long, divergent, tapering, reticulated within by longitudinal and circular white lines (muscular fibers). Branchial aperture with six papillæ. Intestine conspicuously visible through the test; stomach covered by deep orange-colored hepatic glands. Ovaries large, whitish. Color of test, pale hyaline bluish; tubes toward the ends, dull neutral tint.

Diameter of the largest specimens about 25^{mm}.

North Carolina to Massachusetts Bay. Massachusetts Bay (L. Agassiz). Long Island (Coll. Peabody Academy of Science). Bird Shoal near Beaufort, North Carolina (Dr. H. C. Yarrow).

Mr. Binney has published (Plate 22, figs. 315, 316) characteristic colored figures of this species under the name of *M. producta* (Stimpson), which is a very different, sand-covered species.

MOLGULA PRODUCTA Stimpson. (p. 502.)

Proc. Boston Society Natural History, vol. iv, p. 229, 1852; Verrill, op. cit., p. 289, Plate 8, fig. 6, 1872; Binney, in Gould, p. 21 (not the figures, which are *M. pellucida*).

Off Buzzard's Bay, 25 fathoms, sandy. Massachusetts Bay, low-water to 6 fathoms, (Stimpson).

MOLGULA ARENATA Stimpson. Plate XXXIII, fig. 251. (p. 419.)

Proc. Boston Soc. Nat. Hist., vol. iv, p. 230, 1852; Binney, in Gould, Invert., ed. ii, p. 21; Verrill, Amer. Jour. Sci., vol. iii, Plate 8, fig. 5, 1872.

Long Island Sound, near New Haven, 3 fathoms, sand; Vineyard Sound and Buzzard's Bay, 5 to 15 fathoms, sand and gravel. Nantucket (Stimpson).

MOLGULA PAPILLOSA Verrill. (p. 495.)

Amer. Jour. Science, vol. i, p. 57, fig. 4, b, 1871; op. cit., vol. iii, p. 211, Plate 8, fig. 4, 1872.

Body free, nearly globular, or transversely suboval, usually slightly compressed laterally. Integument rather thin, translucent, the surface, both of the tubes and body, entirely covered by particles of sand, broken shells, foraminifera, etc., which adhere firmly. When cleaned the whole surface is thickly covered with prominent granule-like papillæ and numerous slender fibrous processes; the granules are most conspicuous on the tubes, where they usually have a rusty color. The tubes are long, subequal, and their bases are separated by a space usually greater than their diameters; they are quite divergent, both of them curving outward, the anal tube most abruptly. The branchial tube is cylindrical, somewhat longer than the anal, equal to or exceeding the diameter of the body, the orifice surrounded by six rather long and slender, conical, divergent papillæ. The anal tube often bends suddenly outward, tapers slightly, and has a small square aperture, surrounded by a circle of dull reddish brown. In contraction the tubes are not retracted, but are usually shortened to about one-half their length. In life the body, when cleaned, is pale grayish, with an almost transparent integument, through which the convolutions of the dark intestine are conspicuous.

The largest specimens are about 10^{mm} in diameter.

Off Martha's Vineyard, 10 fathoms, stony; Casco Bay and Bay of Fundy, 10 to 20 fathoms.

EUGYRA PILULARIS Verrill. Plate XXXIII, fig. 249. (p. 509.)

Amer. Jour. Science, vol. iii, p. 211, Plate 8, fig. 3, 1872. *Molgula pilularis* Verrill, op. cit., vol. i, p. 56, fig. 4, c, 1871.

Body unattached, globular, covered with a thin layer of mud, and, when the tubes are retracted, looking like a small soft ball. Integument of the body, when cleaned, very thin, soft, nearly transparent, thickly covered with minute granules, and minutely fibrous, usually concealed by the adhering particles of mud and fine sand, but this can be easily removed. The tubes are naked, smooth, nearly transparent, subconical, slender, as long as the diameter of the body, originating close together, and but slightly divergent, both of them nearly straight; they can be wholly retracted, and their bases are surrounded and connected by a narrow, naked, oval or oblong band, which is usually conspicuous when the tubes are withdrawn; in partial contraction, the tubes are conical, subpellucid, reticulated with white lines. The branchial tube is a little shorter than the anal, the aperture surrounded by six acute, conical papillæ, and twelve small, dark, brownish spots. Anal tube a little smaller, slightly longer, a little tapering, with a small square aperture, surrounded by four small lobes and four small, reddish brown eye-spots.

In life the body, when cleaned, is transparent grayish, the dark intestine showing through very distinctly; tubes greenish at base.

Diameter usually about 5^{mm}, seldom more than 6^{mm} or 8^{mm}.

Off Gay Head, Martha's Vineyard, 19 fathoms, soft mud; Casco Bay, 10 to 20 fathoms; Bay of Fundy, off Grand Menan, Eastport Harbor, and South Bay, 6 to 20 fathoms, soft mud. Gulf of Saint Lawrence (Whiteaves).

GLANDULA ARENICOLA Verrill. (p. 502.)

Amer. Jour. Science, ser. iii, vol. iii, pp. 211, 288, 1872.

Body subglobular, rather higher than broad, the whole surface covered with grains of sand, forming a continuous layer. When the sand is removed the surface of the test is reticulately wrinkled and pitted, not furnished with fibers, except at base, where there are a few long, slender, thread-like white ones. Tubes terminal, near together, in the alcoholic specimens short, forming low verrucæ, swollen at base, the ends a little prominent and naked. Apertures square, with four small lobes. The test is tough and opaque. Height, about 12^{mm}; breadth, 10^{mm}; often larger.

Murray Bay, Gulf of Saint Lawrence (Dr. J. W. Dawson). Saint George's Bank, 28 fathoms, sand, abundant, (S. I. Smith). Off Cuttyhunk Island and Buzzard's Bay (T. H. Prudden).

GLANDULA. Species undetermined. (p. 502.)

Vineyard Sound and off Martha's Vineyard, 10 to 20 fathoms, sand.

CYNTHIA PARTITA Stimpson. Plate XXXIII, fig. 246. (p. 311.)

Proc. Bost. Soc. Nat. History, vol. iv, p. 231, 1852; Binney, op. cit., p. 18; Verrill, Amer. Jour. Science, vol. iii, p. 213, 1872. (?) *Cynthia rugosa* Agassiz, Proc. Amer. Assoc., vol. ii, p. 159, 1850 (description inadequate); Binney, op. cit., p. 20 (copied from the preceding). *Cynthia stellifera* Verrill (var.), Amer. Jour. Science, vol. i, p. 93, figs. 5, 6, a, b, 1871.

North Carolina to Massachusetts Bay. Common in Long Island Sound, Vineyard Sound, and Buzzard's Bay, low-water to 15 fathoms. Boston Harbor, 4 fathoms (Stimpson). Off New London, Connecticut (T. M. Prudden).

CYNTHIA CARNEA Verrill. Plate XXXIII, figs. 247, 248. (p. 495.)

American Jour. Science, ser. iii, vol. i, p. 94, figs. 7, 8, 9, 1871. *Ascidia carnea* Agassiz, Proc. American Assoc. for Adv. Sci., ii, p. 159, 1850 (description insufficient); Binney, in Gould's Invertebrata of Mass., ed. ii, p. 25, Plate 24, figs. 334, 335, 1870 (young). (?) *Cynthia gutta* Stimpson, Proc. Boston Soc. Nat. Hist., vol. iv, p. 231, 1852 (young); Binney, op. cit., p. 19, 1870. *Cynthia placenta* (*pars*) Packard, Mem. Boston Soc. Nat. Hist., vol. i, p. 277, 1867; Binney, op. cit., p. 19, Plate 23, figs. 322, 1870; Verrill, Amer. Jour. Sci., vol. xlix, p. 424, 1870.

Martha's Vineyard to Labrador. Off Gay Head, 10 fathoms, stony; common in Eastport Harbor and Bay of Fundy, low-water to 109 fathoms; Casco Bay, less common, 10 to 40 fathoms. Massachusetts Bay (Stimpson). Labrador (Packard).

This species is closely allied to *C. rustica* (Linné, sp.) from Iceland, and may eventually prove to be identical.

CYNTHIA ECHINATA Stimpson. (p. 495.)

Invert. of Grand Menan, p. 20, 1854; Binney, op. cit., p. 18, Plate 23, fig. 326; Verrill, Amer. Jour. Science, vol. i, p. 96, 1871; vol. iii, p. 213, 1872. *Cynthia hirsuta* (young) Agassiz, op. cit., 1850; Binney, in Gould, Invert., ed. ii, p. 20, Plate 24, fig. 336. *Ascidia echinata* Linné, Syst. Nat., ed. xii, p. 1087, 1767. *Ascidia echinata* Fabr., Fauna Grœnl., p. 331, 1780; Rathke, Zoölogica Danica, vol. iv, p. 10, Plate 130, fig. i, 1806; Möller, Index Mollusc. Grœnl., in Kroyer's Nat. Tidsskrift, vol. iv, p. 95.

Martha's Vineyard to Greenland, Iceland, and northern coasts of Europe. Off Martha's Vineyard, 10 fathoms, stony, rare; common in Casco Bay and Bay of Fundy, low-water to 109 fathoms, attached to stones, shells, and other ascidians. Saint George's Bank (S. I. Smith). Banks of Newfoundland (T. M. Coffin). Labrador (Packard).

BOLTENIA. Species undetermined.

Boltenia reniformis Dekay, Nat. Hist. New York, Mollusca, p. 260, Plate 34, fig. 324 (*non* Macleay).

New York Harbor (t. Dekay.)

The description and figure of the single poor specimen seen by Dekay are insufficient for its determination. I have not met with the genus south of Cape Cod, and the locality given may possibly be incorrect.

PEROPHORA VIRIDIS Verrill. (p. 388.)

American Jour. Science, ser. iii, vol. ii, p. 359, 1871.

Colonies composed of numerous nearly sessile individuals, which are small, about 2.5^{mm} to 3^{mm} high, connected by slender stolons, and thickly covering the surfaces over which they creep. Test compressed, seen from the side, scarcely higher than broad, oval, elliptical, or sub-circular, often one-sided or distorted, with a short pedicle, or subsessile at base. Branchial orifice large, terminal; anal lateral or subterminal, both a little prominent, with about 16 angular lobes, alternately larger and smaller. Test transparent; mantle beautifully reticulated with bright yellowish green; intestine yellow.

Vineyard Sound, 2 to 12 fathoms, on algæ and ascidians, common; Little Harbor, Wood's Hole, on piles of wharves, at and below low-water mark, very abundant.

BOTRYLLUS GOULDII Verrill. Plate XXXIII, figs. 252, 253. (p. 375.)

Amer. Jour. Science, ser. iii, vol. i, figs. 14, 19, 1871. *Botryllus stellatus* Gould, Rep. on Inv. of Mass., 1st ed., p. 320, 1841 (*non* Pallas). *Botryllus Schlosseri* Binney, in Gould, Inv. Mass., ed. ii, p. 3, Plate 23, fig. 319, 1870 (*non* Pallas); Dall, Proc. Bost. Soc. Nat. Hist., xiii, p. 255, 1870.

This species commonly forms thick, fleshy, translucent incrustations on sea-weeds and zoöphytes, the form which it assumes depending upon the shape of the object. The masses are often several inches in length and half an inch or more in width. The animals are short oval, as seen at the surface, and form circular or elliptical groups, of from five to sixteen or more, surrounding circular or elliptical cloacal orifices. The "marginal tubes" or buds are numerous in all parts of the common tissue, the enlarged ends appearing as oval or pyriform spots, lighter than the ground-color. The branchial openings are small and circular, surrounded by a light halo. The animals differ considerably in form, according to the state of contraction.

The color is extremely variable; several of the color-varieties have been named and described on pages 375, 376.

Brooklyn, New York, to Boston, Massachusetts. Very abundant at Wood's Hole, Waquoit Pond, and other similar localities along the shores of Vineyard Sound and Buzzard's Bay; abundant at the mouth of Charles River, near Boston. Watch Hill, Rhode Island, and Brooklyn, New York (D. C. Eaton).

AMARŒCIUM PELLUCIDUM Verrill. (p. 401.)

Amouroucium pellucidum Verrill, Amer. Jour. Science, ser. iii, vol. i, p. 290, 1871; vol. iii, p. 211. *Alcyonidium ? pellucidum* Leidy, Jour. Acad. Nat. Science, Philad., ser. ii, vol. iii, 1855, p. 142, Plate 10, fig. 25, (mutilated zooid).

Colonies large, complex, consisting of a large number of small, elongated, clavate colonies, arising from a common base, and more or less separate laterally and at summit, thus forming large aggregated hemispherical or irregular masses, often six inches in diameter, the surface generally covered thickly with adhering sand, but frequently naked over the summits of the colonies, or even over large surfaces of the masses, when, as often happens, the central colonies coalesce; when naked, the tissue is smooth, translucent, gelatinous-looking, and soft. The small side-colonies are long, with a slender stolon-like base, curving outward and ascending, enlarging gradually to the summit, which is more or less convex, usually with a single central cloacal orifice, surrounded by an irregular circle of individual zoöids, varying in number according to the size or age of the colony to which they belong. The zoöids, when mature, are long and slender, varying greatly in length in each colony, according to the state of development of the post-abdomen; the largest are often 20^{mm} to 25^{mm} in length. The stomach is bright orange-red, and quite conspicuous; the slender post-abdomen exceeds in length the rest of the body, but is not more than half the diameter of the thorax, and is slightly constricted at base. In young individuals, not half grown, the post-abdomen forms nearly half the whole length, and is very slender. The branchial aperture has six, short, round papillæ; the anal is situated a short distance from the end of the body, and has short inconspicuous lower lobes, with an elongated, pointed lobe above. The branchial sac is oblong, with numerous longitudinal and transverse vessels and a broad ventral duct. The stomach is about as broad as long, subglobular, with the ends truncated and the surface covered with numerous, interrupted, longitudinal, glandular ridges. The post-abdomen is nearly filled by the large, elongated ovary, which extends nearly to the posterior end on the dorsal or atrial side, and contains numerous closely-packed ovules of comparatively large size, and the conspicuous male organs, extending through the whole length on the ventral or branchial side, in the form of a slightly-convoluted duct. The posterior end terminates in a small, obtuse papilla. The atrium, or cloacal cavity, often contain eggs in which the embryos are well developed, and, in some cases, the free, tadpole-shaped larvæ. The tunic is specked with numerous, minute, purplish brown pigment-cells.

One of the zoöids measured 7.5^{mm} in length; thorax, 2^{mm}; abdomen, 1.5^{mm}; post-abdomen, 4^{mm}; diameter of thorax, $.8^{mm}$ to $.9^{mm}$; of abdomen, about the same; of post-abdomen, $.375^{mm}$ to $.5^{mm}$.

North Carolina to Vineyard Sound. Very abundant in Vineyard Sound, in 6 to 12 fathoms.

AMARŒCIUM STELLATUM Verrill. (p. 402.)

Amouroucium stellatum Verrill, Amer. Journal of Science, ser. iii, vol. i, p. 291, 1871.

Masses large, variable in form, often in the form of thick vertical plates, or erect crest-like lobes, frequently irregular; surface nearly smooth, naked; tissue firm and cartilage-like externally, somewhat translucent, generally pale yellow or flesh-color by transmitted light. The fronds are often six inches or more in breadth and height, and from half an inch to an inch thick. The zoöids are grouped in more or less regular, and generally simple, circular, stellate clusters, scattered over the whole surface, and usually containing from six to twenty individuals, arranged around a central, sub-circular cloacal orifice; in contraction the position of each individual is indicated by an oval spot, more transparent than the common tissue, with a small flake-white spot around the branchial orifice. The individual zoöids are elongated and slender; the post-abdomen more slender, usually considerably exceeding in length the rest of the body, and but slightly constricted proximally; the thorax and abdomen are shorter and stouter than in the preceding species; branchial sac with about twelve transverse vessels; stomach oblong-oval, with numerous longitudinal glandular folds, which are bright orange-red in life; intestine large, light orange or yellow. Branchial tube elongated, bright orange; the orifice with six prominent rounded lobes. Anal orifice subterminal, with a prominent ligulate process above, and several small lobes below.

North Carolina to Cape Cod. Very abundant in Vineyard Sound, in 5 to 15 fathoms, on gravelly and shelly bottoms. Fort Macon, North Carolina (Dr. Yarrow).

AMARŒCIUM CONSTELLATUM Verrill. (pp. 388, 403.)

American Journal of Science, ser. iii, vol. ii, p. 359, 1871 (*Amouroucium*).

Masses thick, turbinate, often incrusting, surface usually convex, smooth; substance firm, gelatinous, translucent, but softer than in *A. stellatum*. Groups stellate, circular, oval or elliptical, often narrow and elongated, or irregular and complex; zoöids much elongated, slender; the branchial tube short, with six rounded lobes. Branchial sac elongated. Color of the masses usually light orange-red, varying to yellowish and pale flesh-color; the branchial orifices with six radiating white lines. Anal orifices often surrounded by a pale or whitish border; zoöids generally orange-yellow; the orifices and tubes with upper part of the mantle bright orange, or lemon-yellow; branchial sac usually flesh-color or pale yellow, sometimes bright orange; stomach with bright orange-red longitudinal glandular ribs; intestine light orange; mantle with minute opaque white specks. In some specimens the cloacal chamber or "atrium" contained three or four bright purple tadpole-shaped larvæ.

Vineyard Sound, 4 to 12 fathoms, frequent; Wood's Hole, on piles of wharf; off Stonington, Connecticut, 4–5 fathoms.

AMARŒCIUM PALLIDUM Verrill. (p. 496.)

American Journal of Science, ser. iii, vol. i, p. 289, 1871 (*Amouroucium*).

Masses sessile, hemispherical or sub-globular, usually attached by a large base. Surface generally evenly rounded, sometimes irregular in large specimens, smoothish, but thinly covered with minute, firmly adherent particles of fine sand, which are imbedded in the surface of the common tissue and scattered throughout its substance. The cloacal openings are few in number and irregularly placed, except in small specimens, which usually have but one large central opening. The animals are much smaller and more numerous than in the preceding species, often forming somewhat circular groups of six or eight individuals around the cloacal openings; outside of the circular groups they are usually irregularly scattered, but sometimes form linear series of eight or ten, and in young specimens with but one central opening they often form a larger outer circle, which is near the margin, more or less irregular, and composed of numerous individuals. The post-abdomen, in all the numerous examples examined, was small, thick, obtuse, and decidedly shorter than the abdomen and thorax taken together; it often terminates in two slender papillæ. Color of the masses pale yellowish or grayish; stomach dull orange-yellow; ovaries yellowish white.

The larger specimens of this species are 15^{mm} to 25^{mm} in diameter; the largest zoöids are 3^{mm} to 4^{mm} long, by $.75^{mm}$ to 1.25^{mm} in diameter; but many are much smaller.

Martha's Vineyard to Gulf of Saint Lawrence. Off Buzzard's Bay, 25 fathoms, gravel; south of Gay Head, 10 fathoms, stony; Casco Bay, 8 to 40 fathoms; Eastport Harbor and Bay of Fundy, low-water to 80 fathoms.

LEPTOCLINUM ALBIDUM Verrill. (p. 403.)

American Journal of Science, ser. iii, vol. i, p. 446, 1872.

Colonies incrusting stones, dead shells, ascidians, etc., forming broad, thin, irregular, coriaceous crusts, with an uneven surface, filled with minute, white, spherical, calcareous grains or corpuscles, which, under the miscroscope, have the surface covered with projecting points. Surface of the crusts covered with small, irregular, scattered prominences, in which the branchial orifices are situated. Cloacal orifices few and distantly scattered. Systems irregular, the zoöids scattered, but often arranged in rather indistinct concentric groups around the cloacal openings, and connected with them by cloacal ducts, which are variously branched, often showing through the integument as dark dendritic lines, converging toward the cloacal orifices from different directions.

Color white, the zoöids light yellowish.

The colonies often become 200^{mm} to 300$_{mm}$ across; thickness seldom more than 2.5^{mm}, commonly about 1.25 ^{mm}; zoöids .5^{mm} to .75^{mm} long; diameter .25^{mm} to .30^{mm}.

Long Island Sound to Labrador. Thimble Islands, near New Haven, 4 to 6 fathoms, rocky; off Stonington, 4 fathoms, rocky; common in Vineyard Sound, 8 to 15 fathoms; abundant in Casco Bay, 6 to 40 fathoms; abundant in the Bay of Fundy, low-water to 80 fathoms. Banks of Newfoundland (T. M. Coffin). Mingan Islands, 10 fathoms (A. E. V.). Saint George's Bank (S. I. Smith).

LEPTOCLINUM LUTEOLUM Verrill. (p. 403.)

American Jour. Science, loc. cit., p. 446, 1872.

This species forms thin, coriaceous crusts, like the preceding, filled in the same way with similar spherical corpuscles. The branchial orifices open at the summits of low verrucæ. The cloacal orifices are small, with four to six lobes, and distantly scattered. Color deep salmon, or somewhat rosy.

The crusts are of all sizes up to 300^{mm} or more in diameter, and are usually somewhat thicker than in the preceding species, with larger and darker colored zoöids.

Connecticut to Bay of Fundy; off Stonington, Connecticut, 4 fathoms, rocky; Vineyard Sound, 6 to 14 fathoms, common; Casco Bay, 10 to 40 fathoms, common; Bay of Fundy, low-water to 80 fathoms, common.

TÆNIOBRANCHIA.

SALPA CABOTI Desor. Plate XXXIII, figs. 254, 255. (p. 445.)

Proc. Boston Soc. Nat. History, vol. iii, p. 75, 1848 (not described); A. Agassiz, op. cit., vol. xi, p. 17, figs. 1 to 5, 1866; Binney, in Gould, Invert., ed. ii, p. 6, figs. 350 to 354, 1870 (description and figures copied from A. Agassiz).

In the typical variety, as described by Mr. Agassiz, the color is pale pink or rosy; the nucleus deep chestnut. Long Island Sound to Saint George's Bank. Common in Buzzard's Bay and Vineyard Sound. Off Saint George's Bank (S. I. Smith).

Var. *cyanea*. (p. 446.)

Nucleus and the borders of the mantle are bright Prussian-blue; surface of the latter delicately reticulated with fine blue lines.

Vineyard Sound, especially off Gay Head, in September.

DOLIOLUM (species undetermined). (p. 446.)

Vineyard Sound (A. Agassiz).

LARVALIA.

APPENDICULARIA (species undetermined, [a]). (p. 446.)

Allied to *A. longicauda* (t. A. Agassiz), op. cit., p. 23, 1866; Binney, op. cit., p. 13 (copied from A. Agassiz).

Long Island Sound to Massachusetts Bay (A. Agassiz).

APPENDICULARIA (species undetermined, [b]). (p. 446.)

Allied to *A. furcata* (t. A. Agassiz), op. cit., p. 23, 1866; Binney, op. cit., p. 13 (copied).

Long Island Sound to Massachusetts Bay (A. Agassiz).

BRYOZOA OR POLYZOA.

PHYLACTOLÆMATA.

PEDICELLINA AMERICANA Leidy. (p. 405.)

Journal Acad. Nat. Sciences, Philadelphia, ser. ii, vol. iii, p. 143, Plate X, fig. 25, 1855.

New Haven, Connecticut, to Vineyard Sound. Point Judith, Rhode Island (Leidy).

GYMNOLÆMATA.

CYCLOSTOMATA.

CRISIA EBURNEA Lamouroux. Plate XXXIV, figs. 260, 261. (p. 311,)

Polyp. flex., p. 138, 1816; Exp. methodique, p. 6; Johnston, British Zoophytes, ed. i, p. 262, Plate 30, figs. 3, 4; ed. ii, p. 283, fig. 62, and Plate 50, figs. 3, 4; Smitt, Kritisk fört. öfver Skandinaviens Hafs-Bryozoer, in Öfvers. af Kongl. Vet.-Akad. Förhandl., 1865, p. 117, Plate 16, figs. 7 to 19. *Sertularia eburnea* Linné, Syst. Nat., ed. x, p. 810; ed. xii, p. 1316.

Long Island Sound to the Arctic Ocean; Spitzbergen to the Mediterranean (t. Smitt); California (t. Johnston). Common near New Haven, and at Thimble Islands, 1 to 6 fathoms, rocky, and in tide-pools; off Watch Hill, Rhode Island, 4 to 5 fathoms, on algæ; common in Vineyard Sound, 4 to 15 fathoms; very common in Casco Bay and Bay of Fundy, low-water to 80 fathoms.

DIASTOPORA PATINA Smitt. (p. 405.)

Smitt, op. cit., p. 397, Plate 8, figs. 13 to 15. *Tubulipora patina* Lamarck, Animaux sans Vert., ed. i, vol. ii, p. 163; ed. ii, vol. ii, p. 244; Johnston, Brit. Zoöph., ed ii, p. 266, Plate 47, figs. 1 to 3.

Long Island Sound to the Arctic Ocean; northern coast of Europe, from Finmark to Great Britain. Near New Haven, at Thimble Islands, 1 to 5 fathoms; Watch Hill, Rhode Island, 4 to 5 fathoms; Vineyard Sound, off Holmes' Hole, 3 to 4 fathoms; very common in Casco Bay, Bay of Fundy, and northward.

TUBULIPORA FLABELLARIS Smitt. (p. 405.)

Op. cit., p. 401, Plate 9, figs. 6 to 8. *Tubipora flabellaris* Fabricius, Fauna Grœnl., p. 430, 1780 (*non* Johnston, sp.). *Tubulipora phalangea* Johnston, Brit. Zoöph., ed. ii, p. 273, Plate 46, figs. 1, 2.

Long Island Sound to Greenland; northern coasts of Europe to Great Britain. Common at Thimble Islands, 1 to 5 fathoms, on algæ, hydroids, etc.; Watch Hill, Rhode Island; Vineyard Sound; Casco Bay; Bay of Fundy, and northward.

CTENOSTOMATA.

ALCYONIDIUM RAMOSUM Verrill. Plate XXXIV, fig. 257. (p. 404.)

American Journal of Science, vol. iii, p. 289, Plate 8, fig. 10, 1872.

Much branched, when full-grown; the branches round, irregularly dichotomus, usually crooked. Surface glabrous, smooth, or nearly so, the cells rather small and crowded, their margins not elevated; zoöids with sixteen slender tentacles. Color ashy brown, or dull rusty brown.

Diameter of branches, mostly 5^{mm} to 6.5^{mm}. Height, $.250^{mm}$ to $.375^{mm}$.

Great Egg Harbor, New Jersey, to Vineyard Sound; common in Long Island Sound, near New Haven, in 1 to 5 fathoms; Thimble Islands; Watch Hill, Rhode Island, etc.

ALCYONIDIUM HIRSUTUM Johnston. (p. 404.)

British Zoöph., ed. i, p. 303, Plate 42, figs. 1, 2; ed. ii, p. 360, Plate 69, figs. 1, 2; Smitt, op. cit., p. 496, Plate 12, figs. 3 to 8. *Alcyonium hirsutum* Fleming, Brit. Anim., p. 517.

Long Island Sound to the Arctic Ocean; Spitzbergen; northern coasts of Europe to Great Britain. Savin Rock, near New Haven, low-water; Thimble Islands, in tide-pools, on *Fucus*, *Phyllophora*, etc.; Vineyard Sound; and Casco Bay.

ALCYONIDIUM HISPIDUM Smitt. (p. 404.)

Op. cit., p. 499, Plate 12, figs. 22 to 27, 1866. *Flustra hispida* Fabricius, Fauna Grœnl., p. 438, 1780; Johnston, Brit. Zoöph., ed. ii., p. 363, Plate 66, fig. 5. *Flustrella hispida* Gray, Brit. Mus. Catal., part i, p. 108.

Long Island Sound to Greenland; Finmark to Great Britain. Very common at Savin Rock, near New Haven, at low water, encrusting stones, *Fucus*, etc.; Thimble Islands; Watch Hill, Rhode Island; Vineyard Sound; Casco Bay; Bay of Fundy, etc.

ALCYONIDIUM PARASITICUM Johnston. (p. 404.)

British Zoöph., ed. i, p. 304, Plate 41, figs. 4, 5; ed. ii, p. 362, Plate 68, figs. 4, 5; Smitt, op. cit., p. 499, Plate 12, figs. 14–19. *Alcyonium parasiticum* Fleming, Brit. Anim., p. 518.

Rhode Island to Arctic Ocean; northern coasts of Europe to Great Britain. Vineyard Sound, on *Phyllophora*.

(?) ALCYONIDIUM GELATINOSUM Johnston. (p. 496.)

Brit. Zoöph., ed. i, p. 300, Plate 41, figs. 1–3; ed. ii, p. 358, Plate 68, figs. 1–3; Smitt, op. cit., p. 497, Plate 12, figs. 9–13. *Alcyonium gelatinosum* Linné, Fauna Suec., ed. ii, p. 538; Syst. Nat., ed. xii, p. 1295.

Gulf of Saint Lawrence; Spitzbergen to Great Britain. A few small specimens, apparently belonging to this species, were dredged in the deeper parts of Vineyard Sound.

VESICULARIA CUSCUTA Thompson. (p. 404.)

Zoöl. Res., mem. v, p. 97, Plate 2, figs. 1–4; Smitt, op. cit., p. 501, Plate 13, figs. 28, 34, 35. *Sertularia cuscuta* Linné, ed. xii, p. 1311. *Valkeria cuscuta* Fleming, Brit. Anim., p. 550; Johnston, Brit. Zoöph., ed. i, p. 252; ed. ii, p. 374.

New Jersey, northward; northern coasts of Europe to Great Britain. In Vineyard Sound it was found on hydroids attached to floating eel-grass, and was also dredged in 6 to 8 fathoms, on algæ, *Sertularia argentea*, and other hydroids; Great Egg Harbor, New Jersey, low water, on *Sertularia pumila;* Casco Bay, on piles of wharf.

VESICULARIA GRACILIS Verrill. (p. 389.)

Bowerbankia gracilis Leidy, Journal Acad. Nat. Sciences, Philad., ser. ii, vol. iii, p. 142, Plate 11, fig. 38, 1855.

Great Egg Harbor, New Jersey, to Vineyard Sound. Point Judith, Rhode Island (Leidy). Vineyard Sound, 6 to 8 fathoms, on hydroids.

VESICULARIA DICHOTOMA Verrill, new sp. (p. 404.)

Stems clustered, cæspitose, usually one or two inches high, slender, flexible, white, and repeatedly forking. The branches stand in different planes, so as often to produce miniature tree-like or shrub-like forms, many of which generally arise close together, forming crowded tufts upon rocks, oyster-shells, or algæ. When the stem or a branch divides, there is a joint formed at the base of each of the forks, by the interposition of a very short segment of a dark brownish, opaque substance, which contrasts strongly with the white translucent substance of the rest of the stem. Zoöids arranged closely in two subspiral rows of six to twelve each, just below each fork of the stem and branches, and not occupying half the length of the internodes, which are naked and smooth below the crowded clusters of the zoöids; these are smooth, greenish brown, broad oval or obovate in contraction, subcylindrical or elliptical in expansion, entirely sessile, and but little narrowed at the base, and so crowded as to appear imbricated. The tentacles are eight, long and slender, in expansion usually more than half the length of the cell.

Great Egg Harbor, New Jersey, on oysters; Savin Rock, at low-water; off New Haven Light, 4 to 6 fathoms, shelly and rocky; Thimble Islands, in rocky tide-pools; Norwalk, Connecticut, on oysters. This is probably the species recorded by Dr. Leidy from Great Egg Harbor under the name of *Valkeria pustulosa*, which is an allied European species.

VESICULARIA ARMATA Verrill, new sp. (p. 405.)

Cells stout, oval, broad at base, with a short and narrow pedicel, attached either singly or in pairs along slender, filiform, creeping stems, which often anastomose, the branches being mostly opposite. Distal end of cells prolonged into four conical processes, each of which, when perfect, supports a long slender spinule, nearly half as long as the cell. Tentacles not seen. Cells yellowish horn-color, with an oval, dark brown internal organ, visible in most of the cells.

Vineyard Sound, on floating sea-weeds attached to *Sertulariæ*, *Halecium gracile*, etc.; also in 6 to 10 fathoms, rocky, on *Sertularia argentea*.

VESICULARIA FUSCA Smitt. (p. 420.)

Op. cit., p. 502, Plate 13, figs. 37–39, 1866. *Avenella fusca* (?) Dalyell, Rare and Rem. Anim. of Scotland, vol. ii, p. 65; vol. i, Plate 12, fig. 11, (t. Smitt).

Long Island Sound northward; northern coasts of Europe to Great Britain. Off South End, near New Haven, 3 to 5 fathoms, on *Alcyonidium ramosum*.

FARRELLA FAMILIARIS. (p. 487.)

Vesicularia (*Farrella*) *familiaris* Smitt, op. cit., p. 502, Plate 13, fig. 36, 1866. *Plumatella familiaris* Gros, Bulletin Soc. Imp. Mascou, vol. xxii, p. 567, Plate 6, G. figs. 1–10 (t. Smitt). *Farrella pedicellata* Alder, Catal., p. 68, Plate 6, figs. 1–3; Quart. Jour. Miscrosc. Soc., vol. v, p. 24, Plate 14, figs. 1–3.

Long Island Sound to Vineyard Sound and northward; coasts of Scandinavia and Great Britain. Thimble Islands, near New Haven, in tide-pools, on algæ; Casco Bay. Saint George's Bank (S. I. Smith).

CHILOSTOMATA.

Cellularina.

ÆTEA ANGUINA Lamouroux. (p. 405.)

Soc. Phil., 1812, p. 184 (t. Smitt); Polyp. flex., p. 153, Plate 3, fig. 6; Expos. Methodique, p. 9, Plate 65, fig. 15; Smitt, op. cit., p. 280, Plate 16, figs. 2–4, 1867. *Sertularia anguina* Linné, Syst. Nat., ed. xii, p. 1317. *Anguinaria spatulata* Johnston, Brit. Zoöph., ed. ii, p. 290, Plate 50, figs. 7, 8.

Long Island Sound, northward; coasts of Scandinavia and Great Britain. In Vineyard Sound it was common at low-water mark and in 6 to 14 fathoms, on *Phyllophora* and hydroids. Off New Haven, 4 to 6 fathoms, on *Halecium gracile*.

EUCRATEA CHELATA Lamouroux. (p. 405.)

Polyp. Corall. flex., p. 149, Plate 3, fig. 5, 1816; Expos. Meth., p. 8, Plate, 65, fig. 10; Smitt, op. cit., 1865, Plate 5, fig. 3; 1867, p. 281, Plate 16, figs. 7–9; Johnston, Brit. Zoöph., ed. ii, p. 288, fig. 64. *Sertularia chelata* Linné, Systema Nat., ed. x, p. 816. *Cellularia chelata* Pallas, Elench. Zoöph., p. 25, 1766.

Martha's Vineyard northward; northern coasts of Europe to Great Britain. Off Gay Head, 10 fathoms, on hydroids and ascidians. Our specimens differ somewhat from the figures of the European form; the cells are simple, more slender, and more elongated; aperture of primary cells somewhat bilabiate; of lateral cells simple and scarcely raised; no processes were observed on the front of any of the cells; the primary cells taper below into a slender, often crooked pedicel, which is about one-third as long as the cell.

(?) CELLULARIA TERNATA Johnston. (p. 496.)

British Zoöph., ed. ii, p. 335, Plate 59, 1848; Smitt, op. cit., 1867, p. 282, Plate 16, figs. 10 to 26. *Cellaria ternata* Ellis and Solander, Zoöph., p. 30. *Menipea ternata* Busk, op. cit., p. 21, Plate 20, figs. 3 to 5. (?) *Cellularia densa* Desor, Proc. Boston Soc. Nat. Hist., vol. iii, p. 66, 1848 (description inadequate).

Cape Cod to the Arctic Ocean; northern coasts of Europe to Great Britain. Off Gay Head, 10 to 20 fathoms; common in Casco Bay, Bay of Fundy, and at Saint George's Bank, 6 to 100 fathoms. South Shoals, 22 fathoms, (Desor).

CABEREA ELLISII Smitt. (p. 420.)

Op. cit., 1867, p. 287, Plate 17, figs. 55, 56. *Flustra Ellisii* Fleming, Mem. Wern. Soc., vol. ii, p. 251, Plate 17, figs. 1 to 3 (t. Smitt). *Flustra setacea* Fleming, Brit. Anim., p. 536; Johnston, Brit. Zoöph., ed. ii, p. 346. *Cellularia Hookeri* Johnston, Brit. Zoöph., ed. ii, p. 338, Plate 60, figs. 1, 2. *Caberea Hookeri* Busk, op. cit., p. 39, Plate 37, fig. 2.

Martha's Vineyard, northward to the Arctic Ocean; northern coasts of Europe, from Finmark to Great Britain. Mouth of Vineyard Sound, off Gay Head, 8 to 12 fathoms; off Buzzard's Bay, 25 fathoms; very common in Casco Bay, Bay of Fundy, and Saint George's Bank, 6 to 100 fathoms. Labrador (Packard).

BUGULA MURRAYANA Busk. (p. 496.)

Catal. Mar. Polyzoa, Brit. Mus., part i, p. 46, Plate 59; Smitt, op. cit., 1867, p. 292, Plate 18, figs. 19 to 27. *Flustra Murrayana* Bean Mss., Johnston, Brit. Zoöph., ed. i, p. 347, Plate 63, figs. 5, 6. *Flustra truncata* Desor, Proc. Boston Soc. Nat. Hist., vol. iii, p. 66 (*non* Linné).

Martha's Vineyard to Spitzbergen; northern coasts of Europe to Great Britain. Off Gay Head, 10 to 20 fathoms; very common in Casco Bay, Bay of Fundy, and Gulf of Saint Lawrence, 1 to 100 fathoms. Saint George's Bank, 20 to 65 fathoms, (S. I Smith). Labrador (Packard).

BUGULA FLABELLATA Busk. (p. 389.)

Catal. Marine Polyzoa, Brit. Mus., part i, p. 43, Plates 51, 52. *Bugula avicularia*, forma *flabellata*, Smitt, op. cit., 1867, p. 290, Plate 18, fig. 11. *Flustra avicularia* Johnston, Brit. Zoöph., ed. i, p. 286, Plate 36, figs. 3, 4; ed. ii, p. 346, Plate 63, figs. 3, 4.

Vineyard Sound, 6 to 8 fathoms; Wood's Hole, abundant on the piles of wharves. Coasts of Great Britain and Belgium.

BUGULA TURRITA Verrill. Plate XXXIV, figs. 258, 259. (p. 311.)

Cellularia turrita Desor, Proc. Boston Soc. Nat. Hist., vol. iii, p. 66, 1848. *Cellularia fastigiata* Leidy, op. cit., p. 142 (*non* Linné, sp.).

North Carolina to Casco Bay. Very abundant in Great Egg Harbor, New Jersey; Long Island Sound; Buzzard's Bay; and Vineyard Sound, low-water to 15 fathoms; Portland, Maine, on piles of wharf.

Flustrina.

MEMBRANIPORA PILOSA Farre. Plate XXXIV, figs. 262, 263. (p. 496.)

Phil. Trans., 1837, p. 412, Plate 27, figs. 1 to 5; Johnston, Brit. Zoöph., ed. i, p. 280, Plate 34, figs. 10, 12, 1838; ed. ii, p. 327, Plate 56, fig. 6, 1847; Smitt, op. cit., 1867, p. 368, Plate 20, fig. 49. *Flustra pilosa* Linné, Fauna Suec., ed. ii, p. 539 (t. Smitt). *Eschara pilosa* Pallas, Elench, Zoöph., p. 50, 1766. *Hippothoa rugosa* Stimpson, Invert. Grand Manan p. 18 (variety *catenularia*). *Tubipora catenularia* Jameson, Wern. Mem., vol. i, p. 561 (t. Smitt).

Long Island Sound to the Arctic Ocean; Finmark to the Mediterranean. Very abundant near New Haven, at Savin Rock, Thimble Islands, etc., in 1 to 6 fathoms, and in tide-pools, on *Chondrus crispus*, *Phyllophora* and other algæ, stones, etc.; Watch Hill, Rhode Island, 4 to 5 fathoms, on algæ, abundant; Vineyard Sound; Massachusetts Bay; Casco Bay; Bay of Fundy, and northward. The variety *catenularia* is common in Casco Bay and Bay of Fundy, from above low-water mark to 50 fathoms. It occurs on the coasts of Northern Europe at various depths down to 300 fathoms. Fossil in the Post-Pliocene of Canada and Labrador (Dawson).

MEMBRANIPORA LINEATA Busk. (p. 406.)

Catal. Mar. Polyzoa, part ii, p. 58, Plate 61, fig. 1; Smitt, op. cit., 1867, p. 363, Plate 20, figs. 23 to 31. *Flustra lineata* Linné, Systema Nat., ed. xii, p. 1301; Johnston, Brit. Zoöph., ed. ii, p. 349, Plate 66, fig. 4. *Escharina lineata* Leidy, Journ. Acad. Nat. Sciences, Philad., ser. ii, vol. iii, p. 141, Plate 10, fig. 22, 1855.

Great Egg Harbor, New Jersey, to the Arctic Ocean; Spitzbergen to Great Britain, low-water mark to 50 fathoms. Common near New Haven, from low-water mark to 6 fathoms, on stones, oysters, algæ, etc.; Watch Hill; Rhode Island; Vineyard Sound; Casco Bay; Bay of Fundy, and northward.

Fossil in the Post-Pliocene of Canada.

MEMBRANIPORA TENUIS Desor. (p. 420.)

Proc. Boston Soc. Nat. Hist., vol. iii, p. 66, 1848.

Long Island Sound to Cape Cod. Common near New Haven and in Vineyard Sound, low-water to 10 fathoms. Muskeget Channel, in 5 fathoms, (Desor).

Escharina.

ESCHARIPORA PUNCTATA Smitt. (p. 424.)

Op. cit., for 1867, Appendix, p. 4, (separate copies, p. 4), Plate 24, figs. 4–7, 1868. *Lepralia punctata* Hassal, Mag. Nat. Hist., vol. vii, p. 368, Plate 9, fig. 7; vol. ix, p. 407; Johnston, Brit. Zoöph., ed. ii, pp. 312 and 478, Plate 55, fig. 1.

Vineyard Sound, northward; northern coasts of Europe to Southern Norway and Great Britain. Vineyard Sound, 6 to 12 fathoms, on shells, etc., common. Saint George's Bank (S. I. Smith). (?) Fossil in the Post-Pliocene of Canada (Dawson).

ESCHARELLA VARIABILIS Verrill. Plate XXXIII, fig. 256. (p. 419.)

Escharina variabilis Leidy, Jour. Acad. Nat. Sci., Philadelphia, ser. ii, vol. iii, p. 142, Plate 11, fig. 37. *Lepralia variolosa* Desor, op. cit., p. 66, 1848 (*not* of Johnston).

South Carolina to Cape Cod and Massachusetts Bay. Very abundant in Great Egg Harbor; Long Island Sound; Buzzard's Bay; Vineyard Sound; Nantucket Harbor; low-water to 25 fathoms. Saint George's Bank, 20 fathoms, (S. I. Smith). Fort Macon, North Carolina (coll. Dr. Yarrow).

MOLLIA HYALINA Smitt. Plate XXXIV, fig. 264. (p. 420.)

Op. cit., for 1867, Ap., p. 16, (separate copies, p. 16), Plate 25, figs. 84–87, 1868. *Cellepora hyalina* Linné, Syst. Nat., ed. xii, p. 1286. *Lepralia hyalina* Johnston, Brit. Zoöph., ed. ii, p. 301, Plate 54, fig. 1. *Cellepora nitida* Fabricius, Fauna Grœnl., p. 435, 1780.

Long Island Sound to Greenland; Spitzbergen to Great Britain. Common near New Haven and at Thimble Island, in tide-pools and from 1 to 6 fathoms, on algæ; Watch Hill, Rhode Island, 4 to 5 fathoms; Buzzard's Bay and Vineyard Sound, abundant; Casco Bay; Bay of Fundy, and northward. Fossil in the Post-Pliocene of Canada (Dawson).

(?) LEPRALIA PALLASIANA Busk. (p. 496.)

Catal. Mar. Polyzoa, Brit. Mus., part ii, p. 81, Plate 83, figs. 1, 2; Smitt, op. cit., for 1867, Ap., p. 19, (separate copies, p. 19), Plate 26, fig. 93, 1868. *Eschara Pallasiana* Moll, die Seerinde, p. 64, Plate 3, fig. 13 (t. Smitt). *Lepralia pediostoma* Hassal, Ann. and Mag. Nat. Hist., vol. vii, p. 368, Plate 9, fig. 4; vol. ix, p. 407; Johnston, Brit. Zoöph., ed. ii, p. 315, Plate 55, fig. 7. *Escharina pediostoma* Leidy, op. cit., p. 141, Plate 10, fig. 23, 1855.

Rhode Island, northward; northern coasts of Europe to Southern Norway and Great Britain. Watch Hill, Rhode Island, 4 to 5 fathoms, on algæ; Vineyard Sound, 6 to 14 fathoms, on *Phyllophora* and other algæ, shells, etc.

Our specimens do not agree perfectly with the European form. Close to the proximal border of the aperture there is a large, but not very prominent, broad-based spine, or subconical process, which is not conspicuous in a view from above, but is prominent in a side-view. In some specimens a few of the cells have several slender spines around the margin of the aperture.

This may prove to be a species distinct from *S. Pallasiana*, but at present I regard it as a variety.

(?) DISCOPORA COCCINEA Smitt. (p. 496.)

Op. cit., for 1867, Ap., p. 26, (separate copies, p. 26), Plate 27, figs. 162–176. (?) *Cellepora coccinea* Abildgard, Zoöl. Dan., vol. iv, p. 30, Plate 146, figs. 1, 2 (t. Smitt). *Lepralia Peachii* Johnston, Brit. Zoöph., ed. ii, p. 315, Plate 55, figs. 5, 6.

Long Island Sound, northward; northern coasts of Europe to Great Britain. Watch Hill, Rhode Island, 4 to 5 fathoms, on red algæ; Vineyard Sound and Quick's Hole, on algæ, etc., in 4 to 12 fathoms.

Fossil in the Post-Pliocene of Canada (Dawson as *L. Peachii*).

The specimens from our coast, referred to the above species, differ considerably from the typical European forms, and may eventually prove to be a distinct species when a careful direct comparison with a large series of European specimens can be made.

The aperture is usually surrounded by a circle of stout, conical or elongated spinules, variable in number, the one nearest the angle of the aperture, on each side, often stouter; but the spines are often absent. A small semicircular avicularium is often seen near one side of the cell, and distant from the aperture. The tooth or spine at the proximal edge of the cell is elongated and more or less bifid at the end.

Celleporina.

CELLEPORA SCABRA Smitt. (p. 419.)

Op. cit., for 1867, Ap., p. 30, (separate copies, p. 30), Plate 28, figs. 183 to 197, 1868. *Eschara scabra* Fabricius, Nye Zoöl. Bidr., Vid. Selsk. Phys. Skr., Hauniæ, vol. i, p. 29 (t. Smitt). *Millepora reticulata* Fabricius, Fauna Grœnl., p. 433, 1780 (*non* Linné).

Vineyard Sound to Greenland; Spitzbergen; northern coasts of Europe. Vineyard Sound and Quick's Hole, 5 to 10 fathoms, on *Phyllophora*, etc., not uncommon.

CELLEPORA RAMULOSA Linné. (p. 312.)

Syst. Naturæ, ed. xii, p. 1285, 1767; Johnston, Brit. Zoöph., ed. ii, p. 296, Plate 52, figs. 4, 5; Smitt, op. cit., for 1867, Ap., p. 31, (separate copies, p. 31), Plate 28, figs. 198–210. *Cellepora verrucosa* Fabricius, Fauna Grœnl., p. 434 (variety) *Cellepora pumicosa* (*pars*) Linné, Syst. Nat., ed. xii, p. 1286; (?) Johnston, Brit. Zoöph., ed. ii, p. 295, Plate 52, figs. 1–3 (variety).

Long Island Sound to Greenland; Spitzbergen; northern coasts of Europe to Great Britain. Very common near New Haven, off South End, at Thimble Islands, and Faulkner's Island, in large tide-pools, low-water to 8 fathoms, chiefly on *Sertulariæ* and other hydroids, and slender red algæ, (mostly the variety *tuberosa*, or *verrucosa*); Watch Hill, Rhode Island, 4 to 5 fathoms; Buzzard's Bay and Vineyard Sound, 1 to 15 fathoms, on hydroids, common; abundant in Casco Bay; Bay of Fundy; and at Saint George's Bank; low-water to 145 fathoms.

RADIATA.

ECHINODERMATA.

HOLOTHURIOIDEA.

THYONE BRIAREUS Selenka. (p. 362.)

Zeitschrift für Wissenschaftliche Zoologie, vol. xvii, p. 353, 1867. *Holothuria Briareus* Lesueur, Journ. Acad. Nat. Sciences, Philadelphia, ser. i, vol. iv, p. 161, 1824. *Sclerodactyla Briareus* Ayres, Proc. Boston Soc. Nat. Hist., vol. iv, pp. 6, 7, 101–3, 1851; Verrill, Proc. Boston Soc. Nat. Hist., vol. x, p. 342, 1866. *Anaperus Bryareus* Pourtales, Proceedings American Assoc. for Adv. of Science, for 1851, p. 10, 1852. *Anaperus Carolinus* Troschel, Müller's Arch. für Anat., 1846, p. 62; Pourtales, op. cit., p. 10.

Texas to Cape Cod. Long Island Sound, at West Haven, Connecticut, Thimble Islands, etc., not common; Vineyard Sound and Buzzard's Bay, 1 to 10 fathoms, not uncommon; Gardiner's Bay, Long Island; Great Egg Harbor, New Jersey; Fort Macon, North Carolina, common (coll. Dr. Yarrow); West Florida (coll. E. Jewett).

STEREODERMA UNISEMITA Ayres. (p. 503.)

Proc. Boston Soc. Nat. Hist., vol. iv, p. 46, 1851; Selenka, op. cit., p. 344, Plate 19, figs. 96, 97. *Anaperus unisemita* Stimpson, Proc. Boston Soc. Nat. Hist., vol. iv, p. 8, 1851; Verrill, op. cit., vol. x, p. 357, 1866. *Cucumaria fusiformis* Desor, Proc. Boston Soc. Nat. Hist., vol. iii, p. 67 (*non* Forbes).

Off Martha's Vineyard, 22 fathoms, sand; Banks of Newfoundland (Stimpson). South Shoals of Nantucket, 22 fathoms, (Desor).

PENTAMERA PULCHERRIMA Ayres. (p. 420.)

Proc. Boston Soc. Nat. Hist., vol. iv, p. 207, 1852; Selenka, op. cit., p. 346.

South Carolina to Vineyard Sound. Off Holmes's Hole, 4 to 5 fathoms; Nobsca Beach, after storms, abundant; Fort Macon, North Carolina (coll. Dr. Yarrow). Fort Johnson, South Carolina (Stimpson).

? MOLPADIA OÖLITICA Selenka. (p. 510.)

Op. cit., p. 257 (in part), 1867. *Chirodota oölitica* Pourtales, Proc. Amer. Assoc. for 1851, p. 13, 1852. *Embolus pauper* Selenka, op. cit., p. 359, Plate 20, fig. 132 1867.

Off Block Island, 29 fathoms, sandy mud; off Boon Island, 95 fathoms, muddy, (A. S. Packard). Massachusetts Bay, in fish stomachs, (Pourtales). Selenka gives "Cape Palmas (?)" as the locality for his "*Embolus pauper*," which was based on specimens sent from the Museum of Comparative Zoölogy—perhaps the original ones described by Pourtales; the locality given is evidently erroneous.

The single specimen from off Block Island is small and imperfect, and may not be this species.

CAUDINA ARENATA Stimpson. (p. 362.)

Marine Invert. of Grand Manan, p. 17, 1853; Selenka, op. cit., p. 358, Plate 20, figs. 129–131; Clark, Mind in Nature, p. 187, figs. 114–116; A. and E. C. Agassiz.

Sea-Side Studies, p. 97, fig. 126. *Chirodota arenata* Gould, Invert. of Mass., ed. i, p. 346, (figure), 1841; Ayres, op. cit., p. 143; Pourtales, op. cit., p. 13. *Caudina* (*Molpadia*) *arenata* Verrill, Proc. Boston Soc. Nat. Hist., vol. x, p. 345, 1866.

Vineyard Sound to Chelsea, Massachusetts. Sometimes abundant on Chelsea Beach, after storms. Wood's Hole (H. E. Webster). Selenka gives "Grand Manan" (? from specimens in Mus. Comp. Zoöl.), but after very careful search during several excursions to that island, I have never been able to find it there, and believe this to be an error. Stimpson knew it only from Massachusetts Bay.

LEPTOSYNAPTA GIRARDII Verrill. Plate XXXV, figs. 265, 266. (p. 361.)

Synapta Girardii Pourtales, Proc. Amer. Assoc. Adv. Science, for 1851, p. 14. *Leptosynapta tenuis* Verrill, Trans. Conn. Acad., vol. i, p. 325. *Synapta tenuis* Ayres, op. cit., p. 11, 1851, (*non* Quoy and Gaimard); A. and E. C. Agassiz, Sea-Side Studies, p. 95, figs. 124, 125; Verrill, Proc. Boston Soc. Nat. Hist., vol. x, p. 342. *Synapta Ayresii* Selenka, op. cit., p. 362, 1867. (?) *Synapta gracilis* Selenka, op. cit., p. 363, Plate 20, figs. 123, 124.

New Jersey to Massachusetts Bay. Common in Long Island Sound, at Savin Rock, and other localities near New Haven, in sand at low-water; abundant in Vineyard Sound, on Naushon Island, etc.; Cape Cod; Chelsea Beach, Massachusetts. Sag Harbor, Long Island, (Ayres). Selenka erroneously gives "Cape Florida" as the locality for *S. Girardii*. It was based on Massachusetts specimens.

LEPTOSYNAPTA ROSEOLA Verrill, sp. nov. (p. 362.)

Body long, slender; integument translucent, filled with numerous minute, scattered, opaque, light-red spots, oval or sub-circular in form; perforated plates smaller than in the preceding species; anchors relatively much longer, with a very slender, elongated shank. General color, rosy or pale red, due to the minute red spots. Length 100^{mm} to 150^{mm}; diameter about 5^{mm} to 6^{mm}.

Long Island Sound, at Savin Rock, near New Haven; Vineyard Sound, at Naushon Island; in sand at low-water mark.

ECHINOIDEA.

STRONGYLOCENTROTUS DRÖBACHIENSIS A. Agassiz. Plate XXXV, figs. 368. (p. 406.)

Revision of the Echini, Parts I and II, pp. 162, 277, Plate 4^a, figs. 2–4, Plate 9, Plate 10, 1872. *Echinus Dröbachiensis* Müller, Zoöl. Dan. Prod., p. 235, 1776, *Toxopneustes Dröbachiensis* Agassiz, Catal. Rais., in Annal. des Sci. Nat., vol. vi. p. 367, 1846. *Euryechinus Dröbachiensis* Verrill, Proc. Boston Soc. Nat. Hist. vol. x, pp. 341, 352, 1866; Trans. Conn. Acad., vol. i, p. 304, 1867; American, Jour. Science, vol. xlix, p. 101. *Echinus neglectus* Lamarck, Anim. sans vert., p. 49, 1816. *Echinus granularis* Say, Journ. Acad. Nat. Sci., Philad., vol. v, p. 225, 1827 (*non* Lamarck). *Echinus granulatus* Gould, Invert., ed. i, p. 344, 1841. *Euryechinus granulatus* Verrill, Proc. Boston Soc., vol. x, pp. 340, 352. *Strongylocentrotus chlorocentrotus* Brandt, Prodr., p. 264, 1835.

Circumpolar: New Jersey to the Arctic Ocean; Spitzbergen to Great

Britain; Behring Straits to Gulf of Georgia; Northern Siberia to Okhotsk Sea and De Castrie's Bay. Very abundant in the Bay of Fundy, from low-water to 109 fathoms; Casco Bay; Massachusetts Bay; mouth of Vineyard Sound and off Gay Head, 10 to 20 fathoms, common; off Holmes's Hole; off Watch Hill, Rhode Island, 4 to 5 fathoms, not uncommon; off New London, Connecticut, plenty, (coll. Prudden); Faulkner's Island, Thimble Islands, and near New Haven, 4 to 8 fathoms, uncommon and small. Off New Jersey, on a bank, in 32 fathoms, (Captain Gedney). Off Saint George's Bank, 430 fathoms, (S. I. Smith).

Fossil in the Post-Pliocene of Portland, Maine; New Brunswick; Canada; and Labrador.

ARBACIA PUNCTULATA Gray. (p. 406.)

Proc. Zoöl. Soc. of London, 1835, p. 58; A. Agassiz, Revision of the Echini, Parts I and II, pp. 91, 263, Plate 2, fig. 4, Plate 5, figs. 1 to 18, 1872. *Echinus punctulatus* Lamarck, Anim. sans vert., p. 47, 1816. *Echinocidaris punctulata* Desmoulin, Syn., p. 306, 1837. *Echinocidaris Davisii* A. Agassiz, Bulletin Mus, Comp. Zoölogy, vol. i, p. 20, 1863; Verrill, Proc. Boston Soc. Nat. Hist., vol. x, p. 340, 1866.

Vineyard Sound to the West Indies and Gulf of Mexico. Common at Wood's Hole, and in Vineyard Sound and Buzzard's Bay, 1 to 12 fathoms; off Watch Hill, Rhode Island, 4 to 5 fathoms; Long Island Sound, near New Haven, and at Charles Island, not common; Fort Macon, North Carolina (coll. Dr. Yarrow). Off Tortugas, 13 to 125 fathoms, (Pourtales). West Florida (E. Jewett).

ECHINARACHNIUS PARMA Gray. Plate XXXV, fig. 267. (p. 362.)

Ann. Phil., p. 6, 1825; A. Agassiz, Revision of Echini, Parts I and II, pp. 107, 316, Plates 11[d], figs. 4, 5, 11[e], figs. 4, 5, 12, figs. 1–13, 1872. *Scutella parma* Lamarck, Anim. sans vert., p. 11, 1816.

New Jersey to Labrador. According to Mr. A. Agassiz, it occurs in the North Pacific, on the west coast of America, from the Aleutian Islands to Vancouver Island, and on the coast of Asia at Kamtchatka, 30 to 70 fathoms; and also at New Holland; India; Indian Ocean; Red Sea, etc. Common along the entire coast of New England and Long Island, from low-water to 100 fathoms, sand. Off New Jersey, on a distant bank, in 32 fathoms, (Captain Gedney). Very abundant at Saint George's Bank and vicinity, 15 to 430 fathoms, (S. I. Smith).

MELLITA PENTAPORA Lütken.

Bidrag til Kundskab om Echiniderne, p. 107, in Vidensk. Middelelser, 1864; Verrill, Trans. Connecticut Academy, vol. i, p. 345, 1867. *Echinus pentaporus* Gmelin, Syst. Nat., p. 3189, 1788. *Encope pentapora* Agassiz, Monog. Scut., Plate 3, 1841. *Scutella quinquefora* Lamarck, Anim. sans vert., p. 9, 1816. *Mellita quinquefora* Agassiz, Mon. Scut., p. 36, 1841; Catal. Rais., in Ann. Sci., vol. vii, p. 138, 1847. *Mellita testudinaria* Gray, Proc. Zöol. Soc., London, 1851, p. 36; Verrill, this Report, pp. 427, 429, (see errata). *Mellita testudinata* Agassiz, Mon. Scut., p. 40, Plate 4[a], figs. 7–9, 1841; A. Agassiz, Revision of the Echini, pp. 141, 322, Plate 11, figs. 13–22, Plate 12[a], Plate 12[c], figs. 1, 2, (name adopted from Klein, 1734, accidentally binomial).

New Jersey to Brazil; very abundant along the whole eastern coast of the United States, south of Cape Hatteras, and along the entire coast of the Gulf of Mexico; rare and local north of Cape Hatteras. Vineyard Sound, 5 to 8 fathoms, rare and dead; outer beach at Great Egg Harbor, New Jersey, dead. Nantucket (Agassiz).

ASTERIOIDEA.

ASTERIAS ARENICOLA Stimpson. Plate XXV, fig. 269. (p. 326.)

Proc. Boston Soc. Nat. Hist., vol. viii, p. 268, 1862; Verrill, vol. x, p. 339, 1866. *Asteracanthion berylinus* Ag. MSS., A. Agassiz, Embryology of Echinod., in Proc. Amer. Acad., 1863; Embryology of the Starfish, in Agassiz Contributions, vol. v, p. 3; Sea-Side Studies, p. 108, figs. 141–145, 1865 (t. Agassiz).

Massachusetts Bay to Northern Florida and the northern shores of the Gulf of Mexico; rare and local, in sheltered localities, north of Massachusetts, as at Quahog Bay, east of Portland, Maine; but not known from the eastern part of the coast of Maine, nor in the Bay of Fundy.

Very common in Long Island Sound; Buzzard's Bay; Vineyard Sound; and along the shores of Long Island, from low-water to 15 fathoms. Not uncommon in Massachusetts Bay, at Nahant, Beverly, &c.

ASTERIAS FORBESII Verrill.

Proc. Boston Soc. Nat. Hist., vol. x, p. 345, 1866. *Asteracanthion Forbesii* Desor, Proc. Boston Soc. N. H., vol. iii, p. 67, 1848.

Buzzard's Bay to Beverly, Massachusetts. Vineyard Sound and off Gay Head, 6 to 14 fathoms; Buzzard's Bay, 6 fathoms; Chelsea and Beverly, Massachusetts, low-water. Vineyard Sound, 8 fathoms, (Desor).

This is probably identical with the preceding species, the differences being, perhaps, chiefly sexual, but I have not yet had opportunities to satisfy myself fully in regard to this point, and, therefore, leave them, for the present, under separate names. Should they be united, the name *Forbesii* has the precedence over all others.

ASTERIAS VULGARIS Stimpson, MSS. (p. 496.)

Packard, in Canadian Naturalist and Geologist, Dec., 1863 (no description); Verrill, Proc. Boston Soc. Nat. Hist., vol. x, p. 347, 1866 (description). *Asteracanthion pallidus* Ag. MSS.; A. Agassiz, Embryology, in Proc. Amer. Acad., 1863 (no description); Embryology of the Starfish, in Agassiz' Contributions. vol. v, p. 3. *Asterias rubens* Gould, Invert., ed. i, p. 345 (*non* Linné).

Long Island Sound to Labrador, and (?) Greenland. Very abundant in Massachusetts Bay, Casco Bay, Bay of Fundy, from above low-water mark to 40 fathoms; in the deeper parts of Vineyard Sound and off Gay Head, in 6 to 25 fathoms, not uncommon; off Watch Hill, Rhode Island, 4 to 5 fathoms, common; Faulkner's Island, Connecticut, low-water, very rare.

LEPTASTERIAS COMPTA Verrill.

Proc. Boston Soc., vol. x, p. 350, 1866. *Asterias compta* Stimpson, Proc. Boston Soc. Nat. Hist., vol. viii, p. 270, 1862; Verrill, op. cit., p. 340.

Off New Jersey, 32 fathoms, (Captain Gedney). Off Martha's Vineyard, 20 to 25 fathoms, rare; off Casco Bay, 30 to 50 fathoms.

CRIBRELLA SANGUINOLENTA Lütken. (p. 407.)

Grœnl. Echinod., p. 31, 1859; Verrill, Proc. Boston Soc. Nat Hist., vol. x, p. 345, 1866. *Asterias sanguinolenta* Müller, Zoöl. Dan. Prod., 2836, 1776. *Asterias oculata* Pennant, Brit. Zoöl., vol. iv, p. 61, Plate 30, fig. 56, 1777. *Asterias spongiosa* Fabricius, Fauna Grœnl., p. 368, 1780. *Linkia oculata* Forbes, Wern. Mem., vol. viii, p. 120, 1839. *Cribella oculata* Forbes, British Starfishes, p. 100, (figure), 1841. *Echinaster oculatus* Müller and Troschel, Syst. Asterid., p. 24, 1842. *Linkia oculata* Stimpson, Invert. of Grand Manan, p. 14, 1853. *Linkia pertusa* Stimpson, op. cit., p. 14. *Echinaster sanguinolentus* Sars, Fauna Litt. Norveg., i, p. 47, Plate 8, figs. 3–6; Oversigt af Norges Echinodermer, p. 84, 1861.

Connecticut to the Arctic Ocean; northern coasts of Europe to Great Britain and France. Very common in the Bay of Fundy, Casco Bay, and on the entire coast of Maine, from low-water to 100 fathoms; Massachusetts Bay; Vineyard Sound, 5 to 20 fathoms, not uncommon; off Watch Hill, Rhode Island, 3 to 5 fathoms; off New London, Connecticut (coll. T. H. Prudden).

OPHIUROIDEA.

OPHIURA OLIVACEA Lyman. (p. 363.)

Ill. Catal. Mus. Comp. Zoölogy, No. 1, Ophiuridæ and Astrophytidæ, p. 23, 1865; Verrill, Proc. Boston Soc. N. H., vol. x, p. 339. *Ophioderma olivaceum* Ayres, Proc. Boston Soc. Nat. Hist., vol. iv, p. 134, 1852.

Cape Cod to North Carolina. Wood's Hole, Buzzard's Bay, and Vineyard Sound, not common; shores of Long Island, frequent; Fort Macon, North Carolina, common, (Dr. Yarrow).

OPHIOPHOLIS ACULEATA Gray. Plate XXXV, fig. 270. (p. 496.)

List of British Animals in Coll. of Brit. Mus., Part I, Rad. Anim., p. 25, 1848; Lütken Additamenta ad Hist. Ophiuridarum, p. 60, Plate 2, figs. 15, a. b, 16, a, b, 1858; Verrill, op. cit., p. 344, 1866. *Asterias aculeata* Linné (*pars*), Syst. Nat., p. 1101; Retzius Vetersk.-Akad., vol. iv, p. 240, 1783; Müller, Prod., 2841, 1776; Zoöl. Dan., vol. iii, p. 29, Plate 99, 1789. *Ophiura bellis* Fleming, Brit. Anim., p. 488, 1828. *Ophiocoma bellis* Forbes, Wern. Mem., vol. viii, p. 226; Brit. Starfishes, p. 53, figure. *Ophiopholis bellis* Lyman, op. cit., p. 96, Plate 1, figs. 4–6. *Ophiolepis scolopendrica* Müller and Troschel, Syst. Aster., p. 96, 1842. *Ophiopholis scolopendrica* Stimpson, Invert. of Grand Manan, p. 13, 1853.

Rhode Island and New Jersey to the Arctic Ocean; Iceland; Spitzbergen; northern coasts of Europe, to the English Channel, Ireland, etc. Very abundant in the Bay of Fundy, Casco Bay, and along the whole coast of Maine, from low-water to 100 fathoms; Massachusetts Bay; off Gay Head, 6 to 8 fathoms, rare; off Watch Hill, Rhode Island, in 4 to 5 fathoms, rocky. Off New Jersey, 30 to 38 fathoms, N. lat. 39° 54′; W. long. 73° 15′, (Josephine Exp., t. Ljungmann). A similar species, perhaps identical, occurs on the northwestern coasts of America.

AMPHIPHOLIS ELEGANS Ljungmann. (p. 420.)

Ophiuroidea viventia huc usque cognita, Öfvers. Kongl. Vet.-Akad. Förh., 1866, p. 312. *Ophiura elegans* Leach, Zoöl. Miscell., iii, p. 57, 1815. *Amphiura elegans* Norman, Ann. and Mag. Nat. Hist., vol. xv, p. 109, 1865. *Ophiocoma neglecta* Forbes, Brit. Starfishes, p. 30, 1841. *Ophiolepis tenuis* Ayres, Proc. Boston Soc. Nat. Hist., vol. iv, p. 133, 1852. *Amphiura tenuis* Lyman, Proc. B. S. N. H., vol. vii, p. 194, 1860. *Amphipholis tenuis* Ljungmann, Öfvers. af Kongl. Vet.-Akad. Förh., 1871, p. 635. *Amphiura squamata* Lyman, Catalogue Ophiur. and Astroph., p. 121, 1865 (*non* Delle Chiage, t. Ljungmann).

Off New Jersey to the Arctic Ocean; northern coasts of Europe to the English Channel. Common in Vineyard Sound, 4 to 15 fathoms; Massachusetts Bay; Casco Bay; Bay of Fundy, low-water to 60 fathoms. Greenland, 15 fathoms, (Lütken, as *A. neglecta*). Off New Jersey, 36 to 38 fathoms, N. lat. 39° 54′, W. long. 73° 15′, (Josephine Exp., t. Ljungmann).

Mr. Ljungmann, in his latest paper, regards this species as distinct both from the Mediterranean species (*Amphiura squamata*), and the English and Norwegian species (*Amphipholis elegans*). The former I have here regarded as distinct, but consider the latter identical with the American form, the differences mentioned being slight and apparently inconstant.

AMPHIURA ABDITA Verrill. (p. 433.)

Amphipholis abdita Verrill, Amer. Jour. of Science, ser. iii, vol. ii, p. 132, 1871; this Report, p. 433. (See errata).

Body plump, pentagonal; the interradial margins concave, and the angles, at base of arms, incised; margin thick, rounded; upper surface of disk covered with very numerous, minute, crowded scales, which encroach more or less upon the radial shields and run up between them in a wedge-like area; lower surface thickly covered with still more minute, granule-like scales. Radial shields elongated, three or more times longer than wide, curved; the outer end geniculate or bent downward, forming a prominent angle above; they are divergent, and separate for their whole length, or barely touch at the outer ends, and are more or less concealed laterally and proximally by the encroachment of the small scales. Arms or rays, 16 times as long as the diameter of the body, or even more, slender, flexible, gradually attenuated to the tips.

Six mouth-papillæ in each angle of the mouth, and two to four additional small rounded papillæ, or tentacle-scales, near the extreme outer angle. Two of the mouth-papillæ, on each side, are placed close together, at about the middle of the edge of the jaw; the outer of these, which is about twice as wide as the inner, is flat, scarcely longer than wide, with the end obtusely rounded or truncate; the inner one is scarcely wider than thick, oblong, rounded at the end; in one case these two papillæ are united together. The third mouth-papilla is stout and rounded, obtuse, larger and longer than either of the others, separated from them by a considerable interval, and brought close to the tooth at the end of the jaw, beyond which it projects inwardly and downwardly.

The mouth-shields are long-oval, or somewhat hexagonal, narrowed outwardly, the outer part of the lateral edges being nearly straight, the outer end rounded or sub-truncate, the inner end broadly rounded. Side mouth-shields triangular with the three edges concave, the inner ends not united, the surface finely granulated. The lower arm-plates are separated by the side plates; the first two are longer than broad, pentagonal, the inner end forming an obtuse angle, the outer edge straight; the next two are about as wide as long, squarish, with the corners rounded or truncate; the following ones are broader than long, somewhat octagonal, the outer and inner edges longest and nearly straight; beyond the middle of the arm they are again pentagonal, with an inner angle. On the first five joints of one specimen there is only a single pair of tentacle-scales, which are small and rounded; on the succeeding joints there are generally two pairs, one of them being considerably smaller than the other; the largest specimen has two pairs of tentacle-scales on all the joints.

Arm-spines three, on each side of all the joints, except the first, which has but two; they are thickened at base, gradually tapering, blunt at tip, sub-equal; the lower one a little curved downward; the upper one stoutest, flattened, scarcely tapering, obtuse; the middle one a little longer than the others, the length about equal to width of lower arm-plates. The upper arm-plates are transversely sub-elliptical, with the outer edge well rounded, the inner edge slightly prominent or angular in the middle, and a little concave to either side, so that the lateral portions are somewhat narrowed; the plates generally touch each other.

Color, when living, brown above, the central area dark brown, a radiating band of the same extending to each interradial margin, and bordered like the central area with pale gray; opposite the base of each arm is a squarish area or radial band of olive-brown; radial plates yellowish brown, the space between them bright blue. In the center of the disk is a small darker brown spot, and five similar ones, corresponding to the bases of the arms, form a circle around the center; five others, more distant, correspond to the interradial spaces; other more minute dark spots are scattered over the disk. Upper arm-plates are mostly dark brown, edged with pale brown or whitish; some of the plates are partially or wholly lighter, yellowish brown, and thus form transverse light bands, or mottlings, consisting of one or more plates; toward the tips these light bands become more numerous, and wider; spines bright brown. Lower side of disk yellowish brown, with a tinge of greenish; plates around the mouth whitish; each of the jaws with two brown spots; mouth-tentacles orange-yellow. Under arm-plates yellowish brown, with the edges paler, and with a distal median spot of whitish; lower arm-spines yellowish brown. In some specimens the arms are dull greenish above, instead of brown.

Diameter of the disk, of the largest specimen, 11^{mm}; length of arms, 180^{mm}.

Long Island Sound; off New Haven, in 4 to 6 fathoms, mud; off Thimble Islands, 3 to 8 fathoms, soft mud, rare.

This species is, in some respects, intermediate between *Amphipholis* and *Amphiura*. With the former it agrees best in the number of the arm-spines and general appearance; but in the structure of the mouth-parts it agrees better with the latter. It will, however, not go into any of the sections or sub-sections established by Ljungmann. It appears to be more nearly allied to *A. Eugeniæ* Ljung., from La Plata, than to any other species hitherto described; the latter has, however, four arm-spines instead of three.

ASTROPHYTON AGASSIZII Stimpson.

Invertebrata of Grand Manan, p. 12, 1853; Lyman, Catalogue, p. 186.

This species was first described from a specimen obtained "not far from the shoals of Nantucket," by Governor John Winthrop, in 1670 and 1671 (Philosophical Transactions), under the name of "Basket-fish" or "Net-fish." Crab Ledge, off Chatham, Massachusetts, (V. N. Edwards.) It occurs on the banks east and north of Cape Cod, and on Saint George's Bank, and is very common in the Bay of Fundy, low-water to 110 fathoms; and is especially abundant in Eastport Harbor, in 10 to 20 fathoms. According to Dr. Lütken it is also found at Greenland and Finmark.

CRINOIDEA.

Antedon dentatus Verrill.

Proc. Boston Soc. Nat. Hist., vol. x, p. 339, 1866. *Alecto dentata* Say, Journ. Acad. Nat. Sci., Philadelphia, vol. v, p. 153, 1825.

This species was described by Say, from a specimen obtained at Great Egg Harbor, New Jersey. It may possibly occur on the southern coast of New England, but I am not aware that it has actually been found so far north.

ACALEPHÆ.

CTENOPHORÆ.

MNEMIOPSIS LEIDYI A. Agassiz. (p. 449.)

Illustr. Catal. Mus. Comp. Zoölogy, North American Acalephæ, p. 20, figs. 22–24, 1865.

Buzzard's Bay and Vineyard Sound; Long Island Sound, off New Haven.

LESUEURIA HYBOPTERA A. Agassiz. (p. 454.)

Catal. North American Acalephæ, p. 23, figs. 25–28.

Newport, Rhode Island, to Massachusetts Bay (A. Agassiz).

PLEUROBRACHIA RHODODACTYLA Agassiz. (p. 448.)

Memoirs Amer. Academy, vol. iv, p. 314, Plates 1 to 5, 1849; Contributions to Nat. Hist. U. S., vol. iii, pp. 203, 294, Plate 2ª, 1860; A. Agassiz, Catalogue, p. 30, figs. 38–51, 1865.

Southern side of Long Island, to Greenland. Not uncommon in Long

Island Sound, near New Haven; common in Vineyard Sound and Massachusetts Bay; very abundant in Casco Bay, Bay of Fundy, and Gulf of Saint Lawrence. Off Saint George's Bank (S. I. Smith). Fire Island, Long Island (S. I. Smith).

IDYIA ROSEOLA Agassiz. (p. 451.)

Contributions to Nat. Hist. U. S., vol. iii, pp. 270–296, Plates 1, 2, 1860; A. Agassiz, Catalogue, p. 36, figs. 52–62, 1865.

Vineyard Sound to Labrador. Off Gay Head, not common; common in Massachusetts Bay and Casco Bay; very abundant in Bay of Fundy and Gulf of Saint Lawrence. Labrador (Packard).

? *Cestum Veneris* Lesueur.

Nouv. Bull. Soc. Phil., 1813, p. 281, Plate 5, fig. 1; Lesson, Zoöphytes Acalephes, p. 70, Plate 1, fig. 1.

Mr. S. I. Smith observed a species, apparently identical with this, at Saint George's Banks, and Mr. A. Agassiz has observed fragments of a similar species near Newport, Rhode Island. This is properly a more southern species, found in the warmer parts of the Atlantic and in the Mediterranean Sea.

DISCOPHORÆ.

AURELIA FLAVIDULA Péron and Lesueur. Plate XXXVI, fig. 271. (p. 449.)

Ann. Mus. Hist. Nat., vol. xiv, p. 47, 1809; Lesson, op. cit., p. 376, 1843; Agassiz, Contributions to Nat. Hist. U. S., vol. iii, Plates 6–11[b]; vol. iv, pp. 10, 160; A. Agassiz, Catalogue, p. 42, figs. 65, 66. *Aurelia aurita* Stimpson, Invert., of Grand Manan, p. 11, 1853.

Buzzard's Bay to Greenland. Common in the upper part of Buzzard's Bay, in spring; off Gay Head and in Vineyard Sound, in August; abundant in Massachusetts Bay; Casco Bay; Frenchman's Bay; Bay of Fundy; and Gulf of Saint Lawrence.

CYANEA ARCTICA Péron and Lesueur. (p. 449.)

Ann. Mus., vol. xiv, p. 51, 1809; Agassiz, Contributions, vol. iii, Plates 3, 4, 5, 5[a], 10, 10[a]; vol. iv, pp. 87, 162; A. Agassiz, Catalogue, p. 44, fig. 67. *Cyanea Postelsii* Gould, Invert., ed. i, p. 347; Stimpson, op. cit., p. 11 (*non* Brandt).

Long Island Sound to Greenland. Common near New Haven; in Buzzard's Bay; Vineyard Sound; very abundant in Massachusetts Bay; Casco Bay; Bay of Fundy; and Gulf of Saint Lawrence. Fire Island, Long Island (S. I. Smith).

Cyanea fulva Agassiz.

Contributions, vol. iv, pp. 119, 162, 1862; A. Agassiz, Catalogue, p. 46 (no description).

Long Island Sound (L. Agassiz). Vineyard Sound (A. Agassiz).

I have been unable to distinguish more than one species among the *Cyaneæ* of our waters, although they vary considerably in color, just as they do farther north, as in the Bay of Fundy. This is probably only a color-variety of *C. arctica*.

DACTYLOMETRA QUINQUECIRRA Agassiz. Plate XXXVI, fig. 272. (p. 449.)

Contributions, vol. iv, pp. 125, 166, 1862; A. Agassiz, Catalogue, p. 48, fig. 69.

Pelagia quinquecirrha Desor, Proc. Boston Soc. Nat. History, vol. iii, p. 76, 1848.

Bermudas to Cape Cod. Long Island Sound, near New Haven; common in Buzzard's Bay and Vineyard Sound.

Pelagia cyanella Péron and Lesueur.

Ann. du Mus. Hist. Nat., vol. xiv, p. 37, 1809; Agassiz, Contributions, vol. iii, Plates 12, 13, 13a; vol. iv, pp. 128, 164; A. Agassiz, Catalogue, p. 47, fig. 68.

Off Saint George's Bank (S. I. Smith). This species inhabits the Gulf of Mexico; Caribbean Sea; and coasts of Florida and North Carolina. It is carried northward by the Gulf Stream to the vicinity of Saint George's Bank, and is, therefore, like the two following, likely to occur occasionally at Nantucket and Martha's Vineyard.

Stomolophus meleagris Agassiz.

Contributions, vol. iii, Plate 14, 1860; vol. iv, pp. 138, 151, 1862; A. Agassiz, Catalogue, p. 40.

Coast of Georgia (Agassiz). Off Saint George's Bank (S. I. Smith).

? *Charybdea periphylla* Péron and Lesueur.

Ann. du Mus. Hist. Nat., vol. xiv, p. 332, 1809; Edwards in Cuvier, Règne Anim., Pl. 55, fig. 2 (from Lesueur); Lesson, op. cit., p. 265, 1843; Agassiz, Contributions, vol. iv, p. 173.

This species was originally described and figured from mutilated specimens taken under the equator in the Atlantic Ocean, and seems not to have been seen by later writers. Mr. S. I. Smith has apparently rediscovered this interesting species off Saint George's Bank.

The specimen obtained by him, while on the United States Coast-Survey steamer Bache, in 1872, is not quite perfect, but agrees pretty nearly with the descriptions and figure cited.

The body in the alcoholic specimen is elevated, bell-shaped, rounded above, with a marked constriction toward the border; transparent, the inner cavity showing through as a large, conical, dark reddish brown spot, with the apex slightly truncated. Border deeply divided into sixteen long, flat lobes, which are of nearly uniform breadth throughout, and slightly rounded, or sub-truncate, at the end; the edges and end thin and more or less frilled; the inner side with two sub-marginal carinæ. Eyes inconspicuous, but small bright red specks are scattered over the marginal lobes. The intervals between the lobes are narrow and generally smoothly rounded, without distinct evidence of the existence of tentacles, except that, in one of these intervals, there is a small and short papilliform process, with brown pigment at the base. The ovaries are mostly wanting, but portions are to be seen as slightly convoluted organs in the marginal region, opposite the intervals between the lobes.

TRACHYNEMA DIGITALE A. Agassiz. (p. 454.)

Catalogue, p. 57, figs. 81–86, 1865. *Medusa digitale* Fabricius, Fauna Grœnl., p. 366, 1780.

Vineyard Sound to Greenland. Wood's Hole, July 1, young specimens. Massachusetts Bay (A. Agassiz).

HYDROIDEA.

Sertularina.

TIAROPSIS DIADEMATA Agassiz. (p. 454.)

Memoirs Amer. Acad., vol. iv, p. 289, Plate 6, 1849; Contributions, vol. iii, p. 354, Plate 31, figs. 9–15; vol. iv, pp. 308, 311, figs. 45–48; A. Agassiz, Catalogue, p. 69, figs. 91–93.

Vineyard Sound to Bay of Fundy. Massachusetts Bay (A. Agassiz). Greenland (Mörch). Wood's Hole, April, 1873.

OCEANIA LANGUIDA A. Agassiz. (p. 454.)

In Agassiz, Contributions, vol. iv, p. 353, 1862; Catalogue, p. 70, figs. 94–102, 1865.

Buzzard's Bay to Bay of Fundy. Common in Vineyard Sound; not uncommon in Eastport Harbor.

EUCHEILOTA VENTRICULARIS McCready. (p. 454.)

Gymnophthalmata of Charleston Harbor, in Proc. of Elliott Society of Nat History, vol. i, p. 187, Plates 11, figs. 1–3, 12, figs. 1, 2, 1857; Agassiz, Contributions, vol. iv, p. 353, 1862; A. Agassiz, Catalogue, p. 74, figs. 104, 105, 1865.

Charleston, South Carolina, to Vineyard Sound.

EUCHEILOTA DUODECIMALIS A. Agassiz. (p. 454.)

In Agassiz, Contributions, vol. iv, p. 353, 1862; Catalogue, p. 75, figs. 106–107[a].

Buzzard's Bay, Naushon Island (A. Agassiz).

CLYTIA JOHNSTONI Hincks. (p. 408.)

Hist. British Hydroid Zoöphytes, p. 143, Plate 24, fig. 1, 1868. *Campanularia Johnstoni* Alder, Northum. and Dur. Catal., in Trans. Tynes. F. C., vol. v, p. 126, Plate 4, fig. 8 (t. Hincks). *Sertularia uniflora* (*pars*) Pallas, Elench. Zoöph., p. 121, 1766. *Campanularia volubilis* Johnston, Brit. Zoöph., ed. ii, pp. 107, 108, fig. 18 (*not* of Linné and Pallas). *Clytia volubilis* Lamouroux, Expos. Meth., p. 15, Plate 4, figs. E, f, F, 1821. *Clytia bicophora* Agassiz, Contributions, vol. iv, pp. 304, 354, Plate 27, figs. 8, 9; Plate 29, figs. 6–9, 1862; A. Agassiz, Catalogue, p. 78, figs. 108–111.

Long Island Sound to the Arctic Ocean; northern coasts of Europe to Great Britain and France. Common near New Haven and at Thimble Islands, in tide-pools and 2 to 6 fathoms; Watch Hill, Rhode

Island, 3 to 5 fathoms; Buzzard's Bay; Vineyard Sound, 1 to 14 fathoms, common; off Block Island, 29 fathoms; abundant in Casco Bay and Bay of Fundy, low-water to 40 fathoms. Saint George's Bank (S. I. Smith).

This species is undoubtedly the one described by Pallas, and according to the strict rules of priority it should be called *Clytia uniflora*.

CLYTIA INTERMEDIA Agassiz. (p. 408.)

Contributions, vol. iv, p. 305, Plate 29, figs. 10, 11, 1862; A. Agassiz, Catalogue, p. 77 (no description).

Vineyard Sound, 6 to 8 fathoms, on *Phyllophora*. Massachusetts Bay (Agassiz).

PLATYPYXIS CYLINDRICA Agassiz. (p. 408.)

Clytia (Platypyxis) cylindrica Agassiz, Contributions, vol. iv, pp. 306, 354, figs. 42–44 (*not* 41, *nor* Plate 27, figs. 8, 9), 1862. *Platypyxis cylindrica* A. Agassiz, Catalogue, p. 80, figs. 112–114. *Campanularia volubilis* Leidy, Jour. Phil. Acad. Nat. Sciences, ser. ii, vol. iii, p. 138, 1855 (*not* Linné, sp.).

Long Island Sound to Massachusetts Bay. Near New Haven, 4 to 6 fathoms, on *Halecium*; Thimble Islands; Watch Hill, Rhode Island; Vineyard Sound; off Buzzard's Bay, 25 fathoms.

ORTHOPYXIS CALICULATA Verrill. (p. 408.)

Campanularia caliculata Hincks, in Annals and Mag. Nat. Hist., ser. ii, vol. xi, p. 178, Plate 5, B, 1853; Brit. Hydroid Zoöph., p. 164, Plate 31, figs. 2–2d *Clytia* (*Orthopyxis*) *poterium* Agassiz, Contributions, vol. iv, pp. 297, 302, fig. 40, Plate 28, Plate 29, figs. 1–5, 1862. *Orthopyxis poterium* A. Agassiz, Catalogue, p. 81, 1865.

Vineyard Sound to Labrador; northern coasts of Europe to Great Britain. Off Gay Head and in Vineyard Sound, 4 to 15 fathoms; common in Massachusetts Bay; Casco Bay; and Bay of Fundy, low water to 30 fathoms. Mingan Islands, Labrador, 6 fathoms, (A. E. V). Henley Harbor, Labrador, 20 to 30 fathoms (A. S. Packard, as *Clytia volubilis*).

CAMPANULARIA VOLUBILIS Alder. (p. 408.)

Catal. Zoöph. Northumb. and Durham, in Trans. Tynes. F. C., vol. iii, p. 125, Plate 4, fig. 7, 1857 (*not* of Johnston); Hincks, Brit. Hyd. Zoöph., p. 160, Plate 24, fig. 2. *Sertularia volubilis* Linné (*pars*), Syst. Nat., ed. x, sp. 19; ed. xii, p. 1311; Pallas, Elench. Zoöph., p. 122, 1766. *Clytia volubilis* A. Agassiz, Catalogue, p. 77 (*not* of Lamouroux).

Vineyard Sound to Greenland and Iceland; northern coasts of Europe to Great Britain; low-water to 100 fathoms. Common in the Bay of Fundy, low-water to 60 fathoms.

CAMPANULARIA FLEXUOSA Hincks. (p. 327.)

Brit. Hyd. Zoöph., p. 168, Plate 33. *Laomedea flexuosa* Hincks, Devon. and Cornwall Catalogue, in Ann. and Mag. Nat. Hist., ser. iii, vol. viii, p. 260, 1861.

Laomedea amphora Agassiz, Contributions, vol. iv, pp. 311, 314, fig. 50, p. 352, Plate 30, Plate 31, figs. 1–8, 1862; A. Agassiz, Catalogue, p. 93.

Long Island Sound to Gulf of Saint Lawrence; northern coasts of Europe, Isle of Man. New Haven, on piles of Long Wharf; Thimble Islands, near New Haven; Vineyard Sound, off Gay Head; abundant on the timbers of the wharves at Eastport, Maine.

OBELIA DIAPHANA Verrill. (p. 327.)

Thaumantias diaphana Agassiz, Mem. Amer. Acad., vol. iv, p. 300, figs. 1, 2, 1849 (? *non* Mörch). *Eucope diaphana* (*pars*) Agassiz, Contributions, vol. iv, Plate 33, fig. 2, 1862; A. Agassiz, Catalogue, p. 83, figs. 115–125.

Long Island Sound to Massachusetts Bay. Abundant in New Haven Harbor and Vineyard Sound, on *Zostera*, *Fucus*, etc.

OBELIA GENICULATA Allman. (p. 407.)

Annals and Mag. Nat. Hist., vol. xiii, May, 1864 (t. Hincks); Hincks, Brit. Hyd. Zoöphytes, p. 149, Plate 25, fig. 1, 1868. *Sertularia geniculata* Linné, Syst. Nat., ed. x, sp. 23; ed. xii, sp. 21, p. 1312; Pallas, Elench. Zooph., p. 117, 1766. *Laomedea geniculata* Lamouroux, Pol. Flex., p. 208; Johnston, Brit. Zoöph., ed. ii, p. 103, Plate 25, figs. 1, 2. *Eucope diaphana* (*pars*) Agassiz, Contributions, vol. iv, p. 322, Plate 34, figs. 1–9, 1862. *Eucope alternata* A. Agassiz, Catalogue, p. 86, 1865.

Long Island Sound to Labrador. Northern Europe, from North Cape to Great Britain. Common near New Haven; at Thimble Islands; Watch Hill, Rhode Island; Vineyard Sound, 4 to 15 fathoms; Massachusetts Bay; Casco Bay; Bay of Fundy, and northward, low-water to 40 fathoms, on *Laminaria*, *Rhodymenia*, etc.

OBELIA POLYGENA Verrill.

Eucope polygena A. Agassiz, Catalogue, p. 86, fig. 126, 1865.

Off Gay Head, 4 to 5 fathoms, not common. Nahant, Massachusetts (A. Agassiz).

OBELIA DIVARICATA Verrill.

Laomedea divaricata McCready, op. cit., p. 195, 1859. *Eucope ? divaricata* A. Agassiz, Catalogue, p. 91, 1865.

Charleston, South Carolina (McCready, Agassiz). A few specimens were found on floating algæ in Vineyard Sound, which appear to belong to this species. It is closely allied to *O. fusiformis* (A. Agassiz, sp.).

OBELIA PYRIFORMIS Verrill. (p. 390.)

Catalogue, p. 88, figs. 127–129, 1865. *Laomedea gelatinosa* Leidy, Journ. Acad. Nat. Sci., Philad., ser. ii, vol. iii, p. 138, 1855 (*not* Pallas, sp.).

Long Island Sound to Bay of Fundy. Very abundant on piles of wharves, etc., at Wood's Hole.

This species is closely allied to the following; in the latter the young medusæ have sixteen tentacles when set free, and the reproductive capsules differ slightly in form.

OBELIA DICHOTOMA Hincks. (p. 407.)

Brit. Hydroid Zoöphytes, p. 156, Plate 28, fig. 1, 1868. *Sertularia dichotoma* Linné, Syst. Nat., ed. x, sp. 24; ed. xii, sp. 22, p. 1312. *Laomedea dichotoma*, var. *a*, Johnston, Brit. Zoöph., ed. ii, p. 102, Plate 26, figs. 1, 2.

Vineyard Sound, northward; northern coasts of Europe to Great Britain. Off Gay Head, 8 to 10 fathoms, on ascidians; Eastport, Maine.

OBELIA LONGISSIMA Hincks.

Brit. Hydroid Zoöph., p. 154, Plate 27, 1868. *Sertularia longissima* Pallas, Elench. Zoöph., p. 119, 1766 (excl. synonymy). *Laomedea longissima* Alder, Trans. Tynes. F. C., vol. iii, p. 121 (t. Hincks). *Laomedea dichotoma*, var. *b*, Johnston, Brit. Zoöph., ed. ii, p. 102. *Campanularia gelatinosa* Van Beneden, Mém. sur le Campan., p. 33, Plates 1, 2 (t. Hincks).

Gay Head; Cape Ann, Massachusetts; Bay of Fundy. Coasts of Belgium and Great Britain.

OBELIA FLABELLATA Hincks. (p. 390.)

Brit. Hydroid Zoöph., p. 157, Plate 29, 1868. *Campanularia flabellata* Hincks, Ann. and Mag. Nat. Hist., ser. iii, vol. xviii, p. 297.

Off Thimble Islands, 4 to 5 fathoms, on *Astrangia;* Watch Hill, Rhode Island, on *Laminaria;* Wood's Hole, on old wreck, in the passage. Coasts of Great Britain.

The hydrarium of this species very closely resembles the *Obelia commissuralis* of Agassiz, and may prove to be identical with it. But the original *O. commissuralis* of McCready, from Charleston, South Carolina, is, perhaps, distinct from that described by Agassiz.

OBELIA COMMISSURALIS McCready. Plate XXXVII, fig. 281. (p. 327.)

Proc. Elliott Soc., vol. i, p. 197, Plate 11, figs. 5–7, 1859; (?) Agassiz, Contributions, vol. iv, pp. 315, 351, Plate 33 (except fig. 2), Plate 34, figs. 10–21, 1862; (?) A. Agassiz, Catalogue, p. 91, fig. 134. *Laomedea dichotoma* Leidy, op. cit., p. 138, Plate 11, fig. 36 (*not* Linné, sp.). ? *Laomedea gelatinosa* Stimpson, Invert. of Grand Manan, p. 8, 1853 (*not* Pallas, sp.).

Charleston, South Carolina (McCready). New Jersey (Leidy). Newport, Rhode Island, and Nahant, Massachusetts (A. Agassiz). New Haven Harbor, on piles; Vineyard Sound, on floating algæ. Grand Manan (Mills, t. A. Agassiz).

The northern specimens possibly belong to the preceding species.

OBELIA GELATINOSA Hincks. (p. 391.)

British Hydroid Zoöphytes, p. 151, Plate 26, fig. 1, 1868. *Sertularia gelatinosa* Pallas, Elench. Zooph., p. 116, 1766. *Laomedea gelatinosa* Lamouroux, Polyp Flex., p. 92; Johnston, Brit. Zoöph., ed. ii, p. 104, Plate 27, fig. 1 (var. *b*). *Campanularia gelatinosa* Lamarck, Anim. sans Vert., ed. ii, p. 134 (t. Hincks). *Laomedea gigantea* A. Agassiz, Catalogue, p. 86, 1865.

New Jersey to Massachusetts Bay; northern coasts of Europe, from North Cape to Belgium and Great Britain; low-water to 20 fathoms. Great Egg Harbor, New Jersey, on oysters; New Haven, on piles of Long Wharf, abundant. Mouth of Charles River, near Boston (H. J. Clark, t. A. Agassiz).

RHEGMATODES TENUIS A. Agassiz. (p. 454.)

In Agassiz, Contributions, vol. iv, p. 361, 1862; Catalogue, p. 95, figs. 136–138.

Buzzard's Bay and Vineyard Sound.

ZYGODACTYLA GRŒNLANDICA Agassiz. Plate XXXVII, fig. 275. (p. 449.)

Contributions, vol. iv, p. 360, 1862; A. Agassiz, Catalogue, p. 103, figs. 153–156. *Æquorea Grœnlandica* Péron and Lesueur, Ann. du Mus., vol. xiv, p. 27, 1809 (t. A. Agassiz).

Buzzard's Bay to Greenland. Common in Vineyard Sound, in June and July.

ÆQUOREA ALBIDA A. Agassiz. (p. 454.)

In Agassiz, Contributions, vol. iv, p. 359, 1862; Catalogue, p. 110, figs. 160–162.

Buzzard's Bay (A. Agassiz).

TIMA FORMOSA Agassiz. (p. 449.)

Contributions, vol. iv, p. 362, 1862; A. Agassiz, Catalogue, p. 113, figs. 164–172.

Vineyard Sound, February and April. Massachusetts Bay (A. Agassiz).

EUTIMA LIMPIDA A. Agassiz. (p. 454.)

In Agassiz, Contributions, vol. iv, p. 363, 1862; Catalogue, p. 116, figs. 173–178.

Buzzard's Bay, Naushon (A. Agassiz).

LAFOËA CALCARATA A. Agassiz. (p. 408.)

Catalogue, p. 122, figs. 184–194. *Lafœa cornuta* Agassiz, Contr., vol. iv, p. 351 (*not* of Lamouroux). *Laodicea calcarata* A. Agassiz, in Agassiz, Contributions, vol. iv, p. 350, 1862. *Campanularia dumosa* Leidy, op. cit., p. 138, 1855 (*not* of Fleming).

South Carolina to Vineyard Sound; Buzzard's Bay and Vineyard Sound. The hydrarium was abundant on floating *Zostera* and algæ in Vineyard Sound, creeping over *Sertularia cornicina;* also at low-water, and in 6 to 8 fathoms on *Phyllophora;* Thimble Islands, in tide-pool, on *Vesicularia.* Charleston, South Carolina (McCready, described as a constituent part of his *Dynamena cornicina*).

HALECIUM GRACILE Verrill, sp. nov. (p. 328.)

Stems slender, flexible, clustered, compound, consisting of many very slender, united tubes, light brown or yellowish, pinnately much branched; branches alternate, ascending, long, slender, tapering, similar to the main stem, and usually similarly subdivided; the branches and branchlets mostly arise from opposite sides of the stem, so that they stand nearly in one plane; ends of branches and the branchlets simple, very slender, translucent, whitish, divided into rather long segments; the articulations not very conspicuous, somewhat oblique; each segment usually with a prominent cylindrical process, arising from near the upper end, which, on the older branches, bears the hydroid cell, but on the young branchlets are themselves hydroid cells, furnished with a thin, slightly expanded border, having a circle of dots near the edge; the older or secondary cells, arising from these, are rather elongated, narrow, cylindrical, with slightly expanded rim, more or less bent and crooked or geniculate at base, and usually with one or two irregular constrictions. Many of the older cells are much elongated, and have two or three old rims below, separated by distances equal to two or three times the diameter. The hydroids are long, slender, with numerous long tentacles, much exsert from the cells. The branchlets and gonothecæ (reproductive capsules) arise in the axils of the hydroid cells, and, like the latter, the gonothecæ are often secund on the branchlets. The male and female capsules are different in form. The male gonothecæ are oblong, subfusiform, about three times as long as broad, obtusely rounded at the end, more gradually tapered to the base; the female gonothecæ are broader, somewhat flattened, usually a little shorter, gradually expanding from the narrow base to near the distal end, which is emarginate; the outer angle broadly rounded and slightly produced; the inner angle prolonged into a short cylindrical hydroid cell, with the edge slightly everted, from which two hydroids usually protrude. Height, 75^{mm} to 150^{mm}; diameter of stems, seldom more than 1^{mm}; length of female gonothecæ, about 1^{mm}; breadth, 0.40^{mm} to 0.45^{mm}; length of male gonothecæ, 1^{mm} to 1.10^{mm}; breadth, 0.30^{mm} to 0.40^{mm}; diameter of hydrothecæ, about 0.12^{mm}.

Great Egg Harbor, New Jersey, on oysters, just below low-water mark; Long Island Sound, near New Haven, in 2 to 6 fathoms, abundant, and also in brackish water on floating timber; Thimble Islands, 2 to 6 fathoms; Buzzard's Bay and Vineyard Sound.

This species is more nearly allied to *H. halecinum* of Europe and Northern New England than to any other described species. It is a much more slender and delicate species, with longer joints, and narrower and more elongated hydrothecæ and polyps. The female gonothecæ, although similar, differ in having the distal ends decidedly emarginate, with the outer angle somewhat produced, though much less so than in those of *H. Beanii*.

ANTENNULARIA ANTENNINA Fleming. (p. 497.)

Brit. Anim., p. 546; Johnston, Brit. Zoöph., ed. ii, p. 86, Plate 19, figs. 1–3; Hincks, Brit. Hydr. Zoöph., p. 280, Plate 61. *Sertularia antennina* Linné, Syst. Nat., ed. x, 1758; ed. xii, p. 1310. *Antennularia indivisa* Lamarck, Anim. sans Vert., ed. ii, vol. ii, p. 156.

Martha's Vineyard to Bay of Fundy; northern coasts of Europe to Great Britain and France. Off Gay Head, 8 fathoms; Casco Bay, 6 to 30 fathoms; Bay of Fundy, 10 to 60 fathoms, not uncommon.

AGLAOPHENIA ARBOREA Verrill.

Plumularia arborea Desor, Proc. Boston Soc. Nat. Hist., vol. iii, p. 65, 1848; A. Agassiz, Catalogue, p. 140.

The original specimen of this species is still preserved in the collection of the Boston Society. It consists of a large number of long, mostly simple, but occasionally forked stems, forming a dense plume-like cluster, united at base by an intricate mass of creeping stolons, which cover what looks like the dead axis of a *Gorgonia*, but is most probably a dried-up black alga, and is certainly not, as Desor supposed, a part of the hydroid. The stems are mostly 4 to 6 inches long, more or less recurved, composed of short joints, and densely covered with the secund pinnæ, which increase in length from the base toward the tips; the pinnæ arise from every joint, and form two close alternating rows along the inner side of the stems; they are directed upward, and more or less curved inward, toward each other, near the tips, and mostly 5^{mm} to 8^{mm} in length, composed of short, stout, oblique joints, not twice as long as broad. Hydra-cells deep, slightly flaring, rising at an angle of about 45°, attached only at base, the upper side less than half as high as the lower, border strongly dentate; one slender median denticle on the upper edge; four lateral ones on each side, of which three are subequal, triangular, rather wide, obtuse, with rounded intervals; the lower or outer lateral one is twice as long, rather acute; the single odd median one, on the outer margin, is equally long and more slender, and usually bent upward. A single large tubular median nematophore is attached to the outer side of the cell, along most of its length, but separated at the end, which is obliquely truncate, with the aperture on the inner side, its tip nor extending beyond the long lateral denticles of the hydra-cell. Lateral nematophores small, sessile, not so long as the upper or inner side of the cells. The large, closed, oblong corbulæ are irregularly scattered among the other pinnæ; they occupy the terminal part of the modified pinnæ, but there are usually three or four unaltered hydra-cells on the basal portion, below the corbula; the pinnæ bearing corbulæ are somewhat shorter than the others.

Shoals of Nantucket, ten miles east of Sancati Head, 14 fathoms, (Desor).

PLUMULARIA TENELLA Verrill, sp. nov. (p. 407.)

Stems clustered, simple, slender, 1 to 2 inches high, horn-colored; branches alternate, very slender, not very long, mostly unbranched, placed toward one face of the stem, inclining forward, and ascending at an angle of about 45°, and originating from the alternate joints of the stem, the internodes being longer than the joints that bear branches; at one side of the base of each branch there is a hydrotheca and accompanying nematophores; the internodes of the stem also bear one or two nematophores. The basal segment of each branch is short; the rest are of three kinds; every third one is usually stouter, and bears a hydrotheca; just in front of each hydrotheca there is usually a very short segment, scarcely longer than broad, and sometimes indistinct, destitute of nematophores; then follows a much longer, slender segment, five or six times as long as broad, articulated by a very oblique joint at its distal end with the thicker and shorter polypiferous segment, and bearing one or two nematophores on the median line, which may be either near the middle or toward the proximal end. Hydrothecæ broad, subcylindrical, a little longer than broad, with a slightly flaring, even rim; the axis forms an angle of about 45° with the branches; the free part of the distal side is about half the length of the proximal side. Nematophores relatively large, usually three with each hydrotheca: one on each side, shorter than the hydrotheca, trumpet-shaped, with a round, cup-like opening, narrowed below, nearly sessile; another, similar in form, placed toward the proximal end of the segment, inclined forward, and nearly reaching the base of the hydrotheca. Gonothecæ not observed.

Off Gay Head, 8 to 10 fathoms, among ascidians; Vineyard Sound, 8 fathoms.

This species is related to *P. Catharinæ* Johnston and *P cornucopiæ* Hincks, from the English coast. The former differs in having opposite branches, smaller and more elongated nematophores, etc.; the latter agrees in having alternate branches, but the nematophores are smaller, longer, and more slender, and the joints of the branches are different.

This is the first genuine species of *Plumularia* that has been discovered on the New England coast.

SERTULARIA ARGENTEA Ellis and Solander. Plate XXXVII, fig. 280. (p. 408.)

Zoöphytes, p. 38; Johnston, Brit. Zoöph., ed. ii, p. 79, Plate 14, fig. 3, Plate 15, figs. 1–3; Hincks, Brit. Hydr. Zoöph., p. 268, Plate 56; A. Agassiz, Catalogue, p. 144.

New Jersey to the Arctic Ocean; northern shores of Europe to Great Britain and France; low-water to 110 fathoms. Great Egg Harbor, New Jersey, in April; common and of large size in Long Island Sound, near New Haven, Thimble Islands, and at Faulkner's Island, 1 to 8 fathoms; Watch Hill, Rhode Island; Vineyard Sound, 1 to 15 fathoms, very common; abundant in Casco Bay; Bay of Fundy; Nova Scotia coast; and Gulf of Saint Lawrence, low-water to 110 fathoms. Saint George's Bank (S. I. Smith).

SERTULARIA CUPRESSINA Linné. (p. 408.)

Syst. Naturæ, ed. x, 1758; ed. xii, p. 1308; Pallas, Elench. Zooph., p. 142, 1766; Johnston, op. cit., p. 80, Plate 16, figs. 1, 2; Hincks, op. cit., p. 270, Plate 57; A. Agassiz, Catalogue, p. 143.

New Jersey to the Arctic Ocean; northern coasts of Europe to Great Britain and France. Great Egg Harbor, New Jersey, with reproductive capsules, in April; Vineyard Sound, not common; Massachusetts Bay; Casco Bay; Bay of Fundy, in tide-pools and from 1 to 110 fathoms, common. Saint George's Bank (S. I. Smith). Absecom Beach, New Jersey (Leidy).

SERTULARIA PUMILA Linné. Plate XXXVII, fig. 279. (p. 327.)

Syst. Naturæ, ed. x, 1758; ed. xii, p. 1306; Pallas, Elench. Zooph., p. 130; Johnston, op. cit., p. 66, Plate 11, figs. 3, 4; Hincks, Brit. Hydr. Zoöph., p. 260, Plate 53, fig. 1. *Dynamena pumila* Lamouroux, Bulletin Soc. Phil., vol. iii, p. 184, 1812; Agassiz, Contributions, vol. iv, pp. 326, 355, Plate 32, 1862; A. Agassiz, Catalogue, p. 141, figs. 225, 226.

New Jersey to the Arctic Ocean; Finmark to Great Britain and France. Great Egg Harbor, New Jersey, on *Fucus;* abundant on the shores of Long Island Sound, Vineyard Sound, and northward, between tides.

SERTULARIA CORNICINA Verrill. (p. 408.)

Dynamena cornicina (*pars*) McCready, op. cit., p. 204, 1859; A. Agassiz, Catalogue, p. 142, 1865.

Charleston, South Carolina, to Vineyard Sound. Not uncommon in Vineyard Sound, 1 to 8 fathoms, often on *Halecium gracile;* also on floating *Zostera*, etc., and covered with *Lafoëa calcarata.*

This species somewhat resembles the preceding, but the hydra-cells are more distant, longer, more prominent, and freer, while the end is distinctly bent outward, making the lower side concave in the middle; aperture strongly bilabiate, often appearing tridentate.

HYDRALLMANIA FALCATA Hincks. (p. 408.)

Brit. Hyd. Zoöph., p. 273, Plate 58, 1868. *Sertularia falcata* Linné, Syst. Nat., ed. x, 1758; ed. xii, p. 1309; *Plumularia falcata* Lamarck, Anim. sans Vert., ed. ii, p. 160; Johnston, Brit. Zoöph., p. 90, Plate 21, figs. 1, 2. *Sertularia tenerissima* Stimpson, Mar. Invert. Grand Manan, p. 8, 1853.

Long Island Sound to the Arctic Ocean; northern shores of Europe to the British Channel. Common near New Haven, and off Thimble Islands, 4 to 8 fathoms; Watch Hill, Rhode Island; Vineyard Sound, and off Gay Head, 6 to 20 fathoms; Massachusetts Bay, abundant; very abundant in Casco Bay and Bay of Fundy, low-water to 110 fathoms; Mingan Islands, Labrador. Saint George's Bank, very abundant, 20 to 150 fathoms, (S. I. Smith, A. S. Packard).

Tubularina.

NEMOPSIS BACHEI Agassiz. (p. 454.)

Mem. Amer. Acad., vol. iv, p. 289, figure, 1849; Contributions, vol. iv, p. 345; A. Agassiz, Catalogue, p. 149, figs. 227–231. *Nemopsis Gibbesi* McCready, op. cit., p. 58, Plate 10, figs. 1–7, 1859.

Charleston, South Carolina, to Nantucket.

BOUGAINVILLIA SUPERCILIARIS Aggasiz. Plate XXXVII, fig. 276. (p. 328.)

Contributions, vol. iv, pp. 289, 291, figs. 37–39, Plate 27, figs. 1–7, 1862; A. Agassiz, Catalogue, p. 153, figs. 232–240. *Hippocrene superciliaris* Agassiz, Mem. Amer. Acad., vol. iv, p. 250, Plates 1–3, 1849.

Newport, Rhode Island, to Bay of Fundy; ? Greenland.

MARGELIS CAROLINENSIS Agassiz. (p. 450.)

Contributions, vol. iv, p. 344, 1862; A. Agassiz, Catalogue, p. 156, figs. 241–248. *Hippocrene Carolinensis* McCready, op. cit., p. 164 (separate copies, p. 62), Plate 10, figs. 8–10.

Charleston, South Carolina, to Vineyard Sound. Wood's Hole, at surface, evening.

EUDENDRIUM DISPAR Agassiz. (p. 408.)

Contributions, vol. iv, pp. 285, 289, 342, fig. 36, Plate 27, figs. 10–21, 1862; A Agassiz, Catalogue, p. 159, fig. 249.

Vineyard Sound to Bay of Fundy; 1 to 20 fathoms.

EUDENDRIUM TENUE A. Agassiz.

Catalogue, p. 160, fig. 250, 1865.

Buzzard's Bay to Bay of Fundy, low-water to 15 fathoms. This is closely allied to the English *E. capillare* Alder, but the latter seems to be a smaller and more delicate species.

EUDENDRIUM RAMOSUM Ehrenberg. (p. 408.)

Corall. roth. Meer, p. 72, 1834; Johnston, Brit. Zoöph., ed. ii, p. 46, Plate 6, figs. 1–3; Hincks, Brit. Hydr. Zoöph., p. 82, Plate 13; ? A. Agassiz, Catalogue, p. 160. *Tubularia ramosa* Linné, Syst. Nat., ed. xii, p. 1302.

Martha's Vineyard to Labrador; northern coasts of Europe to Great Britain. Off Gay Head, 8 to 20 fathoms; Casco Bay, 10 to 60 fathoms; Bay of Fundy, 6 to 100 fathoms. Off Saint George's Bank, 430 fathoms, (S. I. Smith).

DYSMORPHOSA FULGURANS A. Agassiz. (p. 448.)

Catalogue, p. 163, figs. 259, 260, 1865.

Buzzard's Bay, Naushon, and Massachusetts Bay (A. Agassiz).

TURRITOPSIS NUTRICULA McCready. (p. 454.)

Op. cit., pp. 55, 86, 127, Plates 4, 5, 8, fig. 1, 1857–9; Agassiz, Contributions, vol. iv, p. 347; A. Agassiz, Catalogue, p. 167, figs. 269, 270.

Charleston, South Carolina, to Vineyard Sound.

STOMOTOCA APICATA Agassiz. (p. 455.)

Contributions, vol. iv, p. 347, 1862; A. Agassiz, Catalogue, p. 168. *Saphenia apicata* McCready, op. cit., p. 129, Plate 8, figs. 2, 3, 1859.

Charleston, South Carolina (McCready); Newport, Rhode Island (A. Agassiz).

CLAVA LEPTOSTYLA Agassiz. (p. 328.)

Contributions, vol. iv, pp. 218, 222, fig. 32, Plate 20, figs. 11–16[a], Plate 21, figs. 1–10[a], 1862; A. Agassiz, Catalogue, p. 170, fig. 274; Hincks, op. cit., p. 6, Plate 2, fig. 1, 1868. *Clava multicornis* Stimpson, Invert. Grand Manan, p. 11, 1853; Leidy, Journ. Acad. Nat. Sciences, Philad., vol. iii, p. 135, Plate 11, figs. 33, 34, 1855 (*not* of Johnston).

Long Island Sound to Labrador; coasts of Great Britain. Near New Haven Light; Thimble Islands, in tide-pools; Beverly, Massachusetts; Casco Bay, on rocks and *Fucus*, abundant; Eastport, Maine, on piles. Point Judith, Rhode Island (Leidy). Nahant, Massachusetts (Agassiz). Morecombe Bay (Hincks).

CORDYLOPHORA, species undetermined.

Syncoryna, sp., Agassiz, Contributions, vol. iv, p. 339 (no description).

Newport Harbor, Rhode Island (Leidy, t. Agassiz). In 1860 I obtained a species of this genus from the vicinity of Cambridge, Massachusetts, in water that was fresh, or nearly so. It grew to the height of two inches or more, with long slender branches.

WILLIA ORNATA McCready. (p. 455.)

Op. cit., p. 149 (separate copies, p. 47), Plate 9, figs. 9–11, 1859 (Willsia); Agassiz, Contributions, vol. iv, p. 346, 1862; A. Agassiz, Catalogue, p. 171, figs. 274[a], 275.

Charleston, South Carolina (McCready). Buzzard's Bay (A. Agassiz).

CORYNE MIRABILIS Agassiz.

Contributions, vol. iii, Plate 11[c], figs. 14, 15, Plates 17–19; vol. iv, pp. 185–217, figs. 9–31, Plate 20, figs. 1–9, Plate 23[a], fig. 12; A. Agassiz, Catalogue, p. 175, figs. 283–287. *Sarsia mirabilis* Agassiz, Mem. Amer. Acad., vol. iv, p. 224, Plates 4, 5, 1849. ? *Tubularia stellifera* Couthouy, Boston Jour. Nat. Hist., vol. ii, p. 56, 1839. *Coryne gravata* Wright, Edinb. New Phil. Jour., Apr., 1858, Plate 7, fig. 5 (t. Hincks). *Syncoryne gravata* Hincks, Brit. Hydr. Zoöph., p. 53, Plate 10, fig. 1.

The species described by Couthouy may, possibly, have been this; but his species was described as unbranched, and as if it had two distinct circles of tentacles. Martha's Vineyard to Greenland. Common in Massachusetts Bay; Casco Bay; and Bay of Fundy. Scotland (Hincks).

DIPURENA CONICA A. Agassiz. (p. 455.)

In Agassiz, Contributions, vol. iv, p. 341, 1862; A. Agassiz, Catalogue, p. 181, figs. 301–305.

Buzzard's Bay, Naushon (A. Agassiz).

GEMMARIA GEMMOSA McCready. (p. 455.)

Op. cit., p. 151, Plate 8, figs. 4, 5, 1859; A. Agassiz, Catalogue, p. 184, fig. 306. *Zanclea gemmosa* McCready, op. cit., p. 151, 1849; Agassiz, Contributions, vol. iv, p. 344.

Charleston, South Carolina (McCready). Buzzard's Bay (A. Agassiz).

PENNARIA TIARELLA McCready. Plate XXXVII, figs. 277, 278. (p. 327.)

Op. cit., p. 153, 1859; A. Agassiz, Catalogue, p. 187, figs. 311–315. *Globiceps tiarella* Ayres, Proc. Boston Soc. Nat. Hist., vol. iv, p. 193, 1852. *Eucoryne elegans* Leidy, op. cit., p. 136, Plate 10, figs. 1–5, 1855. *Globiceps tiarella* Agassiz, Contributions, vol. iv, p. 344, 1862.

Charleston, South Carolina, to Massachusetts Bay. Great Egg Harbor, New Jersey; near New Haven; Vineyard Sound, common, low-water to 10 fathoms, and on floating algæ.

ECTOPLEURA OCHRACEA Agassiz. (p. 455.)

In Agassiz, Contributions, vol. iv, p. 343, 1862; Catalogue, p. 191, figs. 320–323.

Buzzard's Bay, Naushon (A. Agassiz).

CORYMORPHA PENDULA Agassiz. Plate XXXVI, fig. 273. (p. 510.)

Contributions, vol. iv, pp. 276, 343, Plate 26, figs. 7–17, 1862; A. Agassiz, Catalogue, p. 192, fig. 324. *Corymorpha nutans* Stimpson, Invert. of Grand Manan, p. 9, 1853.

Block Island to Gulf of Saint Lawrence. Common in Casco Bay and Bay of Fundy, 8 to 30 fathoms; off Block Island, 29 fathoms. Off Cape Cod (A. S. Bickmore).

HYBOCODON PROLIFER Agassiz. Plate XXXVIII, fig. 282. (p. 328.)

Contributions, vol. iv, pp. 243, 343, Plate 23[a], figs. 10, 11, Plate 25, figs. 1–15, 1862; A. Agassiz, Catalogue, p. 193, figs. 325–328.

Vineyard Sound to Massachusetts Bay.

PARYPHA CROCEA Agassiz. Plate XXXVI, fig. 274. (p. 390.)

Contributions, vol. iv, pp. 249, 342, Plates 23, 23[a], figs. 1–7, 1862; A. Agassiz, Catalogue, p. 195. ? *Tubularia cristata* McCready, op. cit., p. 156, 1859=*Parypha cristata* Ag., op. cit., p. 342.

Brooklyn, New York, to Boston, Massachusetts. Very abundant near New Haven, on piles in harbor, and in 2 to 6 fathoms, off Thimble Islands; Wood's Hole, on piles, abundant. Warren Bridge, Boston (Agassiz).

This is probably not distinct from *P. cristata*, which is abundant at Charleston, South Carolina, and Fort Macon, North Carolina.

THAMNOCNIDIA TENELLA Agassiz. (p. 407.)

Contributions, vol. iv, pp. 275, 342, Plate 22, figs. 21–30, 1862; A. Agassiz, Catalogue, p. 195.

Rhode Island to Bay of Fundy. Off Watch Hill, 4 to 5 fathoms; Vineyard Sound, 6 to 10 fathoms; common in Casco Bay and Bay of Fundy, low-water to 40 fathoms.

HYDRACTINIA POLYCLINA Agassiz. (p. 407.)

Contributions, vol. iii, Plate 16; vol. iv, pp. 227, 339, figs. 33–35, Plate 26, fig. 18, 1862; A. Agassiz, Catalogue, p. 198, figs. 329, 330. *Hydractinia echinata* Leidy, op. cit., p. 135, Plate xi, fig. 35, 1855 (? *not* of Johnston).

New Jersey to Labrador. Very abundant in Long Island Sound, Vineyard Sound, Casco Bay, and Bay of Fundy, low-water to 60 fathoms. Saint George's Bank (S. I. Smith). Labrador (Packard). Greenland (Mörch). ? Charleston, South Carolina (McCready).

The identity of this with the European species is somewhat doubtful, though united by Hincks and others. The latter extends southward on the European coasts to Great Britain and France.

Physophoræ.

NANOMIA CARA A. Agassiz. (p. 455.)

Proc. Boston Soc. Nat. Hist., vol. ix, p. 181, 1863; Catalogue, p. 200, figs. 332–350.

Newport, Rhode Island; Massachusetts Bay; Nahant (A. Agassiz).

Porpitæ.

PHYSALIA PELAGICA Lamarck. (p. 450.)

Syst. des Anim. sans Vert., p. 356, 1801; Lesson, Acalèphes, p. 545, 1843. *Physalis pelagica* Osbeck, Itin., p. 284, Plate 12, fig. 1, 1757 (t. Lesson). *Holothuria physalis* Linné, Syst. Nat., ed. xii, p. 1090, 1767. *Medusa caravella* Müller, Besch. der Berl. Naturf., vol. ii, p. 190, Plate 9, fig. 2 (t. Lesson); Gmelin, Syst. Nat., p. 3139, 1789. *Physalia caravella* Eschscholtz; Lesson, Hist. Nat. des Zooph. Acalèphes, Plate 11 (explanation). *Physalia arethusa* Tilesius, in Krusensterns Reise, vol. iii, p. 91, Plate 23, figs. 1–6, 1813 (t. Lesson); Agassiz, Contributions, vol. iv, pp. 335, 367, Plate 35, 1862; A. Agassiz, Catalogue, p. 214, figs. 351–354; this Report, p. 450. *Physalia aurigera* McCready, op. cit., p. 176, 1859.

Warmer parts of the Atlantic Ocean and Gulf of Mexico, coming northward in the Gulf Stream to the southern coast of New England and Long Island; and off Saint George's Bank and Nova Scotia. Not uncommon, in good condition, in Vineyard Sound and Buzzard's Bay. Watch Hill, Rhode Island (D. C. Eaton). East of Saint George's Bank (S. I. Smith). Fort Macon, North Carolina (coll. Dr. Yarrow).

VELELLA MUTICA Lamarck. (p. 455.)

Syst. des Anim. sans Vert., p. 355, 1801; Bosc, Hist. Nat. des Vers., vol. ii, p. 158; Lesson, Voy. de la Coquille, Zool., vol. ii, pp. 2, 52, Plate 6, figs. 1, 2; Acalèphes, p. 571, Plate 12, figs. 1, 2; A. Agassiz, Catalogue, p. 216, figs. 355–357. *Medusa velella* Linné, Syst. Nat., ed. xii, p. 1098.

Tropical parts of the Atlantic and Gulf of Mexico, coming northward in the Gulf Stream as far as Nantucket and off Saint George's Bank. Aspinwall (coll. F. H. Bradley); coasts of Florida (Agassiz); Long Island Sound (A. Agassiz).

POLYPI or ANTHOZOA.

ALCYONARIA.

ALCYONIUM CARNEUM Agassiz. Plate XXXVIII, fig. 283. (p. 497.)

Proc. American Association for Adv. of Science, 1850, p. 209; Verrill, Revision of Polyps of Eastern Coast U. S., in Memoirs Boston Soc. Nat. Hist., vol. i, p. 4, 1864; Verrill, Proc. Boston Soc. Nat. Hist., vol. x, p. 343, 1866. *Halcyonium carneum* A. and E. C. Agassiz, Sea-Side Studies, p. 19, figs. 21–23, 1865.

Rhode Island to Gulf of Saint Lawrence. Off Watch Hill, Rhode Island, 4 to 5 fathoms; off Cuttyhunk Island, 10 to 15 fathoms; off Gay Head, 8 to 10 fathoms; common in Massachusetts Bay, Casco Bay, Bay of Fundy, and coast of Nova Scotia, low-water to 80 fathoms. Gulf of Saint Lawrence (Whiteaves). Saint George's Bank (S. I. Smith).

Leptogorgia tenuis Verrill.

Memoirs Boston Soc. Nat. Hist., vol. i, p. 8, 1864. *Gorgonia tenuis* Verrill, Proc. Boston Soc. N. H., vol. x, p. 339, 1866. *Leptogorgia teres* (error typ.) Verrill, Amer. Jour. Science, vol. xlviii, p. 420, 1869.

"Bay of New York." Specimens in the museum of Yale College are supposed to have come from Long Island Sound, but the exact locality is not known.

ACTINARIA.

METRIDIUM MARGINATUM Milne-Edwards. (p. 329.)

Hist. Nat. des Coralliaires, vol. i, p. 254, 1857; Verrill, Revision of Polyps., in Mem. Boston Soc. Nat. Hist., vol. i, p. 22, 1864; Proc. Boston Soc. Nat. Hist., vol. x, p. 337, 1866; American Naturalist, vol. ii, p. 252; Tenney, Natural History, p. 523, figs. 515–517, 1865; A. and Mrs. E. C. Agassiz, Sea-Side Studies, p. 7, figs. 2–7, 1865. *Actinia marginata* Lesueur, Journal Acad. Nat. Sciences, Philad., vol. i, p. 172, 1817; Gould, Invert. Mass., ed. i, p. 349, 1841; Leidy, Journ. Acad. N. S., Philad., ser. ii, vol. iii, p. 140, 1855 Agassiz, Contributions, vol. iii, p. 39, fig. 8, 1860. *Actinia dianthus* Dawson, Canadian Naturalist and Geologist, vol. iii, p. 402, figs. 1, 2, 1858.

New Jersey to Labrador. Common in Long Island Sound, Buzzard's Bay, and Vineyard Sound, but mostly smaller than farther north; abundant in Massachusetts Bay, Casco Bay, and Bay of Fundy, low-water to 90 fathoms.

SAGARTIA LEUCOLENA Verrill. Plate XXXVIII, fig. 284. (p. 329.)

Proc. Boston Soc. Nat. Hist., vol. x, p. 336, 1866; American Naturalist, vol. ii, p. 261.

North Carolina to Cape Cod. Common in Long Island Sound, Buzzard's Bay, and Vineyard Sound; Great Egg Harbor, New Jersey. Fort Macon, North Carolina (coll. Dr. Yarrow).

SAGARTIA MODESTA Verrill. (p. 330.)

Proc. Boston Soc. Nat. Hist., vol. x, p. 337, 1866.

Long Island Sound to Vineyard Sound. Savin Rock, near New Haven; Goose Island; Stony Creek; Naushon Island; low-water, buried in sand or gravel.

PARACTIS RAPIFORMIS Milne-Edwards. (p. 363.)

Hist. Nat. des Coralliaires, vol. i, p. 249, 1857; Verrill, American Journal of Science, vol. iii, p. 436, 1872; Dana, Corals and Coral Islands, p. 23, figure, (in ed. i, as *Sagartia modesta* V.). *Actinia rapiformis* Lesueur, Journ. Acad. Nat. Sciences, Philad., vol. i, p. 171, 1817; Verrill, Memoirs Boston Soc. Nat. Hist., vol. i, p. 35, 1864; Proc. Boston Soc. N. H., vol. x, p. 338.

North Carolina to Long Island Sound. Fort Macon (coll. Dr. Yarrow); New Jersey (Lesueur); near New Haven (Dana).

HALOCAMPA PRODUCTA Stimpson, MSS. Plate XXXVIII, fig. 285. (p. 330.)

Verrill, Revision, in Memoirs Boston Soc. Nat. Hist., vol. i, p. 30, Plate 1, figs, 10, 11, 1864. *Actinia producta* Stimpson, Proc. Boston Soc. Nat. Hist., vol. v, p. 110, 1856. *Corynactis albida* Agassiz, Proc. Bost. Soc. Nat. Hist., vol. vii, p. 24, 1859. *Halcampa albida* Verrill, Memoirs Boston Soc. Nat. Hist., vol. i, p. 29, 1864; A. and E. C. Agassiz, Sea-Side Studies, p. 16, fig. 15, 1865; Verrill, Proc. Bost. Soc. Nat. Hist., vol. x, p. 338, 1870 (*Halocampa*).

South Carolina to Cape Cod. Shores of Long Island Sound, at Stony Creek, etc.; Naushon Island; Martha's Vineyard; Nantucket; Cape Cod. Charleston, South Carolina (Stimpson).

EDWARDSIA FARINACEA Verrill. (p. 510.)

American Journal of Science, vol. xlii, p. 118, 1866.

Off Gay Head, 19 fathoms; Casco Bay, 10 to 70 fathoms; Bay of Fundy, 8 to 90 fathoms.

EDWARDSIA LINEATA Verrill, sp. nov. (p. 497.)

Body cylindrical, elongated, covered over the base and sides with a dirty, brownish, slightly rough and wrinkled epidermis, except anteriorly, below the tentacles, where it is smooth, translucent, and usually with eight impressed, longitudinal, flake-white lines, showing through. Tentacles, 24 to 30, or more, in the larger specimens, slender, tapering, obtuse, white or pale flesh-color, each with a flake-white, longitudinal line along the inner side. Disk, with a white circle around the mouth, and often with 8, or more, radiating, white lines, extending to the base of the inner tentacles; border of the mouth sometimes pale red; naked part of column pale flesh-color, often with a circle of white below the bases of the tentacles, and usually with eight oblong or fusiform flake-white spots between the longitudinal impressed lines.

Length, 25^{mm} to 35^{mm}; diameter, 2.5^{mm} to 3^{mm}. A very young specimen had 18 slender, equal, long tentacles, each with a median longitudinal line of white on the inside; disk with 6 radiating lines of white; naked part of the column with 6 impressed white lines, and with 6 oblong, flake-white spots between them. Breadth across the expanded tentacles, 3^{mm}.

This species is remarkable for not having, in any of the specimens found, a naked basal area, nor any true disk for attachment, thus differing both from *Phellia* and the other species of *Edwardsia.* This may be due to its peculiar habit of nestling in the crevices and interstices between rocks, ascidians, worm-tubes, etc.

Off Watch Hill, Rhode Island, 4 to 5 fathoms, in cavities in and beneath *Astrangia*, etc.; Vineyard Sound and off Gay Head, 6 to 12 fathoms, among ascidians, annelid-tubes, etc., abundant.

Arachnactis brachiolata A. Agassiz. (p. 451.)

Proc. Boston Soc. Nat. Hist., vol. ix, p. 159, 1862; Boston Journal of Nat. Hist., vol. vii, p. 525, 1863; Verrill, Memoirs Boston Soc. N. H., p. 33; Proceedings, vol. x, p. 343.

Mr. A. Agassiz has recently ascertained that this is only a larval form of some species of *Edwardsia.* As it had already developed 16 tentacles, it must belong to one of the species having numerous tentacles when adult.

Peachia parasitica Verrill.

Proc. Boston Soc. Nat. Hist., vol. x, p. 338, 1866; *Bicidium parasiticum* Agassiz, Proc. Boston S. N. H., vol. vii, p. 24, 1859; Verrill, Revision of Polyps, in Memoirs Boston S. N. H., vol. i, p. 31, Plate 1, figs. 14, 15, 1864; A. and Mrs. E. C. Agassiz, Sea-Side Studies, p. 15, fig. 14, 1865.

Cape Cod to Bay of Fundy, on *Cyanea arctica*; Eastport, Maine, buried in gravel at low-water mark (two specimens, of very large size). I am not aware that this species has been found south of Cape Cod, but it will probably be found hereafter, since the *Cyanea* is common.

EPIZOANTHUS AMERICANUS Verrill. Plate XXXVIII, figs. 286, 287. (p. 510.)

American Journal of Science, vol. ii, p. 361, 1871; Dana, Corals and Coral Islands, ed. i, p. 62, figs 1, 2, 1872. *Zoanthus parasiticus* Verrill, Revision of Polyps, in Mem. Boston Soc. N. H., vol. i, p. 34, 1864, (*not* of Duch. and Mich., 1860.) *Zoanthus Americanus* Verrill, op. cit., p. 45; Proc. Boston Soc. Nat. Hist., vol. x, p. 335, 1866. *Gemmaria Americana* Verrill, American Naturalist, vol. ii, p. 9, fig. 42.

Off New Jersey to Gulf of Saint Lawrence, in deep water. Off Block Island, 29 fathoms, on shells occupied by *Eupagurus;* off Grand Manan, in 40 to 50 fathoms, on shells covering *Eupagurus*, and in 109 fathoms, on rocks; off Saint George's Bank, 430 fathoms, on rocks, (S. I. Smith and O. Harger); Saint George's Bank, 60 fathoms, on shells occupied by *Eupagurus* (Smith and Harger); Gulf of Saint Lawrence, on rocks, (Whiteaves); Massachusetts Bay (J. E. Gray). Off New Jersey, N. lat. 40°, W. long. 73°, 32 fathoms, on shells inhabited by *Eupagurus pubescens*, (coll. Captain Gedney).

MADREPORARIA.

ASTRANGIA DANÆ Agassiz. (p. 408.)

Proc. American Assoc., vol. ii, p. 68, 1849 (*not* of Edw. and Haime, 1850); Verrill, Revision Polyps, p. 40, 1864; A. and Mrs. E. C. Agassiz, Sea-Side Studies, p. 16, figs. 16–20, 1865; Verrill, Proc. Boston Soc. Nat. Hist., vol. x, p. 335, 1866; Dana, Corals and Coral Islands, p. 68, figures, 1872. *Astrangia astræiformis* Edw. and Haime, Ann. des. Sci. Nat., vol. xii, p. 181, 1850; Coralliaires, vol. ii, p. 614, 1857; Leidy, Journ. Acad. Nat. Sciences, Philad., vol. iii, p. 139, Plate x, figs. 9–16, 1855; Verrill, Revision of Polyps, p. 39, 1864.

North Florida and west Florida to Cape Cod. Common in Long Island Sound, near New Haven, at Savin Rock, off Thimble Islands, etc., 1 to 6 fathoms, rocks; Watch Hill, Rhode Island, 4 to 5 fathoms; Vineyard Sound and Buzzard's Bay, 2 to 15 fathoms; Fort Macon, North Carolina (coll. Dr. Yarrow). Charleston, South Carolina (Agassiz). West Florida (E. Jewett).

PROTOZOA.

PORIFERA or SPONGIÆ.

CALCAREA.

GRANTIA CILIATA Fleming. (p. 330.)

British Anim., p, 325; Johnston, Brit. Sponges and Lithophytes, p. 176, Plate 20, figs. 4, 5, Plate 21, figs. 6, 7, 1842; Bowerbank, Monog. British Spongiadæ, vol. i, Plate 26, figs. 345, 346ª; vol. ii, p. 19, 1866. *Spongia ciliata* Fabricius, Fauna Grœnlandica, p. 448, 1780. *Sycandra ciliata* Hæckel, Die Kalkschwämme, vol. ii, p. 296, Plate 51, figs. 1^a–1^t, Plate 58, fig. 9, 1872. *Spongia coronata* Ellis and Solander, Zoöphytes, p. 190, Plate 58, figs. 8, 9. *Grantia coronata* Hassall, Ann. and Mag. Nat. Hist., vol. vi, p. 174.

Rhode Island to Greenland; northern coasts of Europe. Common in Casco Bay and Bay of Fundy, low-water to 60 fathoms; Vineyard Sound, not uncommon. Point Judith, Rhode Island (Leidy).

? LEUCOSOLENIA BOTRYOIDES Bowerbank. (p. 500.)

Brit. Spong., vol. ii, p. 28, 1866. *Spongia botryoides* Ellis and Solander, Zoöph., p. 190, Plate 58, figs. 1–4, 1786. *Grantia botryoides* Fleming, Brit. Anim., p. 525; Johnston, op. cit., p. 178, Plate 21, figs. 1–5. *Ascaltis botryoides* Hæckel, op. cit., vol. ii, p. 65, Plate 9, fig. 10, Plate 10, figs. 7^a–7^e.

Martha's Vineyard to Gulf of Saint Lawrence; northern coasts of Europe to England and France.

I refer some of our larger specimens to this species with considerable doubt. They appear to be distinct from the following species, with which they have formerly been confounded.

ASCORTIS FRAGILIS Hæckel.

Op. cit., vol. ii, p. 74, Plate 11, figs. 5–9, Plate 12, figs. 5^a–5^i, 1872. *Leucosolenia thamnoides* Hæckel, Prodrom., p. 243, spec. 70. *Leucosolenia botryoides* H. J. Clark, Mem. Boston Soc. Nat. Hist., vol. i, part 3, p. 323, (sep. copies, p. 19), Plate 9, figs. 40–44, Plate 10, fig. 64, 1866 (*not* of Bowerbank); this Report, pp. 334, 391. *Grantia botryoides* Leidy, op. cit., p. 135, 1855.

Long Island Sound to Gulf of Saint Lawrence. Western coast of Norway, at Bergen, etc. (Hæckel). Common in Long Island Sound, near New Haven, at Thimble Islands, etc.; Watch Hill, Rhode Island; Vineyard Sound; Casco Bay, etc. Massachusetts Bay (H. J. Clark).

Hæckel names the form figured by Clark var. *bifida*.

SILICEA.

MICROCIONA PROLIFERA Verrill.

Spongia prolifera Ellis and Solander, Zoöphytes, p. 189, Plate 58, fig. 5, 1786; Lamouroux, Expos. Méthodique, p. 31, Plate 58, fig. 5. Red sponge, this Report, pp. 330, 409, 476.

This species, when young, forms broad, thin, bright red incrustations over the surfaces of stones and shells. In this stage it agrees well with the British species of *Microciona* described by Bowerbank, all of which are said to be incrusting forms. Our species, at a later period, rises up into irregular lobes and tubercular prominences, which eventually become elongated and subdivided into slender branches, until they often form a profusely and intricately branched sponge, frequently six inches high and as much in diameter. The branches are repeatedly dichotomous, more or less flattened, and often digitate or palmate at the ends. They also frequently anastomose irregularly. The branches, when dry, are brittle and hispid. They consist of stout, horny fibers, which radiate outward and upward from the axis to the periphery, terminating in more or less irregular, slender, blunt papillæ, each of which bears a tuft of numerous slender, acute, more or less bent spicules, arising from its lateral and terminal surfaces. At the tips of the branches the papillæ are more slender and divergent, and the texture is more open and loose. During life these papillæ are connected together by a thin dermal membrane, through which the spicules project but little. The oscules are small and scattered over the surface. Color, when living, dark red to orange-red; when dried, generally dark grayish brown or umber-colored, fading to dull yellowish brown and gray. Diameter of branches mostly 2^{mm} to 5^{mm}.

South Carolina to Cape Cod. Very abundant in Long Island Sound and Vineyard Sound, low-water to 10 fathoms, on oysters and other shells, stones, etc.; Great Egg Harbor, New Jersey; Fort Macon, North Carolina (coll. Dr. Yarrow).

ISODICTYA, species undetermined.

Watch Hill, Rhode Island; Vineyard Sound and Nantucket, washed ashore after storms in winter; Casco Bay; Bay of Fundy.

The specimens from Watch Hill have few broad, thick, palmate branches, with large oscules and an open texture, with multispiculose fibers. They resemble *Isodictya palmata* Bowerbank.

CHALINA OCULATA Bowerbank. (p. 497.)

British Spongiadæ, vol. i, p. 208, Plate 13, fig. 262; vol. ii, p. 361. *Spongia oculata* Linné, Syst. Nat., ed. x, sp. 2; ed. xii, p. 1299; Pallas, Elench. Zooph., p. 390, 1766. *Halichondria oculata* Johnston, op. cit., p. 94, Plate 3.

Rhode Island to Labrador; northern coast of Europe to Great Britain. Off Watch Hill, Rhode Island, 4 to 5 fathoms; off Gay Head, 4 to 15 fathoms; very common in Massachusetts Bay, Casco Bay, and Bay of Fundy; low-water to 80 fathoms.

CHALINA ARBUSCULA Verrill, sp. nov. (p. 409.)

Sponge profusely branched, from close to the thick base; branches repeatedly dichotomous, slender, round or somewhat compressed, seldom broad or palmate. Oscules small, round, irregularly scattered. Texture of the surface finely reticulated when dry, with very delicate fibers, which usually have but a single row of very slender fusiform spicules, covered by a thin layer of horny matter; the reticulations do not usually exceed the length of a single spicule. Primary longitudinal fibers of the larger branches strong, horny, with several lines of spicules; secondary fibers at right angles to the primary ones, much smaller, with fewer spicules. The spicules are slender, fusiform ("acerate"), much smaller and more slender than in the preceding species. Color, when living, dull gray; when dried, brownish, yellowish, or white. The largest specimens are about one foot high; more commonly 6 to 8 inches (150^{mm} to 200^{mm}); breadth often nearly as much; diameter of branches,

4^{mm} to 10^{mm}, mostly about 5^{mm} to 6^{mm}; diameter of the oscules, in dry specimens, about 1^{mm}.

North Carolina to Cape Cod. Very common in Long Island Sound and Vineyard Sound, 1 to 8 fathoms; Watch Hill, Rhode Island; Great Egg Harbor, New Jersey.

This species has a much finer and more delicate texture than *C. oculata*, due to the smaller fibers and spicules, as well as to the smaller meshes of the skeleton. The branches are also smaller and much more numerous than they usually are in that species.

HALICHONDRIA PANICEA Johnston.

Brit. Sponges, p. 114, Plate 10, Plate 11, fig. 5, 1842; Bowerbank, British Spongiadæ, vol. i, p. 195, Plate 19, figs. 300, 303; vol. ii, p. 229, 1866. *Spongia panicea* Pallas, Elench. Zooph., p. 388, 1766. *Tedania* (?), this Report, p. 498.

Rhode Island to the Arctic Ocean; northern coasts of Europe to Great Britain. Abundant at Watch Hill, Rhode Island, on algæ, in 4 to 8 fathoms; off Gay Head; Casco Bay; Bay of Fundy.

HALICHONDRIA, species undetermined, *a*.

Watch Hill, Rhode Island, associated with the preceding.

Grows in large tuberous masses, on algæ, like the last, but has a smoother surface and finer and firmer texture. (See p. 498.)

HALICHONDRIA ?, species undetermined, *b*. (p. 334.)

Long Island Sound near New Haven; Vineyard Sound.

Forms broad, uneven incrustations on the under side of stones, at low-water mark. Color when living, bright yellow. Oscules rather large, conspicuous.

HALICHONDRIA ?, species undetermined, *c*.

Vineyard Sound, on the under side of overhanging banks, on the salt marshes near Waquoit; on the piles of wharves at Wood's Hole.

Forms large, irregular, thick masses, often containing much foreign matter; surface uneven, rising into irregular prominences. Soft and brittle.

This is, perhaps, a species of *Reniera* Schmidt (*Hymeniacidon* Bowerbank).*

RENIERA ?, species undetermined, *a*. (p. 334.)

Vineyard Sound, 1 to 10 fathoms. Forms large, irregular, soft masses, 3 to 5 inches in diameter, of a light yellow color when living.

RENIERA ?, species undetermined, *b*.

Vineyard Sound, 3 to 10 fathoms. Forms large, irregular, thick masses, with numerous acute, irregular, often ragged, conical prominences, rising from its upper surface.

---

* It was not studied carefully when recent; and I have no specimens of this and several of the other species at hand, for most of the sponges were sent elsewhere for comparison with named types, and have not yet been returned.

HALISARCA ?, Species undetermined, *a*.

Watch Hill, Rhode Island, 4 to 5 fathoms. Forms small, soft, somewhat gelatinous masses, on red algæ. (See p. 498.)

SUBERITES COMPACTA Verrill, sp. nov.

This species is remarkable for the compactness of its tissues and the smallness of the canals and pores permeating its substance, as well as for the large size of the plates and crest-like lobes in which it grows. A transverse section of the dried sponge shows very numerous irregular canals, most of them not larger than pin-holes (or less than 0.15^{mm} in diameter). The tissue is very compact throughout, but is more dense close to the surface, which is nearly smooth, the oscules being small and inconspicuous. The spicules are very abundant, crowded, very slender, mostly pin-shaped (spinulate), with the point very acute and the "head" but little enlarged, and often largest a slight distance from the end, so as to give the head a slightly ovate form. Color, when living, bright yellow.

Off Martha's Vineyard, 10 fathoms, sand; Nantucket; Eastern Shore of Virginia.

This is the species described as a "firm siliceous sponge," on page 503. In general appearance it somewhat resembles *Suberites suberea* Gray (*Hymeniacidon suberea* Bowerbank).

CLIONA SULPHUREA Verrill. (p. 421.)

Spongia sulphurea Desor, Proc. Boston Soc. Nat. Hist., vol. iii, p. 68, 1848.

South Carolina to Cape Cod; local farther north. Great Egg Harbor, New Jersey; very abundant in Long Island Sound and Vineyard Sound, on oysters and various other shells, 1 to 15 fathoms. Portland Harbor, Maine, in sheltered localities (C. B. Fuller).

? POLYMASTIA ROBUSTA Bowerbank. (p. 497.)

British Spongiadæ, vol. i, p. 178, Plate 29, fig. 358; vol. ii, p. 62, 1866.

Off Gay Head, 18 to 20 fathoms; common in Casco Bay and Bay of Fundy, 8 to 70 fathoms. Coast of Great Britain (Bowerbank).

The American specimens do not agree in all respects with the description, and may prove to be distinct when a direct comparison can be made. In our specimens the surface is finely hispid; the dermal tissue is firm, and filled with small, slender, often curved, needle-shaped ("acuate"), and pin-shaped ("spinulate") spicules, which project from the surface. The latter form is the predominant one, but the "head" is very small, and they pass gradually into the former kind, in which the "head" is obsolete, or not larger than the shaft. The spicules of the large, radiating fascicles in the body of the sponge are long and large, needle-shaped, with the central portion thickest ("fusiformi-acuate"). The large spicules in the longitudinal fascicles of the cloacal fistulæ are of the same form; the secondary fascicles of the body and the transverse secondary spicules of the fistulæ also have the same form, though much smaller. The "cloacal fistulæ" are numerous, and, when living, are round and tapering, but when dry become flat and bent, or curved to one side. They are mostly 20^{mm} to 40^{mm} long, and 4^{mm} to 6^{mm} in diameter near the base.

Several other species of sponges were collected, which have not been examined.

I have been unable to identify any of our specimens with the *Spongia urceolata* of Desor (Proceedings Boston Soc. Nat. History, vol. iii, p. 67). Possibly it was based on a peculiarly-shaped young specimen of *Microciona prolifera.*

FORAMINIFERA.

Numerous species were collected, especially in the deeper parts of Vineyard Sound and off Martha's Vineyard, but they have not been identified.

ADDENDA.

Crustacea.

CANCER BOREALIS Stimpson. (p. 546.)

A small specimen of this species was dredged off Watch Hill, Rhode Island, in 4 to 5 fathoms, among rocks and algæ, in April. It was found in abundance, and of large size, at Peak's Island and Pumkin Knob, in Casco Bay, Maine, in August, clinging to the sea-weeds, and in tide-pools, above low-water mark.

OCYPODA ARENARIA Say. (Megalops stage.) (p. 337.)

The megalops of this species was found in large numbers, swimming at the surface of Vineyard Sound in September, by Mr. Vinal N. Edwards.

HOMARUS AMERICANUS Edw. (Lobster.) (p. 492.)

Subsequent observations have shown that the breeding-season of the lobster extends over a large part of the year. In Casco Bay female lobsters were found carrying eggs in August and September. Mr. Vinal N. Edwards has forwarded two living females, of medium size, taken in Vineyard Sound, December 12th, both carying an abundance of freshly laid eggs. He states that he finds about "one in twenty" carrying eggs at that season.

THEMISTO, species undetermined.

A species of this genus was taken in large quantities in Vineyard Sound, in September, by Mr. Vinal N. Edwards. It occurred swimming at the surface in vast numbers, and was thrown up by the waves in windrows, extending several miles along the shores of Martha's Vineyard.

CONILERA CONCHARUM Harger. (p. 572.)

This species, previously quite rare, was taken this year in large numbers, in Vineyard Sound, both in spring and autumn, by Mr. Vinal N. Edwards.

Annelida.

PROCERÆA ORNATA Verrill, sp. nov.

Autolytus (?), banded species, this Report, p. 398.

Head short and broad, bluntly rounded or subtruncate above, slightly bilobed or emarginate below. Eyes moderately large; the anterior pair wider apart. Median antenna white, very long, slender, variously curled, reaching to about the twelfth body-segment; posterior tentacles also very long and slender, reaching to about the ninth segment, white at the tips; inner antennæ about one-fourth as long as the median one; the other two pairs of antennæ and tentacles about one-fourth as long as the median one; tentacular cirri of the second (post-buccal) segment short, about equal to the diameter of the body. Dorsal cirri short, about one-third as long as the breadth of the body; setigerous lobe short and broadly rounded; setæ short. Gizzard small, short, elliptical, situated at about the eighth segment. Caudal cirri two, slender, tapering, their length about equal to the diameter of the body. Color of the body white or pale yellowish, annulated with bands of bright red at unequal distances. Length, about 15^{mm}; breadth, 0.5^{mm}.

Long Island Sound, off New Haven; and at Thimble Islands, 1 to 5 fathoms, among hydroids and bryozoa.

ETEONE ROBUSTA Verrill. (p. 588.)

This species, previously known only from a single specimen, was taken at Wood's Hole, in abundance, and of large size, in November, by Mr. Vinal N. Edwards.

Turbellaria.

RHYNCHOSCOLEX PAPILLOSUS Diesing.

Revision der Turbellarien, op. cit., vol. xlv., p. 245, 1862. *Rhynchoprobolus papillosus* Schmarda, Neue wirbell. Thiere, i, p. 1, 11, Plate 2, fig. 25 (t. Diesing). Hoboken, New Jersey, in brackish water, (Schmarda).

POLYCELIS MUTABILIS Verrill, sp. nov.

Body much depressed, thin, changeable in form, often elliptical or oval, frequently broad and emarginate in front, and tapered posteriorly. Marginal ocelli minute, black, forming several rows along the front border, but only one row laterally. Dorsal ocelli larger, forming three pairs of rather ill-defined clusters; the outer clusters are largest, convergent backward; a pair of smaller clusters are situated a little in advance, and nearer together; the third pair is a little farther forward and closer together, often more or less confused with those next behind them. Color, yellowish brown, darker centrally; or pale yellowish, thickly specked with yellowish brown. Length, about 7^{mm} to 9^{mm}, breadth, 5^{mm} to 6^{mm}.

Thimble Islands, 1 to 2 fathoms, among algæ.

Bryozoa.

GEMELLARIA LORICATA Busk.

Catal. Mar. Polyzoa, Brit. Mus., part i, p. 34; Smitt, op, cit., p. 286, Plate 17, fig. 54. *Sertularia loricata* Linné, Syst. Nat., ed. x, p. 285 (t. Smitt). *Gemellaria loriculata* Johnston, Brit. Zoöph., ed. ii, pp. 293, 477, Plate 47, figs. 12, 13.

Nantucket to the Arctic Ocean; northern coasts of Europe to Great Britain. Very common in Casco Bay and Bay of Fundy, low-water to 110 fathoms.

The specimens from Nantucket differ somewhat from the ordinary form. They consist of rather dense tufts of stout stems, two or three inches high, and rather sparingly branched. The cells are larger than usual, elongated obovate, five or six times as long as broad; those of the same pair are not exactly opposite. Aperture deeply crescent-shaped, facing a little outward. Many of the cells, toward the base of the stems, give rise to one or more curious processes from near the base of the cell; these are, at first, slender tubes, rising from a thin roundish spot on the cell, but soon they divide at the tip into two, three, or four forks, which are at first regularly recurved; later these become much elongated, and are converted into slender rootlets or stolons.

ERRATA.

Page 307, line 23, for cavaluted, read convoluted.
Page 310, line 8, page 401, line 12, and elsewhere, for *Ostræa,* read *Ostrea.*
Page 383, line 23, for *Æolidia,* read *Montagua.*
Page 383, line 26, for *Cavolina,* read *Coryphella.*
Page 392, line 23, for micropthalma, read microphthalma.
Page 393, last line, for *Sargatia,* read *Sagartia.*
Page 399, line 21, for *Leptochiton,* read *Chætopleura.*
Page 399, line 32, for *Leptochiton,* read *Trachydermon.*
Page 405, line 27, for *Eucrate,* read *Eucratea.*
Page 407, line 38, for reproducsive, read reproductive.
Page 415 line 25, for *Unicola,* read *Unciola.*
Page 427, line 15, and page 429, line 28, for *Melitta testudinaria,* read *Mellita pentapora.*
Page 433, line 34, for *Amphipholis,* read *Amphiura.*
Page 444, line 12, for *tidentata,* read *tridentata.*
Page 457, line 39, for *Pandaru,* read *Pandarus.*
Page 459, line 36, for *Echthrogalus,* read *Echthrogaleus.*
Page 487, line 10, for A. *planaria,* read A *Planaria.*
Page 488, line 4, for *cantenula,* read *catenula.*
Page 496, line 28, for *A. ternata,* read *C. ternata.*
Page 498, line 5, for *Tedania,* read *Halichondria panicea.*
Page 498, line 30, for Augustus, read angustus.
Page 504, line 41, for page 433, read 432.
Page 508, line 5, for *Acutum,* read *A. acutum.*
Page 509, line 18, for *lævigata,* read *discors.*
Page 509, line 32, for *thraci-formis,* read *thraciformis.*
Page 509, line 33, for Simpson, read Stimpson.
Page 547, line 15, for *Panopius,* read *Panopeus.*
Page 561, line 43, for *pingus,* read *pinguis.*
Page 619, line 16, for Cosco, read Casco.
Page 619, last line, for Cisco, read Casco.
Page 640, first line, for fig. 127, read fig. 124.
Page 666, line 15, after Montagua pilata, insert Plate XXV, fig. 124.
Page 680, line 18, for 185, B., read 184, B.
Page 695, line 34, for fig. 238, read 243.
Page 716, line 35, for fig. 368, read 268.

TABLE OF CONTENTS.

ERRATA.

Page 10, for " there is no bottom, read " there is a bottom." Page 261, for " Sea-bass, 2,500 barrels," read " 2,500 pounds ;" " flat-fish, 1,000 barrels," read " 1,000 pounds ;" " tautog, 500 barrels," read 500 pounds ;" " bass, 700 barrels," read " 700 pounds ;" " mackerel, 200 barrels" read " 200 pounds."

ALPHABETICAL INDEX TO THE REPORT ON THE INVERTEBRATA OF SOUTHERN NEW ENGLAND.

[In the following index the first reference, for the names of genera and species, is to the systematic catalogue, where the synonymy, descriptions, and references to plates may be found. In many cases references to the nominal lists have been omitted.]

XIX.—CATALOGUE OF THE FISHES OF THE EAST COAST OF NORTH AMERICA.

By Theodore Gill.

SCOPE OF CATALOGUE.

The following catalogue may be considered as a new edition of a "Catalogue of the Fishes of the Eastern Coast of North America from Greenland to Georgia," published in 1861, inasmuch as it covers the same ground; but, as it has been entirely recast, and expresses the results of the author's own studies as well as those of others, since the date of its publication, it is essentially a new work.

LITERATURE.

The literature of American ichthyology is quite voluminous, but it is in great part represented in the periodical literature (publications of learned societies and scientific magazines) and by monographic essays or isolated descriptions of genera and species. Exclusive of such articles, there are three principal classes of publications which contain descriptions or references to more or less of the species described:

1. Works on fishes in general.
2. Works on American fishes in general.
3. Works on faunas, or relating to states, &c.

1. The general works on fishes, commencing with Willoughby and Ray, and continued by Artedi, (1738,) Klein, (1740–'49,) Linné, (1748–'68,) Bloch, (1782–'95,) Hauy, (1787,) Bonnaterre, (1788,) Gmelin, (1788,) Walbaum, (1792,) Lacépède, (1798–1803,) Bloch and Schneider, (1801,) Shaw, (1803–'04,) Cuvier and Valenciennes, (1828–'49,) A. Duméril, (1865–'70,) and Günther, (1859–'70,) successively included the species known to them and described by previous naturalists, and the last works include, on the whole, the best descriptions (because comparative) of many of the species. All these works are by foreign authors*.

2. The general works on North American fishes, in whole or part, are by De Kay, Storer, and Gill.

3. The more restricted faunal works, or those relating to specific districts and States, are more numerous, but of very unequal value, some containing descriptions of all the species as well as the including groups,

* A complete bibliographical catalogue of these works is given by the author of the present article in an "Arrangement of the Families of Fishes," published by the Smithsonian Institution.

while others are simple lists of species, to a great degree dependent for their value on the reputation of their authors for knowledge and reliability.

DOUBTFUL SPECIES.

The names of many of the species are still very unsettled or require confirmation. The doubts arise principally from two sources:

1. Erroneous identification with previously-described species.
2. Erroneous differentiation from previously-described species.

Both categories of errors mostly result from two causes:

1. From default of actual comparison of specimens representing the different forms.
2. From erroneous valuation of certain similarities or differences which may exist between the respective forms; in some cases (*a*) the differential characters having been overlooked or subordinated to the common characters, while in others (*b*) differences which may be observed on comparison of isolated specimens are not confirmed by larger series, or fail to apply to forms from intermediate regions.

As might be expected from these considerations, the doubts affect chiefly (1) the species found in the temperate or arctic regions, and which are represented by forms in both hemispheres; and (2) those of large size, represented also in both hemispheres, or inhabitants of the open sea.

The author has not at present the means to solve all these doubts for others or to satisfy himself. While the material for the American forms is often ample, that for the European or exotic types (chiefly in the case of the large sharks, rays, and scombroids) is, in several cases, insufficient. Therefore he has preferred to retain the names given to the American forms as distinct species, although he is inclined to believe that they will be eventually found to be co-specific with other forms. For the guidance of others, these doubtful forms are indicated in the following catalogue, the nature of the doubt being distinguished, whether referring to the more or less dubious distinction of the nominal species, (*d. s.*,) or whether to the dubious identification of the form with another, (*d. @ s.*) Although these stigmas are cast on a number of the names admitted, it is not probable that future comparisons will necessitate changes for most or even a large proportion. Nevertheless, the desirability of a settlement of the doubts one way or the other is not the less decided.

The opportunity for the settlement of some of these questions at least will, however, soon be furnished, as specimens of the desirable species have already been promised, or are on their way from Europe, and in a future report the results of the comparisons may be made known. To the efforts of the Commissioner of Fisheries we have been indebted for the means of determining some of the doubtful questions earlier than would otherwise have been possible, and we will soon have the means of determining others. And as these questions involve several of the species most important in an economical point of view, and as their determination may further throw much light on their geographical distribution and their consequent relations to each other, physiological as well as anatomical, their solution will be no slight boon to science.

CLASSIFICATION.

The classification adopted is that proposed by the author in his "Arrangement of the Families of Fishes," (1872,) published by the Smithsonian Institution, and differs in many respects from that employed in the "Catalogue of the Fishes of the Eastern Coast of North America," (1861.) While, however, it is believed to be a much better exponent of the real relations of the various forms, it is far from perfect, and little attempt has been made to exhibit the forms in a natural sequence; but, to some extent, the task has been attempted. It is necessary to add, in further explanation, that the series is an *inverted ascending one*, (and not a true descending one);—that is, commencing with the most generalized (or lowest) form, the various types have been successively approximated in accordance with their affinities (or supposed affinities) to the preceding forms; but, inasmuch as almost universal usage has accustomed the ichthyologist to look for the specialized (or highest) forms first, they have been so exhibited in the catalogue, subject to the modifications the mode of procedure adopted entails.

NUMBER OF SPECIES.

It will be perceived that only about 351 nominal species are enumerated in the present catalogue, while 394 were given in the catalogue published in 1861, and yet about 50 species have been added since that time. The diminished number is the result of reduction and reference of many nominal species to their proper types, and it is due to the author to state that the necessity for most of those changes was foreseen by him,* and that they were either first effected or the correctness thereof first demonstrated by himself in various articles published from time to time in scientific journals. The limit of reduction, so far as respects species represented on the coast, has now been nearly (but not quite) reached; but the ultimate reductions, already hinted at, will doubtless affect, to some inconsiderable extent, the sum-total of the number of fishes by the reduction of nominal American species to forms of those previously described from elsewhere.

FAUNAS.

The geographical ranges of the marine species of animals might be best indicated by the names of the faunal regions admitted for the sev-

* "The number of species described in the catalogue [of 1861] nominally amounts to 394. It is probable that when the species are thoroughly investigated, the number will be considerably reduced, and that many now retained with hesitation as distinct will be identified with previously known ones."—(Gill, op. cit., 1861, p. 28.)

eral subdivisions of the eastern American coast by various naturalists, but especially Dana, Packard, and Verrill.*

Five such faunas are embraced in the scope of the catalogue, and have been designated by the following names:

1. ARCTIC FAUNA, (properly realm,) which embraces the entire polar region, and extends southward to a yet undetermined distance, but not as far as Newfoundland. Inasmuch, however, as most of the fishes found in the Greenland seas have not been noted as occurring elsewhere, it would be advisable to be specific as to their habitats.

2. SYRTENSIAN FAUNA, distinguished by Packard from the Arctic. It includes the coasts of Labrador and Newfoundland, but its limits have not been well defined.

3. ACADIAN FAUNA, named by Lütken, but first distinguished as the Nova Scotian by Dana. It extends from the Syrtensian southerly to Cape Cod, close to the shore, but pushes farther southward in deeper water, and at a distance from the shore.

4. VIRGINIAN FAUNA, bounded to the north by Cape Cod and to the south by Cape Hatteras.

5. CAROLINIAN FAUNA, extending from Cape Hatteras southward to the northern limits of the coral-reefs of Florida.

It must also be borne in mind that the general character of the coast of the northern faunal areas is quite different from that of the southern ones, the former having a rock-bound shore-line, while the latter (Virginian and Carolinian) have chiefly an areniferous one, with few rocks, and the distinctive peculiarities of the northern and southern faunas are considerably increased by these physical differences of the coast.

Such are the designations that might be most desirable in a scientific treatise. In order, however, to avoid all cavil, the circumlocutory form of designating the limits of the faunas for each species has, at the instance of the Commissioner of Fisheries, been adopted. But it must be understood that many of the species have not been detected at the different points within the limits specified, and may have been only found once. In all cases, however, (except when specially designated as "accidental" or "occasional,") the species, in all probability, can be found at fitting stations within the described limits.

POPULAR NAMES.

The popular names, so far as known, have been added after the scientific ones, and in a number of cases, at the request of the Commissioner of Fisheries, names for popular use have been framed for species having no other distinctive ones. These new terms have been mostly derived from names applied to related forms in this country or England, which are used rather in a generic than specific sense, and with the addition of a

* Verrill (Addison E.) Revision of the Polypi of the Eastern Coast of the United States (December, 1863). <Memoirs read before the Boston Society of Natural History, vol. 1, p. 41.

qualifying adjective for the specific appellatives. It must always be borne in mind, however, that popular names can never be relied upon for the determination of the species, as they vary with locality, and are applied in the most arbitrary manner. Thus, the familiar *Pomatomus saltatrix* is generally known as the "blue-fish" at the principal centers of population, (New York, &c.,) but is also called "horse-mackerel," (at Newport, and Beesley's Point, New Jersey,) "tailor," (at Philadelphia and along portions of the southern coast,) "white fish," "snap-mackerel," and in the young state, "skip-jack;" while, on the other hand, the name "blue-fish" is applied to the squeteague, or weak-fish, (*Cynoscion regalis*,) at Beesley's Point; "horse-mackerel" is transferred to the tunny, along the Massachusetts coast; "tailor" is the name given to the fall-herring, (*Pomolobus mediocris*,) at Washington, and the designation "white-fish" is best known in connection with the *coregoni*. Nor are these exceptional cases. Many fishes have still more varied names along the several parts of the coast, and certain appellatives (such as sun-fish, black-fish, pike, salmon, trout, &c.) are used with still greater latitude than any of those specified.

Under such circumstances it must be obvious to all that, in order to avoid great circumlocution and preliminary explanation, and to insure definiteness of conception, names that are used only in one rigorous sense, and respecting the application of which there can be no doubt, must be *desiderata*, and such conditions are only fulfilled by the scientific names. At the same time, it is undoubtedly desirable that the applications of the popular names along the different portions of the coast shall be ascertained, and therein an explanation may be found of the conflicting accounts given of the different species, the confusion in which the histories of some species is involved being evidently due, in part, to the confusion of names and the misapplication of accounts induced by their diverse applications. The unraveling of this confusion will be one of the objects of the Commissioner, and on a future occasion the varying names and applications of names along different parts of the coast will probably be given in connection with the different species.

I.-TABLE OF THE HIGHER GROUPS.

Class A.—PISCES OR TRUE FISHES.

Sub-Class I.—TELEOSTEI.

Order 1.—Pediculati.

Sub-order.	Super-family.	Family.	Sub-family.	Genus.
	Lophioidea	Maltheidæ .... (1)	Maltheinæ	Malthe *Cuv.*
		Lophiidæ ..... (2)	....	Lophius (*Linn.*) *Cuv.*
	Antennarioidea .	Ceratiidæ ..... (3)	....	Himantolophus *Reinh.*
				Oneirodes *Lütken.*
				Ceratias *Kroyer.*
		Antennariidæ . (4)	Antennariinæ ...	Pterophryne *Gill.*

Order 2.—Plectognathi.

Sub-order.	Super-family.	Family.	Sub-family.	Genus.
Gymnodontes	Orthagoriscoidea	Orthagoriscidæ (5)	Molacanthinæ ...	Molacanthus *Sw.*
			Orthagoriscinæ .	Mola *Cuv.*
	Tetrodontoidea ..	Diodontidæ ... (6)	Diodontinæ	Chilomycterus *Bibron.*
				Trichodiodon *Bleeker.*
		Tetrodontidæ . (7)	Tetrodontinæ ...	Tetrodon *Linn.*
				Chilichthys *Müll.*
Ostracoderma	....	Ostraciontidæ . (8)	Ostraciontinæ ...	Lactophrys *Swains.*
Scleroderma	Balistoidea	Balistidæ ..... (9)	Monacanthinæ ..	Alutera *Cuv.*
				Ceratacanthus *Gill.*
				Stephanolepis *Gill.*
			Balistinæ	Balistes *Linn.*

Order 3.—Lophobranchii.

Sub-order.	Super-family.	Family.	Sub-family.	Genus.
Syngnathi	....	Hippocampidæ (10)	Hippocampinæ ..	Hippocampus *Cuv.*
		Syngnathidæ . (11)	Syngnathinæ	Syngnathus *Linn.*

Order 4.—Hemibranchii.

Sub-order.	Super-family.	Family.	Sub-family.	Genus.
	Centriscoidea ...	Centriscidæ .. (12)	....	Centriscus *Linn.*
	Aulostomoidea ..	Fistulariidæ . (13)	....	Fistularia *Linn.*
	Gasterosteoidea .	Gasterosteidæ (14)	Gasterosteinæ ..	Gasterosteus (*L.*) *Brev.*
				Pygosteus, *Brev.*
				Apeltes (*De Kay*) *Brev.*

ORDER 5.—TELEOCEPHALI.

Sub-order.	Super-family.	Family.	Sub-family.	Genus.
Heterosomata....	....	Soleidæ ...... (15)	Plagusiinæ......	Plagusia *Cuv.*
			Soleinæ	Achirus *Lac.*
		Pleuronectidæ (16)	Pleuronectinæ ..	Euchalarodus *Gill.*
				Pseudopleuronectes *Bl'kr.*
				Myzopsetta *Gill.*
				Limanda *Gottsche.*
				Pleuronectes *Linn.*
				Glyptocephalus *Gottsche.*
			Rhombinæ	Lophopsetta *Gill.*
				Citharichthys *Bleeker.*
			Hippoglossinæ ..	Hippoglossoides *Gottsche.*
				Pomatopsetta *Gill.*
				Chænopsetta *Gill.*
				Hippoglossus *Cuv.*
				Reinhardtius *Gill.*
	Macruroidea	Macruridæ... (17)	....	Macrurus *Bl.*
				Coryphænoides *Gunner.*
Jugulares........	Gadoidea........	Gadidæ ...... (18)	Gadinæ	Boreogadus *Günth.*
				Pollachius *Nilss.*
				Gadus (*Artedi*) *Gill.*
				Microgadus *Gill.*
				Melanogrammus *Gill.*
			Phycinæ	Phycis *Raf.*
				Urophycis *Gill.*
			Lotinæ..........	Molva (*Flem.*) *Nilss.*
			Ciliatinæ........	Onos *Risso.*
				Rhinonemus *Gill.*
				Ciliata *Couch.*
			Brosminæ	Brosmius *Cuv.*
		Merluciidæ... (19)	Merluciinæ	Merlucius *Raf.*
	Ophidioidea	Ophidiidæ.... (20)	....	Ophidium (*Artedi*) *Linn.*
	Brotuloidea	Brotulidæ.... (21)	Bythitinæ.......	Bythites *Reinh.*
	Lycodoidea	Lycodidæ .... (22)	Gymnelinæ	Gymnelis *Reinh.*
			Lycodinæ	Lycodes *Reinh.*
			Zoarciinæ.......	Zoarces *Cuv.*
Acanthopteri....	Blennioidea	Cryptacanthidæ (23)	....	Cryptacanthodes *Storer.*
		Stichæidæ.... (24)	....	Eumesogrammus *Gill.*
				Stichæus *Reinh.*
				Leptoclinus *Gill.*
				Anisarchus *Gill.*
				Lumpenus *Reinh.*

ORDER 5.—TELEOCEPHALI—Continued.

Sub-order.	Super-family.	Family.	Sub-family.	Genus.
Acanthopteri	Blennioidea	Stichæidæ (24)		Leptoblennius *Gill.*
				Centroblennius *Gill.*
		Xiphidiontidæ (25)		Murænoides *Lac.*
		Anarrhichadidæ (26)		Anarrhichas *L.*
		Blenniidæ (27)	Blenniinæ	Blennius *Linn.*
				Hypleurochilus *Gill.*
				Pholis (*Artedi*) *Cuv.*
				Hypsoblennius *Gill.*
				Chasmodes *Cuv. & Val.*
	Batrachoidea	Batrachidæ (28)		Batrachus *Linn.*
	Uranoscopoidea	Uranoscopidæ (29)		Astroscopus *Brevoort.*
	Cyclopteroidea	Cyclopteridæ (30)	Cyclopterinæ	Cyclopterus *Linn.*
				Eumicrotremus *Gill.*
		Liparididæ (31)	Liparidinæ	Liparis (*Art.*) *Linn.*
				Actinochir *Gill.*
			Careproctinæ	Careproctus *Kroyer.*
	Gobioidea	Gobiidæ (32)	Gobiinæ	Gobiosoma *Girard.*
				Gobius (*Linn.*) *Gill.*
			Eleotridinæ	Dormitator *Gill.*
	Cottoidea	Triglidæ (33)	Dactylopterinæ	Dactylopterus *Lac.*
			Triglinæ	Prionotus *Lac.*
				Trigla *Linn.*
		Agonidæ (34)	Leptagoninæ	Aspidophoroides *Lac.*
			Agoninæ	Agonus *Bloch.*
		Cottidæ (35)	Cottinæ	Cottus (*Linn.*)
				Oncocottus *Gill.*
				Gymnacanthus *Sw.*
				(Cottus) *Reinh.*
				Triglops *Reinh.*
		Hemitripteridæ (36)		Hemitripterus *Cuv.*
		Scorpænidæ (37)	Scorpæninæ	Sebastes (*Cuv.*) *Gill.*
				Scorpæna *Linn.*
	Labroidea	Labridæ (38)	Labrinæ	Tautoga (*Mitch.*) *Bleeker.*
				Tautogolabrus *Gunther.*
			Xyrichthyinæ	Xyrichthys *Cuv.*
			Julidinæ	Chœrojulis *Gill.*
		Pomacentridæ (38*a*)		Glyphidodon *Lac.*
	Polynematoidea	Polynemidæ (39)		Trichidion (*Klein.*) *Gill.*
	Teuthidoidea	Teuthididæ (40)		Acanthurus *Forskal.*
	Chætodontoidea	Chætodontidæ (41)	Chætodontinæ	Sarothrodus *Gill.*
				Holacanthus *Lac.*

ORDER 5.—TELEOCEPHALI—Continued.

Sub-order.	Super-family.	Family.	Sub-family.	Genus.
Acanthopteri	Scombroidea	Xiphiidæ .... (42)	Xiphiinæ	Xiphias *Linn.*
			Tetrapturinæ ...	Tetrapturus *Raf.*
				Histiophorus *Lac.*
		Trichiuridæ .. (43)	Trichiurinæ.....	Trichiurus *Linn.*
		Scombridæ ... (44)	Scombrinæ......	Scomber (*Linn.*) *Cuv.*
			Orcyninæ	Sarda *Cuv.*
				Orcynus (*Cuv.*) *Gill.*
				Cybium *Cuv.*
		Carangidæ ... (45)	Vomerinæ	Vomer *Cuv.*
				Selene (*Lac.*) *Brev.*
				Argyriosus *Lac.*
			Caranginæ	Decapterus *Bleeker.*
				Trachurops *Gill.*
				Paratractus *Gill.*
				Carangus (*Girard*) *Gill.*
				Carangops *Gill.*
				Blepharichthys *Gill.*
			Chloroscombrinæ	Chloroscombrus *Girard.*
			Trachynotinæ...	Trachynotus *Lac.*
			Centronotinæ ...	Naucrates (*Raf.*) *Gill.*
				Zonichthys (*Sw.*) *Gill.*
				Halatractus *Gill.*
		Coryphænidæ. (46)	Coryphæninæ ..	Coryphæna *Linn.*
		Stromateidæ . (47)	Centrolophinæ ..	Palinurichthys *Gill.*
			Stromateinæ	Poronotus *Gill.*
				Peprilus *Cuv.*
		Bramidæ ..... (48)	Pteraclinæ	Pteraclis *Gron.*
		Lamprididæ .. (49)	....	Lampris (*Retz.*)
		Zenidæ....... (50)	....	Zenopsis *Gill.*
	Mulloidea	Mullidæ...... (51)	....	Mullus *Linn.*
	Berycoidea......	Berycidæ .... (52)	Holocentrinæ ...	Holocentrum *Bloch.*
	Sciænoidea......	Sciænidæ .... (53)	Otolithinæ	Cynoscion *Gill.*
			Haploidonotinæ.	Pogonias *Lac.*
			Liostominæ	Liostomus *Lac.*
			Sciæninæ	Stelliferus (*Cuv.*) *Stark.*
				Bairdiella *Gill.*
				Sciænops *Gill.*
				Menticirrus *Gill.*
				Micropogon *Cuv.*
	Gerreoidea......	Gerridæ...... (54)	Lariminæ	Larimus *Cuv. & Val.*
				Eucinostomus *B. & G.*

ORDER 5.—TELEOCEPHALI—Continued.

Sub-order.	Super-family.	Family.	Sub-family.	Genus.
Acanthopteri	Percoidea	Pimelepteridæ (55)	....	Pimelepterus *Lac.*
		Sparidæ ...... (56)	Sparinæ	Lagodon *Holb.*
				Archosargus *Gill.*
				Stenotomus *Gill.*
				Sparus (*Linn.*) *Bon.*
		Pristipomatidæ (57)	Lutjaninæ	Lutjanus (*Bl., Schn.*) *Gill.*
			Pristipomatinæ .	Hæmulon *Cuv.*
				Orthopristis *Girard.*
				Pristipoma *Cuv.*
				Anisotremus *Gill.*
		Serranidæ .... (58)	Rhypticinæ	Promicropterus *Gill*
			Serraninæ	Hyporthodus *Gill.*
				Epinephelus *Gill.*
				Trisotropis *Gill.*
				Centropristis *Cuv.*
				Triloburus *Gill.*
				Diplectrum *Holbr.*
				Dules *Cuv.*
		Labracidæ ... (59)	....	Roccus *Gill.*
				Morone *Gill.*
		Ephippiidæ .. (60)	....	Parephippus *Gill.*
		Lobotidæ.... (61)	....	Lobotes *Cuv.*
		Pomatomidæ . (62)	....	Pomatomus *Lac.*
		Elacatidæ .... (63)	....	Elacate *Cuv.*
		Chilodipteridæ (64)	Apogoninæ	Apogonichthys *Bleeker.*
	Priacanthoidea..	Priacanthidæ (65)	....	Priacanthus *Cuv.*
				Pseudopriacanthus *Bleeker*
Incertæ sedis	Ammodytoidea..	Ammodytidæ (66)	Ammodytinæ ...	Ammodytes *Linn.*
			Argyrotæninæ ..	Argyrotænia *Gill.*
	Echeneidoidea ..	Echeneididæ . (67)	....	Leptecheneis *Gill.*
				Rhombochirus *Gill.*
				Remoropsis *Gill.*
				Echeneis (*Linn.*) *Gill.*
	Sphyrænoidea...	Sphyrænidæ . (68)	....	Sphyræna *Bloch.*
Percesoces.......	Mugiloidea......	Mugilidæ .... (69)	....	Mugil *Linn.*
		Atherinidæ .. (70)	....	Chirostoma (*Sw.*)
				Atherina (*Linn.*)
Synentognathi...	....	Belonidæ..... (71)	....	Belone *Cuv.*
		Scomberesocidæ (72)	Exocœtinæ......	Exocœtus *Linn.*
				Halocypselus *Weinl'nd* (*d.g.*)
				Cypselurus *Sw*, (*d. g.*)

ORDER 5.—TELEOCEPHALI—Continued.

Sub-order.	Super-family.	Family.	Sub-family.	Genus.
Synentognathi...	....	Scomberesocidæ (72)	Hemirhamphinæ	Euleptorhamphus *Gill.*
				Hemiramphus *Cuv.*
			Scomberesocinæ	Scomberesox *Lac.*
Haplomi.........	Cyprinodontoidea	Cyprinodontidæ (73)	Cyprinodontinæ.	Cyprinodon *Lac.*
			Hydrargyrinæ ..	Micristius *Gill.*
				Fundulus *Lac.*
				Hydrargyra *Lac.*
Isospondyli	Stomiatoidea....	Stomiatidæ... (74)	Chauliodontinæ.	Malacosteus *Ayres.*
			Stomiatinæ	Stomias *Cuv.*
		Scopelidæ .... (75)	Scopelinæ.......	Scopelus *Cuv.*
			Cocciinæ........	Maurolicus *Cocco.*
		Synodontidæ. (76)	....	Trachinocephalus *Gill.*
				Synodus (*Gron.*) *Bl., Schn.*
	Salmonoidea	Microstomidæ (77)	Argentininæ	Mallotus *Cuv.*
				Osmerus *Artedi.*
			Microstominæ...	Microstoma *Risso.*
		Salmonidæ ... (78)	Salmoninæ	Salmo *Linn.*
	Paralepidoidea ..	Paralepididæ. (79)	....	Paralepis *Risso.*
	Albuloidæ	Albulidæ..... (80)	....	Albula *Gronow.*
	Elopoidea	Elopidæ...... (81)	....	Elops *Linn.*
				Megalops *Lac.*
	Clupeoidea......	Dussumieridæ (82)	....	Etrumeus *Bleeker.*
		Clupeidæ..... (83)	Clupeinæ	Brevoortia *Gill.*
				Alosa *Cuv.*
				Opisthonema *Gill.*
				Pomolobus (*Raf.*) *Gill.*
				Clupea *Linn.*
		Dorosomidæ . (84)	....	Dorosoma (*Raf.*) *Gill.*
		Engraulidæ .. (85)	....	Engraulis *Cuv.*

ORDER 6.—NEMATOGNATHI.

	Siluroidea.......	Siluridæ...... (86)	Ariinæ..........	Ælurichthys *Bd. & Gir.*
				Ariopsis *Gill.*

ORDER 7.—APODES.

Enchelycephali	....	Congridæ ...... (87)	Congrinæ	Conger *Cuv.*
		Anguillidæ..... (88)	....	Anguilla *Thunberg.*
		Saccopharyngidæ (89)	....	Saccopharynx *Mitch.*

SUB-CLASS II.—GANOIDEA.

SUPER-ORDER CHONDROSTEI.

ORDER 8.—GLANIOSTOMI.

Sub-order.	Super-family.	Family.	Sub-family.	Genus.
		Accipenseridæ (90)	Accipenserinæ ..	Accipenser (*Linn.*)

CLASS B.—ELASMOBRANCHII.

SUPER-ORDER PLAGIOSTOMI.

ORDER 9.—RALÆ.

Masticura	Myliobatoidea ...	Cephalopteridæ (91)	....	Ceratoptera *Müll. & Henle.*
		Myliobatidæ . (92)	Ætobatinæ	Ætobatis *Müll. & Henle.*
			Myliobatinæ	Rhinoptera *Cuv.*
				Myliobatis *Dum.*
	Trygonoidea	Trygonidæ ... (93)	Pteroplateinæ ...	Pteroplatea *Müll. & Henle.*
			Trygoninæ	Trygon (*Adanson*) *Cuv.*
Sarcura	Torpedinoidæ ...	Torpedinidæ . (94)	Torpedininæ	Torpedo *Dum.*
	Raiaoidæ	Raiaidæ ..... (95)	Raianæ	Raia (*Linn.*)
		Pristidæ ..... (96)	....	Pristis *Lath.*

ORDER 10.—SQUALI.

Rhinæ	....	Squatinidæ ... (97)	....	Squatina *Dum.*
	Lamnoidea	Cetorhinidæ .. (98)	....	Cetorhinus *Blainv.*
		Lamnidæ ..... (99)	Isurinæ	Isuropsis *Gill.*
				Carcharodon *A. Smith.*
		Odontaspididæ (100)	....	Eugomphodus *Gill.*
		Alopeciidæ ... (101)	....	Alopias *Raf.*
	Galeorhinoidea ..	Sphyrnidæ ... (102)	....	Sphyrna *Raf.*
				Reniceps *Gill.*
		Galeorhinidæ (103)	Galeorhininæ ...	Eulamia *Gill.*
				Aprionodon *Gill.*
				Scoliodon *Müll. & Henle.*
				Galeocerdo *Müll. & Henle.*
			Mustelinæ	Mustelus *Cuv.*
	Scymnoidea	Spinacidæ .... (104)	....	Squalus (*Artedi*) *Raf.*
				Centroscyllium *Müll. & Henle.*
		Scymnidæ .... (105)	....	Somniosus *Les.*

CLASS C.—MARSIPOBRANCHII.

ORDER 11.—HYPEROARTIA.

Sub-order.	Super-family.	Family.	Sub-family.	Genus.
		Petromyzontidæ..(106)	Petromyzontinæ.	Petromyzon (*Linn.*) *Gray*.
				Ammocœtes (*Dum.*) *Gill*.

ORDER 12.—HYPEROTRETA.

		Myxinidæ........(107)	....	Myxine *Linn*.

CLASS D.—LEPTOCARDII.

ORDER 13.—CIRROSTOMI.

		Branchiostomidæ.(108)	....	Branchiostoma *Costa*.

2.—LIST OF SPECIES.

1.—MALTHEIDÆ.

MALTHE VESPERTILIO (Linn.) Cuv.—Bat-fish; nose-fish.
Newfoundland to Florida.

MALTHE CUBIFRONS Rich.—Box-headed sea-bat.
Labrador.

MALTHE NOTATA (Val.) Lütken.—Spotted sea-bat.
Southern Atlantic coast.

2.—LOPHIIDÆ.

LOPHIUS AMERICANUS DeKay.—Bellows-fish (*Newport, R. I.*); goose-fish (*Massachusetts*); monk-fish (*coast of Maine*); also fishing-frog, American angler, sea-devil, &c.
Nova Scotia to Cape Hatteras.

3.—CERATIIDÆ.

HIMANTOLOPHUS GRŒNLANDICUS Reinhardt.—Tufted frog-fish.
Greenland.

ONEIRODES ESCHRICHTII Lütken.—Eschricht's frog-fish.
Greenland.

CERATIAS HOLBOLLI Kroyer.—Holboll's frog-fish.
Greenland.

4.—ANTENNARIIDÆ.

PTEROPHRYNE LÆVIGATA (Cuv.) Gill.—Common frog-fish; mouse-fish; pescador (*Cuba*); toad-fish; devil-fish (*Bermuda*).
Pelagic; accidental on coast.

5.—ORTHAGORISCIDÆ.

MOLACANTHUS NUMMULARIS (Walb.) Gill.—Globe-fish.
Pelagic; accidental on coast.

MOLA ROTUNDA Cuv.—Sun-fish; pez mola (*Cuba*).
Newfoundland to Cape Hatteras.

---

* In giving the occurrence of any species of fish, as from Cape Cod to Cape Hatteras, or between other limits, it is not necessarily to be understood that specimens have actually been taken at these extremes, but only at some point between them. They may, however, be looked for at other localities within the same range.

6.—DIODONTIDÆ.

CHILOMYCTERUS GEOMETRICUS (Linn.) Kaup.—Spiny box-fish; rabbit-fish (*Vineyard Sound*); erizo (*Cuba*).
Cape Cod to Florida.

TRICHODIODON PILOSUS (Mitch.) Bleeker.—Hairy box-fish.
Cape Cod to Cape Hatteras.

7.—TETRODONTIDÆ.

TETRODON LÆVIGATUS (Linn.) Gill.—Smooth puffer; tambor (*Cuba*).
Cape Cod to Florida.

CHILICHTHYS TURGIDUS (Mitch.) Gill.—Rough puffer; porcupine-fish; blower; swell-fish; tambor (*Cuba*).
Cape Cod to Florida.

8.—OSTRACIONTIDÆ.

LACTOPHRYS TRIGONUS (Linn.) Poey—Trunk-fish; box-fish.
West Indian; accidental on the coast (found once at Holmes's Hole, Mass).

9.—BALISTIDÆ.

ALUTERA CUSPICAUDA DeKay. (d. s.)—Long-tailed file-fish.
Cape Cod to Florida.

CERATACANTHUS AURANTIACUS (Mitch.) Gill.—hog-fish; file-fish.
Cape Cod to Florida.

STEPHANOLEPIS MASSACHUSETTENSIS (Storer) Gill. (d. s.)—Storer's file-fish; fool-fish (*New York*).
Nova Scotia to Florida.

BALISTES CAPRISCUS Linn.—European file-fish; Turbot (*Berm*).
Nova Scotia to Florida.

BALISTES POWELI Cope. (d. s.)—Powel's file-fish.
Rhode Island. (Accidental.)

10.—HIPPOCAMPIDÆ.

HIPPOCAMPUS HUDSONIUS DeKay.—Sea-horse; horse-fish.
Cape Cod to Cape Hatteras.

11.—SYNGNATHIDÆ.

SYNGNATHUS PECKIANUS Storer.—Pipe-fish.
Newfoundland to Cape Hatteras.

12.—CENTRISCIDÆ.

CENTRISCUS SCOLOPAX Linn.—Snipe-fish.
European; accidental in American waters (found once in Massachusetts).

13.—FISTULARIIDÆ.

FISTULARIA TABACCARIA Linn.—Tobacco trumpet-fish; unarmed trumpet-fish.
Cape Cod to Florida. (Occasional; specimens obtained at New York.)

14.—GASTEROSTEIDÆ.

APELTES QUADRACUS (Mitch.) Brev.—Four-spined stickle-back.
New Brunswick to Florida.

GASTEROSTEUS ACULEATUS Linn.—Common stickle-back.
Greenland to Newfoundland (at least).

GASTEROSTEUS BIACULEATUS Shaw. (d. s.)—Two-spined stickle-back.
Newfoundland and Labrador.

GASTEROSTEUS NIGER Cuv. and Val. (d. s.)—Black stickle-back.
Newfoundland.

GASTEROSTEUS NOVEBORACENSIS Cuv. and Val. (d. s.)—New York, stickle-back.
New Brunswick to Cape Hatteras.

PYGOSTEUS OCCIDENTALIS (Cuv. and Val.) Brevoort.—Ten-spined stickle-back.
Newfoundland to Cape Hatteras.

15.—SOLEIDÆ.

PLAGUSIA PLAGIUSA (Linn.) Gill. (d. @ s.)—Long sole.
Cape Hatteras to Florida.

ACHIRUS LINEATUS (Linn.) Cuv.—American sole; calico; hog-choker (*New Jersey*); coverclip (*New Jersey*); spotted sole (*Massachusetts Bay*).
Cape Cod to Florida.

16.—PLEURONECTIDÆ.

EUCHALARODUS PUTNAMI Gill.—Putnam's flat-fish.
Nova Scotia to Cape Cod. (Found only in Salem Harbor, Mass.)

PSEUDOPLEURONECTES AMERICANUS (Walb.) Gill.—Common flounder, winter-flounder; mud dab (*Massachusetts Bay*); sole (*New York.*)
Nova Scotia to Cape Hatteras.

MYZOPSETTA FERRUGINEA (Storer) Gill.—Rusty dab; sand dab (*Maine*).
Nova Scotia to Cape Cod.

LIMANDA ROSTRATA (H. R. Storer) Gill.—American dab.
Labrador.

PLEURONECTES GLABER (Storer) Gill.—Smooth plaice; smooth back.
Massachusetts to Maine.

GLYPTOCEPHALUS ACADIANUS Gill.—Long dab.
Maine.

LOPHOPSETTA MACULATA (Mitch.) Gill.—Spotted turbot; window-pane (*New Jersey*); sand flounder (*New York*).
Cape Cod to Cape Hatteras.

CITHARICHTHYS MICROSTOMUS Gill.—Whiff.
New Jersey to Cape Hatteras.

HIPPOGLOSSOIDES PLATESSOIDES (Fabr.) Gill.—Arctic dab.
Polar regions (Greenland).

POMATOPSETTA DENTATA (Storer) Gill.—Summer flounder.
Nova Scotia to Cape Hatteras.

CHÆNOPSETTA OCELLARIS (De Kay) Gill.—Common flounder.
Cape Cod to Cape Hatteras.

CHÆNOPSETTA DENTATA (Linn.) Gill.—Southern flounder.
Cape Hatteras to Florida.

CHÆNOPSETTA OBLONGA (Mitch.) Gill.—Four-spotted flounder.
Cape Cod to Cape Hatteras.

HIPPOGLOSSUS AMERICANUS Gill (d. s.)—Halibut.
Newfoundland to Cape Hatteras.

REINHARDTIUS HIPPOGLOSSOIDES (Walb.) Gill.—Greenland halibut.
Greenland.

17.—MACRURIDÆ.

MACRURUS RUPESTRIS Bloch.—Ingmingoak (*Greenland*).
Greenland.

CORYPHÆNOIDES NORVEGICUS (Gunner) Günth.
Greenland.

18.—GADIDÆ.

BOREOGADUS POLARIS (Sabine) Gill.—Misarkornak (*Greenland*).
Polar regions.

POLLACHIUS CARBONARIUS (Linn.) Bon.—Pollock; coal-fish (*England*).
Greenland to Cape Hatteras.

GADUS MORRHUA Linn.—Common cod-fish; sarandlik and sarandliksoak (*Greenland*).
Polar regions to Cape Hatteras.

GADUS OJAC Rich. (d. s.)—Greenland cod-fish; ojac or ovak (*Greenland*).
Polar regions.

MICROGADUS TOMCODUS (Walb.) Gill.—Tom-cod; frost-fish.
Newfoundland to Cape Hatteras.

MELANOGRAMMUS ÆGLEFINUS (Linn.) Gill.—Haddock.
Newfoundland to Cape Hatteras.

PHYCIS CHUSS (Walb.) Gill.—Codling (*New York*); old English hake; squirrel hake (*Mass.*); ling; chuss (*formerly at New York*); codling (*Newport*); fork-beard (*England*).
Newfoundland to Cape Hatteras.

PHYCIS TENUIS (Mitch.) DeKay.—Codling (*New York*); white hake (*Mass.*); squirrel hake (*Maine.*)
Newfoundland to Cape Hatteras.

UROPHYCIS REGIUS (Walb.) Gill.—Spotted codling.
Cape Cod to Cape Hatteras.

MOLVA VUGARIS Flem.—Ling (*Great Britain*); iverksoak (*Greenland.*)
Polar regions.

ONOS REINHARDTII (Kroyer) Gill.—Five-bearded rockling.
Greenland.

ONOS ENSIS (Reinhardt) Gill.—Three-bearded rockling.
Greenland.

RHINONEMUS CAUDACUTA (Storer) Gill. (d. s.)—4-bearded rockling.
Nova Scotia to Cape Cod.

CILIATA ARGENTATA (Reinh.) Gill.—Mackerel-midge.
Greenland to Cape Hatteras

BROSMIUS BROSME (Fabr.) White. (d. @ s.)—European cusk; nejorpallujak (*Greenland*); torsk or tusk (*Great Britain*).
Polar regions to Cape Cod.

BROSMIUS AMERICANUS Gill. (d. s.)—Cusk (*Mass.*); torsk or tusk (*British provinces*).
Nova Scotia to Cape Cod.

BROSMIUS FLAVESCENS Lesueur. (d. s.)—Cusk.
Banks of Newfoundland.

19.—MERLUCIIDÆ.

MERLUCIUS VULGARIS Flem. (d. @ s.)—European hake; akulliakitsok (*Greenland*).
Greenland.

MERLUCIUS BILINEARIS (Mitch.) Gill.—American hake; silver hake (*Maine*); whiting (*Mass*); stock-fish.
Nova Scotia to Cape Hatteras.

20.—OPHIDIIDÆ.

OPHIDIUM MARGINATUM Mitch.—Little cusk (*New York*).
Cape Cod to Cape Hatteras.

21.—BROTULIDÆ.

BYTHITES FUSCUS Reinhardt.—Amersulak (*Greenland*).
Greenland.

22.—LYCODIDÆ.

GYMNELIS VIRIDIS Reinhardt.—Unernak (Greenland).
Polar regions.

LYCODES VAHLII Reinhardt.—Vahl's lycodes; misarkornak (*Greenland*).
Greenland.

LYCODES RETICULATUS Reinhardt.—Reticulated lycodes; akulliakitsok (*Greenland*).
Greenland.

LYCODES PERSPICILLUM Kroyer.—Spotted lycodes.
Greenland.

LYCODES SEMINUDUS Reinhardt.—Half-naked lycodes.
Greenland.

LYCODES NEBULOSUS Kroyer.—Cloudy lycodes.
Greenland.

LYCODES MUCOSUS Richardson.—Slimy lycodes.
Greenland.

LYCODES POLARIS (Sabine) Rich.—Arctic lycodes.
Polar regions.

ZOARCES ANGUILLARIS (Peck) Storer.—Eel-pout; conger-eel (*Massachusetts Bay*); lamper-eel (*Eastport*).
Newfoundland to Cape Hatteras.

23.—CRYPTACANTHIDÆ.

CRYPTACANTHODES MACULATUS Storer.—Ghost-fish; wry-mouth.
Nova Scotia to Cape Cod.

CRYPTACANTHODES INORNATUS Gill.—Ghost-fish; conger-eel (*Me.*)
Nova Scotia to Cape Cod.

24.—STICHÆIDÆ.

EUMESOGRAMMUS SUBBIFURCATUS (Storer) Gill; Little cusk (*Me.*)
Nova Scotia to Cape Cod.

EUMESOGRAMMUS PRÆCISUS (Kroyer) Gill.
Greenland.

STICHÆUS PUNCTATUS (Fabr.) Reinh.
Greenland.

LEPTOCLINUS ACULEATUS (Reinh.) Gill.
Greenland.

ANISARCHUS MEDIUS (Reinh.) Gill.
Greenland.

LUMPENUS FABRICII Reinhardt.
Greenland.

LEPTOBLENNIUS SERPENTINUS (Storer) Gill.
Nova Scotia to Cape Cod.

LEPTOBLENNIUS GRACILIS (Stuvitz) Gill.
Greenland.

CENTROBLENNIUS NUBILUS (Rich.) Gill.
Greenland.

25.—XIPHIDIONTIDÆ.

MURÆNOIDES FASCIATUS (Schneider) Gill.—Banded butter-fish.
Greenland.

MURÆNOIDES MUCRONATUS (Mitch.) Gill. (d. s.)—Common butter-fish.
Nova Scotia to Cape Hatteras.

Varieties. (?)

MURÆNOIDES MACROCEPHALUS (Girard) Gill. (d. s.)
Massachusetts.

MURÆNOIDES INGENS (H. R. Storer) Gill. (d. s.)
Labrador.

ASTERNOPTERYX GUNELLIFORMIS Rüppell. (d. @ g.)
Greenland. (?)

26.—ANARRHICHADIDÆ.

ANARRHICHAS VOMERINUS (Ag.) Storer. (d. s.)—Wolf-fish; cat-fish (*New England*); kigutilik (*Greenland*).
Greenland to Cape Hatteras.

ANARRHICHAS STEENSTRUPII Gill. (d. s.)—Steenstrup's wolf-fish; kærrak (*Greenland.*)
Greenland.

ANARRHICHAS DENTICULATUS Kroyer.—Small-toothed wolf-fish.
Greenland.

27.—BLENNIIDÆ.

BLENNIUS FUCORUM Cuv. and Val. (d. @ s.; d. @ g.)—Sea-weed blenny.
South Carolina.

BLENNIUS GEMINATUS Wood. (d. @ g.)—Blenny.
South Carolina.

HYPLEUROCHILUS PUNCTATUS (Wood) Gill.—Spotted blenny.
Cape Hatteras to Florida.

PHOLIS CAROLINUS Val.—Carolina blenny.
Cape Hatteras to Florida.

HYPSOBLENNIUS HENTZII (Les.) Gill.—Hentz's blenny.
South Carolina.

CHASMODES BOSCIANUS (Lac.) Cuv. and Val.—Bosc's shanny.
New York to Florida.

CHASMODES QUADRIFASCIATUS Val.—Four-banded shanny.
South Carolina.

CHASMODES NOVEMLINEATUS Val.—Nine-lined shanny.
South Carolina.

28.—BATRACHIDÆ.

BATRACHUS TAU Linn.—Toad-fish; oyster-fish (*New Jersey and Florida*); sapo (*Cuba*).
Nova Scotia to Florida.

29.—URANOSCOPIDÆ.

ASTROSCOPUS ANOPLUS (Cuv. and Val.) Brevoort.—Naked star-gazer.
New York to Florida.

30.—CYCLOPTERIDÆ.

CYCLOPTERUS LUMPUS Linn.—Common lump-fish; lump-sucker, sea-owl, paddle (*Great Britain*); Licorne de mer (*France*).
Polar regions to Cape Hatteras.

EUMICROTREMUS SPINOSUS (Fabr.) Gill.—Spinous lump-fish.
Greenland to Bay of Fundy.

31.—LIPARIDIDÆ.

LIPARIS LINEATA (Lepechin) Kroyer.—Lineated liparis, or sea-snail.
Polar regions to Cape Cod.

LIPARIS ARCTICA Gill.—Arctic liparis.
Greenland (Port Foulke).

LIPARIS FABRICII Kroyer.—Fabricius' liparis.
Greenland.

LIPARIS MONTAGUI Don.—Montagu's liparis, or sea-snail.
Polar regions to Cape Cod.

ACTINOCHIR MAJOR (Walb.) Gill.—Large liparis.
Greenland.

CAREPROCTUS REINHARDTII Kroyer.—Reinhardt's liparis.
Greenland.

32.—GOBIIDÆ.

GOBIOSOMA ALEPIDOTA (Lac.) Girard.—Scaleless goby.
Cape Cod to Florida.

GOBIUS CAROLINENSIS Gill.—Black goby.
Cape Hatteras to Florida.

DORMITATOR LINEATUS Gill.—Striped sleeper.
Cape Hatteras to Florida.

33.—TRIGLIDÆ.

DACTYLOPTERUS VOLITANS (Linn.) Lac.—Flying-robin; murcielago (*Cuba*); civetta de mare (*Naples*); bat-fish (*Bermudas*).
Newfoundland to Florida.

PRIONOTUS EVOLANS (Linn.) Gill.—Lined Sea-robin; flying-fish (*New Jersey*).
Cape Cod to Florida.

PRIONOTUS PUNCTATUS (Bloch.) Cuv.—Spotted sea-robin; rubio volador (*Cuba*).
Florida.

PRIONOTUS CAROLINUS (Linn.) Cuv. and Val.—Web-fingered sea-robin; Carolina robin.
Cape Cod to Florida.

PRIONOTUS PILATUS Storer. (d. s.)—Small-scaled sea-robin.
Massachusetts.

TRIGLA CUCULUS Linn. (d. @ s.)—European gurnard.
European; accidental at New York.

34.—AGONIDÆ.

ASPIDOPHOROIDES MONOPTERYGIUS (Bloch) Storer.
Polar regions to Cape Cod.
AGONUS CATAPHRACTUS (Linn.) Bl. Schn.—Sea-poacher.
Polar regions (Greenland.)
ARCHAGONUS DECAGONUS (Bl. Schn.) Gill.
Greenland.

35.—COTTIDÆ.

COTTUS OCTODECIMSPINOSUS Mitchill.—Slender sculpin; grubby.
Nova Scotia to Cape Hatteras.
COTTUS ÆNEUS Mitchell (d. s.)—Little sculpin.
Cape Cod to Cape Hatteras.
COTTUS GRŒNLANDICUS Cuv. and Val. (d. s.)—Northern sculpin.
Polar regions to Cape Hatteras.

Varieties. (?)

COTTUS POROSUS Cuv. and Val. (d. s.)
Baffin's Bay.
COTTUS OCELLATUS H. R. Storer. (d. s.)
Greenland to Newfoundland.
COTTUS LABRADORICUS H. R. Storer. (d. s.)
Greenland to Newfoundland.
COTTUS GLACIALIS Richardson. (d. s.)
Greenland.
COTTUS PACHYPUS Günther. (d. s.)
Polar regions (Greenland).
COTTUS MITCHILLI Cuv. and Val. (d. s.)
Newfoundland to Cape Hatteras.
COTTUS SCORPIODES Fabricius. (d. @ g.)
Greenland.
GYMNACANTHUS TRICUSPIS (Reinhardt) Gill. (d. s.)
Polar regions.
GYMNACANTHUS PATRIS (H. R. Storer) Gill. (d. s.)
Labrador to Bay of Fundy.
ONCOCOTTUS QUADRICORNIS (Linn.) Gill.
Polar regions.
ICELUS BICORNIS Reinhardt. (d. @ g.)
Greenland.
ICELUS UNCINATUS Reinhardt. (d. @ g.)
Greenland.
COTTUS POLARIS Sabine. (d. @ g.)
Polar regions.
TRIGLOPS PINGELII Reinhardt.
Greenland.
TRIGLOPS PLEUROSTICTUS Cope.
Greenland.

36.—HEMITRIPTERIDÆ.

HEMITRIPTERUS ACADIANUS (Walbaum) Storer.—Sea-raven; yellow sculpin.
Newfoundland to Cape Hatteras.

37.—SCORPÆNIDÆ.

SCORPÆNA PORCUS Linn. (d. @ s.)—Pig-foot.
European; (accidental at New York.)
SCORPÆNA PLUMIERI Bl. Schn. (d. @ s.) Plumer's pig-foot.
West Indian; occasional on northern coast.
SEBASTES NORVEGICUS (Linn.) Cuv. (d. @ s.)—Norway haddock; hemdurgan.
Polar regions to Cape Cod.
SEBASTES VIVIPARUS Kroyer (d. s.)—Red-fish; bream (*Maine*); rose-fish; snapper (*Massachusetts Bay*, Storer); red sea-perch (*New York*); red perch (*Eastport*).
Polar regions to Cape Cod.
SEBASTES FASCIATUS Storer. (d. s. and d. @ g.) Banded red-fish.
Accidental to Massachusetts. (?)

38.—LABRIDÆ.

TAUTOGA ONITIS (Linn.) Gthr.—Black-fish; tautog.
Bay of Fundy to South Carolina; New York.
TAUTOGOLABRUS ADSPERSUS (Walbaum) Gill.—Burgall or bergall (*New York*); cunner or conner; chogset (*N. E.*); blue-fish or blue perch.
Newfoundland to Cape Hatteras.
XYRICHTHYS LINEATUS (Gmel.) Cuv. and Val.—Razor-fish.
West Indian, (occasional on Southern coast?)
CHŒROJULIS GRANDISQUAMIS Gill.
North Carolina.

38*a*.—POMACENTRIDÆ.

GLYPHIDODON SAXATILIS (Linn.) Cuv. and Val.—Cow-pilot (*Berm*).
West Indian (accidental on northern coast; found at Newport.)

39.—POLYNEMIDÆ.

TRICHIDION PLUMIERI (Lac.) Gill.—Thread-fish.
West Indies; occasional northward. (?)
TRICHIDION OCTOFILIS Gill.—Eight-threaded thread-fish.
New York (accidental).

40.—TEUTHIDIDÆ.

ACANTHURUS CHIRURGUS Bloch. and Schneider.—Surgeon-fish; barbero (*Cuba*); doctor-fish (*Bermudas*).
West Indies; occasional northward.
ACANTHURUS NIGRICANS Linn.—Black surgeon
West Indies; occasional northward.

41.—CHAETODONTIDÆ.

SAROTHRODUS MACULOCINCTUS Gill.
Cape Cod to Cape Hatteras.

HOLACANTHUS CILIARIS Lac.—Isabelita (*Cuba*); angel-fish (*Berm.*)
West Indies; occasional northwards.

42.—XIPHIIDÆ.

XIPHIAS GLADIUS Linn.—Common sword fish.
Nova Scotia to West Indies.

TETRAPTURUS ALBIDUS Poey.—The Bill-fish; The Spear-fish.
Cape Cod to West Indies.

HISTIOPHORUS GLADIUS (Brouss.) Gthr.—The Sail-fish.
Cape Cod to West Indies.

43.—TRICHIURIDÆ.

TRICHIURUS LEPTURUS Linn.—Silvery hair-tail.
Cape Cod to Florida.

44.—SCOMBRIDÆ.

SCOMBER SCOMBRUS Linn. (d. @ s.)—Mackerel; wawwhunnekesuog (*Narragansett Indians*, Trumbull); caballa (*Cuba*).
Greenland to Cape Hatteras.

SCOMBER COLIAS Linnæus. (d. @ s.)—Chub-mackerel.
Nova Scotia to Cape Hatteras.

SARDA PELAMYS (Linn.) Cuv.—Bonito; skip-jack (*Boston market*).
Cape Cod to Florida.

ORCYNUS SECUNDI-DORSALIS (Storer) Gill. (d. s.)—Horse-mackerel (*Massachusetts, &c.*); albicore (*Rhode Island*); American tunny.
Newfoundland to Florida.

ORCYNUS ALLITERATUS (Raf.) Gill.—Little tunny; albicore; alleterato (*Naples*); mackerel (*Berm.*); pelagic, occasional on coast (found in large numbers at *Wood's Hole, Massachusetts, August*, 1871).

CYBIUM MACULATUM (Mitch.) Cuv.—Spanish mackerel; spotted mackerel; bay mackerel. (rare in Massachusetts Bay.)
Cape Cod to Florida.

CYBIUM REGALE (Bloch) Cuv.—Cero; black-spotted Spanish mackerel; king fish.
Cape Cod to Florida.

45.—CARANGIDÆ.

VOMER SETIPINNIS (Mitch.) Ayres.—Horse-fish; jorobado (*Cuba*).
Maine to Florida.

SELENE ARGENTEA Lac.—Silver moon-fish; jorobado (*Cuba*).
Cape Cod to Florida.

ARGYRIOSUS VOMER Lac.—Jorobado (*Cuba*).
Cape Cod to Florida.

ARGYRIOSUS CAPILLARIS (Mitch.) DeKay. (d. s.)
Cape Cod to Florida.

DECAPTERUS PUNCTATUS (Mitch.) Gill.—Dotted scad; round robin (*Bermudas*).
Cape Cod to Florida.

DECAPTERUS MACARELLUS (Cuv. and Val.) Gill.—Mackerel scad.
Cape Cod to Florida. (*Wood's Hole, Massachusetts*, 1873).

TRACHUROPS CRUMENOPHTHALMUS (Bloch) Gill.—Big-eyed scad; chicharro (*Cuba*); goggler; goggle-eyed Jack (*Bermudas*).
Cape Cod to Florida.

PARATRACTUS PISQUETOS (Cuv. et Val.) Gill.—Yellow crevallé; cojinua (*Cuba*). Jack, Buffalo Jack (*Bermuda.*)
Cape Cod to Florida.

CARANGUS HIPPOS (Linn.) Gill.—Horse-crevallé; jiguagua (*Cuba*).
Cape Cod to Florida.

CARANGUS FALLAX (Cuv. et Val.) Girard.—Jurel (*Cuba*).
South Carolina.

CARANGUS CHRYSOS (Mitch.) Gill.—Yellow-mackerel (*New York*)
Cape Cod to Florida.

CARANGOPS FALCATUS (Holbr.) Gill.
South Carolina.

BLEPHARICHTHYS CRINITUS (Akerly) Gill.—Thread-fish.
Cape Cod to Florida.

CHLOROSCOMBRUS CHRYSURUS (Linn.) Gill.—Casabe (*Cuba*).
Cape Cod to Florida.

TRACHYNOTUS OVATUS (Linn.) Gthr.—Short pampano; palorrieta (*Cuba*).
Cape Cod to Florida.

TRACHYNOTUS GLAUCUS Cuv. and Val.—Glaucous pampano.
South Carolina to Florida.

TRACHYNOTUS CAROLINUS (Linn.) Gill.—Pompano (*Southern Coast*); cavallé or crevallé (*South Carolina*); pompynose (*New Orleans*).
Cape Cod to Florida.

NAUCRATES DUCTOR (Linn.) Raf.—Pilot-fish; pilot, romero (*Cuba*).
Pelagic; occasional on coast.

ZONICHTHYS FASCIATUS (Bloch) Sw.
South Carolina.

HALATRACTUS ZONATUS (Mitch.) Gill.—Rudder-fish; bonito (*Berm.*)
Cape Cod to Florida.

HALATRACTUS CAROLINENSIS (Holbr.) Gill.
South Carolina.

46.—CORYPHAENIDÆ.

CORYPHÆNA SUEURI Cuv. and Val.—Lesueur's dolphin.
Pelagic; occasional on coast.

CORYPHÆNA PUNCTULATA (Cuv. and Val.) Gthr.—Small-spotted dolphin.
Pelagic; occasional on coast

47.—STROMATEIDÆ.

PALINURICHTHYS PERCIFORMIS (Mitch.) Gill.—Black rudder-fish.
Maine to Cape Hatteras.

POROTONUS TRIACANTHUS (Peck) Gill.—Harvest-fish (*New Jersey*); butter-fish (*Massachusetts*); dollar fish (*Maine*).
Maine to Cape Hatteras.

PEPRILUS GARDENII (Bl. Schn.) Gill.
New York to Florida.

48.—BRAMIDÆ.

PTERACLIS CAROLINUS Val.
South Carolina.

49.—LAMPRIDIDÆ.

LAMPRIS GUTTATA Retz.—Opah.
Occasional off Newfoundland.

50.—ZENIDÆ.

ZENOPSIS OCELLATUS (Storer) Gill. (d. s.)—Ocellated dory.
Massachusetts. (Accidental? Identical with Z. conchifer?)

51.—MULLIDÆ.

MULLUS, sp. incog.
West Indian (?); occasional on coast (found at New York).

52.—BERYCIDÆ.

HOLOCENTRUM SOGHO Bloch—Matajuelo (*Cuba*); squirrel (*Berm.*)
West Indian; accidental on northern coast (found at Newport, Rhode Island).

53.—SCIÆNIDÆ.

CYNOSCION CAROLINENSIS (Cuv. and Val.) Gill.—Salmon-trout; spotted sea-trout (*south coast*); spotted silver-sides (*Scott*).
Cape Hatteras to Florida.

CYNOSCION REGALIS (Bloch) Gill.—Squeteague or squit (*New England*); sheeutts or checutts (*Mohegan Indians*); chickwick (*Connecticut*); weak-fish (*New York*); blue-fish (*Beesley's Point, New Jersey*); trout (*southern coast*); salt-water trout; gray trout (*southern coast*).
Cape Cod to Florida.

CYNOSCION THALASSINUS (Holbr.) Gill.
Cape Hatteras to Florida.

CYNOSCION NOTHUS (Holbr.) Gill.
Cape Hatteras to Florida.

POGONIAS CHROMIS Lacep.—Drum.
Cape Cod to Florida.

LIOSTOMUS XANTHURUS Lacep.—Yellow-tail.
Cape Cod to Florida.

LIOSTOMUS OBLIQUUS (Mitch.) DeKay.—Lafayette (*New York*); goody (*Cape May*); chub (*Norfolk*); roach (*Northampton County, Virginia*).
Cape Cod to Florida.

STELLIFERUS LANCEOLATUS (Holbr.) Gill.
Cape Hatteras to Florida.

BAIRDIELLA PUNCTATA (Linn.) Gill.—Silver-perch (*New Jersey*).
Cape Cod to Florida.

SCIÆNOPS OCELLATUS (Linn.) Gill.—Bass; red bass; sea-bass; spotted bass (*South Carolina*); red-fish (*Gulf of Mexico*).
Cape Cod to Florida.

MENTICIRRUS ALBURNUS (Linn.) Gill.—Carolina whiting.
Cape Hatteras to Florida.

MENTICIRRUS NEBULOSUS (Mitch.) Gill.—King-fish; whiting; hake (*New Jersey*); barb (*New Jersey*).
Cape Cod to Florida.

MENTICIRRUS LITTORALIS (Holbr.) Gill.—Shore-whiting.
Cape Hatteras to Florida.

MICROPOGON UNDULATUS (Linn.) Cuv. and Val.—Croaker; verrugato (*Cuba*).
Cape Cod to Florida.

LARIMUS FASCIATUS Holbrook.
Cape Hatteras to Florida.

54.—GERRIDÆ.

EUCINOSTOMUS ARGENTEUS Baird and Girard. (d. s., d @ g.)
New Jersey southwards.

55.—PIMELEPTERIDÆ.

PIMELEPTERUS BOSCII Lac.—Chopa-banca (*Cuba*); bream (*Berm.*)
Cape Cod to Florida.

56.—SPARIDÆ.

LAGODON RHOMBOIDES (Linn.) Holbrook.—Sargo (*Cuba*).
Cape Cod to Florida.

ARCHOSARGUS PROBATOCEPHALUS (Walb.) Gill.—Sheep's-head.
Cape Cod to Florida.

STENOTOMUS ARGYROPS (Linn.) Gill.—Scup (*Vineyard Sound*); scup-paug; porgy (*New York*); bream (*Rhode Island, formerly*); fair-maid (*East Shore of Virginia*).
Cape Cod to Florida.

SPARUS ACULEATUS (Cuv. and Val.) Gill. (d. s., d. @ g.)—Gilt-head.
Cape Hatteras to Florida.

57.—PRISTIPOMATIDÆ.

HÆMULON ARCUATUM Cuv. and Val.—Grunts.
South Atlantic coast of United States.

HÆMULON FORMOSUM (Linn.) Cuv.
South Atlantic coast of United States.

HÆMULON CHRYSOPTERON (Linn.) Cuv.
South Atlantic coast of United States.

HÆMULON QUADRILINEATUM (Cuv. and Val).—Striped grunt (*Berm.*)
South Atlantic coast of United States.

ORTHOPRISTIS FULVOMACULATUS (Mitch.) Gill.
South Atlantic coast of United States.

ANISOTREMUS VIRGINICUS (Linn.) Gill.
South Atlantic coast of United States.

LUTJANUS CAXIS (Bl. Schn.) Gill.—Yelting, glass-eyed snapper (*Berm.*)
South Atlantic coast of United States.

58.—SERRANIDÆ *Gill.*

PROMICROPTERUS MACULATUS (Holbr.) Gill.—Soap-fish.
Cape Hatteras to Florida.

PROMICROPTERUS DECORATUS Gill. (d. @ s.)
Newport, R. I. (Accidental.)

HYPORTHODUS FLAVICAUDA Gill.
Newport, R. I. (Accidental.)

EPINEPHELUS MORIO (Cuv.) Gill.—Red grouper (*New York?*); cherna de vovero (*Cuba*).
Cape Cod to Florida.

EPINEPHELUS NIGRITUS (Holbr.) Gill. (d. @ g.)
Cape Hatteras to Florida.

EPINEPHELUS OXYPTERUS (DeKay) Gill. (d. s.; d. @ g.)
New York. (Accidental). (?)

TRISOTROPIS ACUTIROSTRIS (Cuv. and Val.) Gill.
Cape Hatteras to Florida.

PROMICROPS GUASA (Poey) Gill.—Guasa, (*Cuba.*)
Florida.

CENTROPRISTIS ATRARIUS (Linn.) Barn.—Black sea-bass; sea-bass (*New York*); black-perch (*Mass.*); black-bass; black-fish (*New Jersey*; blue-fish (*Newport*); black-harry; hannahills (*New York*, DeKay); black-will (*Eastern Shore of Virginia*).
Cape Cod to Florida.

TRILOBURUS TRIFURCUS (Linn.) Gill.
Cape Hatteras to Florida.

DIPLECTRUM FASCICULARE (Cuv. and Val.) Holbrook—Serrano (*Cuba*).
Cape Hatteras to Florida.

DULES AURIGA Cuv. and Val.—Charioteer; coachman (DeKay.)
Cape Cod to Florida.

59.—LABRACIDÆ.

ROCCUS LINEATUS (Bl. Schn.) Gill.—Striped bass (*Eastern States*); rock-fish (*Pennsylvania*, etc.); missuckeke-kequock (*Narragansett Indians*).
Nova Scotia to Florida.

MORONE AMERICANA (Gmelin) Gill.—White perch.
Nova Scotia to Florida.

60.—EPHIPPIIDÆ.

PAREPHIPPUS QUADRATUS (Gun.) Gill.—Moon-fish.
Cape Cod to Florida.

PAREPHIPPUS FABER (Cuv.) Gill.—Moon-fish; angel-fish (*South Carolina*); 3-banded sheep-head; 3 tailed porgy.
Cape Cod to Florida.

61.—LOBOTIDÆ.

LOBOTES SURINAMENSIS Cuv.—Flasher (*New York market*).
Cape Cod to Florida.

62.—POMATOMIDÆ.

POMATOMUS SALTATRIX (Linn.) Gill.—Blue-fish (*New York, and New England except Rhode Island*); horse-mackerel (*Newport, and Beesley's Point, N. J.*); skip-jack (*North Carolina*); green-fish (*Virginia*, DeKay); tailor (*Maryland and Virginia*); white-fish and snap-mackerel (young).

63.—ELACATIDÆ.

ELACATE CANADUS (Linn.) Gill.—Crab-eater.
Cape Cod to West Indies.

64.—CHILODIPTERIDÆ.

APOGONICHTHYS AMERICANUS Castelnau.
West Indian; occasional northwards (found at Newport, R. I.)

65.—PRIACANTHIDÆ.

PRIACANTHUS MACROPHTHALMUS Cuv. (d. s.)—Common big-eye.
West Indian; occasional northwards.

PSEUDOPRIACANTHUS ALTUS (Gill.) Bleeker.—Short big-eye.
Cape Cod to Cape Hatteras.

66.—AMMODYTIDÆ.

AMMODYTES AMERICANUS DeKay.—Sand-launce; sand-eel (*N. Eng.*)
Newfoundland to Cape Hatteras.

AMMODYTES DUBIUS Reinhardt.
Polar regions to Cape Cod.

ARGYROTÆNIA VITTATA (DeKay) Gill. (d. s.; d. @ g.)
New York. (?)

67.—ECHINEIDIDÆ.

LEPTECHENEIS NAUCRATES (Linn.) Gill.—Sucker-fish.
Coast generally.
LEPTECHENEIS NAUCRATEOIDES (Zuiew) Gill. (d. s.)
Coast generally.
RHOMBOCHIRUS OSTEOCHIR (Cuv.) Gill.
West Indian; occasional on northern coast (found at New Bedford, Massachusetts.)
REMOROPSIS BRACHYPTERA (Lowe) Gill.
Occasional on northern coast (found at Holme's Hole, Massachusetts.)
ECHENEIS REMORA Linn.—Sucker; pega (*Cuba*).
Coast generally.

68.—SPHYRÆNIDÆ.

SPHYRÆNA BOREALIS DeKay.—Northern barracuda; sennet (*Berm.*)
Cape Cod to Florida.

69.—MUGILIDÆ.

MUGIL ALBULA Linn.—Mullet.
Cape Cod to Florida.
MUGIL LINEATUS Mitchill.—Striped mullet.
Cape Cod to Florida.
MUGIL PETROSUS Val.
Cape Hatteras to Florida.
MUGIL PLUMIERI Val.
Cape Hatteras to Florida.

70.—ATHERINIDÆ.

CHIROSTOMA NOTATA (Mitch.) Gill.—Silver-sides; friar (*New England*).
Maine to Florida.
CHIROSTOMA MENIDIA (Linn.) Gill.
Cape Hatteras to Florida.
ATHERINA CAROLINA Val.
Cape Hatteras to Florida.

71.—BELONIDÆ.

BELONE LONGIROSTRIS (Mitch.) Gill.—Silver-gar; bill-fish.
Cape Cod to Florida.

72.—SCOMBERESOCIDÆ.

EXOCŒTUS EXILIENS Gmel.—Flying-fish.
Cape Cod to Florida.
EXOCŒTUS NOVEBORACENSIS Mitch.
Cape Cod to Florida.

EXOCÆTUS MELANURUS Val.
Cape Cod to Florida.
HALOCYPSELUS EVOLANS (Linn.) Gill.
Cape Cod to Florida.
CYPSELURUS COMATUS (Mitch.) Weinland. (d. s., d. @ g.)
Cape Cod to Florida.
CYPSELURUS FURCATUS (Mitch.) Weinland. (d. s., d. @ g.)
Cape Cod to Florida.
EULEPTORHAMPHUS LONGIROSTRIS (Cuv. and Val.) Gill.
Cape Cod to Florida.
HEMIRHAMPHUS UNIFASCIATUS Ranzani.
Cape Cod to Florida.
SCOMBERESOX SCUTELLATUS Lesueur.—Skipper; saury; skip jack.
Nova Scotia to Florida.

73.—CYPRINODONTIDÆ

CYPRINODON VARIEGATUS Lac.
Cape Cod to Florida.
CYPRINODON PARVUS Baird and Girard (d. @ g.)
Cape Cod to Cape Hatteras.
MICRISTIUS ZONATUS (Mitch.) Gill.
Cape Cod to Florida.
MICRISTIUS CINGULATUS (Cuv. and Val.) Gill (d. s.)
Cape Cod to Florida.
MICRISTIUS CHRYSOTUS (Gthr.) Gill (d. s.)
Cape Hatteras to Florida.
FUNDULUS HETEROCLITUS (Linn.) Gill.
Cape Cod to Florida.
FUNDULUS PISCULENTUS (Mitch.) Val.—Killi-fish; mummichog.
Maine to Florida.
FUNDULUS MULTIFASCIATUS (Lesueur) Val.
Cape Cod to Florida.
FUNDULUS NIGROFASCIATUS (Lesueur) Val.
Cape Cod to Florida.
HYDRARGYRA MAJALIS (Walb.) Val.
Cape Cod to Cape Hatteras.
HYDRARGYRA SWAMPINA Lac. (d. s.)
Cape Hatteras to Florida.

74.—STOMIATIDÆ.

MALACOSTEUS NIGER Ayres.
Pelagic.
STOMIAS FEROX Reinhardt.
Greenland.

75.—SCOPELIDÆ.

SCOPELUS GLACIALIS Reinhardt.
Greenland.
MAUROLICUS BOREALIS (Nilsson) Gthr (d. s.)
Massachusetts.

76.—SYNODONTIDÆ.

TRACHINOCEPHALUS MYOPS (Bl. Sch.) Gill.
Cape Hatteras to Florida.
SYNODUS FŒTENS (Linn.) Gill.
Cape Cod to Florida.

77.—MICROSTOMIDÆ.

MALLOTUS VILLOSUS (Müller) Cuv.—Capelin.
Polar regions to Nova Scotia.
OSMERUS MORDAX (Mitch.) Gill.—Smelt.
Nova Scotia to Cape Hatteras.
MICROSTOMA GRŒNLANDICA Reinhardt.
Greenland.

78.—SALMONIDÆ.

SALMO SALAR (Linn.) Günther.—Salmon; mishquammauquock (*Narragansett Indians*).
Polar regions to Cape Cod.
SALMO IMMACULATUS H. R. Storer. (d. s.) Sea-trout.
Labrador to Nova Scotia.

79.—PARALEPIDIDÆ.

PARALEPIS BOREALIS Reinhardt.
Greenland.

80.—ALBULIDÆ.

ALBULA CONORHYNCHUS Bloch and Schneider.—Lady-fish.
Cape Cod to Florida.

81.—ELOPIDÆ.

ELOPS SAURUS Linn.—Big-eyed herring; matajuelo blanco and real (*Cuba*).
Cape Cod to Florida.
MEGALOPS THRISSOIDES (Bl. Sch.) Günther.—Jew-fish; tarpum (*Berm.*)
Cape Cod to Florida.

82.—DUSSUMIERIDÆ.

ETRUMEUS TERES (DeKay) Brevoort.—Round herring.
Cape Cod to Cape Hatteras.

83.—CLUPEIDÆ.

BREVOORTIA MENHADEN (Mitch.) Gill.—Menhaden (*Vineyard Sound*;) munnawhatteaug (*Narragansett Indians*); pogy, poghaden (*east coast of New England*); moss-bunker (*New York*); panhaden, panhagen (*New England*); hard-head, bony-fish (*Massachusetts Bay*); skippaug or bunker (*east end of Long Island*); bony-fish (*Saybrook*); white-fish (*Saybrook to Milford, Connecticut*); fat-back and yellow-tail (*coast of North Carolina*); bug-fish (*Carolina*).

Cape Cod to Cape Hatteras.

ALOSA SAPIDISSIMA (Wilson) Storer.—Shad.

Newfoundland to Florida.

OPISTHONEMA THRISSA Gill.—Thread-herring; menhaden (*Portland*); shad-herring (*New York*).

Newfoundland to Florida.

POMOLOBUS PSEUDOHARENGUS (Wilson) Gill. — Herring (*Southern States*); alewife (*New England*); gaspereau (*British provinces*); spring-herring (*New England*); aumsuog (*Narragansett Indians*); kyack, blue-back, alewife, sawbelly, cat-thresher (*Portland, Me.*)

Newfoundland to Florida.

POMOLOBUS MEDIOCRIS (Mitch.) Gill.—Tailor herring (*Potomac*); fall-shad.

Newfoundland to Florida.

CLUPEA HARENGUS Linn.—English herring.

Polar regions to Cape Cod.

84.—DOROSOMIDÆ.

DOROSOMA CEPEDIANUM (Lac.) Gill.—Toothed herring.

Cape Cod to Cape Hatteras.

85.—ENGRAULIDÆ.

ENGRAULIS VITTATUS (Mitch.) Bd. and Girard.—Anchovy.

Cape Cod to Cape Hatteras.

ENGRAULIS BROWNII (Gmelin) Val.—Anchovy.

Cape Cod to Florida (New York, Val).

86.—SILURIDÆ.

ÆLURICHTHYS MARINUS (Mitch.) Baird and Girard.—Fork-tailed cat-fish.

Cape Cod to Florida.

ARIOPSIS MILBERTI (Val.) Gill.—Sea cat-fish.

Cape Cod to Florida.

87.—CONGRIDÆ.

CONGER OCEANICA (Mitch.) Gill.—Conger-eel.

Newfoundland to West Indies.

88.—ANGUILLIDÆ.

ANGUILLA BOSTONIENSIS (Les.) DeKay.—Common eel.

Newfoundland to Cape Hatteras.

89.—SACCOPHARYNGIDÆ.

SACCOPHARYNX FLAGELLUM Mitch.—Gulper.
Pelagic, in deep seas, (lat. 52° N., long. 30° W.—Mitchill.)

90.—ACIPENSERIDÆ.

ACIPENSER OXYRHYNCHUS Mitch. (d. s.)—Sharp-nosed sturgeon.
Cape Cod to Florida.

ACIPENSER BREVIROSTRIS Lesueur.—Short-nosed sturgeon.
Cape Cod to Florida.

91.—CEPHALOPTERIDÆ.

CERATOPTERA VAMPIRUS (Mitch.) Gill.—Devil-fish; manta (*Cuba*).
Cape Cod to Florida.

92.—MYLIOBATIDÆ.

AETOBATIS NARINARI Müll. and Henle.—Bishop-ray; obispo (*Cuba*).
Norfolk, Virginia, to Florida.

RHINOPTERA QUADRILOBA (Les.) Cuv.—Cow-nosed ray.
Cape Cod to Florida.

MYLIOBATIS FREMENVILLEI (Les.) Storer.—Sharp-nosed ray.
Cape Cod to Florida.

93.—TRYGONIDÆ.

PTEROPLATEA MACLURA Müll. and Henle.—Butterfly-ray.
Cape Cod to Florida.

TRYGON CENTRURA (Mitch.) Gill.—Sting-ray; whip-ray; stingaree.
Cape Cod to Florida.

94.—TORPEDINIDÆ.

TORPEDO OCCIDENTALIS Storer.—Torpedo; cramp-fish; numb-fish.
Cape Cod to Florida.

95.—RAIAIDÆ.

RAIA EGLANTERIA Lac. Lesueur.—Clear-nosed ray.
Nova Scotia to Florida.

RAIA ERINACEUS Mitch. (d. s.)—Summer-skate.
Cape Cod to Florida.

RAIA LÆVIS Mitch.—Sharp-nosed skate; winter-skate.
Nova Scotia to Florida.

96.—PRISTIDÆ.

PRISTIS ANTIQUORUM (Linn.) Lath. (d. @ s.)—Saw-fish.
Cape Cod to Florida.

97.—SQUATINIDÆ.

SQUATINA DUMERILI Lesueur. (d. s.)—Angel-fish; shark-ray; monk, or monkey fish, kingston, shark-ray, Fiddle-fish (*Europe*); little bull-head shark (*New York*).
Cape Cod to Florida.

98.—CETORHINIDÆ.

CETORHINUS MAXIMUS Blainv. (d. @ s.)—Basking-shark; sun-fish; sail-fish; hoe-mother (*Great Britain*).
Newfoundland to Cape Hatteras.

99.—LAMNIDÆ.

ISUROPSIS DEKAYI Gill. (d. s.)—Mackerel-shark; dentuda (*Cuba*).
Newfoundland to Florida.

CARCHARODON ATWOODI (Storer) Gill. (d. s.)—Atwood's shark; man-eater (*Maine*).
Newfoundland to Florida.

100.—ODONTASPIDIDÆ.

EUGOMPHODUS LITTORALIS Gill.—Sand-shark; shovel-nose (*Maine*).
Maine to Cape Hatteras.

101.—ALOPECIIDÆ.

ALOPIAS VULPES (Linn.) Bon.—Fox-shark; thresher; swingle-tail; sea-fox; sea ape; pez zorro (*Cuba*); pesce pavone (*Naples*).
Cape Cod to Florida.

102.—SPHYRNIDÆ.

SPHYRNA ZYGÆNA (Linn.) Müll. and Henle.—Hammer-head shark; cornuda (*Cuba*); magnosa (*Naples*).
Cape Cod to Florida.

RENICEPS TIBURO (Linn.) Gill.—Shovel-head shark.
Cape Cod to Florida.

103.—GALEORHINIDÆ.

EULAMIA MILBERTII (Müll. and Henle) Gill.—Blue shark.
Cape Cod to Florida.

EULAMIA OBSCURUS (Lesueur) Gill.—Dusky shark.
Cape Cod to Florida.

APRIONODON PUNCTATUS (Mitch.) Gill.
Cape Cod to Cape Hatteras.

SCOLIODON TERRÆ-NOVÆ (Rich.) Gill.
Newfoundland to Cape Hatteras.

GALEOCERDO TIGRINUS Müll. and Henle.—Tiger-shark; alecrin (*Cuba*).
Cape Cod to Florida.

MUSTELUS CANIS (Mich.) DeKay. (d. s.)—Smooth hound (*Great Britain*); smooth dog-fish; blue-dog (*Massachusetts*); boca dulce (*Cuba*).
Cape Cod to Cape Hatteras.

104.—SPINACIDÆ.

SQUALUS AMERICANUS (Storer) Gill. (d. s.)—Picked dog-fish, dog-fish; bone-dog; skittle-dog; hoe (*Great Britian*).
Newfoundland to Cape Hatteras.

CENTROSCYLLIUM FABRICII (Reinh.) Müll. and Henle.
Greenland.

105.—SCYMNIDÆ.

SOMNIOSUS MICROCEPHALUS (Bloch) Gill. (d. @ s.)—Sleeper-shark; nurse (*Portland*).
Polar regions to Cape Cod.

106.—PETROMYZONTIDÆ.

PETROMYZON AMERICANUS Lesueur. (d. s.)—Lamprey; lamper-eel.
Cape Cod to Cape Hatteras.

AMMOCOETES NIGRICANS (Lesueur) Gill. (d. s.)—Black lamprey.
Cape Cod to Cape Hatteras.

AMMOCOETES APPENDIX (DeKay) Gill. (d. s.)
Cape Cod to Cape Hatteras.

AMMOCŒTES BICOLOR Lesueur. (d. s.)
Cape Cod to Cape Hatteras.

107.—MYXINIDÆ.

MYXINE GLUTINOSA Linn. (d. @ s.)—Hag-fish; sucker; slime-fish.
Polar regions to Cape Cod.

108.—BRANCHIOSTOMIDÆ.

BRANCHIOSTOMA CARIBÆUM Sundevall. (d. s.)—Lancelet.
Cape Hatteras to Florida.

107.—MYXINIDÆ.

MYXINE GLUTINOSA Linn. (d. @ s.)—Hag-fish; sucker; slime-fish.
Greenland.

MYXINE LIMOSA Girard. (d. s.)—Sucker.
Nova Scotia to Massachusetts.

108.—BRANCHIOSTOMIDÆ.

BRANCHIOSTOMA CARIBÆUM Sundevall. (d. s.)—Lancelet.
Cape Hatteras to Florida.

3.—BIBLIOGRAPHY OF EAST COAST FISHES.

I.

The following list embraces almost all the articles purporting to enumerate all the salt-water fishes found at or recorded as inhabiting a given locality, from Greenland to Florida, or (e. g. Holbrook's and Putnam's articles,) commenced with such intention; in addition, the titles of M. Felipe Poey's catalogues are given, as they are indispensable to the American ichthyologist. These articles have been arranged under the names of their authors in alphabetical order. They represent the following geographical areas, commencing with (1) the general works, and then (2) the northern areas.

GENERAL. Gill, Storer (D. H.).—DeKay's "Zoology of New York" may be added as it contains brief notices of the "extra-limital species."

NORTHERN AMERICA. Richardson.

GREENLAND. Fabricius, Reinhardt.

GULF OF ST. LAWRENCE AND BAY OF FUNDY. Fortin, Gill.

LABRADOR. Storer (H. R.)

NOVA SCOTIA. Knight, Perley, Storer (H. R.)

MAINE. Holmes.

MASSACHUSETTS. Lyman, Putnam, Smith, Storer (D. H.)

CONNECTICUT. Linsley.

NEW YORK. Ayres, DeKay, Mitchill.

NEW JERSEY. Abbott, Baird.

SOUTH CAROLINA. Holbrook, Storer.

GEORGIA. Holbrook.

In addition to these, the reports and journals of arctic travelers, and histories and geographies of countries and states may be referred to; but as the lists contained in such works are generally compilations by unscientific persons, they require to be consulted with great caution. Special mention need only be made of Bonnycastle's "Newfoundland in 1842," Belknap's "History of New Hampshire" (1793), Mather's "Geography of the State of New York" (1847), andRussell's "Harper's New-York State Class-Book" (1847).

ABBOTT (Charles Conrad). Catalogue of Vertebrate Animals of New Jersey. . . <Geology of New Jersey. By authority of the legislature. George H. Cook, State Geologist, . . . 1868—Appendix E, or pp. 751–830. ("FISHES," pp. 805–830.)

237 species, of which 194 are marine and 43 fresh-water, are recorded; but many of the names are synonyms, and the list bears evidence of being a compilation, and must be consulted with caution.

AYRES (William O . . .). Enumeration of the Fishes from Brookhaven, Long Island, with Remarks upon the Species observed. . . . <Boston Journal of Natural History, . . . vol. IV, 1844, pp. 255–264 (September, 1842); 265–292 (April, 1843).

61 species are enumerated, including 9 fresh-water species, and observations on the characters and habits of most are recorded

4 species are enumerated as new (*Cottus variabilis* [*Cottus octodecim-spinosus*?], *Gasterosteus millepunctatus* [*Apeltes quadracus*?], *Fundulus fuscus* [= *Melanura*], and *Carcharias griseus* [= *Eugomphodus littoralis*]), the last three of which were described in a succeeding article (Description of four species [including *Leuciscus nasutus*] of Fish from Brookhaven, L. I., all of which are believed to be new), <op. cit., iv, pp. 293–303, pl. 12.

BAIRD (Spencer Fullerton). Report on the Fishes observed on the Coasts of New Jersey and Long Island during the Summer of 1854, by Spencer F. Baird, Assistant Secretary of the Smithsonian Institution. <Ninth Annual Report of the Smithsonian Institution [for 1854], 1855, pp. 317–352+*337.

Reprinted as a pamphlet, with an index, and the following title:

Report to the Secretary of the Smithsonian Institution, on the Fishes of the New Jersey Coast, as observed in the Summer of 1854, by Spencer F. Baird, Assistant Secretary Smithsonian Institution. From the Ninth Annual Report of the Smithsonian Institution for 1854. Washington: Beverley Tucker, Senate Printer, June, 1855. [8vo, 40 pp.]

67 species, of which 57 are marine, or brackish-water, and 10 fresh-water, were observed, and valuable notes on habits and color in a fresh state were recorded.

DEKAY (James E. . . .). Letter from J. E. DeKay, of the Zoological Department, May 7, 1839. <State of New York, ... Communication from the Governor, transmitting Several Reports relative to the Geological Survey of the State. 1840, pp. 7–14.

A mere list of species, of no value.

——— Report of J. E. DeKay, of the Zoological Department [on the Fauna of New York. December 20, 1839]. <Ib. pp. 15–36.

A list like the preceding.

——— Zoology of New-York, or the New-York Fauna; comprising detailed descriptions of all the animals hitherto observed within the State of New-York, with brief notices of those occasionally found near its borders, and accompanied by appropriate illustrations By James E. DeKay. Part IV. Fishes.—Albany: printed by W. & A. White & J. Visscher. 1842. [4to, xiv [1, errata], 415 pp.; atlas, 1 p. l., 79 p. l.]

Descriptions (and, in most cases, figures) of 335 nominal species are given, exclusive of the "extra-limital species" especially so designated, but including some that are really such. Of these 335 nominal species, 265 (including Labraces, Gasterosteidæ, Anguillidæ) are salt- or brackish-water, and 70 fresh-water.

FABRICIUS (Otto). Favna Grœnlandica, systematice sistens animalia Grœnlandiæ occidentalis hactenvs indagata, quoad nomen specificvm, triviale, vernacvlvmqve; synonyma avctorvm plvrivm, descriptionem, locvm, victvm, generationem, mores, vsvm, captvramqve singvli, provt detegendi occasio fvit, maximaqve parte secvndvm proprias observationes Othonis Fabricii ministri evangelii, qvondam Grœnlandis ad coloniam Friderichshaab, . . . Hafniæ et Lipsiæ, impensis Ioannis Gottlob Rothe, . . . MDCCLXXX. [8vo.]

Contains descriptions and notices of 44 species.

FORTIN (Pierre). List of the Cetacea, Fishes, Crustacea, and Mollusca, which now inhabit and have inhabited the Canadian shores of the Gulf of St. Lawrence, and are the object of fishing operations, whether on a large or small scale, and which are used as bait, &c., &c. <Annual Reports of Pierre Fortin, Esq., magistrate in command of the expedition for the protection of the fisheries in the Gulf of St. Lawrence, during the seasons of 1861 and 1862. (Quebec, 1863), pp. 109–124.

——— Continuation of the List of Fish [of] the Gulf and River St. Lawrence. <Annual Reports of Pierre Fortin, Esq., [commanding] the expedition for the protection of the fisheries in the Gulf of St. Lawrence, during the season of 1863, (pp. 60–72), 1864, (pp. 61–69), 1865, (pp. 69–79). (Quebec, 1864–1866.)

The title of each report is slightly varied.

GILL (Theodore Nicholas). Catalogue of the Fishes of the Eastern Coast of North America, from Greenland to Georgia. . . . January, 1861. [8vo, 63 pp.] Issued as an appendix to the "Proceedings of the Academy of Natural Sciences of Philadelphia, 1861."

A list of 394 nominal species, with references, to facilitate identification, to Storer's Synopsis of the Fishes of North America, and, for species not mentioned therein, to other authorities.

——— Synopsis of the Fishes of the Gulf of St. Lawrence and Bay of Fundy. . . . <The Canadian Naturalist and Geologist: a bi-monthly journal of natural science, conducted by a committee of the Natural History Society of Montreal. New series, vol. II, pp. 244–266; August, 1865.

A list of 95 species, of which 81 are marine and brackish, and 14 fresh-water. Dichotomous synoptical tables are given of the orders, suborders, and families, and brief diagnoses of the genera and (where more than one in the genus) of the species.

HOLBROOK (John Edwards). Southern Ichthyology; or, A Description of the Fishes Inhabiting the waters of South Carolina, Georgia, and Florida. By John Edwards Holbrook, M. D., Professor of Anatomy in the Medical College of the State of South Carolina; [etc.] Illustrated with colored engravings, done from life, by J. H. Richard. New York and London: Wiley & Putnam. 1847. No. II. [4to, pp. 1–32, pl. 1–4.]

No others published.

——— [Catalogue of the Fish of the State of Georgia.] <Statistics of the State of Georgia: . . . By George White.—Savannah: W. Thorne Williams. 1849. (Catalogue of the Fauna and Flora of the State of Georgia. Prepared for this work by eminent naturalists. pp. 16–20.)

A list, without notes or remarks, of 140 species, 117 of which are salt- or brackish-water, and 23 fresh-water (excluding the eel).

——— Ichthyology of South Carolina. By John Edwards Holbrook, M. D., Professor of Anatomy in the Medical College of the State of South Carolina; [etc.] Charleston, S. C.: published by John Russell. 1855. [4to, title, pp. 1–182, pl. 1–27.]

Issued in numbers, and terminating in the middle of the description of "*Saurus fœtens.*" Descriptions of 52 species and illustrations of 54 are given.

——— Ichthyology of South Carolina. By John Edwards Holbrook, M. D., [etc.] Vol. I. Charleston, S. C.: published by Russell & Jones. 1860. [4to, title, 4 p. l. (preface), 205 pp., 28 pl.]

This edition was also issued in numbers (10), and was printed by Welch, Bigelow & Co., Cambridge. The descriptions and sequence, with some slight modifications, are the same as in the previous editions, but the plates are new. 56 species are described and illustrated, of which 48 are marine and 8 fresh-water.

A collation of both editions of Holbrook's work is given in a "Review of Holbrook's Ichthyology of South Carolina," [by Theodore Gill,] in the American Journal of Science and Arts (Silliman's), 2d series, vol. XXXVII, pp. 89–94, January, 1864.

HOLMES (Ezekiel). Dr. Holmes' Report on the Fishes of Maine, including some of the Elementary Principles of Ichthyology. (<Part I. Reports upon the Zoology and Botany of the State of Maine.) <Second Annual Report upon the Natural History and Geology of the State of Maine. 1862. pp. 11–117.

The "Second Annual Report upon the Natural History and Geology of the State of Maine. 1862," although paged separately (pp. 1–447), had only this—a bastard-title, and formed an appendix to (although not so specified), and was bound with the "Seventh Annual Report of the Secretary of the Maine Board of Agriculture. 1862. Augusta: Stevens & Sayward, Printers to the State. 1862."

The list of fishes embraces 76 species, and was principally based on a manuscript; of this number, 57 were marine and brackish-water, and 19 fresh-water.

KNIGHT (Thomas F . . .). [1] Descriptive Catalogue of the Fishes of Nova Scotia. By Thomas F. Knight, . . . *E mari merces.* Published by direction of the Provincial Government.—Halifax, N. S. Printed by A. Grant, Printer to the Queen's Most Excellent Majesty. 1866. [8vo, 54 pp.]

51 nominal species of fishes are enumerated and (in most cases described) observations on habits, &c., recorded; 44 of the species are salt- or brackish-water forms, and 7 fresh-water.

——— [2] Shore and Deep Sea Fisheries of Nova Scotia. By Thomas F. Knight, . . . *E mari merces.* Published by direction of the Provincial Government.—Halifax, N. S. Printed by A. Grant, Printer to the Queen's Most Excellent Majesty. 1867. [8vo, vi (1 l.), 113 pp.]

With pinkish paper-covers, respectively entitled, at middle half (1, 2), Pamphlets on the Fishes and Fisheries of Nova Scotia. (1)—No. I. Fishes of Nova Scotia, and (2)—No. II. Shore and Deep Sea Fisheries.

As indicated by the title, this report is chiefly devoted to the fisheries from an economical and political point of view.

LINSLEY (**James Harvey**). Catalogue of the Fishes of Connecticut, arranged according to their natural families; prepared for the Yale Natural History Society, . . . <The American Journal of Science and Arts. Conducted by B. Silliman. (New Haven), xlvii, 1844, pp. 55–80.

A list of 173 nominal species, of which 148 are salt- or brackish-water, and 25 fresh-water.

LYMAN (**Theodore**). Fishes taken in the Waquoit Wier, April 18 to June 18, 1871. Sixth Annual Report of the Commissioners on Inland Fisheries for the year ending January 1, 1872. Boston: Wright & Potter, State Printers, . . . 1872.

"Most of the nomenclature is by Dr. Franz Steindachner; and some notes by Professor Agassiz are added, marked Ag."

The list enumerates 44 species, and is enriched with observations on the economical relations and habits of some of the species.

MITCHILL (**Samuel Latham**). Report, in part, of Samuel L. Mitchill, M. D., Professor of Natural History, &c., on the Fishes of New-York.

I. Apodal.—Eel--silver-fish.
II. Jugular.—Cod—blenny—stomodon.
III. Thoracic.—Flounder—sea-basse—mackerel—gurnard—dolphin.
IV. Abdominal.—Salmon—pike—elops—silver-side—mullet—flying-fish—polynemus—herring—carp—perch—black-fish—bergal—striped basse—weak-fish.
V. Chondropterygious.—Sturgeon—shark—ray—lamprey.
VI. Branchiostegious.—Toad-fish—sun-fish—sea-horse—fishing-frog.

*** Those marked thus * have been described from fresh specimens; with this note ☞ are supposed to be species unknown to the systems, or not plainly enough described; and by this sign ¶ may be used for human food.

The new genera are four, *Stomodon* [=*Merlucius* Raf.], *Morone*, *Tautoga*, and *Roccus*.

A very considerable number of fishes, well known to the author of these beginnings of an attempt, are not even named in the present list, because they have not come to hand during the few weeks that have elapsed since its commencement. Such are the pond-fish, king-fish, sheeps-head, and a multitude more.

New York: printed by D. Carlisle, No. 301 Broadway, January 1, 1814. [12mo, 28 pp., including title.]

To avoid all doubt, it may be specifically stated that the title above given is an exact transcript (kindly furnished by Mr. Brevoort) of the title-page of the work.

——— The Fishes of New York, described and arranged. . . . <Transactions of the Literary and Philosophical Society of New-York: . . . , vol. I, 1815, pp. 355–492, pl. 1–6.

In the introductory remarks, 147 species (and, in addition, 19 varieties) are summed up. These are arranged according to Shaw's modification of the Linnæan system, and the generic diagnoses are mostly copied (sometimes with slight verbal modifications) from Shaw's work. 60 of the species are illustrated (mostly from drawings by Dr. Akerly, a brother-in-law of Dr. Mitchill) on 6 steel-plates.

The preceding work appears to have been translated into French by F. J. Meisser, a physician of Brussels, it being apparently the work referred to under the title: "Mémoire sur l'ichthyologie de l'Amérique Septentrionale, par Mitchill, traduction de l'anglais," in Vandermaelen's Dictionnaire des hommes des lettres, des savans et des artistes de la Belgique (1837), p. 29. I have never seen the work.

——— Memoir on Ichthyology. The Fishes of New York described and arranged. In a supplement to the Memoir on the same subject, printed in the New-York Literary and Philosophical Transactions, vol. I, pp. 355–492. By Samuel L. Mitchill. <The American Monthly Magazine and Critical Review, vol. II (New-York: 1817–1818), pp. 241–248 (February, 1818); 321–328 (March, 1818).

In this supplement 42 nominal species are added, of which 31 are given as marine and 11 are enumerated as fresh-water; but two of the latter ("the fresh-water eel," and "long-jawed fresh-water pike," or *Belone*) are really rather salt- or brackish-water species.

PERLEY (M . . . H . . .). Report upon the Fisheries of the Bay of Fundy. By M. H. Perley, Esquire, Her Majesty's Emigration Officer at Saint John, New Brunswick, . . . Fredericton: J. Simpson, Printer to the Queen's Most Excellent Majesty. 1851. [8vo, viii, 176 pp.]

Contains a list of 55 nominal species, of which 42 are salt-water and 13 fresh-water.

——— Descriptive Catalogue [in part] of the Fishes of New Brunswick and Nova Scotia, by M. H. Perley, Esquire, Her Majesty's Emigration Officer at Saint John, New Brunswick. [Second edition.] Fredericton: J. Simpson, Printer to the Queen's Most Excellent Majesty. 1852. [8vo, cover-title, 50 pp.]

Contains a list of 62 nominal species, of which 49 are salt-water and 13 fresh-water. It is a second edition of the catalogue in the preceding work (pp. 118–159).

POEY (Felipe). Conspectus Piscium cubensium. Extrait des Memorias sobre la Historia natural de la isla de Cuba, tome 2e, dont la pagination a été conservée. Par Felipe Poey. Habana, 1861: imprenta de la viuda de Bareina y compañia, calle de la Reina, num. 6. [8vo, title, pp. 357–404.]

An extract from the following work:

——— Memorias sobre la Historia natural de la isla de Cuba, acompañadas de sumarios latonis, y estractos en Frances. Por Felipe Poey, catedratico de zoologia y de anatomia conparada de la real universidad de la Habana, y socio pundador de la Sociedad Entomologica de Francia. Toma 2o. Habana: imprenta de la viuda de Bareina, calle de la Reina, num. 6, 1856–1858.

——— Synopsis Piscium cubensium. Catalogo razonado de los peces de la isla de Cuba, extractado del Repertorio fisico-natural de la isla de Cuba, Director Felipe Poey, tome 2o, página 279 y siguientes [–465]. Por Felipe Poey. Habana, 1868: imprenta de la viuda de Bareina y compa, calle de la Reina, No. 6. [8vo, 1 title, pp. 279–465.]

Although primarily catalogues of Cuban, and therefore extra-limital, forms, they are almost indispensable to the investigator of the North American species.

PUTNAM (Frederick Ward). [Fishes of Essex County, Massachusetts.] <Proceedings of the Essex Institute, vol. I, pp. 144, 148, 201, . . . 1855–'6.

Discontinued after the third article; 22 species (Percidæ—Scombridæ) were enumerated.

REINHARDT (Johan). Fortegnelse over Grönlands Pattedyr, Fugle og Fiske, . . . <Rink (H . . .) Grönland, geographisk og statistik beskrevet, Kjöbenhavn, 1857.

Reprinted (from same types) with rest of natural history in the following work:

Naturhistoriske Bidrag til en Beskrivelse af Grönland, af J. Reinhardt, J. C. Schiödte, O. A. L. Mörch, C. F. Lütken, J. Lange, H. Rink . . . Kjöbenhavn. Louis Kleins Bogtrykkeri. 1857, (pp. 20–27.)

A nominal list of 69 species, with references to original descriptions, or to the Fauna Grœnlandica of Fabricius, and with the names current among the Esquimaux. Only four of the species (Salmonidæ) are fresh-water.

The same list (but without the references to authorities) was translated and published in Etzel's (Anton von) Grönland geographisch und statistisch beschrieben. Aus dänischen Quellenschriften. Stuttgart, J. G. Cotta'scher Verlag. 1860. (pp. 582–584.)

RICHARDSON (**John**). Fauna Boreali-Americana; or, the Zoology of the Northern Parts of British America: containing Descriptions of the Objects of Natural History Collected on the late Northern Land Expeditions under the command of Captain Sir John Franklin, R. N. Part third. The Fish. By John Richardson, M. D., F. R. S., F. L. S., . . . , Surgeon and Naturalist to the Expeditions. Illustrated by numerous plates. Published under the authority of the Right Honourable the Secretary of State for Colonial Affairs.—London: Richard Bentley, New Burlington street. MDCCCXXXVI. [4to, xv, 327 (+1) pp., 24 pl. (numbered 74–97).]

SCHŒPFF (**Johann David**). Beschreibung einiger nord-amerikanischer Fische, vorzüglich aus den Neu-Yorkischen Gewässern, . . . <Schriften der Gesellschaft naturforschender Freunde zu Berlin. viii, 138–194, 1788.

SMITH (**Jerome Van Crowninshield**). Natural History of the Fishes of Massachusetts, embracing a practical essay on angling. By Jerome V. C. Smith, M. D. [Cut.] Boston: Allen and Ticknor. 1833. [12mo, vii, 399 (+1) pp.]

An exceptionally and even ludicrously erroneous and worthless compilation. Its character was exposed in "Remarks on the 'Natural History of the Fishes of Massachusetts, . . .' Read before the Boston Society of Natural History, March 20, 1839. By D. Humphreys Storer, M. D. <American Journal of Science and Arts (Silliman's), vol. XXXVI, July, 1839, pp. 337–349." According to Dr. Storer (p. 348), the work of his compatriot contains "notices of 105 species, of which 80 are foreigners, and but 25 are found in the waters of our State. Of these 105 species, 36 are illustrated by figures; of these 36 illustrations, but 9 accompany species which are found on our coast; of these 9 figures, 6 are copied from '*Strack's Plates*,' and 3 from Mitchill's '*Fishes of New York*;' of the 36 illustrations [small wood-cut figures] contained in this '*History*,' not one is drawn from nature."

——— A Catalogue of the Marine Fishes taken on the Atlantic Coast of Massachusetts. . . . [Also, "Fishes found in the Rivers, Mountain-Streams and Ponds of Massachusetts."] <Report on the Geology, Mineralogy, Botany, and Zoology of Massachusetts, . . . By Edward Hitchcock, . . . Boston, 1833, pp. 553–554.

A list of 52 nominal species of marine and 17 of fresh-water fishes.

——— [Revised Catalogue of the Fishes of Massachusetts.] <Op. cit., 1833, pp. 597–598.

A list of 102 nominal species, 83 of which (including the Bodiani=Morone) are salt- or brackish-water, and 19 fresh-water.

——— A Catalogue of the Marine and Fresh-Water Fishes of Massachusetts, . . . <Op. cit., second edition. Boston, . . . , 1835, pp. 534–538.

A list of the same character as the preceding, enumerating 106 nominal species (and 2 varieties), of which 89 are salt- or brackish-water, and 17 fresh-water. Reproduced (pp. 15–18) in the "Catalogues of the Animals and Plants of Massachusetts." (Edited by Edward Hitchcock), Amherst, 1835, reprinted (same type) from the second edition of the above-cited work.

The catalogue is a repetition of the names (without descriptions or remarks) of the author's "Natural History of the Fishes of Massachusetts."

This compilation was also criticised (by Dr. D. H. Storer) in 1837 in "An Examination of the 'Catalogue of the Marine and Fresh-water Fishes of Massachusetts,' by J. V. C. Smith, M. D.," contained in Professor Hitchcock's "Report on the Geology, Mineralogy, &c., of Massachusetts. By D. Humphreys Storer, M. D." <Boston Journal of Natural History, . . . vol. I, pp. 347-365, pl. viii (May, 1836).

STORER (David Humphreys). A Report on the Fishes of Massachusetts. By D. Humphreys Storer, M. D. <Boston Journal of Natural History, . . . , vol. II, 1839, pp. 289–558, pl. vi–viii.

Descriptions are given of 107 nominal species, 91 of which are salt- or brackish-water, and 16 fresh-water; in the concluding remarks, 9 additional undeterminate species are indicated as probable inhabitants of the Massachusetts waters.

——— Supplement to the Ichthyological Report. <Ib., vol. III, 1841, pp. 267–273.

——— Additional Descriptions of, and Observations on, the Fishes of Massachusetts. 1842. <Ib., IV, 1844, pp. 175–190.

A second supplement to the report.

——— Reports on the Ichthyology and Herpetology of Massachusetts. By D. Humphreys Storer, M. D. . . . <Reports on the Fishes, Reptiles, and Birds of Massachusetts. Published agreeably to an order of the legislature, by the commissioners on the zoological and botanical survey of the State. Boston: Dutton & Wentworth, State Printers. 1839. [8vo, xii [+ 2 l.], 426 pp., 4 pl.], pp. 1–253, with half-title,—Fishes of Massachusetts,—pp. 1-202, pl. 1–3.

The report on the fishes is the same as that published in the "Boston Journal of Natural History," but (1) an entirely different introduction is added, (2) the supplementary observations on "*Carcharias obscurus*" (B. J., III, 558) are omitted, and (3) supplementary observations are added (pp. 405–409) on several species.

The plates are apparently printed from the same lithographic stones.

——— A Synopsis of the Fishes of North America. . . . <Memoirs of the American Academy of Arts and Sciences. New series. Vol. II. (Cambridge, 1846), pp. 253–550.

739 nominal species from all North America (including the West Indies) are described. The descriptions, however, are mostly inaptly compiled and insufficient.

——— A Synopsis of the Fishes of North America. By David Humphreys Storer, M.D., A. A. S., . . . Cambridge: Metcalf and Company, printers to the university. 1846. [4to, 1 p. l. (=title), 298 pp.]

A reprint, with separate pagination, title-page, and index, of the preceeding.

——— [Catalogue of the Fishes of South Carolina.] <Report on the Geology of South Carolina. By M. Tuomey, . . . Columbia, S. C. . . . 1848. Appendix.—Catalogue of the Fauna of South Carolina. [Edited by Lewis R. Gibbes. pp. i–xxiv]—4. Class. Fishes. [By D. H. Storer, pp. x–xiii.]

A nominal list of 140 species (23 of which are fresh-water species), representing 90 genera, is given; it is little trustworthy.

——— A History of the Fishes of Massachusetts. By David Humphreys Storer. <Memoirs of the American Academy of Arts and Sciences (Boston), new series, viz:—

(1,) V, pp. 49–92, pl. 1–8, 1853;
(2,) V, pp. 122–168, pl. 9–16, 1853;
(3,) pp. 257–296, pl. 17–23, 1855;
(4,) VI, pp. 309–372, pl. 24–29, 1858;
(5,) VIII, pp. 389–434, pl. 30–35, 1863;
(6,) IX, pp. ——, pl. 36–39, 1867.

134 species are described and (except one—the *Pholis subbifurcatus*=*Eumesogrammus subbifurcatus*) illustrated, and, in an appendix, a nominal list (by Mr. Frederick Putnam, of Salem) of 21 additional species is published. Of the 134 species, 116 are salt- or brackish-water, and 18 fresh-water.

——— A History of the Fishes of Massachusetts. By David Humphreys Storer, M. D., A. A. S. . . . (Reprinted from the Memoirs of the American Academy of Arts and Sciences.)—Cambridge and Boston: Welch & Bigelow and Dakin & Metcalf. 1867. [4to, 2 p. l., 287 pp., 39 pl.—pl. 39 folded.]

As indicated on the title-page, a reprint of the preceding, or rather a collection of extras of the several parts of that work separately and consecutively paged, and with independent title-page and index.

STORER (Horatio Robinson). Observations on the Fishes of Nova Scotia and Labrador, with Descriptions of New Species. . . . (1850). <Boston Journal of Natural History, VI, 1857, pp. 247–270, pl. 7–8.

A list of 29 species.

II.

The following titles of articles by the author are appended for the purpose of affording ready reference to papers wherein are given the reasons for many of the changes in the nomenclature of the species enumerated in the catalogue. The articles are designated in the sequence adopted in the classification used in the catalogue. The arguments for the adoption of the names used for the species of several families, in most cases, are given in the articles on those families cited.

GILL (Theodore Nicholas). Synopsis of the Pleuronectoids of the Eastern Coast of North America. . . . <Proceedings of the Academy of Natural Sciences of Philadelphia, 1864, pp. 214–224.

——— Synopsis of the North American Gadoid Fishes. . . . <P. 1863, pp. 242–254.

——— Synopsis of the Family of the Lycodoidæ. . . . <P. 1863, pp. 254–262.

——— On the cranial characteristics of Gadus [Microgadus] proximus, Grd. [type of the genus Microgadus]. . . . <P. 1865, p. 69.

——— Synopsis of the Uranoscopoids. . . . <P. 1863, pp. 108–117.

——— Synopsis of the Cyclopteroids of Eastern North America. . . . <P. 1864, pp. 189–194.

——— On the Gobioids of the Eastern Coast of the United States. . . . <P. 1863, pp. 267–271.

——— Note on the Species of Sebastes of the Eastern Coast of North America. . . . <P. 1863, pp. 333–335.

——— Description of a New Species of Chœrojulis from North Carolina. . . . <P. 1863, pp. 205–207.

——— Synopsis of the Carangoids of the Eastern Coast of North America. . . . <P. 1862, pp. 430–443.

——— Catalogue of the North American Sciænoid Fishes. . . . <P. 1863, pp. 28–32.

——— On the Liostominæ. . . . <P. 1861, pp. 89–93.

——— On the Haploidonotinæ. . . . <P. 1861, pp. 100–105.

——— Revision of the Genera of North American Sciæninæ. . . . <P. 1861, pp. 79–89.

——— On the Genus Anisotremus, Gill. . . . <P. 1861, pp. 105–108.

——— Monograph of the Genus Labrax. . . . <P. 1860, pp. 108–119.

——— Notes on the Nomenclature of Genera and Species of Echeneidoidæ. . . . <P. 1864, pp. 59–61.

——— Synopsis of the Eastern American Sharks. . . . <P. 1864, pp. 258–265.

XX.—LIST OF FISHES COLLECTED AT WOOD'S HOLE.

By S. F. Baird.

All the species of fishes in the following list (121 in number) were collected by the United States Commission during the season of 1871, with the exception of a few taken there the following year by Vina N. Edwards, and of *Lactophrys trigonus* and *Hippocampus hudsnius*, given by Dr. Storer as taken at Holme's Hole, or Vineyard Haven. A complete collection was secured for the National Museum, together with many duplicates for distribution to college and other museums throughout the country, and for exchange. Of all taken in 1871, photographs were made on plates, 11 × 14 inches, representing the fishes either of life size or as reduced to within the above dimensions, and in their different ages and varieties, thus showing the rate of growth, and other facts.

At some future time I hope to present detailed biographies and descriptions of all the species, with suitable figures.

Mola rotunda (Cuv.)	The Sun-Fish.
Tetrodon lævigatus L.	The Smooth Swell-Fish.
Chilichthys turgidus (Mitch.) Gill.	The Rough Swell-Fish.
Chilomycterus geometricus (L.) Kaup.	The Box-Fish.
Lactophrys trigonus (L.) Poey.	The Trunk-Fish.
Alutera cuspicauda DeKay.	The Brown File-Fish.
Ceratacanthus aurantiacus (Mitch.) Gill.	The Orange File-Fish.
Stephanolepis setifer (Bennett) Gill.	The Standard File-Fish.
Balistes vetula, Linn.	The Trigger-Fish—The old wife.
Hippocampus hudsonius DeKay.	The Sea-Horse.
Syngnathus peckianus Storer.	The Pipe-Fish.
Lophius americanus DeKay.	The Goose-Fish—The Monk-Fish.
Achirus lineatus (L.) Cuv.	The Hog-Choker; the Sole.
Pseudopleuronectes americanus (Walb.) Gill.	The Common Flat-Fish.
Myzopsetta ferruginea (Storer) Gill.	The Rusty Flat-Fish.
Chænopsetta ocellaris (DeKay) Gill.	The Common Flounder.

CHÆNOPSETTA OBLONGA (Mitch.) Gill.	The Four-spotted Flounder.
HIPPOGLOSSUS AMERICANUS Gill.	The Halibut.
LOPHOPSETTA MACULATA (Mitch.) Gill.	The Spotted Turbot.
AMMODYTES AMERICANUS DeKay.	The Sand-Eel—The Sand-Launce.
MERLUCIUS BILINEATUS (Mitch.) Gill.	The Silver Hake—The Whiting.
POLLACHIUS CARBONARIUS (L.) Bon.	The Pollock.
GADUS MORRHUA (L.)	The Cod-Fish.
MICROGADUS TOMCODUS (Walb.) Gill.	The Tom-Cod.
MELANOGRAMMUS ÆGLEFINUS (L.) Gill.	The Haddock.
PHYCIS CHUSS (Walb.) Gill.	The Hake.
LEPTECHENEIS NAUCRATES (L.) Gill.	The Sucker.
LEPTECHENEIS NAUCRATEOIDES (Zuiew.) Gill.	The Sucker.
RHOMBOCHIRUS OSTEOCHIR (Cuv.) Gill.	The Sucker.
REMOROPSIS BRACHYPTERA (Lowe) Gill.	The Sucker.
ECHENEIS REMORA L.	The Sucker.
BATRACHUS TAU L.	The Toad-Fish.
CYCLOPTERUS LUMPUS L.	The Lump-Fish.
MURÆNOIDES MUCRONATUS (Mitch.) Gill.	The Rock-Eel.
COTTUS OCTODECEM-SPINOSUS Mitch.	The Sculpin.
COTTUS MITCHILLI DeKay.	Mitchill's Sculpin.
DACTYLOPTERUS VOLITANS (L.) Cuv. and Val.	The Flying Gurnard.
PRIONOTUS EVOLANS (Linn.) Gill.	The Striped Sea-Robin.
PRIONOTUS CAROLINUS (L.) Cuv. and Val.	The Carolina Sea-Robin.
HEMITRIPTERUS ACADIANUS (Walb.) Storer.	The Sea-Raven.
CYNOSCION REGALIS (Bl.) Gill.	The Weak-Fish—The Squeteague.
LIOSTOMUS OBLIQUUS (Mitch.) Cuv. and Val.	The Lafayette.
MENTICIRRUS NEBULOSUS (Mitch.) Gill.	The King-Fish.
PIMELEPTERUS BOSCII (Lac.)	Bosc's Pimelepterus.
STENOTOMUS ARGYROPS (L.) Gill.	The Scup—The Porgy.

LOBOTES SURINAMENSIS (Bl.Schn.) Cuv.	The Flasher.
TAUTOGA ONITIS (L.) Gthr.	The Tautog.
TAUTOGOLABRUS ADSPERSUS (Walb.) Gill.	The Cunner.
CENTROPRISTES ATRARIUS (L.)	The Sea-Bass.
ROCCUS LINEATUS (Bl.) Gill.	The Striped Bass—The Rock-Fish.
MORONE AMERICANA (Gmel.) Gill.	The White Perch.
POMATOMUS SALTATRIX (L.) Gill.	The Blue-Fish.
ELACATE CANADUS (L.)	The Cobia.
XIPHIAS GLADIUS (L.)	The Sword-Fish.
HISTIOPHORUS GLADIUS (Brouss.) Lac.	The Sail-Fish.
TETRAPTURUS ALBIDUS Poëy.	The Bill-Fish—The Spear-Fish.
PALINURICHTHYS PERCIFORMIS (Mitch.) Gill.	The Rudder-Fish.
PORONOTUS TRIACANTHUS (Peck) Gill.	The Butter-Fish.
SCOMBER SCOMBRUS Linn.	The Common Mackerel.
CYBIUM MACULATUM (Mitch.) Gill.	The Spanish Mackerel.
CYBIUM REGALE (Bloch) Cuv. and Val.	The Cero, or King-Fish.
SARDA PELAMYS (L.) Cuv.	The Bonito.
ORCYNUS SECUNDI-DORSALIS (Storer) Gill.	The Horse-Mackerel.
ORCYNUS ALLITERATUS (Raf.) Gill.	The Small Tunny.
VOMER SETIPINNIS (Mitch.) Ayres.	The Horse-Fish.
DECAPTERUS PUNCTATUS (Mitch.)	The Dotted Scad.
DECAPTERUS MACARELLUS (C. and V.)	The Mackarel Scad.
TRACHUROPS CRUMENOPHTHALMUS (Bl.) Gill.	The Big-eyed Scad.
PARATRACTUS PISQUETOS (Cuv. and Val.) Gill.	The Yellow Crevallé.
CARANGUS HIPPOS (Linn.) Gill.	The Horse-Crevallé.
BLEPHARICHTHYS CRINITUS (Akerly) Gill.	The Thread-Fish.
TRACHYNOTUS OVATUS (L.) Gthr.	The Round Pompano.
TRACHYNOTUS CAROLINUS (L.) Gill.	The Common Pompano—The Crevallé.
HALATRACTUS ZONATUS (Mitch.) Gill.	The Northern Pilot.
MUGIL LINEATUS Mitch.	The Mullet.
CHIROSTOMA NOTATA (Mitch.) Gill.	The Sand-Smelt—The Friar.
APELTES QUADRACUS (Mitch.) Br.	The Four-spined Stickle-Back.
GASTEROSTEUS BIACULEATUS Shaw.	The Two-spined Stickle-Back.

Pygosteus dekayi (Ag.) Brev.	DeKay's Stickle-Back.
Belone longirostris (Mitch.) Gill.	The Silver Gar—The Bill-Fish.
Scomberesox scutellatus Les.	The Skipper.
Cyprinodon variegatus Lac.	The Mummichog.
Fundulus pisculentus (Mitch.) Cuv. and Val.	The Mummichog.
Fundulus multifasciatus (Les.) Val.	The Mummichog.
Hydrargyra majalis (Walb.) Val.	The Mummichog.
Salmo salar L.	The Salmon.
Osmerus mordax (Mitch.) Gill.	The Smelt.
Exocætus melanurus Val.	The Flying-Fish.
Engraulis vittata (Mitch.) B. & G.	The Anchovy.
Brevoortia menhaden (Mitch.) Gill.	The Menhaden.
Alosa sapidissima (Wilson) Storer.	The Shad.
Pomolobus pseudo-harengus (Wilson) Gill.	The Alewife.
Pomolobus mediocris (Mitch.) Gill.	The Fall-Shad—The Tailor-Shad.
Clupea elongata Les.	The Sea-Herring.
Conorhynchus macrocephalus (Lac.) Gill.	The Lady-Fish.
Elops saurus L.	The Big-eyed Herring.
Conger oceanica (Mitch.) Gill.	The Conger-Eel.
Anguilla bostoniensis (Les.) DeKay.	The Eel.
Ælurichthys marinus (Mitch.) Baird and Girard.	The Sea Cat-Fish.
Acipenser oxyrhynchus Mitch.	The Sharp-nosed Sturgeon.
Acipenser brevirostris Les.	The Blunt-nosed Sturgeon.
Rhinoptera quadriloba (Les.) Cuv.	The Cow-nosed Ray.
Myliobatis fremenvillei Les.	The Sharp-headed Ray.
Pteroplatea maclura (Müll. and Henle).	The Butterfly-Ray.
Torpedo occidentalis Storer.	The Torpedo—The Cramp-Fish.
Trygon centrura (Mitch.) Gill.	The Sting-Ray.
Raia erinacea Mitch.	The Prickly Skate.
Raia lævis Mitch.	The Barn-door Skate.
Raia diaphana Mitch.	The Summer-Skate.
Isuropsis dekayi Gill.	The Mackerel-Shark.

CARCHARODON ATWOODI (Storer) Gill.	The Man-Eater.
EUGOMPHODUS LITTORALIS Gill.	The Sand-Shark.
ALOPIAS VULPES (L.) Bon.	The Thrasher-Shark.
SPHYRNA ZYGÆNA (L.) Müll. and Henle.	The Hammer-head Shark.
EULAMIA MILBERTI (Müll. and Henle) Gill.	The Blue-Shark.
EULAMIA OBSCURA (Les.) Gill.	The Dusky Shark.
GALEOCERDO TIGRINUS Müll. and Henle.	The Tiger-Shark.
MUSTELUS CANIS (Mitch.) DeKay.	The Smooth Dog-Fish.
SQUALUS AMERICANUS (Storer) Gill.	The Horned Dog-Fish.
SQUATINA DUMERILI.	The Angel-Fish.
PETROMYZON AMERICANUS Les.	The Lamprey-Eel.

XXI.—TABLE OF TEMPERATURES OF THE LITTLE HARBOR, WOOD'S HOLE, MASS., FROM JANUARY, 1873, TO DECEMBER, 1873, (INCLUSIVE.)

FURNISHED BY THE LIGHT-HOUSE BOARD FROM OBSERVATIONS OF CAPT. B. J. EDWARDS.

The observations were all taken at 9 a. m. at the south end of the Government light-house wharf, the water being there about ten feet deep. The harbor is of moderate extent and shallow, the greatest depth at low water being about ten feet. The rise and fall of tide is but slight, seldom exceeding two feet.

JANUARY, 1873.			
Date.	Surface.	Bottom.	Remarks.
Jan. 1	30	30	Wind N.N.W., light; floating ice.
2	30	30	Wind N. W., light; floating ice.
3	31	31	Wind S. W., light; floating ice.
4	31	32	Wind W., light; floating ice.
5	31	31	Wind S. S. E., light; floating ice.
6	33	34	Wind W. S. W., strong; floating ice.
7	31	32	Wind N.N.W., light; floating ice.
8	31	32	Wind N. E., light; floating ice.
9	33	34	Wind W., moderate; no ice.
10	30	31	Wind W., fresh; floating ice.
11	30	30	Wind W.N.W., fresh; ice mak'g.
12	30	30	Wind N. W., strong; floating ice.
13	31	31	Wind S. E., light; floating ice.
14	31	32	Wind S. W., fresh; floating ice.
15	31	32	Wind E., fresh; floating ice.
16	33	33	Wind S., fresh, no ice in harbor.
17	38	37	Wind S., strong; no ice; raining.
18	35	35	Wind N. E., fresh; no ice; raining.
19	35	35	Wind W. by S., fresh; no ice; clouds.
20	31	32	Calm; thin ice on the water.
21	32	34	Calm; thin ice in the harbor.
22	35	35	Wind W. by S., fresh; no ice in harbor.
23	33	33	Wind N. W., light; no ice.
24	32	33	Wind N. E., strong; snowing.
25	30	30	Wind N. N. W., fresh; ice making in harbor.
26	30	31	Calm; thin ice on water.
27	30	31	Wind N. E.; snowing; thin ice on water.
28	30	31	Wind W. N. W., moderate; floating ice.
29	29	29	Wind N. W., fresh; ice making.
30	30	30	Calm; harbor covered with ice.
31	30	31	Wind W. N. W., fresh; harbor covered with ice.

FEBRUARY, 1873.			
Date.	Surface	Bottom.	Remarks.
Feb. 1	31	31	Wind W. N. W., light; thin ice in harbor.
2	30	30	Wind N. W., light; thin ice in harbor.
3	30	30	Wind W. by S., fresh; harbor covered with ice.
4	30	30	Wind N. W., light; thick fog; ice in harbor.
5	31	31	Wind W. N. W., light; floating ice in harbor.
6	31	31	Wind S. W., light; floating ice in harbor.
7	31	32	Wind E. S. E., light; floating ice in harbor.
8	33	33	Wind W. by S., light; no ice in harbor.
9	32	32	Wind N. W., light; no ice in harbor.
10	30	30	Wind N. W. by N., fresh; ice making in harbor.
11	30	30	Wind S., light; harbor full of thin ice.
12	31	32	Wind N., light; thin ice in harbor.
13	30	30	Wind N. E., strong; snowing.
14	30	30	Wind N. E., light; snowing; some ice.
15	30	30	Calm; thin ice in the harbor.
16	30	31	Wind S. E., light; thin ice in the harbor.
17	33	32	Wind N. E.; snowing; been shining; thawing.
18	31	31	Wind N., light; some thin ice in harbor.
19	33	32	Wind S. S. E., fresh; no ice in harbor.
20	32	32	Wind W. N. W., fresh; no ice in harbor.
21	32	32	Wind E. S. E., light; no ice in harbor.
22	30	30	Wind W. N. W., strong; some thin ice in harbor.
23	30	30	Wind W. N. W., strong; ice making in harbor.
24	29	29	Do.
25	29	29	Wind W.N.W., moderate; clear; ice making.
26	30	30	Wind W. N. W., light; floating ice in harbor.
27	31	31	Calm; some thin ice in harbor.
28	31	31	Wind N. N. W., light.

MARCH, 1873.

Date.	Surface.	Bottom.	Remarks.
Mar. 1	31	32	Wind S. W., light; no ice in harbor.
2	31	32	Wind W., light; no ice in harbor.
3	32	32	Wind N.E.; snowing; some drift-ice.
4	30	30	Wind N. N. W.; bottom-frost in the harbor.
5	30	30	Wind N. N. W., light; surface-frost in harbor.
6	31	32	Calm, and thin ice in harbor.
7	31	31	Wind S.W., fresh; harbor full of ice.
8	31	32	Do.
9	31	32	Wind W. by S., fresh; harbor full of ice.
10	31	32	Wind S.W., fresh; some ice in harbor.
11	31	32	Wind S.E., brisk.
12	32	32	Wind S.W., strong; no ice.
13	32	33	Wind N.W., fresh.
14	34	35	Wind W.; clear.
15	36	36	Wind S.W.; clouds.
16	35	35	Wind W.; clouds.
17	34	34	Wind N.W., fresh.
18	34	34	Wind W.; clear.
19	37	38	Wind W., moderate.
20	36	37	Wind S.E.; clouds.
21	37	38	Wind W. S.W., strong.
22	36	36	Wind W., fresh.
23	37	38	Do.
24	36	36	Wind N.W., light.
25	36	36	Wind E., moderate.
26	35	35	Wind E., brisk.
27	34	34	Wind W. N.W., brisk; clear.
28	36	36	Calm; clear.
29	39	40	Wind S. by E., brisk; clouds.
30	39	40	Wind W. S.W., fresh gale.
31	38	38	Wind E. S.E., moderate.

APRIL, 1873.

Date.	Surface.	Bottom.	Remarks.
Apr. 1	39	39	Wind W.; clear.
2	41	42	Wind S. E. by S., strong gale.
3	41	41	Wind W. by S., light; fog.
4	42	42	Wind W. N. W., light; clear.
5	39	39	Wind N. N. W.; clouds.
6	40	40	Wind E., light; clouds.
7	42	42	Wind S. E., light; fog.
8	42	42	Wind S. W., light; fog.
9	42	42	Wind E., light; clouds.
10	44	44	Wind N. W., light.
11	42	42	Clear and calm.
12	43	43	Wind E., strong gale; rain.
13	42	42	Wind N. E., fresh; rain.
14	42	42	Wind W. N. W., brisk; clouds.
15	42	42	Wind N. by E., light.
16	43	43	Wind N. E., brisk.
17	44	44	Wind E. S. E., light.
18	44	44	Wind S. S. W., light; fog.
19	43	43	Wind N. W., light; clouds.
20	45	45	Wind W. N. W., light; clear.
21	44	44	Wind W., light; clouds.
22	42	42	Wind W., light; clear.
23	43	43	Wind N., light; clear.
24	45	45	Wind N. N. W., light; clear.
25	44	44	Wind W. N. W., moderate.
26	44	44	Wind W. N. W., brisk.
27	44	44	Wind W. by N., brisk.
28	45	45	Wind W. N. W., light.
29	47	47	Do.
30	48	47	Calm, with rain.

MAY, 1873.

Date.	Surface.	Bottom.	Remarks.
May 1	49	48	Clear; wind W. S. W., light.
2	50	49	Rain; wind S. S. W., light.
3	46	46	Clouds; wind N. E., brisk.
4	46	46	Clear; wind N. N. E., brisk.
5	49	48	Clear; wind S. W., fresh.
6	49	48	Clear; wind N. E., light.
7	50	49	Clear; calm.
8	51	51	Clear; wind E. S. E., light.
9	50	50	Rain; wind E. S. E., brisk.
10	50	49	Clouds; wind S. S. W., light.
11	50	49	Fog; wind E. S. E., moderate.
12	48	48	Clouds; wind W. S. W., light.
13	50	50	Clear; wind S. W., brisk.
14	50	50	Clear; wind W. N. W., light.
15	51	50	Clear; wind W. N. W., brisk.
16	53	52	Clear; calm.
17	53	52	Clouds; wind N. W., light.
18	53	52	Clear; wind W. S. W., light.
19	52	52	Clear; wind W., light.
20	53	52	Do.
21	54	54	Clouds; wind S. E., light.
22	56	55	Clouds; wind S. by E., light.
23	60	56	Clear and calm.
24	58	56	Fog; wind S. W., light.
25	59	56	Clear and calm.
26	59	57	Do.
27	58	57	Fog; wind S. W., light.
28	58	58	Fog; wind S. W., brisk.
29	59	58	Clear; wind W., light.
30	62	60	Clear; wind N., light.
31	56	56	Clear; wind N. E., brisk.

JUNE, 1873.

Date.	Surface.	Bottom.	Remarks.
June 1	58	57	Clear; wind W. S. W., brisk.
2	59	58	Clear; wind N. E., light.
3	58	58	Clouds; wind E. N. E., brisk.
4	56	56	Clouds; wind S. S. W., light.
5	57	57	Clouds; wind E. N. E., light.
6	61	60	Fog; wind S. W., light.
7	59	59	Clouds; calm.
8	57	58	Clouds; wind N. E., brisk
9	57	57	Clear; wind N. N. E., brisk.
10	59	58	Clear; wind W. S. W., light.
11	60	60	Clouds; wind S. W., brisk.
12	60	60	Clear; wind N., light.
13	61	61	Clear; wind E. S. E., light.
14	61	61	Clouds; wind E., light.
15	59	59	Clouds; wind N. W., light.
16	64	62	Clear; wind S. W., light.
17	65	64	Do.
18	64	63	Clear; wind N. N. W., light.
19	65	64	Fog; wind S. W., light.
20	67	66	Clear; wind S. W., light.
21	65	64	Clear; wind N., light.
22	65	64	Clear; wind E. S. E., light.
23	65	64	Clear; wind S. W., light.
24	65	64	Clouds; wind E. S. E., light.
25	65	65	Clear; wind S. E., light.
26	65	64	Clear; wind S. W., light.
27	66	65	Clear; wind W. S. W., brisk.
28	67	67	Clouds; wind S. W., brisk.
29	68	67	Clear; wind S. W., brisk.
30	69	69	Fog; wind S. S. W., brisk.

JULY, 1873.

Date.	Surface.	Bottom.	Remarks.
July 1	70	69	Wind S. S. W., light.
2	69	68	Do.
3	71	70	Do.
4	71	70	Wind S. S. W., brisk.
5	71	70	Wind S. W., brisk.
6	71	69	Wind S. W., light.
7	67	67	Clear; wind E. N. E., light.
8	68	67	Clear; wind S. S. E., light.
9	68	68	Clouds; wind N. N. E., light.
10	68	68	Clear; wind S. S. E., light.
11	70	69	Clouds; wind N. W., light.
12	68	68	Clear; wind N. N. W., light.
13	69	68	Clear; wind S. W., light.
14	71	70	Do.
15	73	72	Clear; wind W. S. W., light.
16	70	69	Clear; wind N., light.
17	69	68	Clouds; wind E., light.
18	67	66	Clouds; wind S. E., light.
19	66	66	Do.
20	69	68	Clear; wind W. N. W., light.
21	69	68	Clouds; wind N. W., light.
22	70	69	Clear; wind W., light.
23	71	71	Do.
24	72	71	Clear; wind W. S. W., brisk.
25	70	70	Clear; wind E. S. E., light.
26	72	71	Clear; wind S. W., brisk.
27	72	72	Clouds; wind S. W., brisk.
28	74	73	Fog; wind S. W., light.
29	74	74	Do.
30	75	74	Do.
31	73	72	Clear; wind N. E., light.

AUGUST, 1873.

Date.	Surface.	Bottom.	Remarks.
Aug. 1	73	72	Fog; wind S. E., light.
2	75	74	Fog; calm.
3	75	74	Fog; wind S. E., light.
4	75	74	Clear; wind W. N. W., light.
5	73	72	Clear; wind E. N. E., light.
6	72	71	Clear; wind S. W., light.
7	73	72	Clear; wind S. W., brisk.
8	73	73	Clear; wind W. S. W., brisk.
9	73	72	Clear; wind N., light.
10	73	72	Clear; wind N. E., light.
11	72	71	Clear; wind E., light.
12	71	70	Clear; wind E., light.
13	70	69	Clouds; wind E., brisk.
14	69	68	Rain; wind E., brisk.
15	69	68	Clouds; wind N., light.
16	71	70	Fog; wind S. W., light.
17	71	70	Clear; wind N., light.
18	71	70	Clouds; E. S. E., light.
19	70	70	½ ebb; wind S. W., brisk.
20	72	72	¼ ebb; wind N. E., and rain.
21	70	70	1st qr. ebb; wind E. S. E., light.
22	70	71	1st qr. ebb; wind E. S. E., brisk.
23	72	71	High water; wind S. W., fog.
24	68	69	High water; wind N. W., brisk.
25	65	65	Do.
26	68	68	High water; wind N. N. E., light.
27	68	68	4th-qr. flood; wind N. N.E., light.
28	69	68	Do.
29	70	69	4th-qr. flood; wind S. W., light.
30	70	70	½ flood; rain; wind S. W., light.
31	71	70	½ flood; wind S. W., light.

SEPTEMBER, 1873.

Date.	Surface.	Bottom.	Remarks.
Sept. 1	70	70	Fog; calm; low water.
2	70	70	Clear; wind W. N. W., brisk.
3	68	68	Clear; wind W. N. W., light.
4	70	69	Rain; wind S. S. W., brisk; half tide.
5	70	70	Fog; wind S. W., light.
6	69	69	Clear; wind N. W., light.
7	68	68	Clear; wind E., light; high water.
8	68	68	Clouds; wind E. S. E., light.
9	67	67	Clear; E. N. E., light.
10	66	66	Clouds; wind E. N. E., light.
11	65	65	Clouds; wind E.N.E., light; half tide.
12	66	66	Clear; calm.
13	67	68	Fog; wind S. W., light.
14	64	64	Rain; wind N. N. W., brisk; low water.
15	62	62	Clear; wind N., brisk.
16	63	62	Clouds; wind S. W., brisk.
17	63	62	Clear; wind N. N. E., light.
18	63	63	Clear; wind S. S. E., light; half tide.
19	65	65	Clouds; wind S. S. E., brisk.
20	64	64	Rain; wind N. N. W., brisk.
21	62	62	Clear; wind W. N. W., light; high water.
22	60	60	Clear; wind S. E., light.
23	62	62	Clouds; wind S. E., light.
24	64	64	Clouds; wind N. N. W., light.
25	63	63	Clear; wind N. E., light; half tide.
26	64	64	Clear; wind S. W., light.
27	64	64	Do.
28	65	65	Fog; wind S. W., brisk; low water.
29	66	66	Fog; wind S. W., brisk.
30	65	65	Rain; wind N. by E., brisk.

OCTOBER, 1873.

Date.	Surface.	Bottom.	Remarks.
Oct. 1	62	62	Clear; wind N. E., light; half tide.
2	63	63	Clear; wind S. W., light.
3	62	62	Clear; calm.
4	62	62	Clouds; wind S. S. E., brisk.
5	64	64	Clouds; wind S. W., brisk.
6	64	64	Clear; wind S., brisk; high water.
7	64	64	Clouds; wind N. W., brisk.
8	62	62	Clouds; wind N. E., strong gale.
9	58	58	Do.
10	57	57	Clouds; wind N. E., brisk; half tide.
11	57	57	Clear; wind N. E., brisk.
12	57	57	Clear; wind N. E., light.
13	57	57	Clear; wind W. S. W., brisk.
14	57	57	Clear; wind W. S. W., brisk; low water.
15	57	57	Clear; wind N. N. E., light.
16	56	56	Clear; wind S. S. W., light.
17	57	57	Clear; wind N. N. E., brisk; half tide.
18	57	57	Clouds; wind N. E., light.
19	58	58	Clouds; wind E. S. E., light.
20	59	59	Rain; wind S. E., brisk.
21	61	61	Clouds; wind S. S. W.; high water.
22	59	59	Clouds; wind S. E., light.
23	58	58	Clear; wind S. by E., light.
24	58	58	Clouds; wind S. W., light.
25	58	58	Clear; wind N. N. E., light; half tide.
26	57	57	Clear; wind N. E., light.
27	57	57	Rain; wind S. S. W., brisk.
28	56	55	Clouds; wind N. E., light; low water.
29	54	54	Clear; wind W. by S., brisk.
30	51	51	Clear; wind N. E., light.
31	52	51	Rain; wind E. N. E., light.

NOVEMBER, 1873.				DECEMBER, 1873.			
Date.	Surface.	Bottom.	Remarks.	Date.	Surface.	Bottom.	Remarks.
Nov. 1	52	52	Clear; wind W. N. W., brisk; half tide.	Dec. 1	34	34	Clear; wind N. N. W., brisk.
2	52	52	Clouds; wind W. N. W., brisk.	2	33	33	Clouds; wind S. E., brisk.
3	52	51	Clear; wind S. W., brisk.	3	34	34	Fog; calm; high tide.
4	52	51	Clear; wind W. N. W., brisk.	4	40	40	Fog; wind S. S. W., brisk.
5	52	50	Clear; wind N. W., light; high tide.	5	41	41	Clear; wind W. N. W., light.
6	51	50	Clear; wind N. E., light.	6	36	37	Clear; wind N. N. W., light.
7	51	51	Clouds; wind E. N. E., light.	7	36	36	Clear; wind N. N. W., light; half tide.
8	51	50	Rain; wind W. S. W., light.	8	35	35	Clear; wind N. N. E., light.
9	50	50	Clouds; wind W. N. W., brisk; half tide.	9	36	36	Rain; wind S. W., light.
10	48	48	Clouds; wind W. N. W., brisk.	10	37	37	Clear; wind W. N. W., brisk; low tide.
11	45	45	Clear; wind N. W., brisk.	11	36	37	Clouds; calm.
12	47	47	Clouds; wind S. S. W., brisk.	12	38	38	Rain; calm.
13	46	46	Clear; wind W. N. W., brisk; low tide.	13	38	38	Rain; wind E. N. E., light.
14	42	42	Clouds; wind W. N. W., brisk.	14	38	38	Clear; wind N. W., light; half tide.
15	41	40	Clear; wind W. N. W., brisk.	15	36	36	Clouds; wind W., brisk.
16	41	41	Clouds; wind E. S. E., brisk; half tide.	16	38	38	Clouds; wind S. W., light.
				17	37	38	Fog; calm.
				18	39	39	Fog; calm; high tide.
17	43	43	Clouds; wind E., light.	19	38	38	Clouds; winds E. S. E., light.
18	44	44	Rain; wind N. E., strong gale.	20	39	39	Clouds; wind W. N. W., brisk.
19	41	41	Clear; wind N. N. W., brisk.	21	37	37	Clear; wind N. W., light.
20	41	41	Clouds; wind N. N. W., light.	22	36	36	Clear; wind N. W., light; half tide.
21	40	40	Clear; wind N. W., light; high tide.	23	35	35	Clouds; wind N. E., light.
22	40	40	Clear; calm.	24	35	35	Clouds; wind N. N. E., light.
23	40	40	Do.	25	35	35	Clouds; wind N. W., light; low tide.
24	40	40	Rain; wind S. E., brisk.				
25	42	42	Clouds; calm; half tide.	26	37	37	Clouds; wind E., brisk.
26	37	36	Clear; wind W. N. W., brisk.	27	35	35	Clouds; wind N. E., light.
27	34	34	Clouds; wind N. E., light.	28	32	33	Snow; wind W. N. W., brisk.
28	35	35	Clear; wind N. W., brisk; low tide.	29	32	33	Clear; wind W. S. W., brisk; half tide.
29	35	35	Clear; wind W. N. W., brisk.	30	33	34	Clear; wind W. N. W., brisk.
30	35	35	Do.	31	31	31	Do.

MEAN TEMPERATURES.

For the months.

	Surface.	Bottom.
January	31.5	32.0
February	30.7	30.7
March	34.0	34.4
April	43.0	43.0
May	53.0	52.1
June	62.2	61.7
July	70.2	69.5
August	71.0	70.4
September	65.4	65.3
October	58.4	58.3
November	44.0	43.7
December	36.0	36.2

For the quarters.

	Surface.	Bottom.
January, February, and March	32.0	32.4
April, May, and June	52.7	52.2
July, August, and September	68.9	68.4
October, November, and December	46.1	46.0
For the half years.		
January to June	42.4	42.3
July to December	57.5	57.4
For twelve months.		
For the year	49.9	49.7

XXII.—LIST OF ILLUSTRATIONS.

WOOD-CUTS IN THE BODY OF THE REPORT.

PLATES.

MAP.

XXIII.—GENERAL INDEX.

[For special index to the report of Professor Verrill on the marine invertebrates, see page 757. This should always be referred to in the search for any name.]

A.

B.

H.

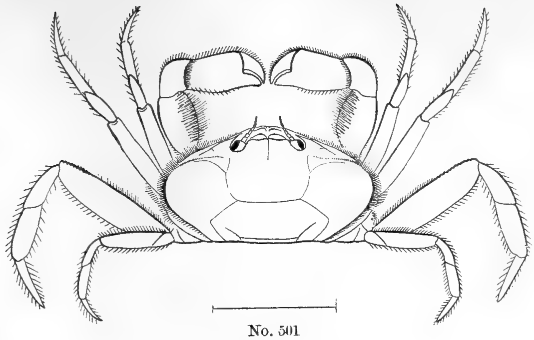
EXPLANATION OF PLATE I.

FIGURE 1.—Pinnixa cylindrica Say, (p. 546;) male, enlarged four diameters.
2.—Pinnotheres ostreum Say, (p. 546;) male, enlarged four diameters.
3.—Panopeus depressus Smith, (p. 547;) male, natural size.
4.—Platyonichus ocellatus Latreille, (p. 547;) male, slightly reduced in size.

(All the figures were drawn by J. H. Emerton.)

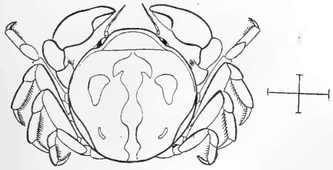
Plate I.

Fig. 1.



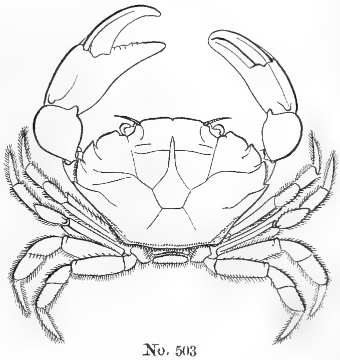
No. 501

Fig. 2.



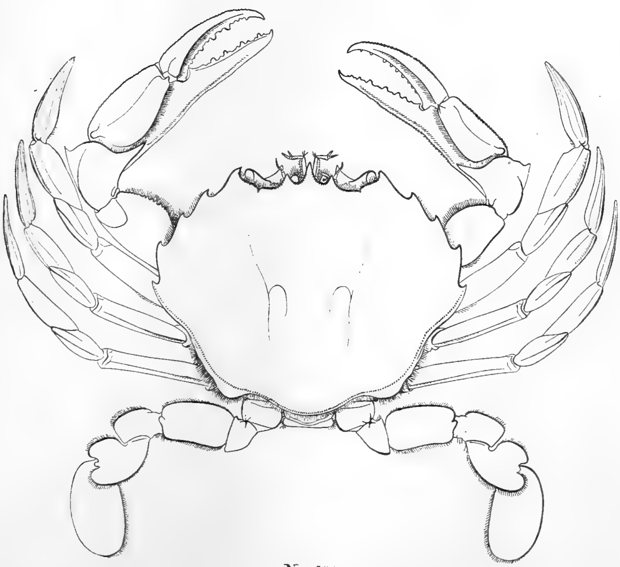
No. 502

Fig. 3.



No. 503

Fig. 4.



No. 504

EXPLANATION OF PLATE II.

FIGURE 5.—Hippa talpoida Say, (p. 548;) dorsal view, enlarged about two diameters.

6.—Pandalus annulicornis Leach, (p. 550;) dorsal view, slightly reduced in size.

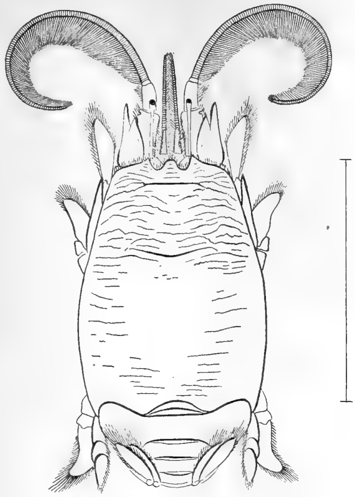
7.—Gebia affinis Say, (p. 549;) female; lateral view, slightly enlarged.

8.—Callianassa Stimpsoni Smith, (p. 549;) larger cheliped; outside, natural size.

9.—Palæmonetes vulgaris Stimpson, (p. 550;) male; lateral view, enlarged one and one-half diameters.

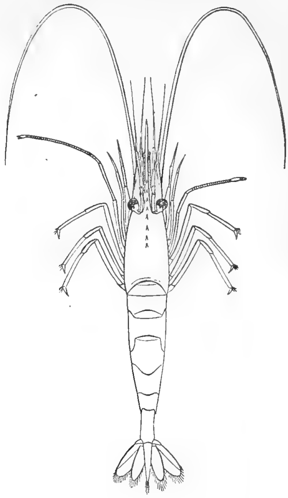
(All the figures were drawn by J. H. Emerton.)

Fig. 5.



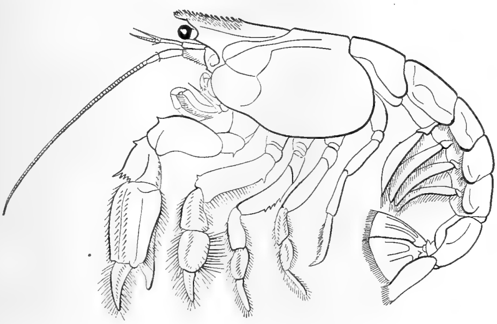
No. 507

Fig. 6.



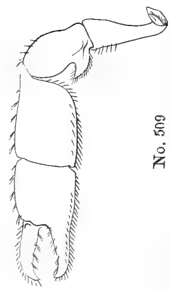
No. 515

Fig. 7.



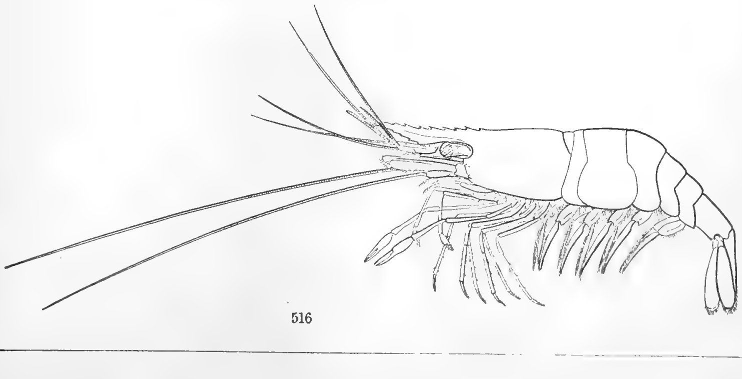
508

Fig. 8.



No. 509

Fig. 9.



516

EXPLANATION OF PLATE III.

FIGURE 10.—Crangon vulgaris Fabr., (p. 550;) male; dorsal view, natural size.

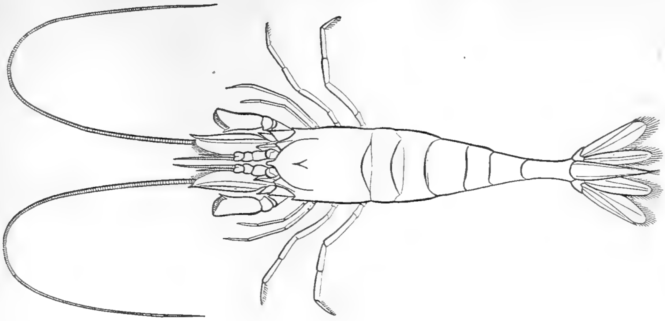
11.—Virbius Zostericola Smith, (p. 550;) female; lateral view, slightly enlarged.

12.—Mysis stenolepis Smith, (p. 551;) young female; lateral view, enlarged four diameters. The anterior margin of the carapax is not well represented in this figure; see description.

13.—Diastylis quadrispinosa G. O. Sars, (p. 554;) lateral view, enlarged seven diameters.

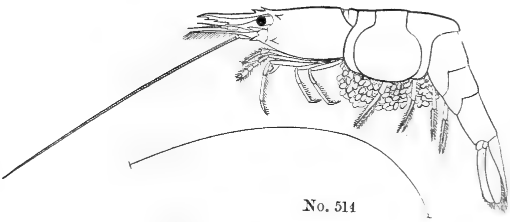
(All the figures were drawn by J. H. Emerton.)

Fig. 10.



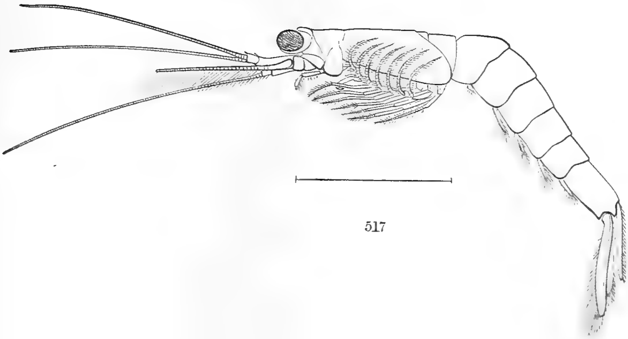
No. 513

Fig. 11.



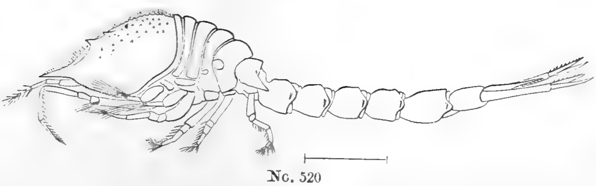
No. 514

Fig. 12.



517

Fig. 13.



No. 520

EXPLANATION OF PLATE IV.

FIGURE 14.—Orchestia agilis Smith, (p. 555;) male; lateral view, enlarged five diameters.

15.—Gammarus ornatus Edwards, (p. 557;) male; lateral view, enlarged two diameters.

16.—Amphithoë maculata Stimpson, (p. 563;) male; lateral view, enlarged two diameters.

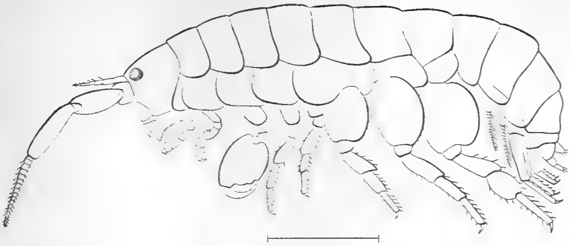
17.—Ampelisca sp., (p. 561;) lateral view, enlarged five diameters.

18.—Cerapus rubricornis Stimpson, (p. 565;) female; lateral view, enlarged five diameters; and hand of the second pair of legs of the male, enlarged the same amount.

19.—Unciola irrorata Say, (p. 567;) male; dorsal view, enlarged six diameters.

(All the figures were drawn by J. H. Emerton and S. I. Smith.)

Fig. 14.

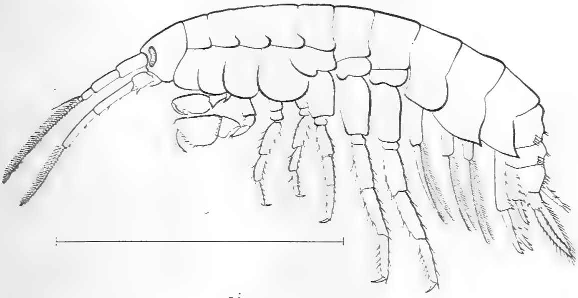


No. 521

Fig. 16.

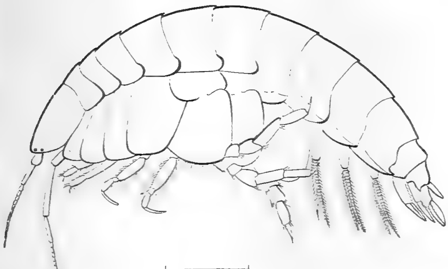
No. 526

Fig. 15.



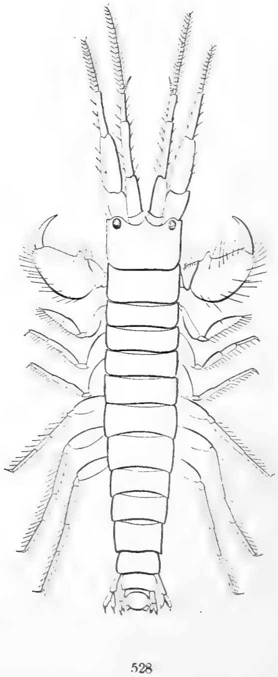
524

Fig. 17.



522

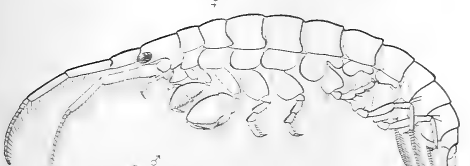
Fig. 19.



528

Fig. 18.

♀



No. 527

EXPLANATION OF PLATE V.

FIGURE 20.—Caprella geometrica Say, (p. 567;) lateral view, enlarged about three diameters.

21.—Sphæroma quadridentata Say, (p. 569;) dorsal view, enlarged five diameters.

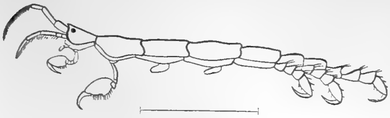
22.—Idotea cæca Say, (p. 569;) male; dorsal view, enlarged three diameters.

23.—Idotea irrorata Edwards, (p. 569;) male; dorsal view, enlarged two diameters.

24.—Idotea robusta Kroyer, (p. 569;) male; dorsal view, enlarged two diameters.

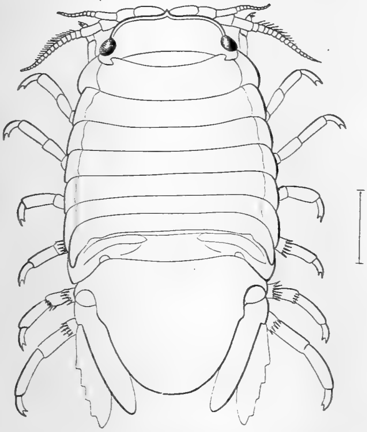
(Figures 20, 21, 23, and 24, were drawn by J. H. Emerton; figure 22 by O. Harger.)

Fig. 20.



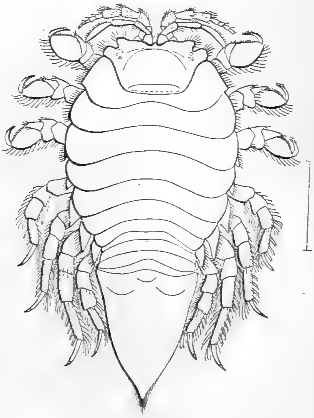
No. 529

Fig. 21.



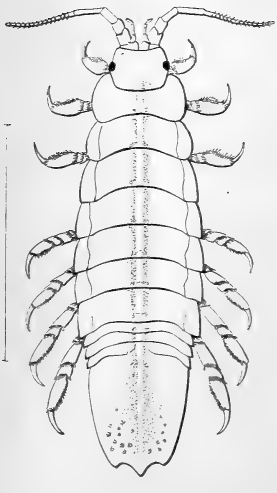
No. 532

Fig. 22.



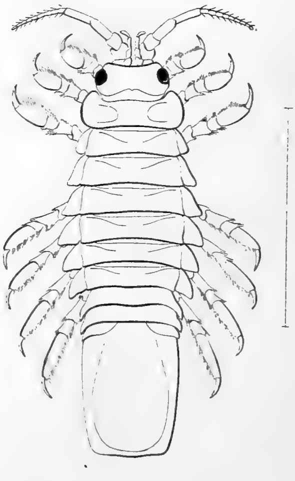
No. 782

Fig. 23.



533

Fig. 24.



534

EXPLANATION OF PLATE VI.

FIGURE 25.—Limnoria lignorum White, (p. 571;) dorsal view, enlarged ten diameters.

26.—Erichsonia filiformis Harger, (p. 570 ;) dorsal view, enlarged five diameters.

27.—Erichsonia attenuata Harger, (p. 570 ;) dorsal view, enlarged three diameters.

28.—Epelys trilobus Smith, (p. 571 ;) dorsal view, enlarged ten diameters.

29.—Livoneca ovalis Harger, (p. 572 ;) dorsal view, enlarged three diameters.

(Figure 25 was drawn by S. I. Smith ; 26 and 28 by O. Harger ; 27 and 29 by J. H. Emerton.)

Fig. 25.

No. 531

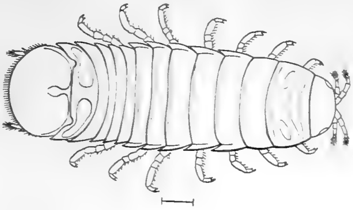
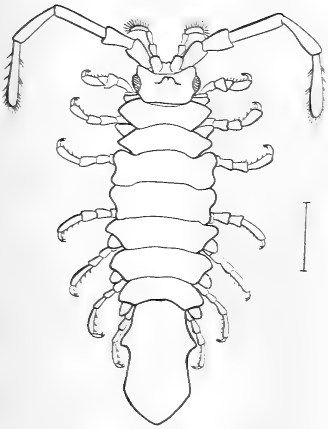
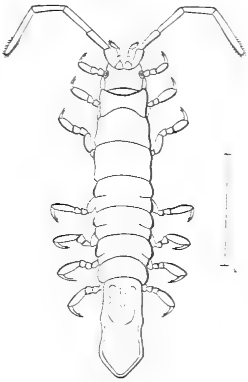


Fig. 26.



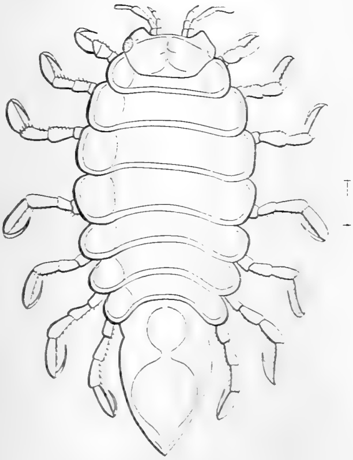
No. 784

Fig. 27



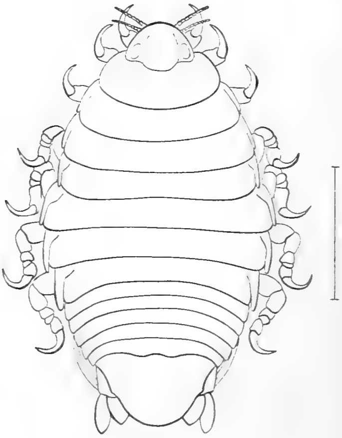
No. 535

Fig. 28.



No 783

Fig. 29.



No. 530

EXPLANATION OF PLATE VII.

FIGURE 30.—Lerneonema radiata Steenstrup and Lütken, (p. 578;) female, enlarged two diameters.

31.—Pandarus, (p. 576;) female; dorsal view, enlarged five diameters.

32.—Nogagus Latreillii, (p. 576;) male; dorsal view, enlarged five diameters

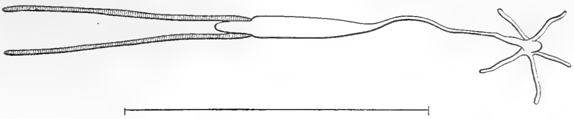
33.—Sapphirina, (p. 573;) male; dorsal view, enlarged ten diameters.

34.—Lepas fascicularis Ellis and Solander, (p. 579;) lateral view of a single animal from a large cluster, slightly enlarged.

35.—Phoxichilidium maxillare Stimpson, (p. 544;) male; dorsal view, enlarged two diameters.

(Figure 33 was drawn by S. I. Smith; all the others by J. H. Emerton.)

Fig. 30.



No. 538

Fig. 31.

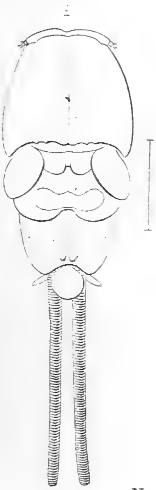
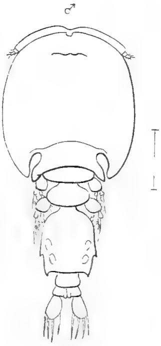
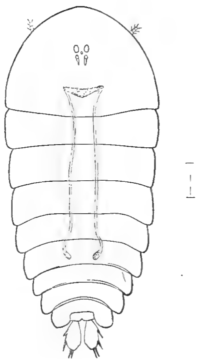


Fig. 32.



No. 537

Fig. 33.



No. 536

Fig. 34

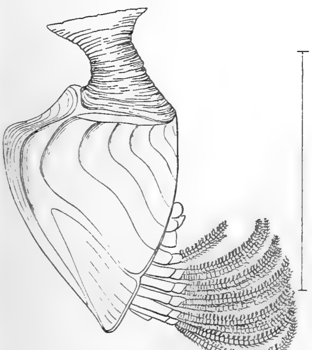
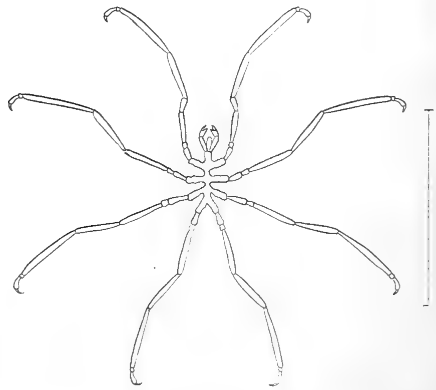


Fig. 35.



No. 540

EXPLANATION OF PLATE VIII.

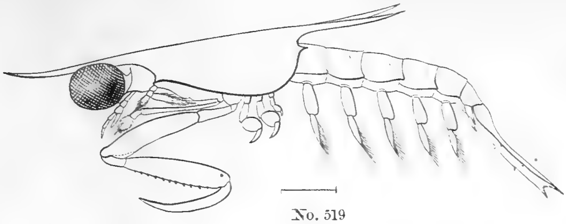
FIGURE 36.—Squilla empusa Say, (p. 536;) lateral view of the free-swimming larvæ in one of its later stages, enlarged ten diameters.

37.—Zoëa of the common crab, *Cancer irroratus*, (p. 530;) in the last stage just before it changes to the megalops condition; lateral view, enlarged seventeen diameters.

38.—Megalops stage of the same, just after the change from the zoëa condition; dorsal view, enlarged thirteen diameters.

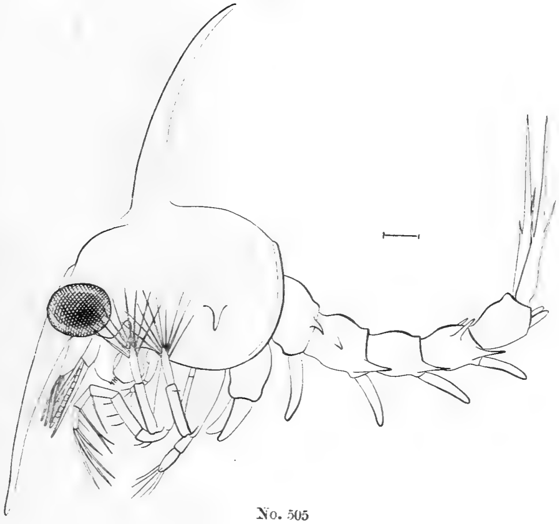
(All the figures were drawn by J. H. Emerton.)

Fig. 36.



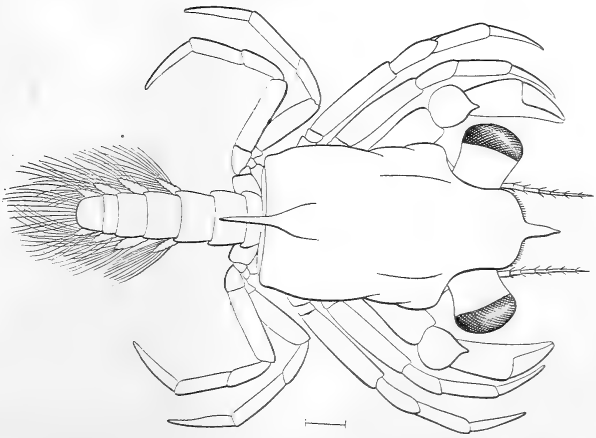
No. 519

Fig. 37.



No. 505

Fig. 37 a.



No. 506

EXPLANATION OF PLATE IX.

Larval young of the Lobster, *Homarus Americanus* Edwards, (p. 522.)

FIGURE 38.—*A*. Lateral view of the larval young in the first stage observed, enlarged seven diameters.

B. The same in a dorsal view, the abdomen held horizontally.

C. Antennula, enlarged fourteen diameters.

D. One of the thoracic legs of the second pair, enlarged fourteen diameters; *a*, exopodus; *b*, epipodus; *c*, branchiæ.

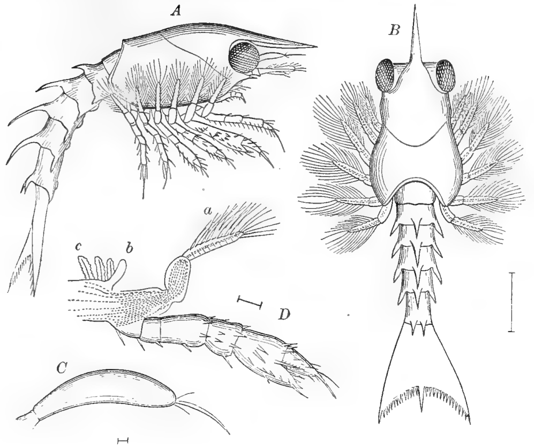
39.—*E*. Lateral view of the larval young in the third stage, enlarged five and one-half diameters.

F. Terminal portion of the abdomen seen from above, enlarged ten diameters; *a*, one of the small spines of the posterior margin of the terminal segment, enlarged fifty diameters.

G. Basal portion of one of the legs of the second pair, showing the epipodus and branchiæ, enlarged fourteen diameters.

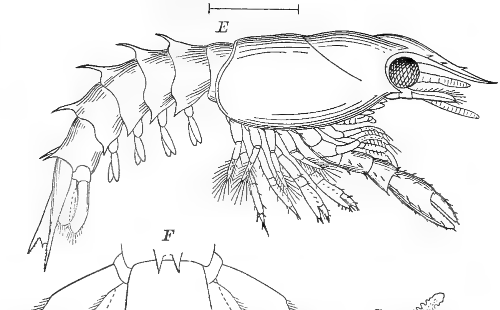
(All the figures were drawn from alcoholic specimens, by S. I. Smith.)

Fig. 38.



511

Fig. 39.



No. 512

EXPLANATION OF PLATE X.

FIGURE 40.—Lepidonotus squamatus, (p. 581;) anterior part of the body, head, and proboscis; dorsal view.

41.—The same; end of the proboscis; front view, showing the jaws and papillæ.

42.—Lepidonotus sublevis, (p. 581;) dorsal view.

43.—Rhynchobolus dibranchiatus, (p. 596;) anterior part of body, mouth and head; lower side.

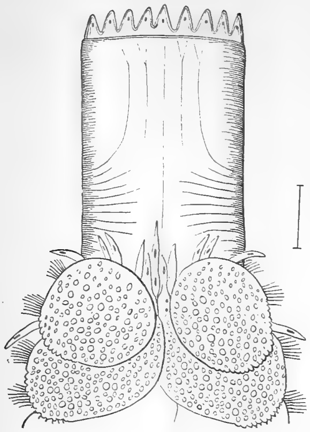
44.—The same; lateral appendage, showing the dorsal cirrus, the upper and lower branchiæ and the setigerous lobes between them.

45.—Rhynchobolus Americanus, (p. 596;) anterior part of the body and extended proboscis; dorsal view.

46.—The same; lateral appendages, showing the dorsal cirrus, the branched gill, the setigerous lobes, and the ventral cirrus.

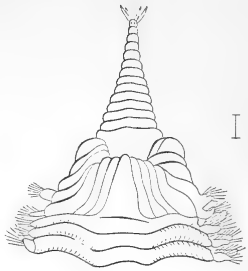
(Figures 40, 41, 42, 45, were drawn from nature by J. H. Emerton; 44 by A. E. Verrill; 43 and 46 were copied from Ehlers.)

Fig. 40.



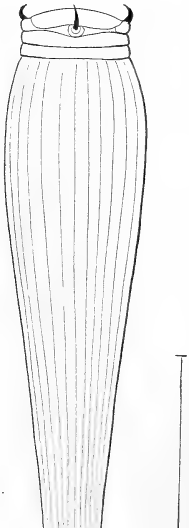
No. 544

Fig. 43.



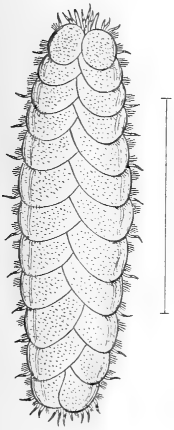
557

Fig. 45.



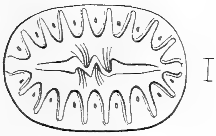
No. 559

Fig. 42.



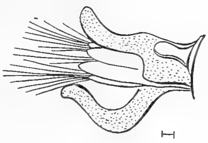
No. 543

Fig. 41.



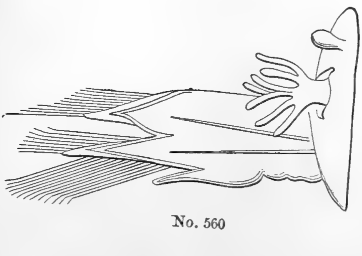
No. 545

Fig. 44.



No. 558

Fig. 46.



No. 560

EXPLANATION OF PLATE XI.

FIGURE 47.—Nereis virens, (p. 590;) head little more than natural size; dorsal view.

48.—The same; extended proboscis; dorsal view.

49.—The same; probosci; sventral view.

50.—The same; lateral appendage.

51.—Nereis limbata, male, (p. 590;) a few segments of the middle region of the body, anterior region, head and extended proboscis; dorsal view.

52.—Nereis pelagica, female, (p. 591;) natural size; dorsal view.

53.—The same; male, natural size; dorsal view.

54.—The same; head more enlarged; dorsal view.

55.—The same; proboscis; ventral view.

56.—Phyllodoce gracilis?, (p. 586;) head; dorsal view.

(Figure 51 was drawn from nature by J. H. Emerton; 47, 48, 49, 50, 52, 53, were copied from Ehlers; 54, 55, from Malmgren; 56, from A. Agassiz.)

Fig. 47.

545

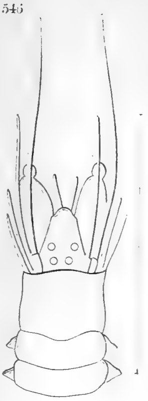
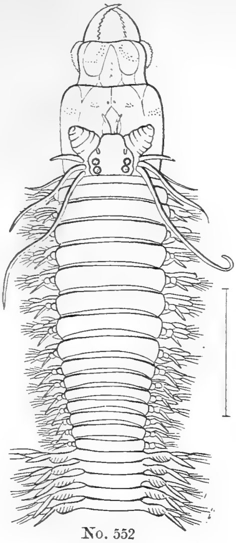
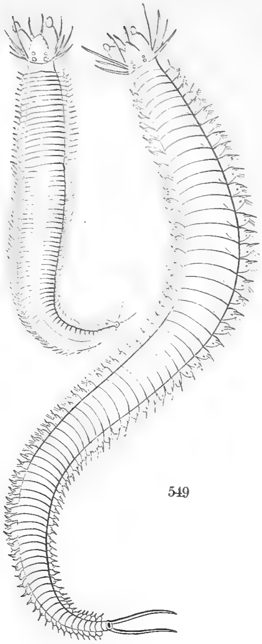


Fig. 51.



No. 552

Fig. 53. Fig. 52.

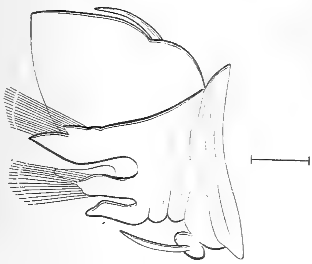


549

Fig. 48.

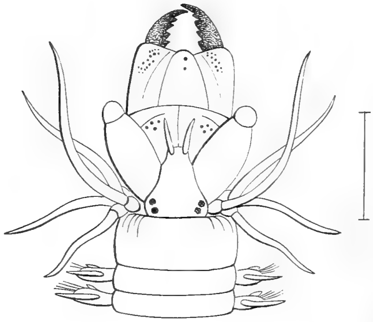
Fig. 49.

Fig. 50.



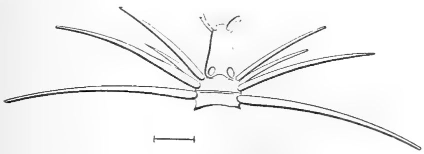
No. 548

Fig. 54.



No. 550

Fig. 56.



565

Fig. 55.

No. 551

EXPLANATION OF PLATE XII.

FIGURE 57.—Nephthys picta, (p. 583;) anterior part of body and head, much enlarged; dorsal view.

58.—Nephthys bucera, (p. 583;) anterior part of body and head, enlarged; ventral view.

59.—Nephthys ingens, (p. 583;) anterior part of body and extended proboscis; ventral view.

60.—The same; dorsal view.

61.—Podarke obscura, (p. 589;) dorsal view, from a specimen preserved in alchohol and much contracted in length.

62.—Nectonereis megalops, (p. 592;) ventral view.

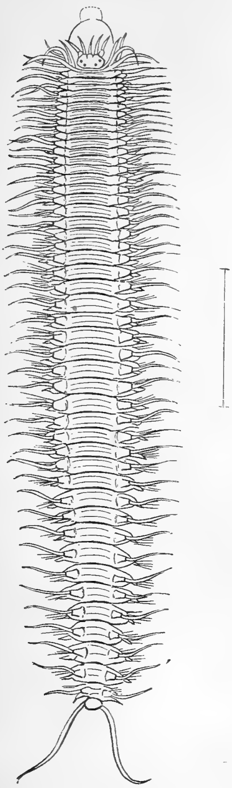
63.—The same; anterior region of body and head; dorsal view.

64.—Marphysa Leidyi, (p. 593;) anterior part of body and head, enlarged about three diameters; dorsal view.

(Figures 57 and 58 were copied from Ehlers; all the rest were drawn from nature by J. H. Emerton)

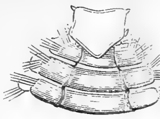
Plate XII.

Fig. 61.

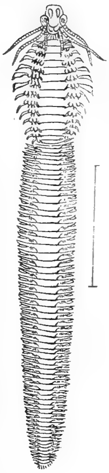


No. 566

Fig. 57.

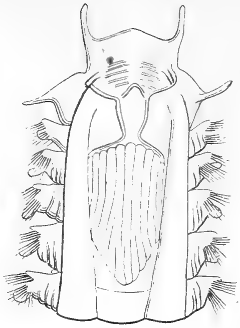


F 62.



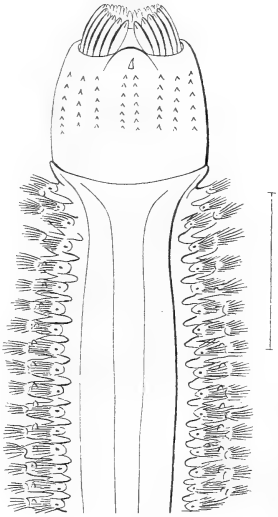
No. 567

Fig. 58.



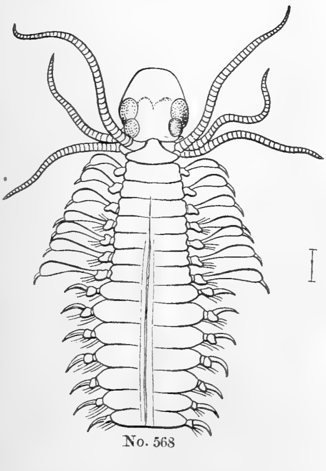
No. 562

Fig. 59.



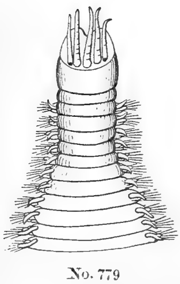
No. 564

Fig. 63.



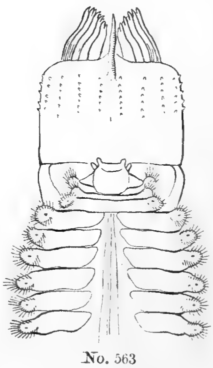
No. 568

Fig. 64.



No. 779

Fig. 60.



No. 563

EXPLANATION OF PLATE XIII.

FIGURE 65.—Autolytus cornutus, (p. 590;) an asexual individual, from which a male is about to separate; dorsal view, enlarged about six diameters; A, A, A, antennæ of the former; C, C, C, C, two tentacles and one tentacular cirrus on each side, followed by the dorsal cirri; F, the intestine; *d*, the long setæ and dorsal cirri of the male.

66.—The same; anterior part of a female, more enlarged; the letters as before; *b*, the eyes; *e*, the eggs; *f*, the intestine; 3, one of the appendages of the anterior region of the body; *c*, the dorsal cirrus; *h*, the setigerous tubercle, supporting hooked setæ.

67.—Diopatra cuprea, (p. 593;) head and anterior part of body, showing part of the branchiæ; side view.

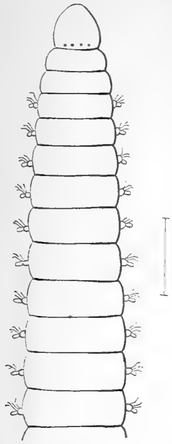
68.—The same; ventral view, showing the mouth open and jaws thrown back.

69.—Lumbriconereis opalina, (p. 594;) anterior part of body; dorsal view.

70.—The same; lateral appendage and setæ.

(Figures 65 and 66 were copied from A. Agassiz; 67, 68, 69 were drawn from nature by J. H. Emerton; 70, by A. E. Verrill.)

Fig. 69.



No. 555

Fig. 65.

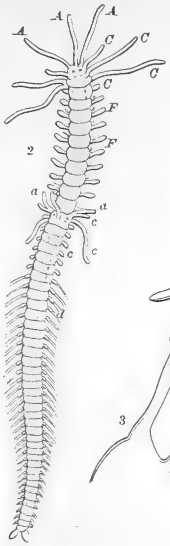
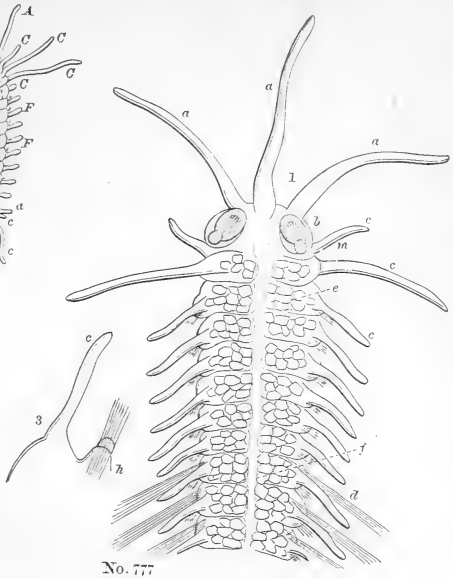
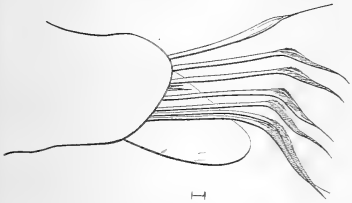


Fig. 66.



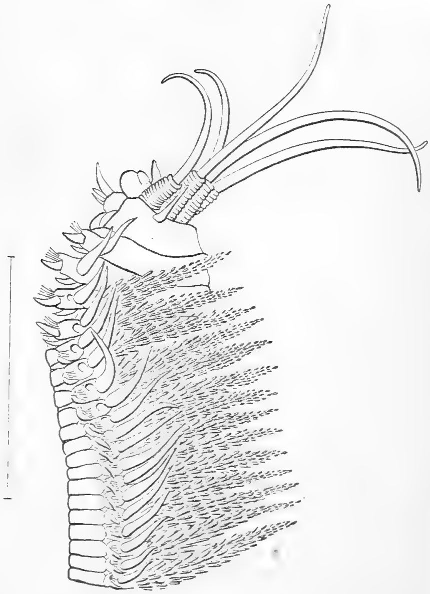
No. 777

Fig. 70.



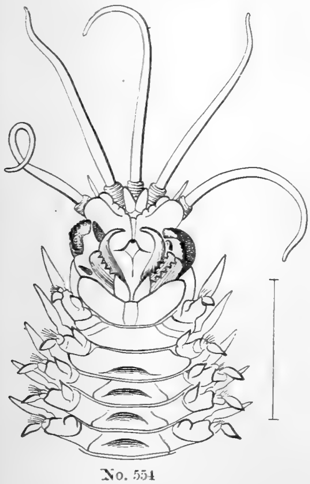
No. 556

Fig. 67.



No. 553

Fig. 68.



No. 554

EXPLANATION OF PLATE XIV.

FIGURE 71.—Clymenella torquata, (p. 608;) natural size; lateral view.

72.—The same; head and extended proboscis; front view.

73.—The same; posterior and caudal segments; dorsal view.

74.—Sternaspis fossor, (p. 606;) dorsal view.

75.—Trophonia affinis, (p. 605;) anterior portion; dorsal view.

76.—Anthostoma robustum, (p. 597;) anterior portion of body, head, and extended proboscis; dorsal view, natural size.

77.—Spio setosa, (p. 602;) anterior segments and head; side view; only one of the two large tentacles is represented.

78.—Polydora ciliatum, (p. 603;) anterior and posterior parts; dorsal view.

(Figures 71, 72, 73, 75, 76, were drawn from nature by J. H. Emerton; 74, by A. E. Verrill; 77, 78, were copied from A. Agassiz.)

Plate XIV.

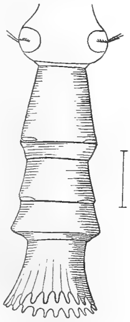
Fig. 71.

No. 577

Fig. 72.

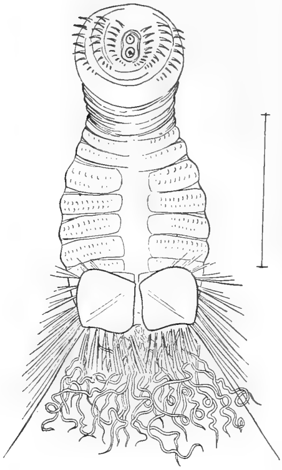
No. 578

Fig. 73.



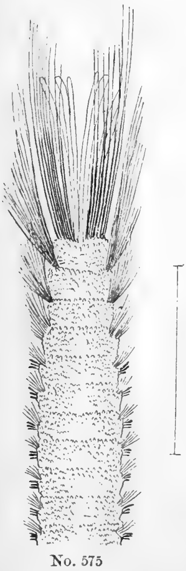
No. 579

Fig. 74.



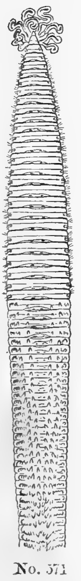
No. 576

Fig. 75.



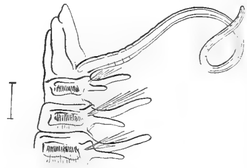
No. 575

Fig. 76.



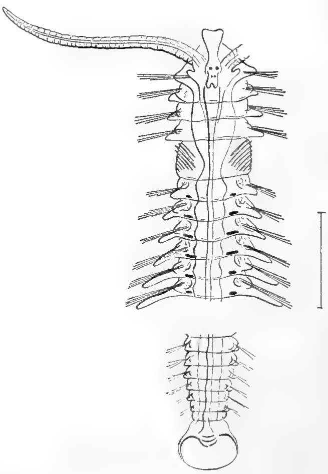
No. 571

Fig. 77.



569

Fig. 78.



570

EXPLANATION OF PLATE XV.

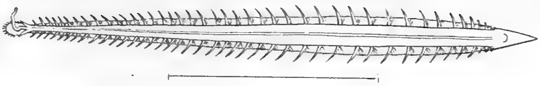
FIGURE 79.—Ammotrypane fimbriata, (p. 604;) ventral view.

80.—Cirratulus grandis, (p. 606;) natural size, from a living specimen; lateral view.

81.—The same; natural size, from a preserved specimen; dorsal view.

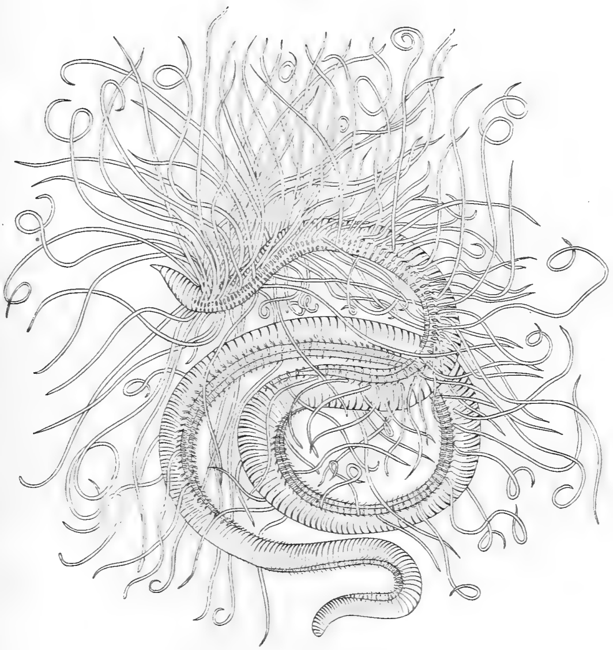
(Figures 79 and 81 were drawn from nature by J. H. Emerton; figure 80, by A. E. Verrill.)

Fig. 79.



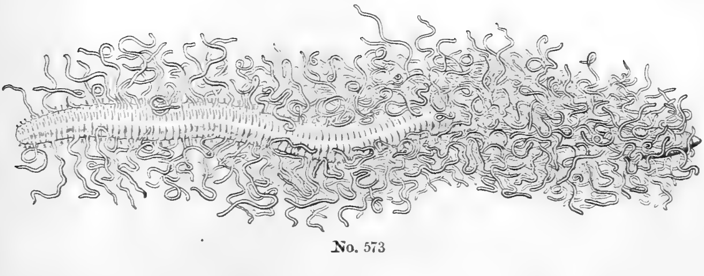
No. 572

Fig. 80.



No. 574

Fig. 81.



No. 573

EXPLANATION OF PLATE XVI.

FIGURE 82.—Amphitrite ornata, (p. 613;) lateral view, somewhat reduced, from a living specimen.

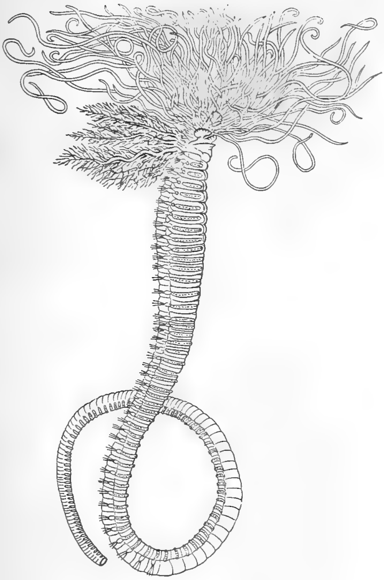
83.—Ampharete gracilis, (p. 612;) lateral view.

84.—Euchone elegans, (p. 618;) lateral view.

85.—Polycirrus eximius, (p. 616;) dorsal view of a living specimen creeping by means of its tentacles; natural size.

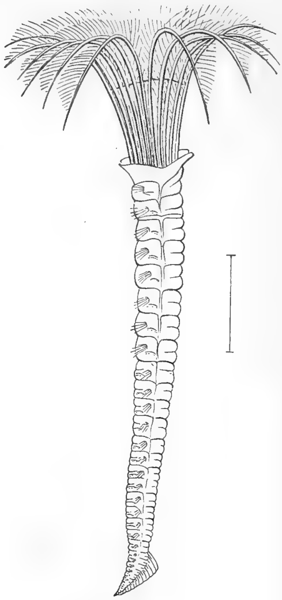
(Figures 82, 84, 85, were drawn from nature by A. E. Verrill; 83, by J. H. Emerton.)

Fig. 82.



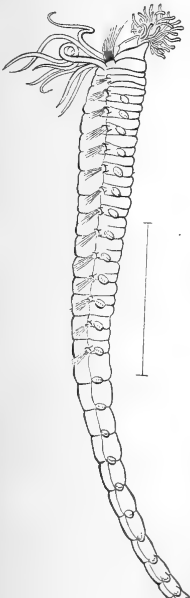
No. 586

Fig. 84.



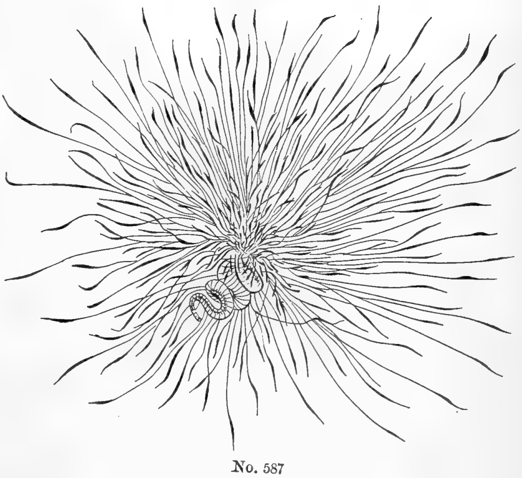
No. 585

Fig. 83.



No. 584

Fig. 85.



No. 587

EXPLANATION OF PLATE XVII.

FIGURE 86.—Potamilla oculifera, (p. 617;) in its tube, with branchiæ fully expanded, from a living specimen, found at Eastport, Maine.

87.—Cistenides Gouldii, (p. 612;) lateral view.

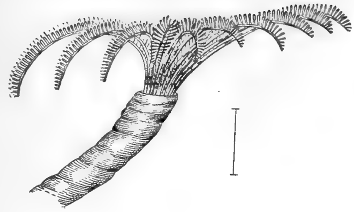
87*a*.—The same; head and branchiæ, dorsal view.

88.—Sabellaria vulgaris, (p. 611;) lateral view.

88*a*.—The same; view of the operculum and tentacles, from above.

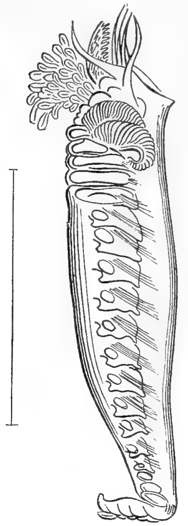
(Figures 84, 88, 88*a* were drawn from nature, by J. H. Emerton; 87, 87*a* by A. E. Verrill.)

Fig. 86.



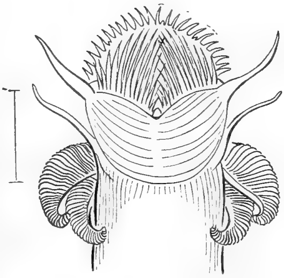
No. 778

Fig. 87.



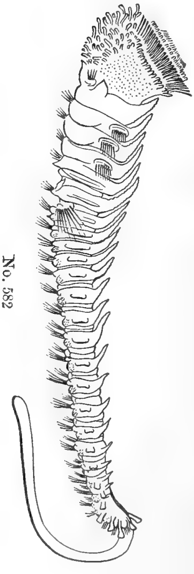
No. 580

Fig. 87*a*.



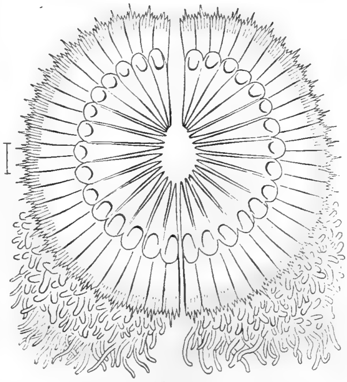
No. 581

Fig. 88.



No. 582

Fig. 88*a*.



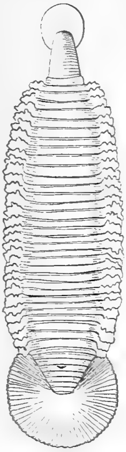
No. 583

EXPLANATION OF PLATE XVIII.

FIGURE 89.—Branchiobdella Ravenelii, (p. 624;) dorsal view, natural size.
90.—Malacobdella obesa, (p. 625;) dorsal view.
91.—Pontobdella rapax, (p. 625;) dorsal view.
92.—Phascolosoma cæmentarium, (p. 627;) lateral view.
93.—P. Gouldii, (p. 627;) lateral view, reduced one-half.
94.—Pontonema marinum, (p. 634;) female, lateral view, enlarged 15 diameters; *o*, eggs; *v*, genital orifice.

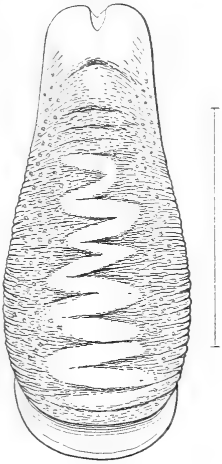
(Figure 94 was drawn from a living specimen, by A. E. Verrill; all the others were drawn from preserved specimens, by J. H. Emerton.)

Fig. 89.



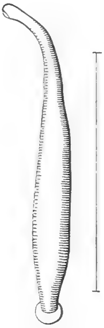
No. 588

Fig. 90.



No. 781

Fig. 91.



No. 589

Fig. 94.

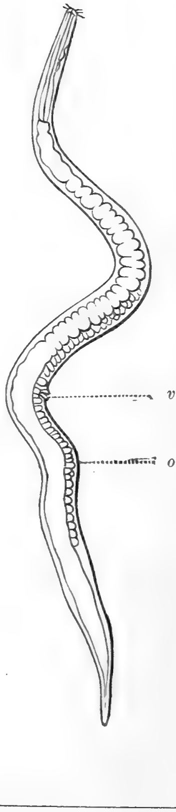
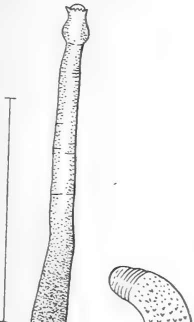
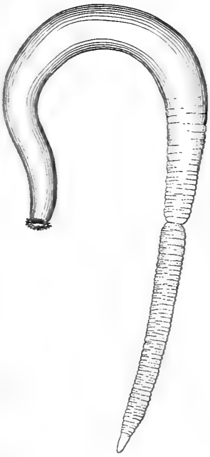


Fig. 92.



No. 596

Fig. 93.



No. 780

EXPLANATION OF PLATE XIX.

FIGURE 95.—Cosmocephala ochracea, (p. 630;) anterior portion, enlarged nearly three diameters, dorsal view.

95*a*.—The same; ventral view.

96.—Meckelia ingens, (p. 630;) anterior portion of a specimen not full grown, natural size.

96*a*.—The same; ventral view of the anterior portion and head of a larger specimen, in a different state of contraction, natural size.

97.—Polinia glutinosa, (p. 631;) dorsal view, enlarged two diameters.

98.—Tetrastemma arenicola, (p. 629;) dorsal view.

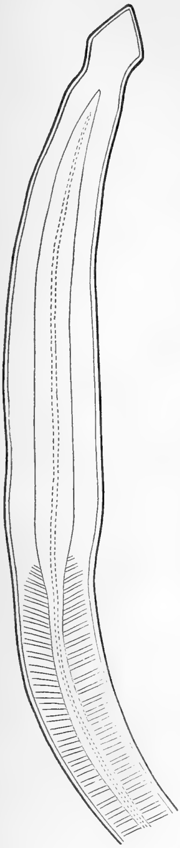
99.—Stylochopsis littoralis, (p. 632;) dorsal view.

100.—Planocera nebulosa, (p. 632;) dorsal view.

(All the figures were drawn from living specimens, by A. E. Verrill.)

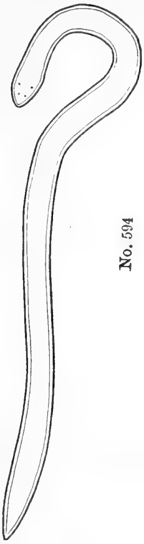
Plate XIX.

Fig. 96.



No. 591

Fig. 98.



No. 594

Fig. 97.

No. 593

Fig. 95.

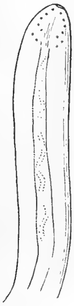


Fig. 95*a*.

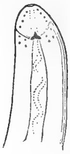
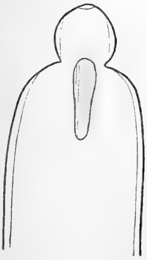
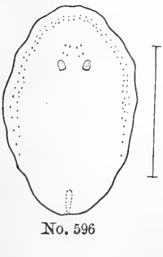


Fig. 96*a*.



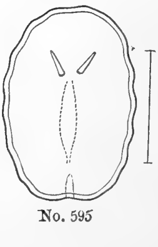
No. 592

Fig. 99.



No. 596

Fig. 100.



No. 595

EXPLANATION OF PLATE XX.

FIGURE 101.—Loligo pallida, (p. 635;) dorsal view, about one-third natural size.

101*a*.—The same; the "pen" dorsal side.

102.—Loligo Pealii?, (p. 635;) a cluster of the eggs.

103.—The same; an embryo just before hatching, much enlarged; a', a'', a''', a'''', the right "arms" belonging to four pairs; *c*, the side of the head; *e*, the eye; *f*, the caudal fins; *h*. the heart; *n*, the mantle in which color-vesicles are already developed and capable of changing their colors; *o*, the internal cavity of the ears; *s*, the siphon; *y*, the portion of the yolk not yet absorbed.

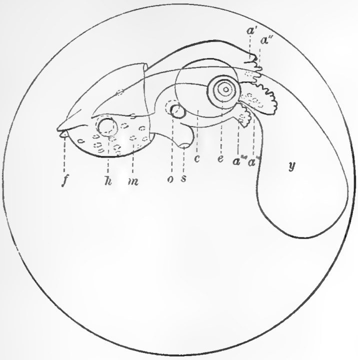
104.—The same; an embryo in an earlier stage of development, more highly magnified; the letters are the same as before.

105.—The same; a young specimen, recently hatched, found swimming at the surface, dorsal view.

(Figures 103, 104 are camera-lucida drawings made from the living specimens, by A. E. Verrill; all the others were drawn from preserved specimens, by J. H. Emerton.)

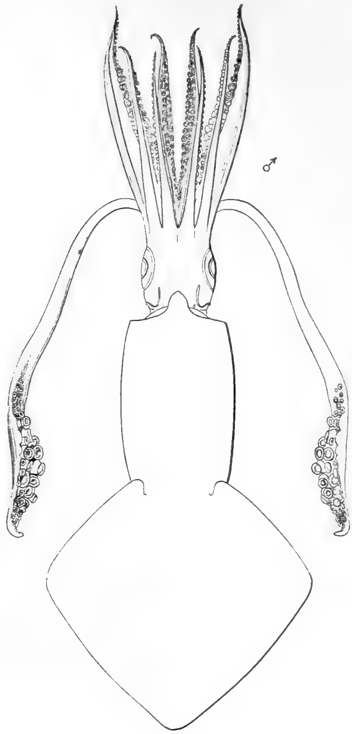
Plate XX.

Fig. 103.



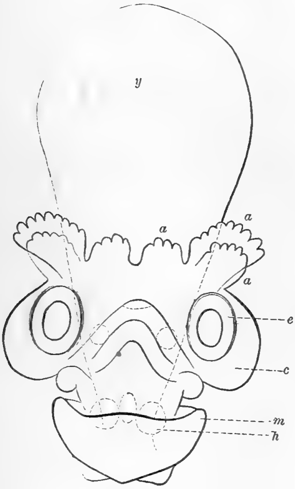
No. 775

Fig. 101.



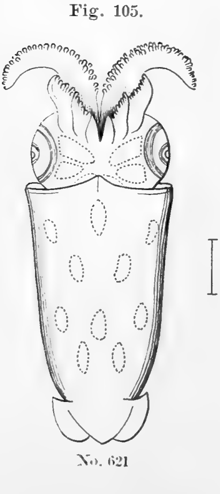
No. 622

Fig. 104.



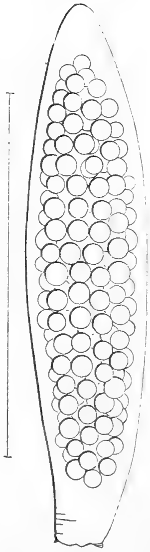
No. 774

Fig. 105.



No. 621

Fig. 102.



No. 620

Fig. 101*a*.

No. 623

EXPLANATION OF PLATE XXI.

FIGURE 106.—Pleurotoma bicarinatum, (p. 638 ;) natural size.
107.—Bela plicata, (p. 637 ;) natural size.
108.—Bela harpularia, (p. 636 ;) natural size.
109.—Anachis similis, (p. 644 ;) natural size.
110.—Astyris lunata, (p. 645 ;) enlarged.
111.—Astyris zonalis, (p. 645 ;) enlarged.
112.—Tritia trivittata, (p. 641 ;) natural size.
113.—Ilyanassa obsoleta, (p. 641 ;) natural size.
114.—Nassa vibex, (p, 640 ;) natural size.
115.—Neptunea pygmæa, (p. 639 ;) natural size.
116.—Urosalpinx cinerea, (p. 641 ;) natural size.
117.—Eupleura caudata, (p. 642 ;) natural size.
118.—Purpura lapillus, (p. 642 ;) natural size.
119.—The same ; banded variety.
120.—The same ; egg-capsules, enlarged one-third.
121.—Buccinum undatum, (p. 638 ;) natural size.
122.—Scalaria multistriata, (p. 660 ;) enlarged.
123.—Scalaria lineata, (p. 660 ;) enlarged.

(Figure 120 was drawn from nature by J. H. Emerton ; the rest are from Binney's Gould, drawn by E. S. Morse.)

Fig. 107.

Fig. 106.

Fig. 109.

Fig. 111.

Fig. 110.

Fig. 108.

Fig. 112.

Fig. 114.

Fig. 113.

Fig. 118.

Fig. 119.

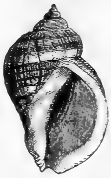
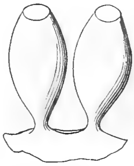


Fig. 120.



No. 785

Fig. 115.

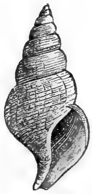


Fig. 117.

Fig. 121.

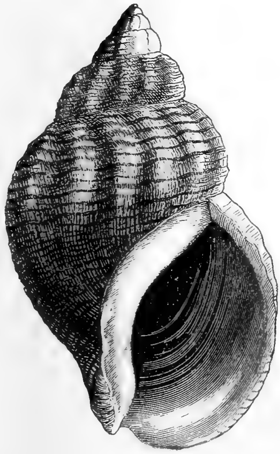


Fig. 122.

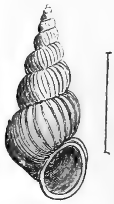


Fig. 116.

Fig. 123.

EXPLANATION OF PLATE XXII.

FIGURE 124.—Fulgur carica, (p. 640;) natural size.

(From Binney's Gould, drawn by E. S. Morse.)

Fig. 124.

EXPLANATION OF PLATE XXIII.

FIGURE 125.—Crucibulum striatum, (p. 651;) natural size.
126.—The same; side view.
127.—Crepidula plana, (p. 650;) natural size.
128.—C. convexa, (p. 650;) natural size.
129.—C. fornicata, (p. 649;) natural size.
129*a*.—The same; young specimen.
130.—Neverita duplicata, (p. 646;) natural size.
131.—Lunatia immaculata, (p. 646;) natural size.
132.—Natica pusilla, (p. 647;) slightly enlarged.
133.—Lunatia heros, (p. 646;) natural size.
134.—The same; with the animal extended, as in crawling; dorsal view.
135.—The same, variety triseriata, (p. 354;) young, natural size.
136.—The same variety; natural size, lower side.

(From Binney's Gould, drawn by E. S. Morse.)

Plate XXIII.

Fig. 125.

Fig. 126.

Fig. 127.

Fig. 128.

Fig. 129a.

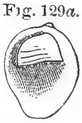


Fig. 129.

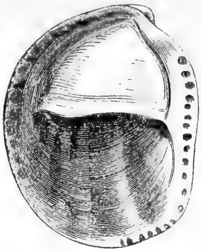


Fig. 130.

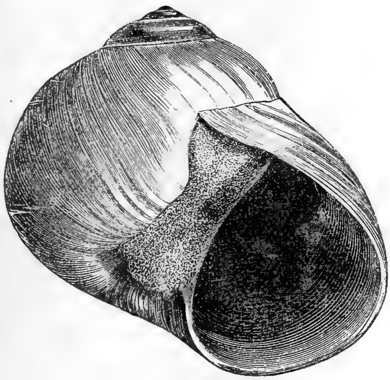


Fig. 131.

Fig. 132.

Fig. 135.

Fig. 136.

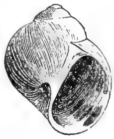


Fig. 134.

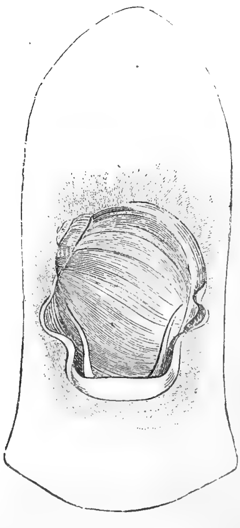


Fig. 133.

EXPLANATION OF PLATE XXIV.

FIGURE 137.—Littorina rudis, (p. 651;) natural size.
138.—Littorina palliata, (p. 652;) natural size.
139.—Lacuna vincta, (p. 652;) enlarged.
140.—Littorinella minuta, (p. 653;) enlarged.
141.—Rissoa aculeus, (p. 654;) enlarged.
142.—Skenea planorbis, (p. 655;) enlarged.
143.—Odostomia producta, (p. 656;) enlarged.
144.—O. fusca, (p. 656;) enlarged.
145.—O. trifida, (p. 656;) enlarged.
146.—O. trifida, var., (p. 656;) enlarged.
147.—O. impressa, (p. 656;) enlarged.
148.—O. seminuda, (p. 657;) enlarged.
149.—Eulima oleacea, (p. 655;) natural size.
150.—Cerithiopsis terebralis, (p. 648;) enlarged.
151.—C. Emersonii, (p. 648;) enlarged.
152.—Triforis nigrocinctus, (p. 648;) enlarged.
153.—Cerithiopsis Greenii, (p. 647;) enlarged.
154.—Bittium nigrum, (p. 648;) enlarged.
155.—Turbonilla elegans, (p. 657;) much enlarged.
156.—Margarita obscura, (p. 661;) natural size.
157.—Vermetus radicula, (p. 649;) natural size.
158.—Cæcum pulchellum, (p. 649;) natural size and enlarged.
159.—Acmæa testudinalis, (p. 661;) natural size.
159*a*.—The same; lower side.
159*b*.—The same, variety alveus; natural size.

(Figure 155 was drawn from nature, by A. E. Verrill; the others are from Binney's Gould, mostly drawn by E. S. Morse.)

Fig. 137.

Fig. 138.

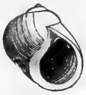


Fig. 139.

Fig. 140.

Fig. 141.

Fig. 142.

Fig. 143.

Fig. 144.

Fig. 145.

Fig. 146.

Fig. 147.

Fig. 148.

Fig. 149.

Fig. 150.

Fig. 151.

Fig. 152.

Fig. 153.

Fig. 154.

Fig. 155.

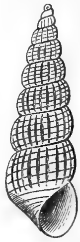


Fig. 156.

Fig. 157.

Fig. 158.

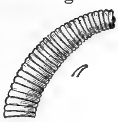


Fig. 159.

Fig. 159*b*.

EXPLANATION OF PLATE XXV.

FIGURE 160.—Utriculus canaliculatus, (p. 663;) enlarged.
161.—Bulla solitaria, (p. 662;) natural size.
162.—Amphisphyra debilis, (p. 663;) enlarged.
163.—Cylichna alba, (p. 664;) natural size.
164.—Cylichna oryza, (p. 664;) enlarged.
165.—Actæon puncto-striata, (p. 664;) enlarged.
166.—Trachydermon ruber, (p. 662;) natural size.
167.—Chætopleura apiculata, (p. 661;) natural size.
168.—Alexia myosotis, (p. 662;) natural size.
169.—Melampus bidentatus, (p. 662;) natural size.
169*a*.—The same; banded variety, (p. 662;) natural size.
170.—Doto coronata, (p. 665;) *a*, dorsal view, enlarged; *b*, head, from above; *c*, one of the branchiæ.
171.—Elysiella catulus, (p. 668;) enlarged three diameters.
172.—Elysia chlorotica, (p. 667;) enlarged two diameters.
173.—Doridella obscura, (p. 664;) *a*, dorsal view; *b*, ventral view, enlarged.
174.—Montagua pilata, (p. 666;) natural size.
175.—Hermæa cruciata, (p. 667;) enlarged.
176.—Doris bifida, (p. 664;) enlarged three diameters.
177.—Cavolina tridentata, (p. 669;) natural size.
178.—Styliola vitrea, (p. 668;) enlarged three diameters.

(Figures 171, 172, 173, 174, 178 were drawn from nature, by A. E. Verrill; 169*a*, 170 by E. S. Morse; 175 by A. Agassiz; 176, by J. H. Emerton; 177 was copied from Cuvier, (last ill. ed.) The rest are from Binney's Gould, mostly by E. S. Morse.)

Plate XXV.

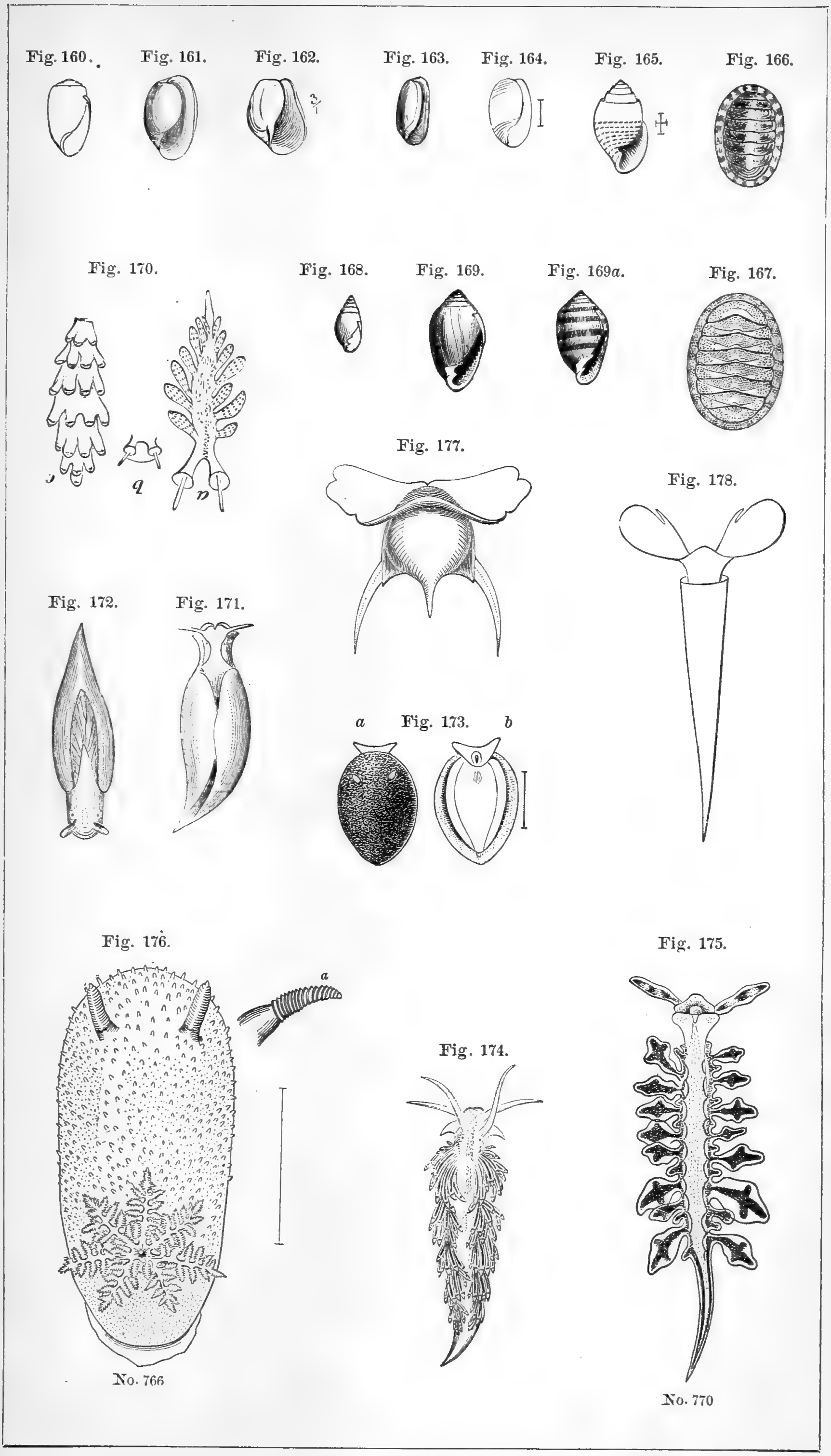


Fig. 160.
Fig. 161.
Fig. 162.
Fig. 163.
Fig. 164.
Fig. 165.
Fig. 166.
Fig. 170.
Fig. 168.
Fig. 169.
Fig. 169a.
Fig. 167.
q
p
Fig. 177.
Fig. 178.
Fig. 172.
Fig. 171.
a
Fig. 173.
b
Fig. 176.
a
Fig. 175.
Fig. 174.
No. 766
No. 770

EXPLANATION OF PLATE XXVI.

FIGURE 179.—Mya arenaria, (p. 672;) with animal in extension, reduced to one-half the natural size.

180.—Angulus tener, (p. 677;) animal reduced one-half.

181.—Tagelus gibbus, (p. 675;) with animal, the siphons not fully extended, one-half natural size.

182.—Ensatella Americana, (p. 674;) with animal extended, one-half natural size. The figure at the right shows some of the terminal papillæ enlarged.

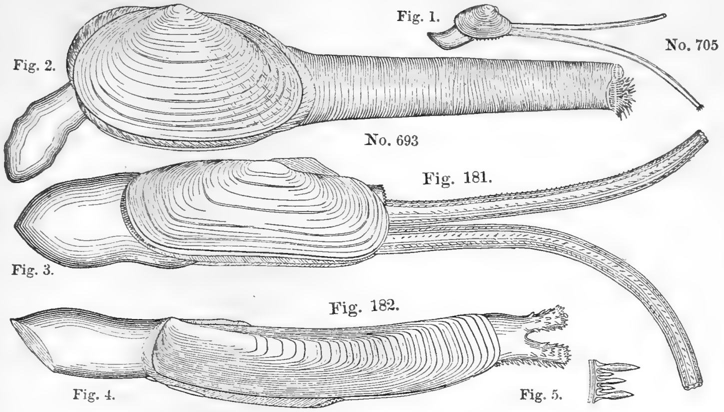
183.—Teredo navalis, (p. 669;) enlarged two diameters.

184, A.—Venus mercenaria, (p. 681;) natural size.

184, B.—Mulinia lateralis, (p. 680;) natural size.

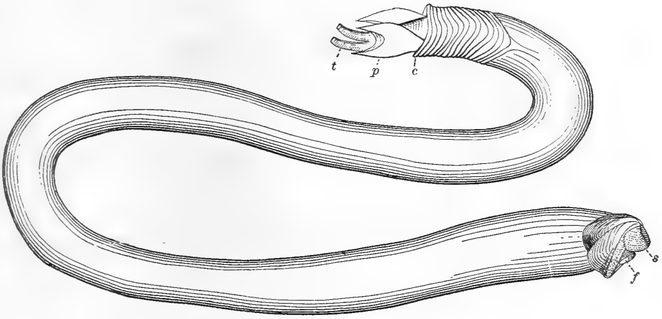
(The figures were all drawn from nature, by A. E. Verrill.)

Fig. 179. Fig. 180.



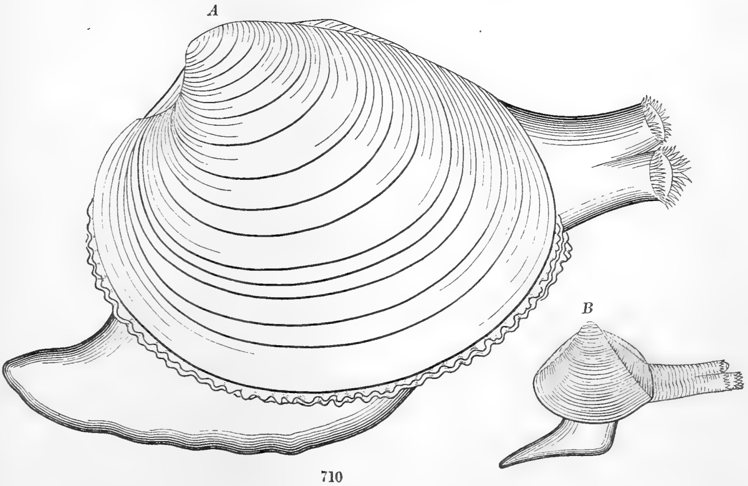
No. 688

Fig. 183.



No. 686

Fig. 184.



710

EXPLANATION OF PLATE XXVII.

FIGURE 186.—Teredo navalis, (p. 669;) shell and pallets.
187.—Teredo Thomsoni, (p. 670;) shell and pallets.
188.—Teredo megotara, (p. 670;) shell and pallets.
189.—Xylotrya fimbriata, (p. 670;) shell and pallets.
190.—Gastranella tumida, (p. 678;) shell, enlarged six diameters.
191.—Corbula contracta, (p. 672;) natural size.
192.—Saxicava arctica, (p. 671;) natural size.
183.—Clidiophora trilineata, (p. 673;) natural size, with animal.
194.—Lyonsia hyalina, (p. 672;) natnral size.
195.—Thracia truncata, (p. 674;) natural size.
196.—Thracia myopsis, (p. 673;) natural size.
197.—Periploma papyracea, (p. 673;) natural size.
198.—Cochlodesma leanum, (p. 673;) natural size.
189.—Petricola pholadiformis, (p. 680;) natural size.
200.—Pholas truncata, (p. 670;) natural size.

(Figure 190 was drawn by A. E. Verrill; all the rest are from Binney's Gould, mostly drawn by E. S. Morse.)

Plate XXVII.

Fig. 186.

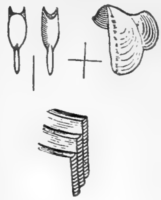


Fig. 187.

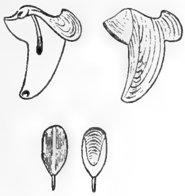


Fig. 189.

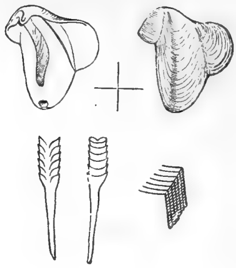


Fig. 190.

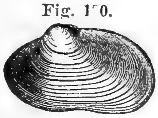


Fig. 188.

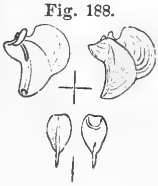


Fig. 192.

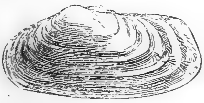


Fig. 191.

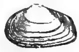


Fig. 195.

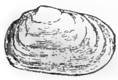


Fig. 193.

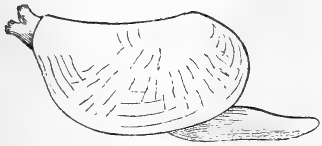


Fig. 194.

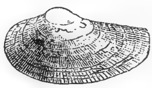


Fig. 196.

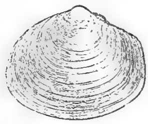


Fig. 199.

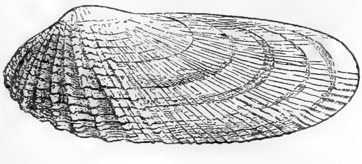


Fig. 197.

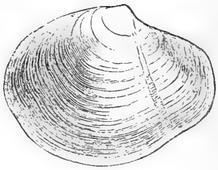


Fig. 200.

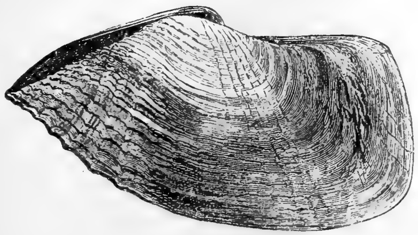
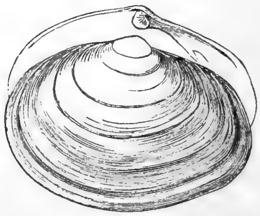


Fig. 198.



EXPLANATION OF PLATE XXVIII.

FIGURE 201.—Cyprina Islandica, (p. 683;) natural size.
202.—Mactra solidissima, (p. 680;) natural size.

(The figures are both from Binney's Gould, drawn by E. S. Morse.)

Fig 201.

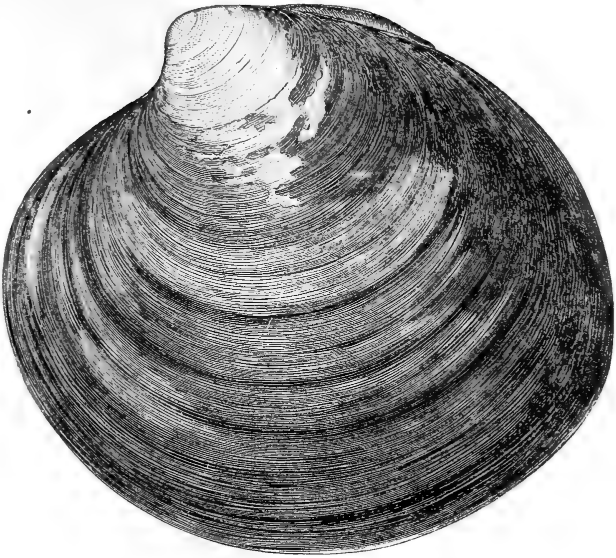
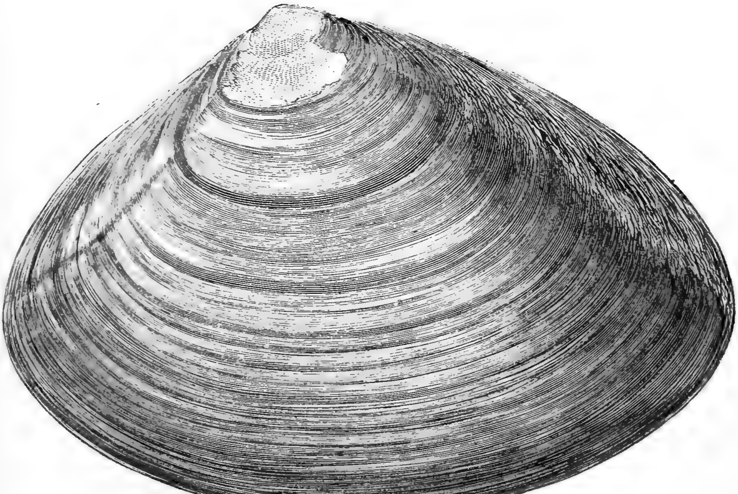


Fig. 202



EXPLANATION OF PLATE XXIX.

FIGURE 203.—Astarte undata, (p. 684;) somewhat reduced.

204.—Astarte castanea, (p. 685;) natural size.

205.—Astarte quadrans, (p. 685;) natural size.

206.—Gouldia mactracea, (p. 685;) natural size.

207.—The same, inside of one valve, enlarged.

208.—Lævicardium Mortoni, (p. 683;) natural size, with animal.

209.—Cardium pinnulatum, (p. 683;) natural size.

210.—Solenomya velum, (p. 688;) natural size.

211.—Cyclas dentata, (p. 686;) natural size.

212.—Lucina filosa, (p. 686;) natural size.

213.—Cryptodon Gouldii, (p. 686;) enlarged two diameters.

214.—Cryptodon obesus, (p. 687;) enlarged three diameters.

215.—Cyclocardia Novangliæ, (p. 684;) natural size.

216.—Cyclocardia borealis, (p. 683;) natural size.

(Figures 203, 207, 214 were drawn by A. E. Verrill; 215 by E. S. Morse; the rest from Binney's Gould, and mostly drawn by E. S. Morse.)

Plate XXIX.

Fig. 203.

Fig. 208.

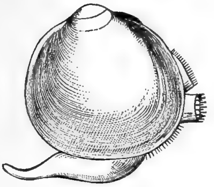


Fig. 210.

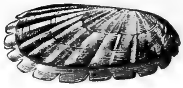


Fig. 204.

Fig. 205.

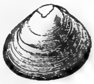


Fig. 209.

Fig. 211.

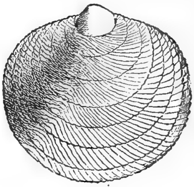


Fig. 207.

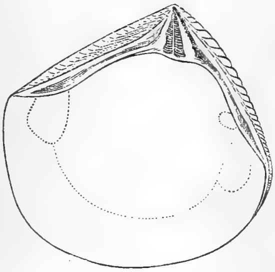


Fig. 206.

Fig. 212.

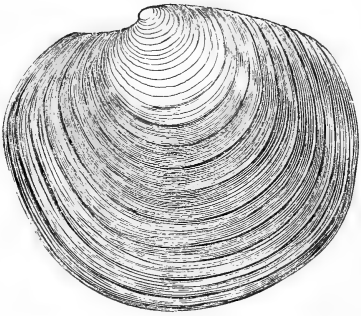


Fig. 215.

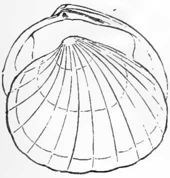


Fig. 213.

Fig. 214.

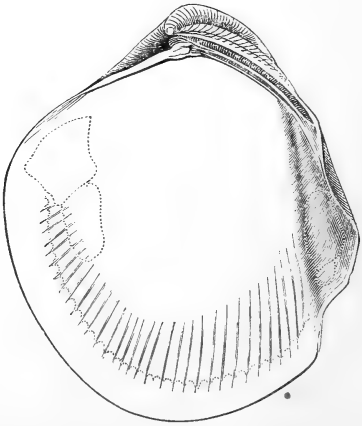
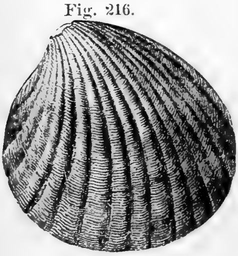


Fig. 216.



EXPLANATION OF PLATE XXX.

FIGURE 217.—Tagelus gibbus, (p. 675;) natural size.
218.—Tegelus divisus, (p. 676;) natural size.
219.—Callista convexa, (p. 681;) natural size.
220.—Tottenia gemma, (p. 682;) enlarged.
221.—Cumingia tellinoides, (p. 679;) natural size.
222.—Macoma fragilis, var. fusca, (p. 676;) natural size.
223.—Angulus tener, (p. 677;) natural size.
224.—Angulus tenellus, (p. 677;) natural size.
225.—Tellina tenta, (p. 678;) natural size.
226.—Kellia planulata, (p. 688;) enlarged.
227.—Argina pexata, (p. 692;) natural size.
228.—Scapharca transversa, (p. 691;) natural size.
229.—Nucula delphinodonta, (p. 691;) enlarged.
230.—Nucula proxima, (p. 691;) natural size.
231.—Yoldia sapotilla, (p. 689;) natural size.
232.—Yoldia limatula, (p. 689;) natural size.

(Figure 224 was drawn by A. E. Verrill; the rest are from Binney's Gould, by E. S. Morse.)

Plate XXX.

Fig 217.

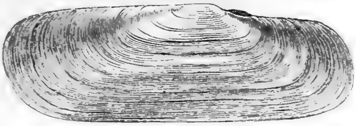


Fig. 218.

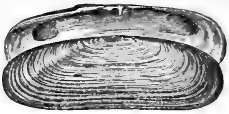


Fig. 219.

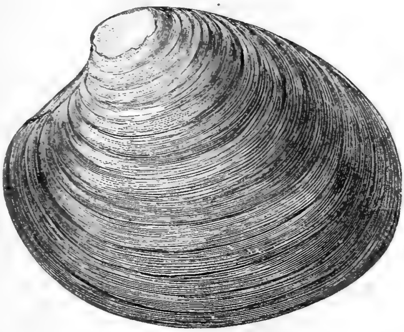


Fig. 220.

Fig. 221

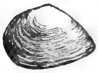


Fig. 222.

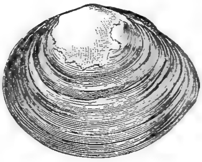


Fig. 224.

Fig. 223.

Fig. 227.

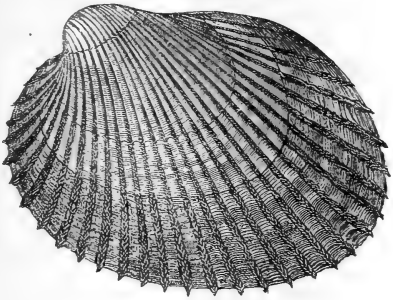


Fig. 229.

Fig. 230.

Fig. 225.

Fig. 231.

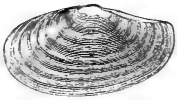


Fig. 226.

Fig. 228.

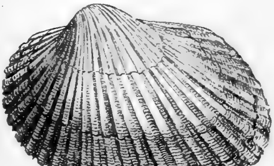
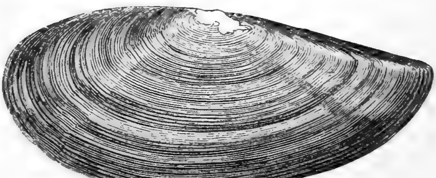


Fig. 232.



EXPLANATION OF PLATE XXXI.

FIGURE 233.—Crenella glandula, (p. 695.)
234.—Mytilus edulis, (p. 692.)
235.—Modiolaria corrugata, (p. 694.)
236.—Modiolaria nigra, (p. 694.)
237.—Modiola modiolus, (p. 693.)
238.—Modiola plicatula, (p. 693.)

(All the figures are of natural size, and from Binney's Gould, drawn by E. S. Morse.)

Plate XXXI.

Fig. 233.

Fig 234.

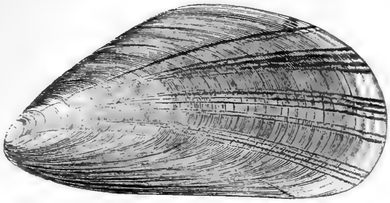


Fig. 235.

Fig. 236.

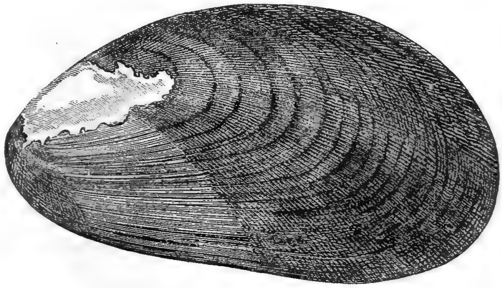


Fig. 237.

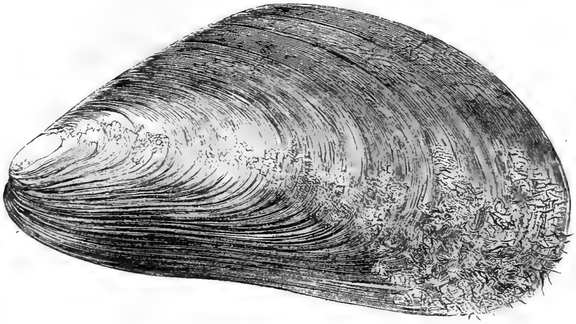
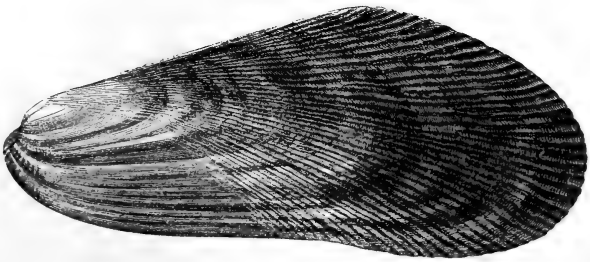


Fig. 238.



EXPLANATION OF PLATE XXXII.

FIGURE 239.—Anomia aculeata, (p. 697 ;) lower side, natural size.
240.—The same, upper side.
240*a*.—The same, portions of the upper side magnified.
241.—Anomia glabra, (p. 696 ;) profile view, natural size.
242.—The same, (p. 696 ;) lower side
242*a*.—The same, (p. 696 ;) young, natural size.
243.—Pecten irradians, (p. 695 ;) natural size.
244.—Siliqua costata, (p. 675 ;) natural size.
245.—Ensatella Americana, (p. 674 ;) natural size.

(The figures are from Binney's Gould, drawn by E. S. Morse.)

Fig. 239.

Fig. 240.

Fig. 244.

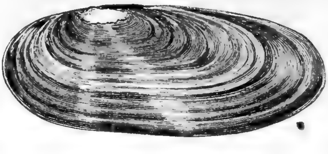


Fig. 241.

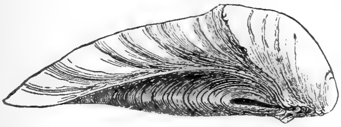


Fig. 242*a*.

Fig. 240*a*.

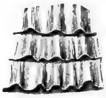


Fig. 242.

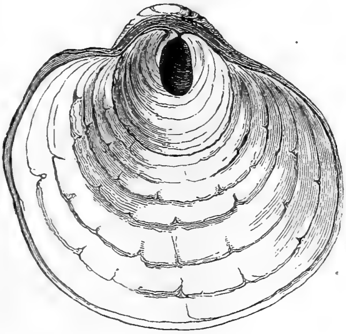


Fig. 245.

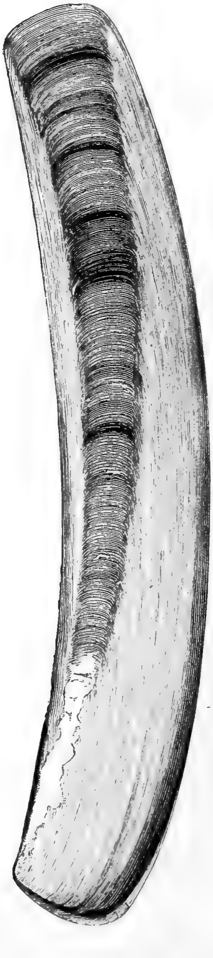
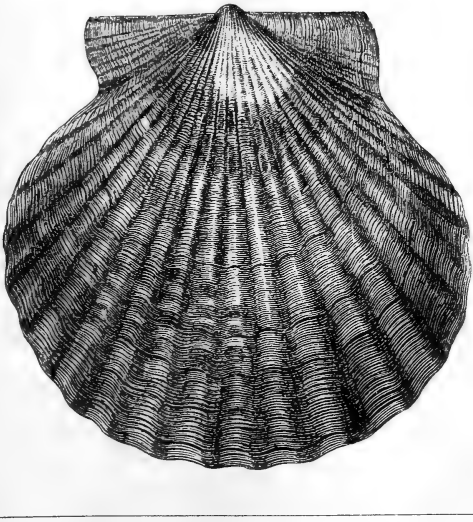


Fig. 243.



EXPLANATION OF PLATE XXXIII.

FIGURE 246.—Cynthia partita, variety stellifera, (p. 701;) natural size.

247.—Cynthia carnea, (p. 701;) natural size.

248.—The same, (p. 701;) younger specimens, natural size.

249.—Eugyra pilularis, (p. 700;) natural size.

250.—Molgula Manhattensis, (p. 699;) smooth variety, natural size.

251.—Molgula arenata, (p. 699;) natural size.

252.—Botryllus Gouldii, (p. 702;) colony incrusting the stem of Tubularia, somewhat enlarged.

253.—The same; one of the zoöids, enlarged ten diameters; *a*, anal tube and orifice; *s*, stomach; *g*, groove and vessels along the edge of the branchial sac, inside; *o*, left ovary; *b*, bud, attached by a slender stolon.

254.—Salpa Cabotti, (p. 706;) solitary individual, from the dorsal side, enlarged; *h*, heart; *s*, small chain of salpæ budding within the old one.

255.—The same; one of the individuals from a mature chain, three-quarter view enlarged; *a*, posterior or anal opening; *b*, anterior or branchial opening; *c*, processes by which the individuals of the chain were united; *h*, heart; *n*, nervous ganglion; *o*, nucleus; *r*, gill.

256.—Escharella variabilis, (p. 713;) few of the cells, much enlarged.

(Figure 256 was drawn by A. Hyatt; 254 and 255 were copied from A. Agassiz; the others were drawn by A. E. Verrill.)

Plate XXXIII.

Fig. 246.

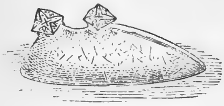


Fig. 247.

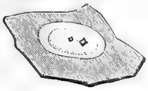


Fig. 248.

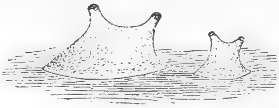
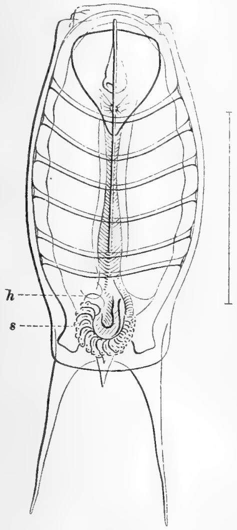
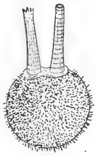


Fig. 254.



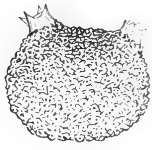
750

Fig. 249.



Eugyra
749

Fig. 251.



748

Fig. 253.

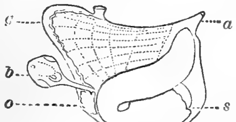


Fig. 250.

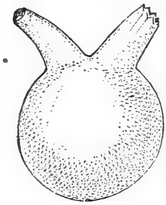
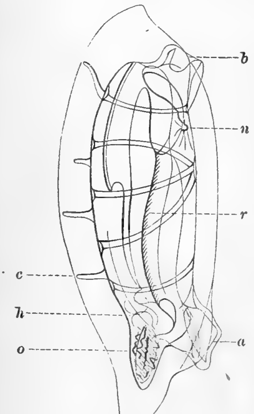


Fig. 255.



751

Fig. 252.

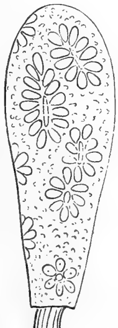
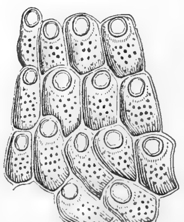


Fig. 256.



No. 765

EXPLANATION OF PLATE XXXIV.

FIGURE 257.—Alcyonidium ramosum, (p. 708;) a young unbranched specimen, enlarged two diameters.

258.—Bugula turrita, (p. 712;) extremity of a branch, enlarged.

259.—The same; a branchlet more highly magnified.

259*a*.—The same; a branchlet bearing ovicells.

260.—Crisia eburnea, (p. 707;) a cluster of branches, enlarged.

261.—The same; a branch bearing an ovicell, more highly magnified.

262.—Membranipora pilosa, (p. 712;) a few of the cells, seen from above, magnified.

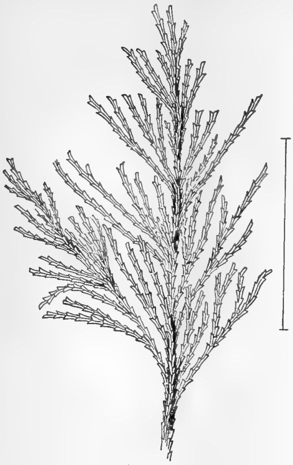
362*a*.—The same; a single cell, seen in profile.

263.—The same; one of the zoöids expanded.

264.—Mollia hyalina, (p. 713;) one of the zoöids in expansion, highly magnified.

(Figures 257, 259, 259*a* were drawn by A. E. Verrill; the rest were furnished by A. Hyatt.)

Fig. 258.



No. 766

Fig. 259.

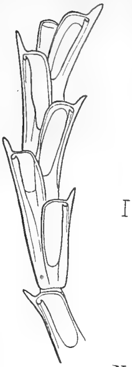
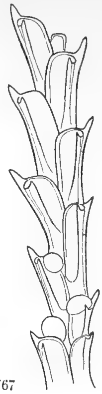
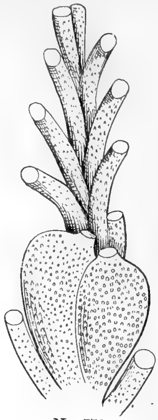


Fig. 259*a*.



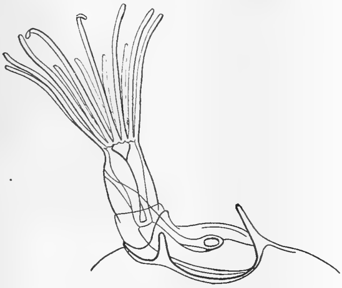
No. 767

Fig. 261.



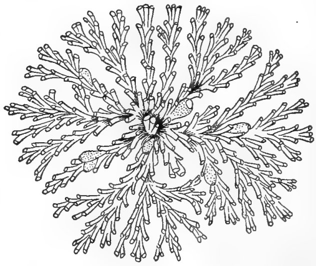
No. 772

Fig. 263.



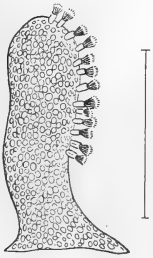
No. 769

Fig. 260



No. 771

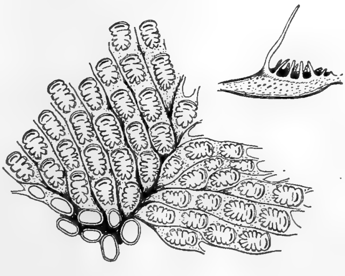
Fig. 257.



754

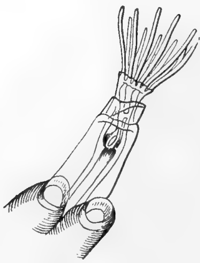
Fig. 262.

Fig. 262*a*.



No. 768

Fig. 264.



No. 773

EXPLANATION OF PLATE XXXV.

FIGURE 265.—Leptosynapta Girardii, (p. 716;) anterior part of the body, enlarged one-half.

266.—The same; perforated plates from the skin, and the "anchors," highly magnified.

267.—Echinarachnius parma, (p. 717;) upper surface with the spines partly removed, natural size; *a*, ambulacral zones; *b*, interambulacral zones.

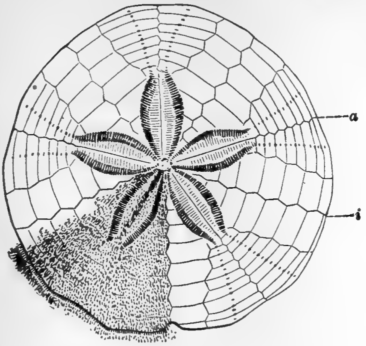
268.—Strongylocentrotus Dröbachiensis, (p. 716;) side view, natural size.

269.—Asterias arenicola, (p. 718;) dorsal view, somewhat reduced.

270.—Ophiopholis aculeata, (p. 719;) dorsal view, about one-half natural size.

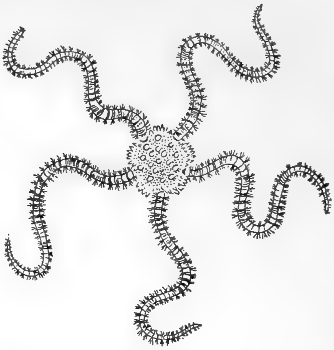
(Figures 265, 266 were drawn by A. E. Verrill; 267, 269 were copied from A. Agassiz; 268, 270 were drawn by E. S. Morse.)

Fig. 267.



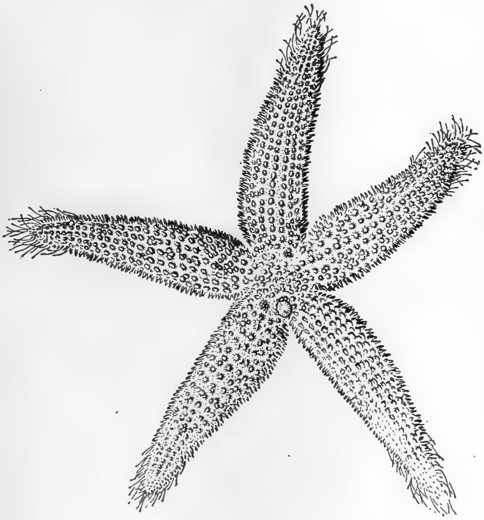
617

Fig. 270.



No. 615

Fig. 269.



616

Fig. 265.

618

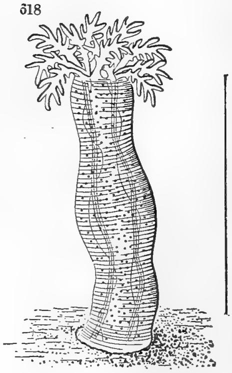


Fig. 266.

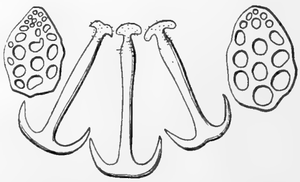
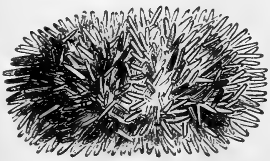


Fig. 268.



EXPLANATION OF PLATE XXXVI.

FIGURE 271.—Aurelia flavidula, (p. 723;) upper side, about one-fourth the natural size.

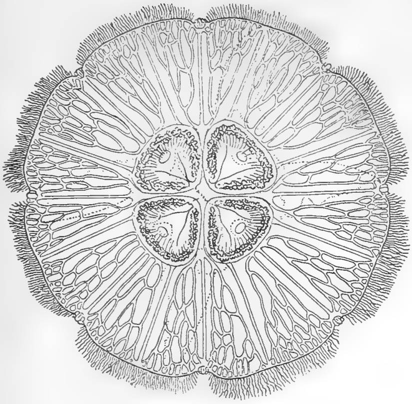
272.—Dactylometra quinquecirra, (p. 724;) lateral view, one-fourth the natural size.

273.—Corymorpha pendula, (p. 736;) natural size.

274.—Parypha crocea, (p. 736;) natural size.

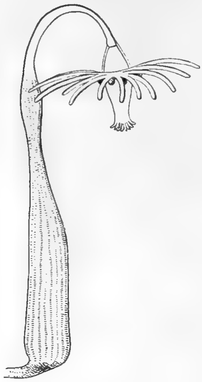
(Figure 272 was copied from A. Agassiz, Catalogue Acalephs; the others were copied from L. Agassiz, Contributions to Natural History of United States.)

Fig. 271.



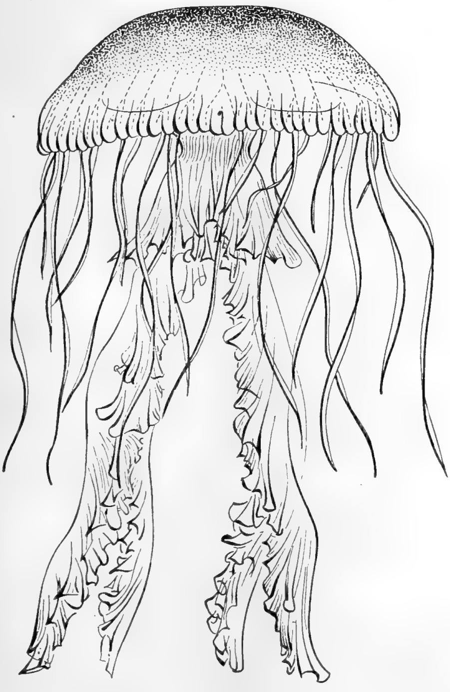
No. 613

Fig. 273.



No. 608

Fig. 272.



No. 614

Fig. 274.

No. 607

EXPLANATION OF PLATE XXXVII.

FIGURE 275.—Zygodactyla Grœnlandica, (p. 729;) profile view, one-half natural size.

276.—Bougainvillia superciliaris, (p. 733;) a branch, much enlarged.

277.—Pennaria tiarella, (p. 735;) a branch, natural size.

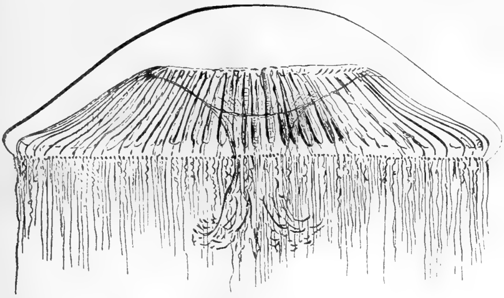
278.—The same; one of the hydroids, with medusæ, buds developing at the base of the proboscis.

279.—Sertularia pumila, (p. 732; part of a colony on a frond of sea-weed, natural size.

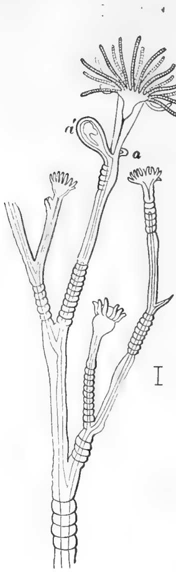
280.—Sertularia argentea, (p. 732;) a branch bearing reproductive capsules, (gonothecæ,) with the soft parts removed, much enlarged.

281.—Obelia commissuralis, (p. 728;) a branch bearing hydroids and one female gonotheca, much enlarged.

(Figures 275 and 279 were copied from A. Agassiz; 276 and 281 from L. Agassiz; 278 from J. Leidy; 7 and 280 were drawn by A. E. Verrill.)

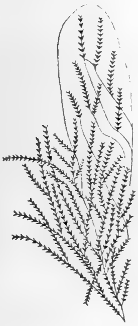


No. 612

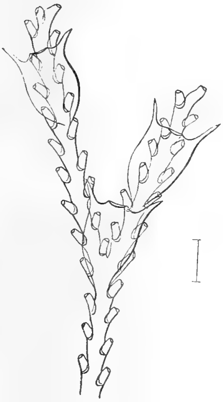


No. 606

Fig. 279.

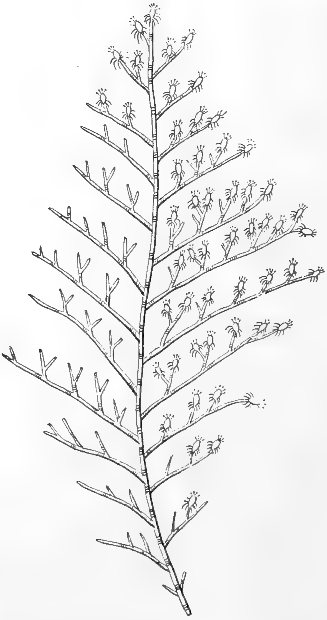


No. 603



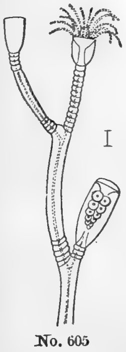
No. 604

Fig. 277.



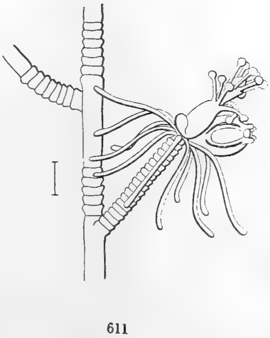
No. 610

Fig. 281.



No. 605

Fig. 278.



611

EXPLANATION OF PLATE XXXVIII.

FIGURE 282.—Hybocodon prolifer, (p. 736;) natural size, the head seen from the back side.

283.—Alcyonium carneum, (p. 737;) three of the polyps fully expanded, much enlarged.

284.—Sagartia leucolena, (p. 738;) natural size, in expansion, but the tentacles are not fully extended; the * indicates the long odd tentacle.

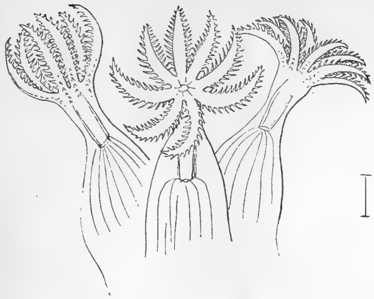
285.—Halocampa producta, (p. 738;) natural size, well expanded, but the body may be much more elongated.

286.—Epizoanthus Americanus, (p. 740;) a colony which had completely covered and absorbed a shell occupied by a hermit-crab, (Eupagurus pubescens,) which still lived within the cavity; the polyps are not expanded, natural size.

287.—The same; one of the polyps in full expansion, natural size.

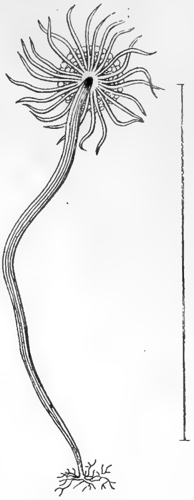
(Figure 282 was copied from L. Agassiz; 286 is from the American Naturalist, drawn by E. S. Morse; the rest were drawn by A. E. Verrill.)

Fig. 283.



No. 598

Fig. 282.



No. 609

Fig. 284.

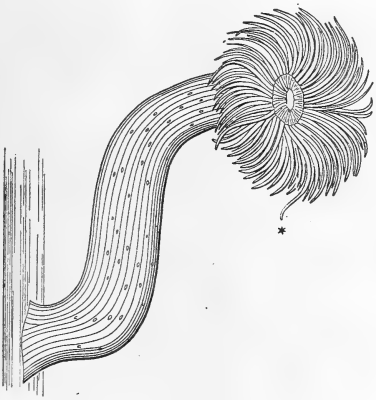
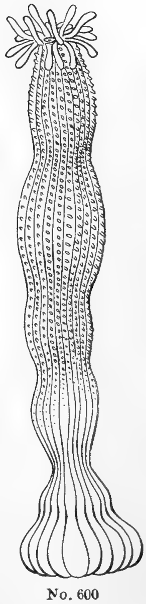


Fig. 285.



No. 600

Fig. 286.

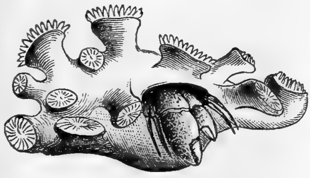
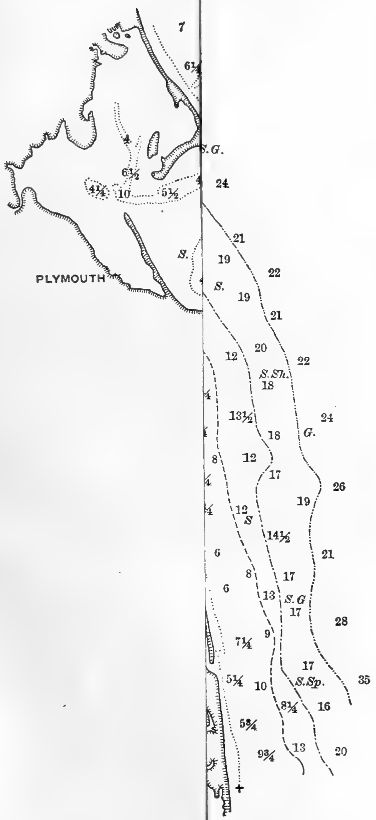
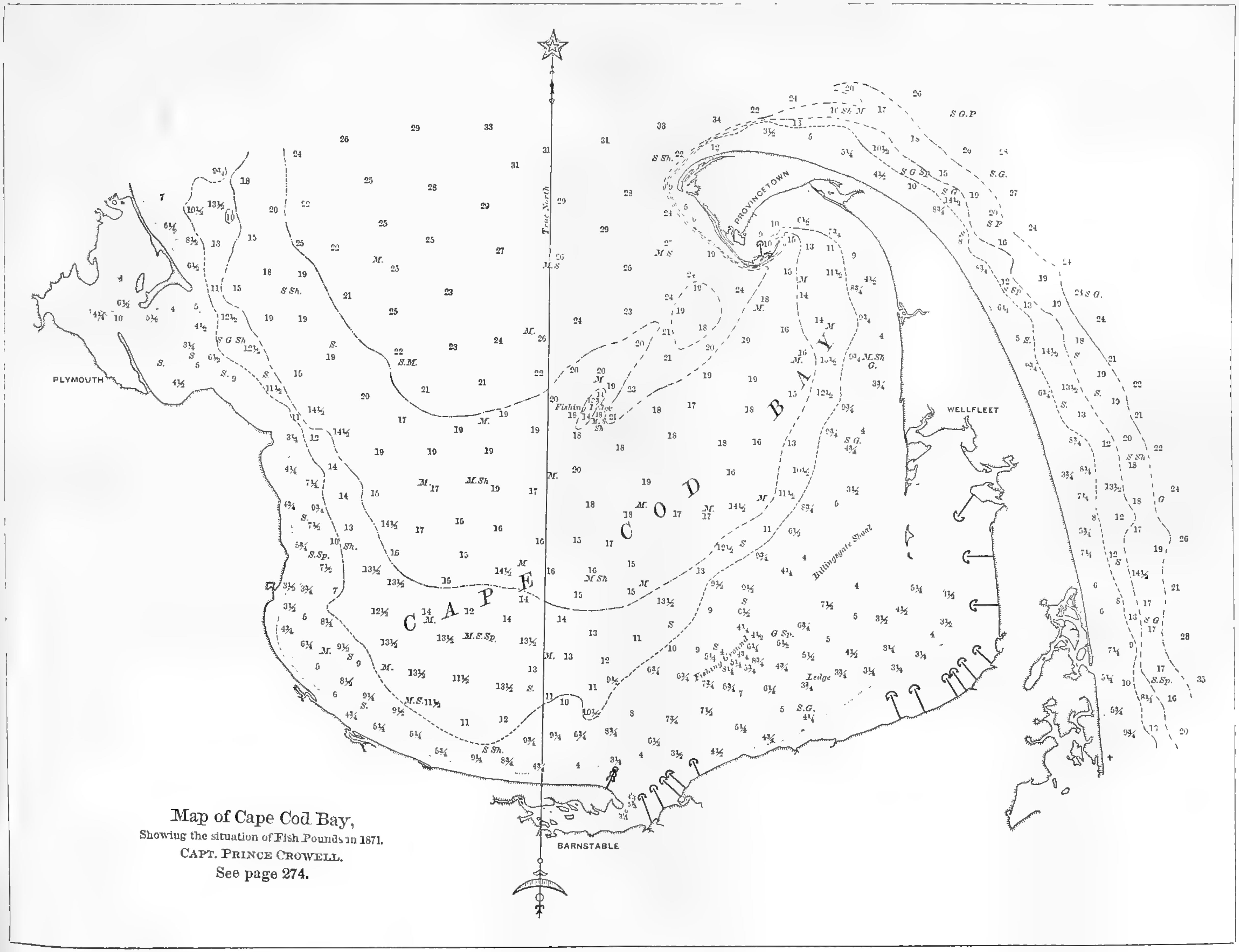


Fig. 287.

Plate XXXIX.



Show



Map of Cape Cod Bay,
Showing the situation of Fish Pounds in 1871.
CAPT. PRINCE CROWELL.
See page 274.

Fig. 20.

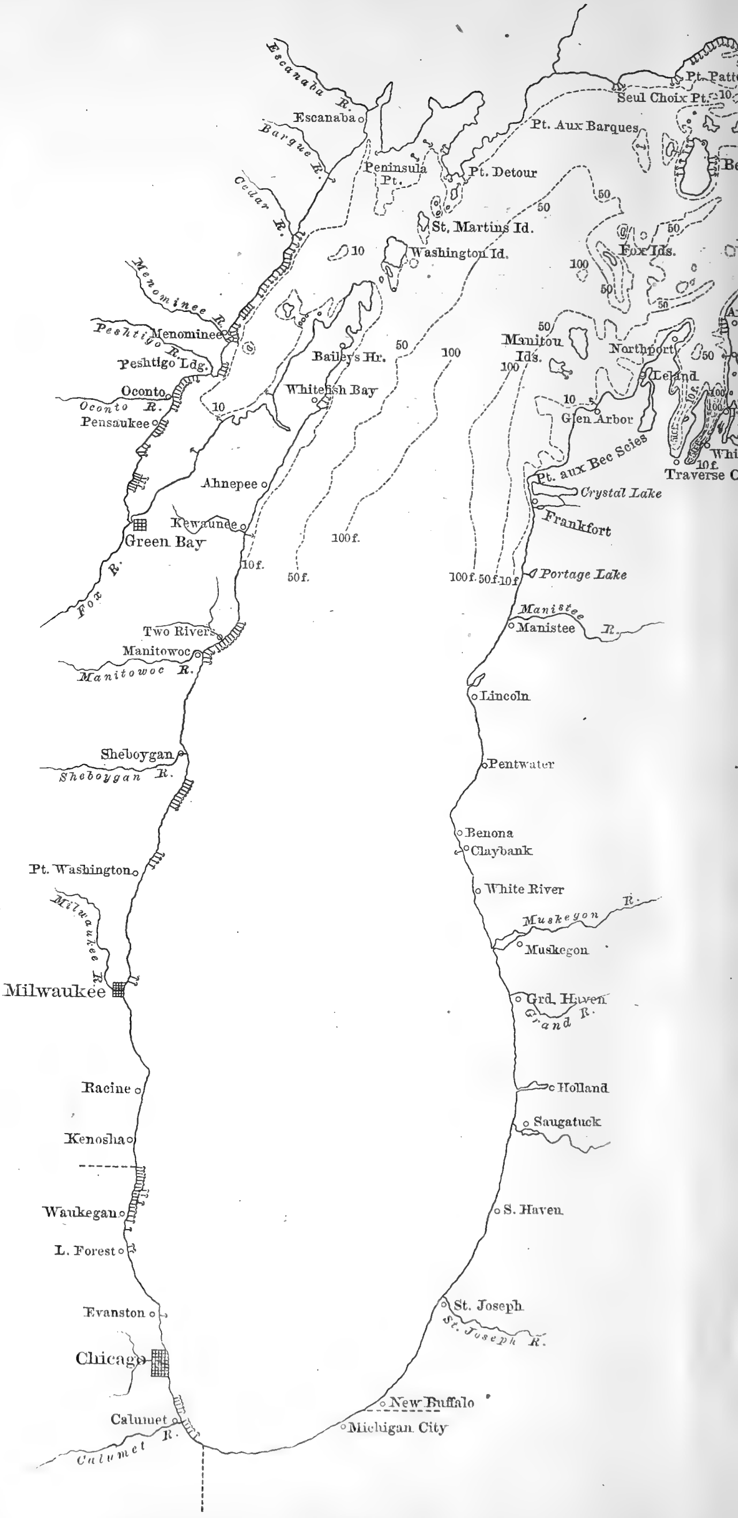


DIAGRAM SHOWING THE LOCATION OF FISH-PONDS ON LAKE MICHIGAN IN 1871 ackinaw

Fig. 20.

DIAGRAM SHOWING THE LOCATION OF FISH-PONDS ON LAKE MICHIGAN IN 1871.